# Lean Accounting: Current State and Future Needs Assessment

**Gene Fliedner**
**Oakland University**

*Lean practitioners use a various performance assessment and control metrics. Anecdotal evidence suggests some cost accounting metrics do not serve lean practitioners well. This recognition has led to the recent emergence of lean accounting. This paper focuses on the impetus for its emergence. The limitations of current cost accounting practices as they pertain to lean practitioners are identified and explained. The content is not to suggest a better means of accounting, but rather to recognize the reasons for the emergence of lean accounting and to provide guidance relevant towards the creation of system assessment and control metrics for lean practitioners.*

## INTRODUCTION

The term lean as applied to transformation systems was originally suggested in 1988 (Krafcik, 1988). The term lean evolved from the just-in-time concept which began to appear in the United States in approximately 1980. Despite many who attribute the origins of lean largely to the efforts of Toyota in the mid 1940's, the body of lean knowledge has been evolving for millennia with many contributors (Fliedner, 2016). There are several simple explanations of lean. For instance, lean is the enhancement of productivity through waste elimination. A second explanation is the reduction of non-value adding, avoidable activities and assets. A third explanation is a customer-driven philosophy for waste elimination and organization wide continuous or ongoing improvement. Since the 1980s, lean has been a prominent business strategy gaining popularity with the comparative performance examination of global automotive plants (Womack, Jones, & Roos, 1990).

Lean is also learning approach based largely on evaluating past experiences through questioning and observation. It is critical that the evaluation of past experiences consider real time (immediate) as well as long-term experiences. Numerous transformation system performance metrics are available to assist system performance assessments. The metrics devised to assist the lean practitioner commonly focus on a specific aspect of system performance such as time (e.g., time, cost, or quality).

Performance metrics are collected and used for three primary purposes. First, the metrics enable a better understanding or monitoring of the current system state. Second, the metrics subsequently permit control activities (corrective actions) which guide improvement efforts towards the ideal state. Third, the metrics are used for both internal and external stakeholder reporting purposes.

This paper focuses on the emergence of lean accounting. This subject is garnering increasing attention. The emergence of lean accounting has occurred in large part due to limitations of current cost accounting practices which form the basis of numerous transformation system performance metrics. This paper identifies and explains these limitations of current cost accounting practices. The content is not to suggest a better means of accounting, but rather to identify potential shortcomings of current accounting practices, which may promote future improvement efforts. Along these lines, this paper provides guidance relevant towards the creation of metrics for the lean practitioner. Going forward, lean accounting will have a significant impact on transformation system operating practices, performance metrics, as well as both internal and external reporting practices. The remainder of this paper is organized in the following sections. First, numerous performance metrics and their characteristics utilized by the lean practitioner are identified. Second, a current assessment of cost accounting practice and financial metrics, including a notation of their inherent deficiencies is offered. Lastly, the deficiencies of current cost accounting practices are then used to identify the performance metric needs of the lean practitioner in the third section.

**TABLE 1**
**LEAN PERFORMANCE METRIC EXAMPLES**

| **Lean metric nature** | |
|---|---|
| Time-based | • Total order throughput time<br>• Average system order throughput time<br>• Process velocity = throughput time/value-added time<br>• Net operating time available = total operating time available − production and maintenance downtime<br>• Plant availability = total operating time available/net operating time available<br>• Number of process steps; machine setups; material touches |
| Cost-based | • Number of process or system employees<br>• Inventory turnover = cost of goods sold/average inventory<br>• Days of inventory outstanding = 365 days/inventory turnover<br>• Efficiency = actual output/standard output<br>• Utilization = total resource time usage/total resource time availability<br>• Yield = (units produced−defective units)/units produced<br>• Process step efficiency = (order batch size × *takt* time)/total process step operating time<br>• Labor productivity = units of output/units of labor |
| Quality-based | • Number of defects (defect rates)<br>• Scrap rates<br>• First time through = (order batch size − number of defects in order)/order batch size |
| Flexibility-based | • Setup times (possibly as a portion of pitch times)<br>• Range of worker task capabilities<br>• Range of machine task capabilities<br>• Routing alternatives |
| Sustainability-based | • Extent of energy requirements supplied by renewable/alternative energy sources<br>• Waste to landfill (indexed to net sales)<br>• Volatile air emissions (indexed to net sales)<br>• Environmental protection agency toxic release inventory (indexed to net sales) |
| Safety- or morale-based | • Number of job accidents<br>• Employee satisfaction<br>• Staff retention |

## LITERATURE REVIEW

Ideally, lean practitioners will rely upon a broad set of performance measures possessing numerous characteristics. These characteristics can include (1) financial metrics, (2) current, or real-time system performance, (3) a depiction of the current state of the process relative to the planned or expected state, (4) engaging the individual(s) close to the process and those individuals who are responsible for maintaining and correcting the process, (5) relying, if possible, upon multiple sensory functions simultaneously (e.g., coupling audio signals with visual signals), (6) utilization of smaller time increments between data capture points enabling issues being brought to light sooner and more easily, highlighting the introduction of assignable sources of variation, (7) use for accountability regarding investigative results, and (8) an ability to depict multiple-state conditions (e.g., utilization of various colors).

Key lean performance metrics may be categorized by the objective they recognize such as time (e.g., takt, pitch or throughput), cost, quality, flexibility (e.g., short set up time or the variety of items produced), sustainability (e.g., reclamation or recycling achievements), or safety and morale. Alternatively, a lean metric may be categorized by the portion of the system it monitors, ranging from a measure as small as a machine (e.g., machine set-up time), to a complete process (e.g., throughput time for a batch process), to the entire organization itself (e.g., return on invested capital and earnings before interest and taxes). A variety of lean metrics have been proposed in the literature (e.g., Cesaroni & Sentuti, 2014). Although not meant to be an exhaustive list, frequently encountered lean metrics categorized by objective are identified in TABLE 1.

The vast majority of research demonstrates that firms commonly rely on nonfinancial information and metrics when employing lean (Kennedy & Widener, 2008). It is desirable to rely upon a variety of metrics possessing various characteristics. For instance, metrics that are visual enhance understanding and communication capabilities. Visual management techniques employed within a lean management system have the ability to convey a lot of information quickly. Furthermore, people remember information better when it is represented and learned verbally and visually. However, data that is conveyed in financial terms is often better understood. People easily understand the value of a dollar.

Many of the metrics noted in Table 1 lack a direct financial nature. For instance, the amount of inventory (e.g., days of inventory outstanding) expresses the number of days that would be expected for demand to consume the existing number of units of inventory. However, a critical element of many business choices relates to the financial bottom line. Financial implications of strategic choices and tactical decisions can materially affect lean practices. Simply put, many common lean performance metrics may be converted into financial terms; however, they are not directly financially focused. Therefore, cost-based metrics are an essential aspect of current state assessments.

## COST ACCOUNTING CURRENT STATE ASSESSMENT

Often the application point for the lean microscope depends upon the environment. For example, in lower-volume, batch environments, the examination of connections and flows between resources is critical for waste reductions. This is true given system variability (variable order sizes as well as variable processing, material, and labor requirements) resulting in variable flow paths and consequential downstream arrival delays. Given longer system throughput times of batches, it becomes imperative for the system “drumbeat” (takt times and pitch times), or the connections and flows between resources, to be consistent. Alternatively, in higher-volume, repetitive processes, it is assumed that processes are initially designed with a common takt time for a limited product line across system resources. Therefore, a greater focus on the productivity of the resources themselves is typically pursued. In particular, a measure such as overall equipment effectiveness (OEE) and the six big losses of equipment utilization, which focuses on equipment availability (equipment failure, setup, and adjustment), equipment speed loss (idling, minor stoppages, and reduced speeds), and output loss due to lower quality (defects and reduced yields) are useful (Nakajima, 1988). It should be evident that OEE focuses upon more than one objective. The point is, not all lean metrics are useful for all types of transformation processes. Given their varied nature, lean practitioners should rely upon a variety of metrics, both financial and nonfinancial.

Cost accounting is commonly thought of as having an external reporting focus. As an integral business function though, cost accounting also provides cost-based performance metrics for internal current state assessments and process control activities. Cost accounting measures and records internal transactions and contributes to various internal and external documents, primarily financial in nature, based upon Generally Accepted Accounting Principles (GAAPs).

Anecdotal evidence suggests cost accounting performance metrics do not always serve lean practitioners well for several reasons. First, cost accounting performance metrics provide information after the fact. For instance, measures calculated at the end of a period such as a month or a quarter may delay or prevent proactive actions. Continuous improvement activities require timely information. Second, cost accounting performance metrics may be vague, such as the allocation of indirect overhead costs to a line of products. Traditional cost accounting typically allocates overhead in correlation with direct labor costs. However, traditional cost accounting methods were designed in the early 1900's to support mass production techniques when direct labor costs were a much higher proportion of total costs (e.g., 60%) and overhead costs were nearly insignificant (e.g., 10%). Today, it is not uncommon for direct labor costs to be as low as 10% resulting in a nearly arbitrary allocation practice (Kroll, 2004). Continuous improvement activities require accurate system performance information. Third, measures, which are primarily financial in nature such as standard costs, do not relate to the customer's perspective of value-added tasks for specific products. This too confounds process improvement activities.

The term *lean accounting* has emerged as a consequence of the potential cost accounting practices deficiencies when attempting to assess system performance (Maskell, 2000; Maskell & Baggaley, 2004; Maskell & Baggaley, 2006). Various authors have noted that accounting measurement and control methods must evolve in order to assist lean initiatives (e.g., Maskell & Kennedy, 2007; Cesaroni & Sentuti, 2014). Arguments can be found in the literature that lean necessitates changes in accounting practices and operations control and measurement systems (Fullerton & McWatters, 2002; Maskell & Baggaley, 2004).

Although there exists numerous manuscripts in the literature extolling the virtues of lean accounting, to date there is no formal definition, but rather an identification of the deficiencies of alternative accounting practices. Lean accounting attempts to rationalize the necessity to track, allocate, and monitor financial metrics at numerous, pinpoint locations within operation processes. This is especially burdensome for batch processes. The manuscripts in the literature promoting lean accounting have focused on high volume, repetitive manufacturing systems. Lean accounting recognizes that voluminous transaction processing attributable to standard costing and overhead allocation practices does not add value to well-understood, stable (high volume, repetitive) processes. Lean accounting suggests many of the financial transactions focused on tracking, allocating, and monitoring financial metrics may be unnecessary and eliminated.

A sound understanding of cost accounting practices and financial metrics is important for lean practitioners' comprehension of the intent of lean accounting and for choices both in the boardroom and on the factory floor. These practices and metrics may reflect data that are financial in nature or they may reflect data that concern defects due to unmet specifications. Alternatively, the data may reflect process flow interruptions. The point is lean practitioners benefit from the knowledge of a broad set of performance assessment tools with the frequency of data collection being determined by the value of the data itself. Highly stable operations often require less data collection and transaction processing. Some of the more significant accounting practices and financial metrics topics impacting lean practitioners' choices both in the boardroom and on the factory floor are identified in the following sections.

**Cost Accounting**

Cost accounting provides much of the information used for external reporting purposes and internal decision making. Cost accounting typically collects, analyzes, and disseminates financial and nonfinancial information related to the costs of resource acquisition and consumption supporting transformation processes.

*Cost allocation* is used to describe the assignment of indirect costs (e.g., lease, overhead, insurance, taxes, and quality control) to particular cost objects (e.g., individual jobs, orders, a product, department, machine, or material). The objective of allocating indirect costs to an object is to measure the underlying usage of indirect resources by objects. Cost accounting relies upon individuals within responsibility centers to provide estimates of resource usage for cost allocation purposes. Resource usage often cuts across multiple departments making accurate estimates difficult at best. Indirect costs, costs that are assumed to be related to an object such as a part, machine, or an order, cannot be directly or easily traced to it. Indirect costs are nonetheless attributed to the object despite the difficulty tracing costs.

Indirect costs can comprise a significant portion of overall costs assigned to objects. The historical practice of allocating indirect costs in this manner has been done for several reasons. First, it assumes this information is necessary for economic decision making, such as determining a selling price for a product. However, in a product's inception, the selling price may not sufficiently cover production costs, as production volumes are commonly low relative to later periods. Leaders should always examine decisions from a systematic point of view; otherwise, some products assessed as being successful in later life cycle stages may never initially go into production. Second, full cost disclosure, even though one may be relying upon inaccurate cost estimates, can be used to motivate employees to alter designs. Various strategies, including simplicity from fewer parts, the use of standardized components, or possibly alternative materials or technologies can be followed to alter designs. Third, estimates for reasonable reimbursement rates may be required. Fourth, external information reporting is often necessary.

Unfortunately, indirect cost estimates can be wrong to a great extent, leading to poor decision making. This sometimes occurs because indirect costs are often accounted for with definitive time periods (e.g., a week or month). However, indirect costs may be incurred beyond these discreet time periods. Furthermore, indirect costs are often assumed to be incurred at a linear rate such as the incurrence of monthly rent. Yet not all months have the same number of working days. And, there may be variable (seasonal) aspects to some indirect costs, further reducing the effectiveness of estimates.

An additional cost allocation issue is whether indirect costs are controllable, minimally influenced, or uncontrollable. This issue is similar to non-value-adding activities. Most would agree that non-value-adding activities should be reduced, if not eliminated, as they are wasteful. Unfortunately, not all non-value-adding activities can be eliminated, as they may not be avoidable. Some costs that are allocated to objects are uncontrollable. Examples of uncontrollable costs include depreciation, workspace charges, general and administrative overhead allocations, and even direct labor during periods of low demands as the labor may not be transferred or eliminated. Uncontrollable costs should be recognized so managers do not pursue matters beyond their immediate, direct control.

**Batch Process Product or Job Costing Choices: Variable, Absorption, and Throughput Inventory Costing**

Reported income is a key metric in the performance evaluation of all managers. There are three historical product (job) costing approaches utilized in lower-volume batch processes: *variable, absorption,* and *throughput inventory costing.* These methods differ in when they capture *inventoriable costs*, which refers to the timing of when costs of a product (job) are incurred (expensed) and reported as cost of goods sold. It is important to understand that the incurrence and reporting of costs can significantly impact performance perceptions.

Variable, absorption, and throughput inventory costing methods are traditional sequential costing methods commonly used in lower-volume batch processes. Namely, product (job) costing for transformation systems assumes a sequential approach whereby accounting journal entries occur at sequential process stages such as procurement (raw materials inventory), fabrication (work-in-process inventory), final assembly (finished goods inventory), and distribution. Each one of these process stages requires recording journal entries.

*Variable costing* reports variable manufacturing costs (both direct and indirect) in the period in which the product is sold, not necessarily in the period in which the product is produced. Variable costing reports variable manufacturing costs in the form of stored inventory, allowing for delayed reporting of manufacturing costs, until the period in which the product is sold which significantly impacts or distorts the firm's income statement. Fixed manufacturing costs (both direct and indirect) are excluded from inventoriable costs and therefore are treated as an expense in the period in which they are incurred.

Furthermore, if variable manufacturing costs are reported in the form of stored inventory, there are implications regarding the firm's balance sheet.

*Absorption costing* is an inventory costing method of expensing all costs associated with manufacturing a particular product. It absorbs, or includes, both variable and fixed manufacturing costs as inventoriable costs. Absorption costing uses the total direct costs and indirect overhead costs associated with manufacturing a product as the cost base. Relative to the variable costing method, use of absorption costing can encourage managers to produce more inventory than necessary in order to inflate income in the period because absorption-costing inventories both variable and fixed manufacturing costs. In general, if inventories increase during an accounting period, more operating income will be reported under absorption costing than variable costing. All nonmanufacturing costs are expensed in the period in which they are incurred under both variable- and absorption-costing approaches.

Contrary to variable and absorption costing, *throughput costing* treats all costs, except those related to variable direct materials, as expenses of the period in which they are incurred. Namely, only variable direct costs are inventoriable costs. It should be clear that the three alternative product-costing methods impact reported income differently. Variable and absorption costing can promote the unnecessary buildup of inventories which leads to inflated current period performance because they treat some costs as inventoriable thereby avoiding their immediate incurrence. It should be noted that among the three product-costing methods, GAAP requires absorption costing for external financial reporting. Differences among these three product (job) costing are summarized in TABLE 2.

**TABLE 2**
**COMPARISON OF BATCH PROCESS PRODUCT COSTING METHOD EXPENSING MANNER**

| Inventoriable Costs | Variable Costing | Absorption Costing | Throughput Costing |
|---|---|---|---|
| 1. Variable Direct Material Costs | Yes | Yes | Yes |
| 2. Variable Direct Conversion Costs* | Yes | Yes | No |
| 3. Variable Indirect Manufacturing Costs | Yes | Yes | No |
| 4. Fixed Direct Manufacturing Costs | No | Yes | No |
| 5. Fixed Indirect Manufacturing Costs | No | Yes | No |

*Variable direct conversion costs refer to all direct manufacturing transformation costs less direct material costs

Although absorption costing is the method most commonly used, there is disagreement as to the favored inventory costing approach. Lean practitioners might consider throughput costing to encourage greater efficiencies. However, throughput costing is not allowed for external reporting if its use results in materially different numbers than those reported by absorption costing. As previously noted, GAAP does not allow throughput costing to be used for external financial reporting for U.S. firms. However, GAAP is not followed globally. Furthermore, there is disagreement among accountants as to a favored product-costing approach. Some accountants suggest variable costing be used for external reporting because the fixed portion of manufacturing costs is more closely related to manufacturing capacity than to the actual production of specific units. Other accountants suggest absorption costing be used for external reporting because inventories should carry both variable and fixed cost components as both are necessary for production. The lean practitioner must question the value added of the product costing approach as well as the possibility for using more than one product costing approach.

As noted above, product (job) costing for lower-volume batch transformation systems assumes a sequential approach whereby accounting journal entries occur at sequential process stages. Each one of these process stages requires recording journal entries. An alternative to traditional product (job) costing is *backflush inventory costing*. It is sometimes used in systems with short throughput times that maintain little in-process inventories or highly stable periodic inventory levels. Although it still reflects a linear process flow, backflush inventory costing often omits capturing one or more in-process accounting journal entries, effectively delaying the costing process until final assembly is completed. Costs are then "flushed" back at the end of the production run and assigned to the goods. This eliminates some of the detailed tracking of costs at intermediate production process steps, a feature common to traditional sequential costing systems. The detailed tracking of traditional sequential costing systems may simply not provide the value-added information for monitoring and control purposes.

By eliminating work-in-process accounts and journal entries, backflush costing simplifies the accounting process. However, this simplification and other deviations from traditional costing systems means that backflush costing may not always conform to GAAP. For example, work-in-process inventories may exist but would not be recognized in financial statements. This system also complicates a potential audit trail, as the ability to identify resource consumption at sequential process stages may be eliminated.

**Repetitive Process Costing: Weighted Average and First In, First Out**

Accounting in high-volume repetitive processes sometimes uses a process-costing approach for financial reporting. It is sometimes assumed that each item consumes similar resources and consequently direct material costs, direct labor costs, and indirect manufacturing costs in systems producing largely identical, mass-produced items. As a result of uniformity, a process-costing approach treats all units produced as equivalent through the adoption of an average production cost per unit to calculate unit costs of products or services.

As a result of equivalent products, rather than having separate journal entries for different products at each stage of the production process (e.g., fabrication work in process or assembly work in process) as product-costing alternatives practice, process-costing methods result in a single journal for each process stage. There are two alternative process costing methods commonly uses in high-volume, line flow processes: weighted average and a first in, first out (FIFO) methods. These methods differ on inventory cost flow assumptions each resulting in different work-in-process and work-completed costs.

The weighted average process-costing method calculates an equivalent unit cost of work done to date, regardless of the actual period or timing in which the work was completed. It assigns this cost to both the number of equivalent units completed and transferred downstream as well as to the equivalent units transferred to work-in-process inventory at the end of the period. The *weighted average cost* is the total of all costs entering the work-in-process journal account (regardless of timing) divided by total equivalent units of the work done to date.

The FIFO process-costing method may be best explained as a four-step process. First, it assigns the cost of the previous period's equivalent unit ending inventory (current period's equivalent unit work-in-process beginning inventory) to the first units completed and transferred downstream during the current period. Second, it assigns the costs of equivalent units worked on but not finished during the period to the remaining equivalent unit work-in-process beginning inventory. Third, cost assignment proceeds to equivalent units arriving, completed, and transferred downstream during the period. Fourth, cost assignment proceeds to equivalent units arriving and remaining in work-in-process inventory.

The principal differences between these two process-costing procedures include the following observations. First, the weighted average process-costing method aggregates inherited units and costs (work done in prior periods and accounted for as current period beginning inventory) with units and costs of work done during the current period. As a result, the weighted average process-costing method tends to smooth (averages) equivalent unit costs. Second, the weighted average process-costing method is computationally simpler than the four-step FIFO process. Third, the FIFO process-costing method for equivalent unit costs are determined solely for work done during the current period. Therefore the FIFO method is more transparent with information concerning periodic cost changes, which may enhance one's performance-monitoring ability. Fourth, costs of completed units and, therefore, operating income can be materially different under the two approaches when the direct material or transformation process costs vary greatly from period to period or when there is a dramatic change in periodic work-in-process inventory levels relative to work transferred downstream. This can influence one's understanding of financial reports. Regardless of the method, process-costing approaches are typically used exclusively in high-volume process industries that produce similar items, given their need to determine equivalent units. Otherwise, the average production cost per unit is too broad.

Beyond cost-based lean metrics, there are additional financial controls and metrics that lean practitioners should be aware of as well. In any investment decision, various financial considerations should be assessed. It should be apparent that many variables impact the cost accounting metrics. For instance, material costs, tooling expenditures and the consequential amortization schedule, equipment depreciation schedules, indirect overhead allocation costs, and many other variables impact operating profits. For monitoring, controlling, and improvement activities, the implications of these consequences should be well understood.

The choices about: (1) the degree of detailed estimation, collection, analysis, and reporting of information, (2) product- or service-costing methods (e.g., variable, absorption, or throughput costing), (3) product-costing alternatives (e.g., standard costing using sequential tracking or backflush costing), and (4) process costing methods (e.g., weighted average and FIFO) can each have profound impacts on costs of goods sold and therefore both internal and external financial reporting implications. These are but a few of the cost accounting issues confronting the lean practitioner and which have driven the emergence of lean accounting.

**Activity-Based Accounting Systems**

Emerging lean accounting practices seek to reduce non-value-adding transaction processing, eliminate standard costs in favor of actual costs, and eliminate cost allocations. Activity-based costing (ABC) represents a step in this direction. ABC attempts to improve upon traditional estimating approaches of indirect costs by focusing on less aggregated or more detailed transformation activities, such as actual machine setup times, design activities, or inspection activities for each specific product in order to allocate indirect costs to objects on the basis of specific activities undertaken for each product. It has been observed that ABC has a superior ability to trace costs to products, services, customers, and production activities than traditional cost systems and thus it should support lean initiatives (Cooper, 1996).

ABC activities may rely upon process flowcharts to more accurately trace and estimate indirect costs. Process flowcharts may provide a more finely structured mapping of transformative activities allowing a more accurate cost tracing and subsequent allocation.

ABC systems commonly use utilize a four-part cost hierarchy (Horngren, Foster & Datar, 2000). The hierarchies are based upon different types of cost drivers or differing degrees of difficulty in determining cause-and-effect relationships for cost allocations, which may be estimated based upon a process flowcharting investigation. Four-part hierarchies, which determine how indirect costs are allocated are typically related to (1) output unit-level cost measures, (2) order- or batch-level cost measures, (3) product- or service-sustaining cost measures, and (4) facility-sustaining cost measures. Each of these hierarchies is defined in the following text.

*Output unit-level cost measures* assess indirect costs against resources consumed producing specific products or services. Examples of these activities include electrical consumption and machine maintenance. Costs associated with these activities are assumed to be directly proportionate with the output levels for a product or service. Indirect costs deemed related to unit output levels are allocated directly using a measure such as unit outputs. For example, assume the monthly electric bill for an organization producing 500 units of product A and 250 units of product B is $1,000. In this example, monthly electric costs allocated to product A would be $666.67 (500/750 × $1,000), while $333.33 (250/750 × $1,000) would be allocated to product B.

*Order- or batch-level cost measures* assess indirect costs against resources consumed producing an order or a batch of a product or a service rather than against unit output levels. Examples of these activities would include item procurement or setup activities. Costs associated with these activities are assumed to be incurred once per order or batch for a product or service. Assume the setup costs associated to produce a batch of product A are estimated to be $250. If five setups are done for product A during the month, the costs allocated for product A setups would be $1,250 (5 × $250).

*Product- or service-sustaining cost measures* assess indirect costs against resources consumed producing a specific product or service. This assessment does not occur on the basis of units or batches, but rather for the product or service itself. Examples of this would include vendor identification, product design, product engineering, and tooling costs. Each of these activities incurs costs, which cannot be directly traced to unit or batch volumes.

*Facility-sustaining cost measures* assess indirect costs against resources consumed producing all of the organization's products and services. Examples of these costs include lease, custodial, security, information technology, and other costs. Determining cause-and-effect relationships for these cost allocations are most difficult. Therefore, some organizations deduct these costs from operating income rather than pursuing a product cost allocation approach.

Cost hierarchies used within ABC systems promote identification of cost cause-and-effect relationships. The idea of ABC systems is to promote more accurately the tracing and estimating of indirect costs, which may promote efficiency improvements. The cost cause-and-effect relationships promote more accurate indirect cost tracing and estimating, which may allow for waste elimination and efficiency improvements. However, it is important to understand the effort involved in determining detailed identification of cost drivers and cost categories. Detailed ABC systems can be costly to initiate, understand, operate, and maintain. It should be emphasized, a chief disadvantage of ABC systems is the level of effort involved given the detailed data collection and assessment of the four-part cost hierarchy explained above. In effect, the lean practitioner must question the value added of the detailed information. Some firms have abandoned ABC because of its necessary resource commitment (Huntzinger, 2007).

### Value Stream Costing

Value Stream Costing (VSC) emerged to address the short-coming of ABC (Maskell & Baggaley, 2004). VSC attempts to utilize a value stream mapping approach to focus attention on resources used, treating the value stream as a separate organizational unit, rather than focusing on individual products. VSC offers several advantages over traditional costing approaches (Baggaley & Maskell, 2003; Ruiz-de Arbulo-Lopez, et. al., 2013). First, treating the value stream as a separate organizational unit simplifies the accounting process significantly reducing potentially voluminous transaction processing to account for costs. Second, it provides relevant, item-specific cost information similar to ABC. Third, the item-specific cost information encourages continuous improvement efforts.

Although it supports continuous improvement efforts, unfortunately as a costing approach VSC has limitations. VSC makes no distinction between direct and indirect costs considering all conversion costs as direct, considers material cost (inventory) as the only relevant variable cost in decision making, and assigns each resource to a single value stream. The value stream itself is treated as a separate organizational unit, being treating it as a high-volume flow process. As proposed, VSC is not applicable to all process types as it does not address shared resources within batch processes. Namely, VSC does not lend itself to use within batch processes. Furthermore, much of the VSC literature to date only offers declarative statements concerning its virtues without beneficial empirical evidence (Ruiz-de Arbulo-Lopez, et. al., 2013).

## LEAN ACCOUNTING NEEDS ASSESSMENT

Lean accounting seeks to reduce steps in transaction processing, eliminate standard costs in favor of actual costs, and discontinue cost allocations (Kennedy & Widener, 2008). The discussion above begins to bring to light the information needs of the lean practitioner and the desired future state of lean accounting. As previously noted, lean practitioners will ideally rely upon a broad set of performance measures possessing numerous characteristics. These performance measures should possess the characteristics noted below.

First, cost-based metrics are desirable as everyone understands the value of the dollar. There will always be a need for accounting with a cost basis. However, not every performance metric will have a financial nature. Performance metrics must possess the characteristics which support process improvement. This must be true regardless of whether the process is a low-volume batch process, high-volume repetitive process, manufacturing or service, for profit or non-profit. Lean is experiencing applications in numerous industries including manufacturing, healthcare, financial services, and many others. Measurement systems and metrics must evolve as transformation processes and practices evolve.

Second, performance metrics must enable decision-makers to act upon the information in a current, or real-time manner. The information must reflect current system performance relative to the planned or expected system state enabling proactive control measures to be taken. This will facilitate faster reaction capability or the agility of the transformation process. Further, performance metrics must be under the control of the individual(s) close to the process. These must be the individuals who are responsible for maintaining the process as well as those possessing the authority for correcting the process. Namely, performance metrics must engage those with an interest in ensuring the appropriate outcomes. This will promote accountability regarding investigative results as well as emphasize continuous improvement.

Third, performance metrics must capture information that is specific enough in several dimensions: process-, time-, and product-specific. This information might reflect machine-level, process-level, or company-level data, utilizing a short time increment between data capture points (e.g., hourly or weekly), possibly for a particular product or batch enabling issues being brought to light sooner. This data does not have to be captured and shared system-wide, but it must be acted upon in a localized manner. Despite the level of detail, it must also be economically justified, both from an internal control and external customer perspective. In particular, the value of the information must exceed the cost of its capture and assessment. Various technologies presently exist that enable the capturing of real-time, localized, cost-effective information. For example, bar code and radio-frequency identification technologies can identify the consumption of specific items within an exact stage of any form of transformation process. These technologies presently afford cost-effective solutions to achieve the desired process-, time-, and product-specific information capture.

Fourth, performance metrics should rely upon multiple sensory functions simultaneously (e.g., coupling audio signals with visual signals) coupled with an ability to depict multiple-state conditions (e.g., utilization of various colors). Reliance upon multiple sensory functions enhances communication abilities as well as reducing errors. Several noteworthy examples of specific lean performance metrics possessing some of these characteristics have been noted in the literature (e.g., see Cesaroni & Sentuti, 2014; Maskell & Baggaley, 2006).

## CONCLUSIONS

Lean reflects a managerial paradigm devoted to a customer-driven philosophy for the enhancement of productivity through non-value added waste reduction. Performance metrics are an essential element used for the assessment of the current system state relative to a desired system state. Anecdotal evidence is emerging that suggests cost accounting performance measurement processes and metrics do not always serve lean practitioners and company leaders well. Many variables impact the cost accounting performance metrics. For instance, incurrence of material costs, tooling expenditures and the consequential amortization schedule, equipment depreciation schedules, indirect overhead allocation costs, and many other variables impact operating profits. For monitoring, controlling, and improvement activities, the implications of these consequences should be well understood.

There is a wide array of important lean performance metrics beyond cost accounting performance metrics. Some performance metrics focus on various system objectives (e.g., cost or time), others examine specific system elements (e.g., machine utilization), some are not directly financial in nature (e.g., inventory turns), and others are directly financial (e.g., payback period). One important philosophical observation regarding lean is simply that not all lean principles, practices, and tools (including various performance metrics) are equally applicable in all types of environments. Although not well-defined nor explained to date, it should be apparent that the term lean accounting has emerged in an effort to address the implementation shortcomings of current cost accounting practices across different types of process environments.

Emerging lean transformation system monitoring and control procedures are attempting to focus on recent system or current state performance, social controls (e.g., encouraging worker cross-training), and visualization approaches. Technology is facilitating and will continue to facilitate the identification of more costs as direct rather than as indirect costs.

It is important to understand that many variables impact lean performance metrics. This observation is not limited to the cost accounting metrics. Monitoring, controlling, and improving transformation processes are data driven. The focus, nature, and limitations of each metric should be understood. Lean practitioners benefit from the knowledge of a broad set of performance assessment tools.

## REFERENCES

Baggaley, B. & Maskell, B. (2003). Value stream management for lean companies, Part II. *Journal of Cost Management*, 17, (3), 24-30.

Cesaroni, F. M. & Sentuti, A. (2014). Implementing a lean accounting system in a lean enterprise. Retrieved from http://s3.amazonaws.com/academia.edu.documents/39525087/Implementing_a_Lean_Accounting_System_in20151029-30676-pkg8bm.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1494517072&Signature=gXmaXx1UE8RAoNgGTlByGdtzk%2Bs%3D&response-content-disposition=inline%3B%20filename%3DImplementing_a_Lean_Accounting_System_in.pdf

Cooper. R. (1996). Activity-based management and the lean enterprise. *Journal of Cost Management*, 9, (4), 6-14.

Fliedner, G. (2016). *Leading and managing lean*. New York, New York: Business Expert Press.

Fullerton, R. R. & McWatters, C. S. 2002. The role of performance measures and incentive systems in relation to the degree of JIT implementation. *Accounting, Organizations, and Society*, 27, (8), 711-735.

Horngren, C. T., Foster, G., & Datar, S. M. (2000). *Cost accounting, a managerial emphasis.* 10th Edition. Upper Saddle River, NJ: Prentice Hall.

Huntzinger, J. R. (2007). *Lean cost management: Accounting for lean by establishing flow.* Fort Lauderdale, FL: J. Ross Publishing, Inc.

Kennedy, F. A. & Widener, S. K. (2008). A control framework: Insights from evidence on lean accounting, *Management Accounting Research*, 19, (4), 301-323.

Krafcik, J. F. (1988). Triumph of the lean production system. *Sloan Management Review*, 30, (1), 41-52.

Kroll, K. M. (2004). The lowdown on lean accounting. Retrieved from journalofaccountancy.com, April, 15, 2017.

Maskell, B. H. (2000). Lean accounting for lean manufacturers. *Manufacturing Engineering,* 125, (6), 46-53.

Maskell, B. H. & Baggaley, B. L. (2004). *Practical lean accounting: A proven system for measuring and managing the lean enterprise.* New York, NY: Productivity Press.

Maskell, B. H. & Baggaley, B. L. (2006). Lean accounting: What's it all about? *Target*, 22, (1), 35-43.

Maskell, B. H. & Kennedy, F. A. (2007). Why do we need lean accounting and how does it work? *Journal of Corporate Accounting & Finance*, 18, (3), 59-73.

Nakajima, S. (1988). *Introduction to TPM: Total productive maintenance*. Cambridge, MA: Productivity Press.

Ruiz-de Arbulo-Lopez, P., Fortuny-Santos, J. & Cuartecasas-Arbos, L. (2013). Lean manufacturing: Costing the value stream. *Industrial Management & Data Systems*, 113, (5), 647-668.

Womack, J. P., Jones, D. T. & Roos, D. (1990). *The machine that changed the world.* New York, NY: Macmillan Publishing Company.