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New Theories on Cost Management

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Preface

The purpose of this working paper is to review the new theories on cost management, particularly addressed by the so-called "Relevance Lost"-perspective. This perspective is developed by the two American professors of accounting, Robert S. Kaplan and H. Thomas Johnson. Their point of departure is that in the current climate of rapid technological change, vigorous global and domestic competition and the enormous expansion of information-processing capabilities, current management accounting systems are inadequate and outdated. Their contribution has triggered a fresh and welcomed debate on new management accounting systems. However, the debate is not easily accessible, and the ambition of this working paper is to critically review some of the novel perspectives. Focus is on conceptual issues rather than operational questions, implementation or empirical evidence. The purpose is to discuss strengths and weaknesses of the different models, and explore the conditions under which they seem to be most adequate.

The paper is written by Svein Ole Borgen, and is a refined version of his term paper submitted in the Ph.D-course "New Theories on Cost Management" at Norwegian School of Economics and Business Administration, Bergen. The guidance of Associate Professor Arne Riise is gratefully acknowledged. Hopefully, the paper is useful for those who are interested in the interplay between modern production philosophy, organization development and new accounting models. Thanks to Berit Helen Grimsrud for valuable assistance in making the manuscript ready for publishing.

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1 Introduction

In their book "Relevance Lost", the two professors of accounting Robert S. Kaplan and H. Thomas Johnson strongly criticized today's current management accounting information (Johnsen and Kaplan, 1987, p.1):

> *"Today's management accounting information, driven by the procedures and cycle of the organization's financial reporting system, is too late, too aggregated, and too distorted to be relevant for managers' planning and control decisions…Management accounting reports are of little help to operating managers as they attempt to reduce costs and improve productivity".*

Their conclusion was that in today's climate of rapid technological change, vigorous global and domestic competition, and the enormous expansion of information-processing capabilities, current management accounting systems are inadequate and outdated. The contributions from Kaplan, Johnson and others have triggered a fresh and much welcome debate on new management accounting systems. However, the debate is not easily accessible, and the ambition of this working paper is to critically review some of the novel perspectives. Focus is on conceptual issues rather than operational questions, implementation or empirical evidence. The purpose is to discuss strengths and weaknesses of the different models, and explore the conditions under which they seem to be most adequate. This is not necessarily easy to read explicitly out of the accounting literature, as the weaknesses tend to be systematically underplayed. Particularly, this seems to hold true in the most enthusiastic part of the literature. The major part is devoted to the two conceptual versions which have been devoted the most interest; Activity Based Cost (ABC) and Activity Based Profitability Analysis (ABPA). Other interesting accounting concepts, such as Variability Accounting (VAR), Throughput Accounting (TA) and Non-Financial Performance Measurement (NFPM), are briefly compared to ABC/ABPA.

Although the main objective of the paper is to review the key features of the abovementioned models, particular focus is given to one specific issue: Which of the models in question is the best facilitator of modern production philosophy such as JIT (Just-in-time) and TQM (Total Quality Management)?

The discussion proceeds as follows: In chapter two, I address the shortcomings of conventional cost accounting systems such as Full Cost-models and Contribution Margin-models. The major critique from Kaplan and al. (1990) and Johnson and Kaplan (1987) is referred. In chapter three, the features of ABC, ABPA, VAR and TA are briefly presented. Focus is set on conceptual issues, as well as the conditions under which the various methods give the most precise cost information. In chapter four, this discussion is closed by addressing three issues that are of particular interest with respect to the implementation of modern production philosophy: (i) Which of the models is best capable of making an economic evaluation of unused capacity? (ii) Which model is best capable of pursuing an economic assessment of re-pricing strategies? (iii) Which model is most relevant with respect to performance measurement?

2 Shortcomings of conventional cost accounting systems

As competition has become more intense in most western countries, profitability margins have tended to shrink in many companies. Throughout the last few decades, the product structure of many companies has become more and more complicated. The product specter is more diversified, and product-mix-decisions are more complex. The cost structure of many manufacturing companies has changed. One significant change is that direct costs to a large extent are substituted by indirect costs, which is read off in the so-called capital/wage-ratio. Obviously, the significance of allocating indirect costs properly is increasing. The challenge is to generate true information of product costs, customer costs, order costs etc. There is a growing need for more advanced systems of calculations. Reliable measurement systems may even represent a competitive advantage within the current business environment. Following Johnson and Kaplan (1987), conventional cost accounting systems are not able to deal with the new challenges. A substantial share of the so-called "Relevance Lost"-literature is devoted to a detailed historical review of these perspectives. Kaplan (1988) shows that the standard cost accounting model had their origins in the scientific management movement, approximately 100 years ago. At that time, the key to efficiency was to maximize output produced by direct labor or by machines operated by the workers. Consequently, accounting systems emerged that developed standards for measuring individual worker and machine efficiency. The current competitive environment, however, challenge many manufacturers to achieve the ambitions of management philosophies like Total Quality Control and Just-in-time production. Standardized production in large batches is substituted by customized products in low volumes. Following the "Relevance Lost"-literature, conventional cost accounting models have become major stumbling blocks to companies' efforts to become high-quality, more responsive, and more flexible manufacturers. The laconic comment of Kaplan is that

> *".. admist all these changes, the one constant is the firms management accounting system"* (Johnson and Kaplan, 1987).

The essence of the critique raised by Kaplan (1988) is that conventional cost accounting systems have lost their relevance, as these systems tend to deliver distorted data, too late, and too aggregated. His more specific critique can be summarised as follows:

a. Too few cost drivers. According to Kaplan et al. (op. cit.), one fundamental weakness of traditional cost accounting systems is the fact that the allocation of indirect cost is based on too few cost drivers. Typically, direct wages, machine time, and material cost are the major cost drivers in traditional cost accounting systems. The consequence of too simple allocation procedures is that, at the extreme, indirect costs are allocated by 400–1000% addition to direct labour. This limited number of cost drivers tends to be overfocused so that product costs become distorted and inaccurate. Inefficient marketing decisions are made, and waste and complexity in production is enhanced (Turney, 1990:95). Kaplan also argues that the emphasis on the expenses and efficiency of direct labour causes companies to overfocus this factor. However, direct labour may sometimes be a relatively unimportant production factor. The savings that would result from reducing direct labour tend to be overstated. If the systems instead had focused on materials utilization, through closely monitoring reductions in inventory levels, rework, scrap, obsolescence and throughput times, the financial measures would likely have supported the fundamental operating improvements. Kaplan explains this overemphasis on direct labour costs by referring to the practice of emphasizing direct labour to utilization measures, with ratios like "earned to actual hours" and "indirect to direct labor". This practice reflects a mutation of the standard cost model, and does no longer match current competitive conditions. Thus, traditional summary measures of local performance (purchase price variances, direct labor and machine efficiencies, ratios of direct to indirect labor, volume variances) should be eliminated, since they conflict with attempts to improve quality, reduce inventories and throughput times, and increase flexibility. In short, conventional cost systems tend to hinder manufacturing improvement programs.

b. Cross-subsidizing effects between products and orders. Conventional cost accounting systems tend to cross-subsidize products and orders. Often, high-volume, standard products cover an overproportional part of total costs, so that low-volume-products are subsidized. The high-volume products are overcosted, whereas customer-adjusted, low-volume products tend to be undercosted. Products in small batches consume more resources than products in larger batches. Tailormade products consume more resources than standard products. Products sold often in small quantities consume more resources than products sold with lower frequency and in larger quantities. Customers who buy small quantities frequently are less profitable than customers who buy larger quantities less frequently. Products made on customers' orders are significantly more expensive than standard products. Large-volume standard products tend to subsidize small volume special products. The company runs the risk of accepting an increasing share of custom-made orders at the expense of standard products, resulting in a profit loss (Israelsen, 1993:119). Kaplan claims that the issue of detecting free riders and overcosted products is impossible to solve within an accounting system with conventional cost drivers only.

c. Limited units of analysis and change. Conventional cost accounting systems lack the capacity to facilitate cross-functional analysis. Advanced manufacturing systems are characterized by tight linkages across functions. A systemic perspective is needed, but is unfortunately absent in traditional cost accounting systems. Traditional cost accounting measures fail when setting focus on small and local, rather than systemwide measures of efficiency and productivity (Kaplan, 1990:37). Measures that track each

dimension of the companies' performance in isolation distort management's understanding of how effectively the organization as a whole implements the strategy of the company. The classification of costs by function fails to support the management of activities, drivers, and cross-functional processes. Cross-functional cooperation is inhibited (Turney, 1990: 95). The current competitive environment implies that previous keys to efficiency and high performance are outdated. Measures of individual worker efficiency and individual machine efficiency must be substituted by measures that facilitate systemic analysis and change.

d. Financial and tax considerations have overshadowed other objectives. In principle, accounting systems have four major objectives (Johnsen and Kaplan, 1987: 228): *(i) Cost allocation used for the periodic financial and tax statements, (ii) To facilitate process control, (iii) To calculate true product cost (prices, profitability etc.), and (iv) To support ad hoc studies.* According to Kaplan, these four objectives cannot all be covered within one, single system. To date, the financial and tax functions tend to be the winners. Focus is biased towards financial and tax accounting at the expense of other management and planning purposes such as setting prices and make product-mix-decisions. That cost allocation systems are predominantly designed to produce periodic income statements and balance sheets partly explains the irrelevance of today's cost systems for managerial decisions.

So far, I have referred Kaplan's critique without contesting his interpretation of the term conventional cost system. The "Relevance Lost"-literature predominantly addresses critical remarks towards fullcost-models as well as contribution-margin models (CM). CM-analysis is criticized for not being able to ensure the coverage of long-term costs (Kaplan et al., 1990). Most companies are committed to long-term-investments in products, markets and customers. CM-analysis runs the risk of undercosting products. As CM-models tend to underplay the costs of capacity, the models may lead you to keep everything, so that a bias exists towards conservative decisions. On the contrary, fullcost-models tend to reject short-term profitable orders. However, Kaplan et al. does not deliver a comprehensive, empirical analysis of conventional cost accounting systems. Their discussion is not necessarily true to the vast array of cost accounting methods found in practice.

3 A brief presentation of the new theories on cost management

3.1 Activity Based Costing[1]

The term Activity Based Costing is subject to various interpretations. Commonly, an ABC system is defined as

> *"a two-stage allocation process that fully allocates costs to products, customers or some other ultimate cost object"* (Noreen, 1991).

The CAM-I Glossary of Activity Based Management provides a more elaborated interpretation of ABC:

> "*ABC is a method that measures the cost and performance of process-related activities and cost objects. ABC assigns cost activities based on their use of resources, and assigns cost to cost objects, such as products or customers. ABC recognizes the causal relationship of cost drivers to activities".* (The CAM-I Glossary of Activity-Based Management, 1990).

ABC systems assign costs to products on the basis of multiple cost drivers. In addition to the conventional volume-related drivers, volume-unrelated drivers are included also. This contrasts to traditional cost systems that usually apply only one allocation basis. This basis is typically direct labor or machine hours, which are both proportional to production volume (Noreen, 1991). ABC was developed as an improved full-cost, unit calculation procedure. There is some confusion concerning the distinction between traditional cost systems and ABC-systems (Noreen, 1991). Following Noreen, traditional cost

1 It is important to mention that there are two versions of Activity Based Costing. In this paper, the first version is denoted Activity Based Costing, whereas the second version is denoted Activity Based Profitability Analysis (ABPA). The latter version addresses some novel issues compared to ABC, as will be clarified in chapter 3.2.

systems are merely ABC-systems that are poorly designed. ABC subsumes conventional procedures for determining product costs. It should be mentioned, however, that conventional cost systems in Noreen's terminology closely resemble full-cost models with a limited set of unit-level cost drivers.

The allocation procedure of ABC-systems

The most well known feature of ABC is its two-stage allocation procedure. The increasing proportion of indirect costs must be allocated by means of a wider set of cost drivers than direct labour, direct material and machine hours. The ambition of ABC-systems is to trace true, long-term cost consumption according to cause and effect. Hence, the core issue of cost allocation is variability. Misallocation occurs because the variability of indirect costs is not in proportion to the allocation base. Costs are not necessarily driven by volume, since non-volume driven costs exists also. For instance, product diversity may be an essential cost driver. Still, both volume-based and non-volume-based drivers are *unit level drivers*. The core of the ABC-perspective is to demonstrate that by identifying and applying non-volume-based cost drivers at the unit level, product costs can be calculated that are true to the real resource consumption. More specifically, the two-stage allocation procedure consists of the following five steps:

First, actions are aggregated into activities. The cost of a product is based on its consumption of activities. "Activity" is an aggregate, and the accuracy of this aggregate obviously influences product costs.

Second, the costs of activities are reported. At this step, it is decided which actions within each activity costs should be reported for. The detail of production and product cost reporting is determined also. For instance, should set-up-costs be reported as an aggregate, or rather be divided into "machine-setup" and "material movement"?

Third, the first stage allocation basis (ACP=Activity Cost Pool) is selected. In this stage, the method for calculating the total costs of an activity is determined. The end product is one cost pool per activity. Thereby, ABC attempts to overcome an alleged weakness of conventional cost system; namely too limited set of cost pools. In conventional cost systems, a melting pot of heterogenous cost types are normally in use. This heterogenity makes it impossible to trace true consumption and measure true product costs. At this third step, the accuracy of the recording as well as the evaluation of costs per activity is determined. All costs related to carrying out a given activity are placed in the same Activity Cost Pool. The greater the desired recording accuracy of actual cost consumption, the greater the number of activities and pools the cost-recording system has to accomodate.

Fourth, the activity centres are identified. At this step, the detail of which cost accounts can report on the organizational location of elements of an activity is determined.

Finally, the second stage cost driver is selected. For every Activity Cost Pool, a driver must be identified that describes the scale of the activity. This driver form the basis for a calculation of costs per unit of the cost driver. The cost driver must reflect, first, the resource consumption and costs as estimated in the accompanying Activity Cost Pool. Secondly, the cost driver should reflect the various products' utilization of these activities. Thus, the choice of cost driver obviously affects the accuracy of calculating product costs. For instance, ABC would recommend the number of purchase orders or another measure that links the cost of procurement activities more directly to those parts and products that place demand on those activities.

In sum, the major advantage of the two-stage allocation procedure is that different measures of resource consumption can be used at each stage.

Which costs form part of activity based costing?

In ABC, the cost of a product is the sum of the costs of all activities required to manufacture and deliver the product, with two exceptions. The first exception is Research and Development-costs of completely new products, and the other exception is costs of idle capacity. Either represent investment in the future, rather than the costs of current products. Following Israelsen (1993) it is impossible to identify an allocation base or a driver that describes a reasonable relation between these groups of resources and the existing product portfolio.

The conditions under which ABC provides true product costs

Noreen (1991) explores the conditions under which ABC provides true and relevant information. He emphasises the conceptual closeness of ABC and conventional full-cost models. He demonstrates that to provide true product costs, the allocation procedure of either models rests on the following conditions:

- Separability; i.e. the costs for one product must be separable from the costs of other products.
- Homogenity; i.e. a cost driver must be identified that describes the capacity cost or the long-term variation for the cost pool.
- Linearity; i.e. a linear link must exist between the cost drivers and the costs of the cost pool in question.

Doubtless, the conditions required for ABC-systems to accurately reflect avoidable product costs and incremental activity costs are quite strong. For instance, all dependencies between products in the production process are ruled out. But in fact, the same line of critique is also to be addressed to conventional full-cost models.

To wrap up, ABC is developed as a critique of conventional cost accounting models for their oversimplified treatment of variability. Costs are not only driven by volume, and conventional volume-related cost drivers should be supplemented by non-volume-related cost drivers. A greater part of the ABC-literature is applied to demonstrate that more cost drivers in the allocation procedure provide more precise product cost. The ambition of ABC-models is to facilitate more informed decisions about product pricing, product-mix decisions, product-drop decisions etc. In ABC-models, all costs are treated as variable cost. Moreover, the typical arguments in favor of Contribution Margin-models are contested. Contribution Margin-models presuppose that costs of capacity must be dealt with outside the cost accounting system. The door is open for subjective rule-of-thumb judgements, without sufficient anchorage in accounting philosophy. ABC-models are characterized by a continuous search for relevant cost drivers. The identification of cost-drivers can be of substantial interest with respect to rationalization of work operations. Since the most significant cost-drivers are identified, there is an incentive also to attack them. This is highly relevant with respect to the implementation of cost-reduction programs. For instance, JIT-programs typically struggle to make set-up operations as efficient as possible, following for instance the SMED-methodology (Single Minute Exchange of Dies). By applying for instance “minutes pr. set-up” as a cost driver, more attention is paid to the economic significance of reducing set-up-costs.

ABC is not an universal recipe, and is not of equal interest to all companies. Following Israelsen, the relevant type of firm is first and foremost the low- and high-volume manufacturer of custom-order products (Israelsen, 1993:119). For such products, prices cannot be set in advance. The components of the product are normally not identified prior to the tender stage. For manufacturers of standard products, ABC seems to be less relevant. Their prices are more or less fixed when the product enters the market.

3.2 The Activity Based Profitability Analysis[2]

ABPA has three essential features. First, ABPA has a wider scope than ABC, i.e. more cost objects. Second, ABPA has a different conceptualization of variability, and thirdly, ABPA has another treatment of capacity costs than ABC. Let me elaborate these differences in more detail. First, in their book published in 1991, Cooper and Kaplan (1991) are no longer solely occupied with the assessment of true product cost; that cost calculation is in exact correspondence with actual resource consumption. In addition, the ambition of ABPA is to support operational and strategic decisions about market segments, customers, distribution channels etc. Despite the abovementioned sceptisism towards contribution margin-models, a shift towards contribution-margin analysis can easily be traced in the second version of the ABC-model. In the first version (ABC), variability had to be reflected by means of either volume- or non-volume unit-level drivers. In ABPA, unit-level drivers are supplemented by drivers at other activity levels. A tiered contribution margin-hierarchy that consists of four activity levels is developed. Following ABPA, the major activities of a facility's production process are classified into one of the following four categories: unit-level, batch-level, product-level or facility-level activities. Costs in the first three categories of activities are assigned to products using cost drivers that capture the underlying behavior of the costs that are being assigned. The costs of facility-level activities are treated as period costs or allocated to products in some arbitrary manner (Cooper and Kaplan, 1991). By classifying the resource consumption of all resources into four levels, the function of calculation as a decision-support tool is improved.

ABPA as a resource usage model

Cooper and Kaplan (1991) are sceptical to too much focus on resources supplied, i.e. Activity Availability, defined as the practical capacity of the activity measured in cost-driver units. The purpose of ABPA is to assess *consumption* of resources, rather than available resources. Activity usage is defined as the share of capacity that is consumed by the products. Because the distinction between expenses and costs is introduced in ABPA, the difference between availability of resources (expenses) and the use of these resources (costs) can be traced in detail. The following elementary equation will always hold true (Cooper and Kaplan, 1992):

Activity Availability = Activity Usage + Unused Capacity

According to this equation, the following allocation rules are developed in ABPA: First, costs of used capacity are allocated to the products. Second, costs of unused capacity are treated as a time-related rather than product-related cost. Thus, costs of unused capacity are not allocated to products at all. This latter solution is based on the viewpoint that capacity is time-driven rather than production-driven. The reason why unemployed machine capacity is not allocated to products or any other objects is that any other basis would yield distortions due to fluctuations in activity. The lower the activity, the higher the product costs.

[2] The term Activity Based Profitability Analysis is applied according to Israelsen's recommendation. This further development of ABC was first introduced in the article "Profit Priorities from Activity-Based Costing" (Cooper and Kaplan, 1991).

3.3 Variability Accounting

The VAR-tradition is strongly connected to the pioneering work of Vagn Madsen (1951 and 1969). His ambition was to supplement conventional cost accounting models with more flexible accounting systems. He claimed that neither full-cost nor variable cost models were applicable on a general basis. A multi-purpose cost-accounting system was called for. This is consistent with Kaplan's (1989) slogan that one cost system is not enough. Since there are no standard solution to all accounting tasks, a maximum flexible system is required. Flexible systems are capable of facilitating tailor-made economic analysis, including also opportunity cost-analysis. In VAR, flexibility is recognized by the fact that the account structure is unique to every organization. This model introduces a strict distinction between cost-data recording and cost-data manipulation. With respect to the recording task, any cost should be characterized by type, department and objective. Technically, this lay the ground for addressing critical questions like: How much was spent? Who spent it? For what purpose was it spent? Which results were obtained? The parallel recording in three dimensions imply that the sum of production factor costs always equals the sum of departments' cost which further equals the sum of costs recorded against cost objectives. The cross-reference between these three recording dimensions is commonly kept in computer-based recordings. The implication is that various combinations of information can easily be retrieved as desired both between the dimensions and in larger or smaller sub-groups.

VAR shares the ambition of ABC and ABPA that any arbitrary allocation in the cost account record must be avoided. However, the procedure of VAR is very distinct from the procedures used by ABC and ABPA. Within the VAR-framework, a natural hierarchy of accounts is constructed in the objectives and departments dimension, consisting of superjacent, subjacent and adjacent accounts. The principle for recording resource consumption in the department and objectives dimension is to place it as far down the hierarchy as a non-arbitrary assignment allows, and for which a measurement of the actual resource consumption has actually been carried out. This emphasis on avoiding non-arbitrary allocation implies that only direct consumption is recorded. If the cost consumption is indirect for two or more departments or objectives, the cost item will be placed at the level immediately above the department or objective concerned. The distinction between direct and indirect costs makes sense only in relation to specific objectives. Thereby, the taken-for-granted distinction between variable and fixed costs is ignored. Through this procedure, also seemingly indirect costs are transformed to direct costs. In other words, direct costing is achieved within VAR by establishing a more detailed account structure. This may leave the impression that particularly in large and complex organizations, the number of new accounts may increase by an inflationary rate. Does the chart of account tend to be extremely detailed? There are two main comments to this issue. First, the level of detail in the VAR account structure must always be determined by means of some kind of cost-benefit-analysis. Second, this problem can be avoided if relational database software is used. Improved IT-technology makes it possible that the record in VAR—encompassing "type of production factor", "department", "cost objective", "quantity of production factor" in addition to the cost—is represented by a virtual record, in a virtual table. An extended table of factor-input statistics along with an input-price table may improve substantially the potential for tailor-made economic evaluation. A variety of prices may be included, such as historical prices, current prices, standard prices, price-functions and even opportunity costs. Until this vision becomes reality, however, VAR applies the cost valuation method "actual consumption at standard prices" (Israelsen, 1993:17).

In ABC-models, cost drivers form the basis for allocating the costs of the various Activity Cost Pools to the products. As already indicated, such a two-stage allocation

procedure does not take place in VAR-models. In VAR-models, for each established cost objective, one must identify, measure and record a unit of output to which the costs of the objective concerned vary proportionally. This unit of output is labelled "variability factor". The variability factor helps explain and forecast the development in actual and budgeted costs of the objective in question. By definition, the variability factor in VAR-models and the cost driver of ABC-models are identical. Both cost drivers and variability factors are quantitative factors, with which cost vary almost proportionally. Further, the scope of the term "cost" is of course an essential feature of an accounting system. In VAR, costs are defined as "a periods' entire actual resource consumption, excluding depreciations" (Israelsen, 1993:59). Depreciations are kept outside the VAR-records because it is impossible to identify a variability factor for this type of cost. In VAR-models, recording takes place solely in statistical form, and not according to the double-entry book-keeping principle. However, there is still a dualistic connection between VAR and the financial accounts. Although recording in the two systems takes place independently of each other, they can easily be balanced (Israelsen, 1993). Far from all dimensions of the production factor are included in the cost-recordings. Within the VAR-system are found production factor costs, activities, capacity utilization and variability factors. Outside the VAR-system is capacity per production factor per period, absolute divisibility of production factor and discharge horizon for production factor. This implies that an in-depth exploration of absolute divisibility and reversibility of production factors goes beyond the capability of VAR. According to Israelsen (op. cit.) however, an extention in this direction is straightforward.

To sum up, three principles exist for attributing costs in the department and objectives dimension: First, recording must take place as far down the hierarchy as a non-arbitrary allocation allows. Second, as much informative data as possible must be gathered. Third, cost-benefit-analysis should determine whether or not more detailed information is required to enlighten a specific economic decision. It should be added that the need for cost-benefit-analysis might be reduced in the future due to cheaper information processing.

3.4 The Stepped Contribution Margin-hierarchy

Within the VAR-model, profitability analysis is pursued by means of a so-called "stepped contribution margin"-hierarchy. There are a number of decisive principles for constructing the stepped CM-hierarchy (Israelsen, 1993). First, the quantitative resource consumption must vary approximately in proportion to the scale of activity under the classification object concerned. Second, a sufficient scope and depth of the accounting structure must be developed, which enables costs to be assigned to those classification objects with which the contribution hierarchy operates. The form of contribution is derived from the variability recordings. This implies that the stepped contribution margin analysis is tailor-made to the specific production structure of the company in question. The third principle is that the effect of resource consumption on revenue creation or the reduction effect on other costs must be confined to the period to which the costs are attributed. To clarify the basic features of the VAR-hierarchy, Israelsen compares this hierarchy with the "pure stepped contribution hierarchy". This hierarchy makes rigorous demands on objectivity in the cost allocation procedure. Compared to the "pure stepped contribution hierarchy", the VAR-model is somewhat modified. There are no explicit discharge horizon, no absolute divisibility of the production factors and no periodical divisibility. In VAR-models, the identity principle is ignored. Moreover, in VAR-models the cost consumption concept is used in its "pagatorian" form, which precludes depreciation and imputed interest. The reason why depreciation is not

allocated to products is that such an allocation would have ignored the variability principle. What about separability and divisibility between production factors in the VAR-models? How do VAR-models treat the costs of multifunctional resources? The criterion for direct attributability of costs in the department dimension is "*quantitively put in and measured factor consumption"* (Israelsen, 1993:31). The divisibility and nature of the production factor are not used directly as a criterion. However, a variability accounting record will still show whether a production factor is multifunctional or unique. This is due to the multidimensional registration of VAR; the cross-reference between production factor cost, department cost and cost objective.

To sum up, the advantage of VAR-models compared to ABC/ABPA-models, is first and foremost the increased flexibility. VAR-models seem to be much better suited for opportunity analysis, because VAR-models are not restricted to the two-stage allocation procedure of ABC/ABPA-models. This feature has important implications for profitability analysis, strategic cost analysis etc. Moreover, VAR-models offer a larger potential for analysis because it provides the necessary information inputs without having allocated these overhead items in beforehand. VAR-models offer an unambiguous measurement of the resource consumption/cost relationship. This feature exists only at a more aggregated level of activity costing. It should be added that in VAR-models, the "disposition time" (time horizon for acquisition and discharge of a resource/production factor) is absent. This treatment of reversibility and absolute divisibility goes beyond the capability of VAR-models. This information could have provided useful information about the earliest day of reversibility.

3.5 Throughput Accounting

The next option to explore is the model known as Throughput Accounting (TA), which is particularly linked to the works of Galloway and Waldron (1989). They develop an operational accounting system based on the so-called OPT-philosophy (Optimized Production Technology). The OPT-philosophy was figured out by Goldratt and Cox (1986), and described in the novel "The Goal". Galloway and Waldron are particularly concerned with misconceptions related to the true cost of direct labor. They argue that when "standard hours produced" are measured, unfortunate incentives are set up. More precisely, the inherent and unfortunate objective is to "keep people busy producing". Batch size is often balanced against set-up costs to avoid too much lost production capacity. Queue times are used to ensure that fluctuation in load can be smoothed. Batches out of sequence are combined to save set-up costs. Work is brought forward to conserve capacity. The subsequent effect is that production activities are out of synchronization with sales. The more a company applies standard hours, the more its attention is diverted from the real cost drivers. Poor design for manufacture, poor production engineering and inadequate production planning are other flaws of conventional cost systems. "Contribution" is a commonly quoted factor in marketing and sales decision making. Galloway and Waldron demonstrate the inadequacy of this concept. Contribution Margin models are not a proper guide to profitability. It is necessary to bring in the factor of capacity and the rate of production also. Moreover, Galloway and Waldron claim that when a company accumulates the elements of labor cost and calculate a component or product cost, another incorrect assumption is made. The assumption is that as long as the time spent on a single operation is reduced, the company as a whole benefits. This line of thought overlooks the significance of bottlenecks in production flows. This notion is at the core of OPT, stating that an hour lost at a bottleneck is an hour lost for the total system, and an hour saved at non-bottleneck is just a mirage. Thus, bottlenecks should govern both throughput and inventories. More

precisely, the approach of Galloway and Waldron (1988:31) can be addressed as follows:

> *"Before we can really control the cost of labor, we first have to recognize the true relationship between inventory, lead times, due-date performance and manufacturing cost".*

First, this statement acknowledges the fact that *businesses*, not individual products are profitable. Second, both volume and margin are required to meet the largely fixed daily cost of running the business. To maximize profit, it is insufficient merely to maximize productivity of the workforce. Inventory has to be minimized as well. Galloway and Waldron claim that any decision that increases inventory is a bad decision. Any measure that encourages the creation of inventory is a bad measure. Following Galloway and Waldron, companies must learn to design products for manufacture and to use production engineering skills to facilitate ever shorter leadtimes. Such efforts must be reflected in the economic measures of the company. Standard hours and volume measures should be replaced by measures of throughput achievement, leadtime and due-date performance measures. In order to control costs, and particularly labor costs, each available minute must be used effectively. As formulated by Galloway and Waldron (op. cit.), we do not want the time of the workforce allocated to the generation of inventory.

The abovementioned discussion paid particular attention to the minimization of total costs through the synchronization of production to demand. More precisely, there are three cornerstones in the vocabulary of Galloway and Waldron (1989):

Concept 1: Cost. Manufacturing units are an integrated whole whose operating costs in the short term are largely pre-determined. It is more useful and infinitely simpler to consider the entire cost, excluding material, as fixed and call it Total Factory Cost.
Concept 2: Inventory. For all businesses, profit is a function of the time taken for manufacturing to respond to the needs of the market. This implies that profitability is inversely proportional to the level of inventory in the system, since the response time is itself a function of all inventory.
Concept 3: Product profitability. The rate at which a product contributes money determines relative product profitability. And the rate at which the factory spends it determines absolute profitability. The rate at which a product contributes money compared to the rate at which the factory spends it determines absolute profitability.
Thereby, three operational measures are developed: "Return per factory hour", "Cost per factory hour" and "Throughput accounting ratio". These measures are defined as follows:

Return per factory hour = (Sales price – Material cost)/(Time on the key resource)

Cost per factory hour = (Total factory cost)/(Total time available on the key resources)

Then the core of TA's operational framework is reached; namely the so called «Throughput Accounting Ratio», (TA-ratio):

TA ratio = (Return per factory hour)/(Cost per factory hour)

The TA-ratio measures the rate at which money is earned, as opposed to the contribution that results from each individual sale. A manufacturing company is only profitable if the rate at which the money is earned is higher than the rate at which it is spent making the products. The rate at which money is earned is dependent on the product mix. Products are neither profitable nor unprofitable, only companies are.

According to Galloway and Waldron, the TA-ratio offers a management tool for strategically directing the business. It is a measure that brings marketing and production together, and helps the business to focus on the resolving of its current constraints. Albeit the TA-model provides highly relevant and interesting topics to the forefront, some weaknesses should also be mentioned. First, the scope of TA-models is relatively limited. It is particularly useful with respect to order planning, and determining priority based on the profitability of complete orders, taking bottlenecks into consideration. However, TA is a relatively narrow tool compared to ABC and VAR. Further, TA can be contested due to its relatively short time perspective. The philosophy underlying TA-models is that of short-cycle manufacturing. It is basically focused on optimizing product mix in the short run. Based on the presentation of Galloway and Waldron, an in-depth examination of the issues of separability, divisibility and reversibility is not possible within the framework of TA-models. Hithereto, TA is not a widespread model. As far as I know, no empirical evaluations exist. Consequently, it is difficult to judge whether or not TA-models work as the advocates claim, and what the more specific success criteria are.

3.6 Non-financial performance measurement

Four different accounting systems have now been reviewed: ABC, ABPA, VAR and TA. This section deals with a different, and much broader approach. In the following, focus is set not solely on shortcomings of "conventional cost accounting systems", but on general weaknesses of most cost accounting systems. This line of thought, as represented by among others Johnson (1992), and Hall, Johnson and Turney (1990), has as its point of departure a historically based critique of the irrelevance of cost accounting information as such. Johnson et al develops a historically based framework to clarify his arguments. For instance, in the "Relevance Lost"-period (from 1950 to 1980), management is denoted as "Remote-Control"-management. In this period, as well as in the preceding industrial era, top-down-cost accounting information systems constitute the basis for a wide range of management decisions, related to marketing, sourcing, controlling organization units and individuals etc. Although ABC and ABPA are the recommended accounting systems, the authors strongly emphasize their weaknesses also. Johnson claims that the value of ABC is to a large extent dependent on the way it is applied. They hold that ABC becomes just another type of top-down command tool if it is used to control work and processes. This argument is supported by Hall, in saying that

> *"The value of a cost number depends on the cost model used: definition of relevant activities, cost drivers, cost objects, and methods of allocation"* (Hall, 1990:150).

The problem with cost models is that they simply accept measures used in decision making without asking how they have been developed or what are their intrinsic biases. For instance, Johnson traces the pioneering efforts of General Electric (GE). GE set out to improve their management of indirect costs. The ambition was to extend their use of accounting information from planning their financing only, to also controlling their operations and guiding their marketing decisions. After a while, they identified causes of costs far better than traditional cost accounting and budget tools. But the core objection of Johnson is that the activity cost analysis did not generate process maps, the analysis had no clear customer focus, and did not lead to bottom-up ideas for generating continuous process improvement. The activity analysis of GE was not very helpful in efforts to increase flexibility. No accounting information, not even activity based cost management information can help companies to achieve competitive excellence.

Therefore, Johnson, Hall et al. are explicitly occupied with organizational design, such as participation, decentralized decision making and empowerment. Further, a wider range of performance measures is needed, non-financial as well as financial.

The overall challenge for companies in the current competitive environment is to become more flexible by empowering workers to remove constraints, and become more responsive by building long-term customer relationships. As attention-directers and motivators, companies need performance measures. These measures must monitor the degree of success in building customer loyalty and increase flexibility. The enemies of flexibility are delay, excess and variation. In principle, measures should be developed that track people's overall success in removing delay, excess, and variation. A wide range of performance indicators should be applied that are tailor-made to the companies' structure and needs. Interesting candidates are "Quality Ranking in industry by customer survey", "Fallout" (i.e. the ratio of finished to started numbers of units), "Total productivity", "New-model development time", "Suggestions per employee" etc. There are six categories of improvement goals: Quality, dependability, waste (resource) saving, flexibility, innovation, development of people (Johnson, 1992). An overall set of performance measures should relate to all these goals. For instance, it is normally of strategic interest to have easily accessible information about how much time spent to do something exceed the time one ought to spend if there were no delay. The ratio "Total time/necessary time" may cover this variable. Further, most companies are interested in acquiring knowledge about how evenly processes are balanced, compared to the final demand rate. Then the ratio "Use rate/demand rate" is a natural performance ratio. Given that the company wants to know how much work in progress exceeds what is needed to exactly supply what the customer wants, the adequate ratio may be "Number of pieces per workstation". The quint-essence is that even the best cost accounting information is unable to supply this type of information. No accounting information, not even activity based cost management information, can help companies achieve competitive excellence (Johnson, 1993:132). The true character of accounting information is the reflected financial magnitudes of products sold and resources consumed. This information tells nothing about the capabilities of processes to satisfy customer wants, attitudes and desires. The pathway to flexibility is to remove constraints. Constraints must be removed by people. Therefore, Johnson et al. argue strongly in favor of decentralized organization forms, as well as decision-relevant information at all levels in the organization.

4 Conclusion: Which cost accounting model is the best JIT-facilitator?

I have now briefly compared the basic features of five novel cost accounting models. Focus is set on their conceptual foundation rather than operational and technical procedures. The paper will be ended by an evaluation of which of these models is the best JIT-facilitator. This question obviously needs some clarification. One could reasonably argue that the implementation of modern production philosophy such as Just-in-time and Total Quality Management to a large extent would reduce the need for cost information. For instance, the need for keeping detailed track of work-in-process inventory is normally diminishing, as lead-times are attacked. However, this raises no challenging questions for any accounting systems, and is not given further notice here. At the outset, it is more relevant to assume that even though companies' efforts to implement JIT and increased process quality yield impressive results in the short run, these results are not necessarily effective in the long run since reliable activity cost information is absent. Without a robust measurement system, JIT and TQM tend to suffer. This is nicely demonstrated by Kaplan in his case study research (Kaplan, 1990:15–38). Kaplan's conclusion is close to Turney's (1991:95) claim that conventional cost systems hamper manufacturing improvement programs in several ways: Inaccurate product costs encourage marketing decisions that increase waste and complexity in production. An exclusive focus on unit-level drivers encourages behavior that interferes with design for manufacturability and continuous improvement programs. The classification of costs by line item and function fails to support the management of activities, drivers and cross-functional processes, and inhibits cross-functional cooperation.

The incongruency between production systems and cost accounting systems can be formulated in a more principal line of thought also. One essential design parameter of cost accounting system is to make the underlying business as transparent as possible. Transparency implies that the cost control system should build on the production control system. When conventional production systems are changed ("from Just-in-case-manufacturing" to "Just-in-time-manufacturing"), the conventional cost systems must be

substituted to "JIT-cost systems". I shall close the discussion by briefly mentioning three important themes that are central in this respect:

- Economic evaluation of unused capacity.
- Economic assessment of re-pricing strategies.
- The significance of performance measurement as a tool for motivating actions towards key JIT-success parameter of the company.

Economic evaluation of "unused capacity"

A successful JIT/TQM-implementation may be a vehicle for a steadily increasing share of "unused capacity". Unused capacity is potential waste since the production factor is no longer needed or productive. Unused capacity can be connected to activities or objectives that—after the JIT-principles are implemented—no longer have any significant effect for the manufacturing process. Let us reformulate this issue in terms of accounting theory. The issue is whether or not the accounting systems are capable of providing a true economic evaluation of the disclosure of heterogenous, multifunctional resources. The fundamental issue of attributing a cost to a classification object is addressed. Particularly in case of complex, multifunctional resources, the notions of "relative divisibility" and "reversibility" are highly relevant. Relative divisibility tracks the production factor divisibility relative to activities and/or objectives. Reversibility is expressed by the disposition time of the resource; i.e. the time horizon for acquisition and discharge of the resource. To structure this problem further in terms of accounting theory, a criteria for exploring the causal relation between production factors and objects is needed. It is natural to apply the so-called identity principle labelled by Riebel:

> *"The cost of a production factor is only attributable to a given classification object if (i) the underlying absolute divisibility of the factor is less than or equal to the classification object's resource requirement (and thus relatively divisible with it), (ii) the contractual period of the factor is shorter than or equal to that of the classification object, plus that (iii) the discharge horizon of the factor is shorter than the commencement of the classification object's period." (Israelsen, 1993:102.)*

Given this strong criterion of objectivity and reliability, which of the cost accounting models (ABC/ABPA, VAR or TA) offer the best solution? The first-best solution with respect to the strict principle of identity cited above, is the pure decision-informational stepped contribution hierarchy (Israelsen, 1993:101). In fact, this solution is a direct operational and technical reflection of the identity principle. The rigorous criterion of objectivity and reliability inherent in the identity principle is embodied in this hierarchy. To make the point clear, let us recall the design principles of the stepped contribution-margin-hierarchy within the VAR-model: The quantitative resource consumption must vary approximately in proportion to the scale of activity under the classification object in question. A sufficient scope and depth of the accounts structure must be developed that enables costs to be assigned to those classification objects with which the contribution hierarchy operates. The effect of resource consumption on revenue creation or the reduction effect on other costs is confined to the period to which the costs are attributed. Compared to the pure decision hierarchy, the discharge horizons and absolute divisibility of the production factors are ignored in the VAR-models. But as underlined by Israelsen, due to the cross-reference between production factor cost, department cost and cost-objective, the VAR-models will still reveal whether a production factor is multifunctional or unique. A production factor is multifunctional if it appears from the departments and objectives dimension that the cost equivalent shows up in two or more departments or objectives respectively (Israelsen, 1993:32). Still it must be left to

calculations outside the VAR-accounts to evaluate the economic significance of idle resources. Although less stringent than the pure decision-informational stepped contribution hierarchy, the VAR-solution represents a satisfactory solution with respect to evaluating the economic effects of unused capacity.

With respect to the capability of ABPA (the tiered contribution hierarchy) to solve the issue of idle capacity, I am far more sceptical. Recall, first, the basic equation, underlying the technical allocation rules of ABPA:

Activity Availability = Activity Usage + Unused Capacity

Costs of used capacity are allocated to the products, whereas costs of unused capacity are treated as a time-related rather than product-related cost. Capacity is time-driven rather than production-driven. However, the issue of relative or absolute divisibility is unsatisfactorily dealt with in ABPA. Its notion of "activities" is not necessarily a good answer to the issue of homogenity and separability (Bjørnenak, 1993). In other words, "activity" is not necessarily capable of describing variability and capacity. An activity cost pool is a combination of inputs with different degrees of variability. Hence, the condition of homogenity is violated. The possibility for differentiation at a detailed level according to true variability scarcely exists. Further, capacity is connected to resources that as a rule have different capacity. Cost classification according to cost factors may secure homogenity better than activity cost pools. True measures in ABPA presuppose that capacity for one activity is separable from the capacity for other actions, but this condition seldom holds true. In short, the more cost groups (pools), the greater problems with separability, and the more cost groups, the more arbitrary is the allocation of capacity between the various activities (Bjørnenak, 1993). Subsequently, when discharging of resources is required to realize cost-reductions, the problem of divisibility might preclude the potential gains from becoming effectuated. Further, the discharge horizon is ignored in ABPA. The timing of the economic consequences is unspecified. The discharge horizon of the factors of production is ignored, due to the inclusion of depreciations in the cost allocations. The conclusion is that VAR is better than ABC/ABPA with respect to the abovementioned problem, because the design rules of VAR are closest to the identity principle. Compared to VAR, ABPA represents a less stringent causal concept, and a less stringent cost evaluation concept.

What about Throughput Accounting? My impression is that the issues of separability and reversibility are not explicitly addressed within the TA-framework. If true, TA can hardly be evaluated according to the identity principle at all. TA simply states that all costs are fixed, which undermines a more refined discussion of variability and capacity. Variability and capacity should be discussed relative to objectives, resources etc., as demonstrated by VAR and ABPA. However, with respect to an economic evaluation of "unused capacity", TA may contribute through a dynamic, short-termed analysis of bottlenecks. In relatively simple business situations, this may be of great value. Given that non-financial performance measurement is not concerned with economic evaluation in monetary terms, it is not reasonable to review this model with respect to "unused capacity".

Economic assessment of re-pricing strategies

Successful JIT/TQM-efforts may lead to or run parallel to a re-pricing strategy. Commonly, JIT/TQM-programmes are part of a novel marketing strategy that puts more emphasize on customized, low volume products. This new product mix tends to make more demand on resources that perform batch and product-sustaining activities. Thus, re-pricing products, services and customers might be required, so that the revenues received are higher than the costs of resources used to the new manufacturing and sales

strategy. Typically, prices may be raised to customers who order highly customized products in low volumes, and lowered to customers ordering standard products in high volumes. To what extent are the various accounting models capable of dealing with this re-pricing issue? First, this challenge could be interpreted as a mainstream issue of ABC. Empirical studies of ABC support the view that large volume standard products tend to subsidize small volume (customized) products (Kaplan, 1990). However, there are rigid conditions that must be fulfilled if ABC/ABPA are to provide true cost and profitability measures. My conclusion is that ABC/ABPA will normally provide more relevant cost and profitability data than full-cost systems. However, due to its more stringent conceptual framework, VAR will probably be an even better solution. The input- and cost statistics of VAR contain sufficient data to enable ABC's product calculation. Further, with respect to areas of applicability, we should keep in mind that VAR is a more universal tool than ABC/ABPA. ABC/ABPA is most relevant for low- and high-volume manufacturers of custom-order products (Israelsen, 1993:119). There are some doubts whether TA provides a sufficiently long-term perspective on the companies' pricing policy. TA runs the risk of being too shortsighted. So far, I have not succeeded in identifying a more in-depth, critical evaluation of TA with respect to this issue. The same goes for Non-Financial Performance Measurement (NFPM). To determine true product costs and profitability is beyond the scope of NFPM. Thus, any evaluation of NFPM with respect to this issue is either meaningless or unfair.

Performance measurement as a motivational tool

In any JIT-program, a set of specific action parameters must be identified. For instance, Merli proposes that the following action parameters are relevant: Order and visibility, Quality Improvement, Uniform plant load (synchronization of production to demand), Process flow redesign, Set-up reduction, and Pull System Scheduling (Merli, 1990). Further, the issue of measuring improvements on each of these action parameters is raised. With respect to this issue, non-financial performance measurement and activity management are highly relevant. Johnson's (1992) reply to the challenge of measuring continuous improvements is that "simple is best". By constructing performance measures that embody the critical success factor of the company (due-time deliveries, no defects etc.), a strong incentive system is normally established. These non-financial measures should be tailor-made to the specific tasks. Even the best cost accounting system represents only the shadow of activities and actions. More specifically, neither ABC, ABPA, VAR nor TA provides sufficient solutions to the issue of measuring performance and continuous improvements. On the contrary, when quality, due-time deliveries etc. are under control, the financial results will follow. As supplementary devices to accounting system, I agree that non-financial measurement systems are of great value. In my view, Johnson's arguments in favor of non-financial performance measurement are highly relevant. Measures that facilitate cross-functional analysis are probably more supportive than the measurement systems that are limited to single, isolated operations. However, performance measurements as guiding and motivational tools must be addressed within the orbit of theories on organization design, particularly for high-performance measurement. Johnson can obviously be criticized for delivering too simple analysis and recommendations. His rethoric is strong, but where are the critical comments and potential shortcomings of his own perspective? My impression is that Johnson should relate his reflections on motivation, empowerment etc. to a larger theoretical body. Within organization theory, there are a heterogenous and steadily growing body of knowledge on participation, decentralized organizational forms, bureaucracies etc. From this literature, a number of critical issues can be drawn, many of which could shed light on Johnson's optimistic analysis. It is beyond the scope of this paper to elaborate on this issue. The point is made to suggest an interesting arena for

further research; the still diffuse zone between accounting theory and organization theory. Finally, I would like to mediate some thoughts on the development of scientific and common sense knowledge in the field of management accounting theory. The examination of Israelsen nicely demonstrates that, although development of scientific knowledge in principle should be regarded as a collective project, the reality may be different. The emerging history of accounting theory and practice is characterized by the fact that the key contributors insufficiently relate their "novel" concepts and procedures to the prevailing body of knowledge. TA is loosely conceptually linked to ABC/ABPA, VAR is not conceptually linked to TA. VAR is not conceptually linked to ABC/ABPA, albeit Israelsen's contribution is of great value, and to some extent has bridged the two systems. Johnson et al. adds new and supplementary dimensions to all models. Further, all models build on different interpretations of conventional cost accounting-systems, which demonstrates also that conventional cost system is far from a clear-cut concept.

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