ACTIVITY BASED COSTING REVISITED BY MANAGERIAL ECONOMICS LOGIC

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Abstract

This paper identifies a number of differences in the treatment of costs and expenditures in activity-based costing (ABC) and a management accounting system based on the managerial economics model. At present, ex ante ABC models incorporating a resource consumption model and a resource spending model with what-if capabilities are recommended for activity-based budgeting in order to make better-informed strategic and operational decisions. Using a numerical example, the paper demonstrates the resulting cost distortions in ex ante ABC models and their profitability segments when costs are non-linear and in situations where opportunity costs are relevant. The paper also shows how these distortions can be avoided in a budget layout based on managerial economics.

Keyword: Activity Based Costing, neo-classical economics, managerial economics, budgeting, attention directing analyses, management control

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1. Introduction

Since its introduction at the second part of the 1980s, the aim, content and methods of Activity-Based Costing (ABC) have undergone several changes *(see endnote 1)*. From an initial focus on product-costing (Cooper 1988), ABC now also includes attention-directing analyses in the form of profitability analyses of different segments – products, customers, distribution channels, markets, etc. – and analyses of the relation between the configuration and utilization of the firm's resources (Cooper and Kaplan 1991b, 1998). Despite these developments, however, the latest versions of ABC are still built up around the central elements of the original system. These include both the focus on identifying and describing the firm's activities, encompassing the financial and non-financial resource consumption these involve, and the tracing of activities and activity costs to cost objects using activity cost drivers.

Nonetheless, while retaining several important features, ABC has undergone two major changes since its first appearance. The one involves a categorization of activities, e.g. as unit-level, batch-level, product-sustaining and facility-sustaining activities, in an effort to avoid arbitrary allocations of costs to the unit level (Cooper 1990). The other concerns the measurement of resource supply and demand through a description of the relation between activity availability on the one hand, and estimated as activity usage and unused capacity on the other (Cooper and Kaplan 1992). Such developments could indicate that ABC is moving away from classical Anglo-Saxon accounting, with roots in a tradition of full-cost allocation, towards becoming a management and control tool, built up around a managerial economics core. This is supported by the fact that ABC has formed the basis for Activity-Based Budgeting (ABB) and Activity-Based Management (ABM), both of which have a strong ex ante management theme.

The tasks of the management accounting system can be divided into ex ante and ex post tasks. The former include ex ante product costing, budgeting and product mix decisions, while the latter include ex post product costing, variance analyses and attention-directing analyses. Under ABC, all three ex ante tasks can allegedly be solved using consumption and/or spending model. An alternative to this is a model building on a managerial economics foundation.

Other papers have analyzed the extent to which, or under which conditions, ABC is in accordance with neoclassical economics – see especially Noreen (1991), Christensen and Demski (1995) and Bromwich and Hong (1999). Individually and jointly, these papers show that ABC provides relevant, i.e. decision relevant, cost only under very restricted conditions. Bromwich and Hong (1999), for example, identify seven prerequisites for ABC to show relevant costs, three of which relate to conditions on the underlying technology or production function, two to the required cost accounting system, and two to input price behavior *(see endnote 2)*.

This paper has the purpose to revisit Activity Based Costing by managerial economics logic to identify the areas where the decision-maker should beware of relying on the resulting ABC information.

Unlike the aforementioned three papers, this paper explicitly discusses the difference between managerial economics and ABC in the context of an

existing company with some capacities in place – not necessarily the currently most efficient, and with different degrees of avoidability – and with an existing product portfolio. The paper makes use of a numerical example to show the different layouts of the two procedures' product profitability statements and to illustrate the consequences of the different costing procedures. In the example we allow for input prices to be non constant (e.g. through discounts), for marginal productivity of resources to be positive (both give rise to digressively rising costs), and non-perfect divisibility of inputs.

The paper compares the thinking in the two models ex ante. The most obvious comparison here is between the managerial economics budget and mix model, based on an assumption of idle capacity, and the consumption model under the same assumption. This is done in section 2. In section 3, the managerial economics model under scarce capacity is then compared with ABC's spending model. Important model differences are pointed out in both sections. Sections 2 and 3 assume that all resources used in an activity are unique to the activity concerned and not used in other activities, and discuss primary activities only, ignoring secondary activities. Section 4 addresses the two systems' handling of secondary activities and associated costs, and section 5 discusses the consequences for activity costs and activity capacity measurement when resources are not unique to activities. Finally the conclusion is drawn in section 6.

2. The Managerial Economics Budget and Mix Model versus ABC's Consumption Model under Idle Capacity (ex ante)

Managerial economics makes a fundamental distinction between resource acquisition and resource use decisions; the reason being that the two types of decision are based on different economic rationales. Decisions on the purchase of resources with a low degree of reversibility belong to capital budgeting, i.e. multi-period calculations. Resources with a relatively higher degree of reversibility are included in periodic budgeting and in periodic mix decisions. However, these decisions are framed by strategic (including multi-period) decisions – sometimes called "decisions about decisions", or meta-decisions. Periodic budgeting and related mix decisions involve a number of central managerial economics concepts, such as marginal costs, and avoidable costs, including whether the latter are separate or common. These forms of differentiation are immaterial to ABC's consumption model. The differences between the two models are illustrated in figure 1 and 2. The example is kept simple in the way that the sketched company produces only four products. Figure 1 show cost and revenue assignment in the product dimension using the managerial economics model, while figure 2 shows the same dimensions using the ABC consumption model.

< Insert figure 1 about here >

The first columns in the figure are designed to ease comparison with the ABC model by using typical names for the ABC hierarchy levels. Section C contains marginal costs per unit of driver – here per transaction driver – and the period's budgeted number of driver units at the respective levels, provided that the levels form part of the figure's hierarchy of specific cost objects. In the corresponding levels in section A, the marginal costs are multiplied by the number of driver units. As a comparison of section A and the total avoidable costs column shows, this does not lead to an exhaustive allocation of the total budgeted expenditure. Section B in figure 1 shows positive non-product-assignable avoidable costs for all levels in the product hierarchy. This reflects the fact that all these levels are illustrated using digressively rising costs. For example, quantity discounts and positive marginal productivity can serve as examples of the behavior of materials costs. These costs can only be avoided by closing down the entire product program, and is therefore not assignable to individual products. The other examples of activity costs in the figure are not assignable to the respective specific cost objects. On the other hand, since they are avoidable, they can be saved by closing down the total product and sales program *(see endnote 3)*.

The "required minimum net revenue" of the period shows for individual products, the net revenue which makes the firm financially indifferent to the sale, and appears as the sum of the marginal costs at all the subjacent levels. However, this is an approximation, due to the fact that, ideally, avoidable costs for the respective specific cost objects should be included. The reason why this procedure is not used is that it would require calculations of the discontinuation of every single product while retaining the rest of the product and sales program – a vast number of calculations for any realistic product portfolio. With digressively rising costs, a multiplication of marginal costs and corresponding driver units underestimates avoidable costs of the specific cost objects, and vice versa for progressively rising costs. However, the model's assumptions imply that adjustments *during* the period are only marginal in relation to the budget and underlying action plans drawn up *prior to* the period *(see endnote 4)*.

As can be seen from section B in figure 1 the total of products have to bring in more than their respective minimum net revenues, they must also jointly cover avoidable common costs—€ 324,410 in figure 1. Minimum net revenue of € 764,010—corresponding to the period's total avoidable costs—is therefore the period's indifference revenue. From a cost point of view, there is no logical way in which common costs, irrespective of the level on which they occur, can be assigned to the hierarchies' cost objects. The planned net revenue in the figure is therefore solely the result of market analyses and considerations – especially price elasticity, cross elasticity of

demand, and long-term considerations. For the sake of completeness, it should be mentioned that the period's non-avoidable costs are not included, since they are irrelevant to decision-making. It should also be noticed that the examples in the figures do not include the avoidable cost of resources unique to the specific cost objects. These do not present a problem, and consequently left out, since they can otherwise just be assigned to the specific cost objects, resulting in a corresponding rise in the segments' required minimum revenue. Nor are discretionary costs of product development and process improvements incorporated, since they do not constitute decision information for the one-period program.

The resulting layout shows whether continued operations are profitable, what the minimum revenue (given the aforementioned reservation about approximation) should be per segment and in the aggregate, and what the marginal costs of minor changes in the planned action program will be, and thus provides decision-makers the information they need to make their decisions in these areas.

< Insert figure 2 about here >

Figure 2 show the same hierarchies as in figure 1, this time using the principles for cost assignment as in ABC's consumption model. Note, however, that the example does not include non-avoidable costs (e.g. depreciations which are not a function of the assets' use) *(see endnote 5)*, which are normally a part of the ABC model. On this point, the difference between the two models is so obvious that we will not let it get in the way of the analysis and discussion of the less obvious differences.

In the consumption model cost of resources supplied is divided into costs of "used" and "unused" resources. This distinction is relevant when resources cannot be made available as needed, i.e. for so-called "committed resources" (Cooper and Kaplan 1992, 1998). The categorization is based on an estimate of the practical capacity of available resources per activity and a budgetary expectation of how much is expected to be used. The capacity and its utilization are in our example estimated in number of transaction driver units, but could also be estimated in number of duration driver units. In terms of cost, each activity is estimated at the average costs per driver unit calculated as the total costs of the activity (the activity's Activity Cost Pool, ACP), divided by the practical capacity. Since we are in the ex ante domain, this procedure corresponds to "ABC, the Time-Driven Way" (Kaplan and Anderson 2004, 135). Since we assume no capacity constraints in figure 2, the figures for all activities in the "unused" column are positive. This is not the case for "materials costs", however, the supply of which is just expected to equal consumption, nor for "common sales and administrative costs" and "facility-sustaining level costs", because the assumptions for measuring the capacity are not met, and therefore cannot be applied to these costs. It is worth noting that the costs under "unused" do not reflect the fact that they can be saved, even though we have limited ourselves here to avoidable costs. This is due to two things in particular. Firstly, they are estimated at average costs and not marginal costs. Secondly, the quantum nature of the underlying resources has not been taken into account. The latter is taken into account in the spending model, however, and is therefore discussed later.

The continued illustration of the ABC information layout is based on an interpretation of Cooper and Kaplan's work on Activity-Based Costing. Firstly, it seems obvious that what is desired is a summation of the costs across the various levels in the respective hierarchies (Cooper and Kaplan 1991; March 1987). This results in what is called "required minimum net revenue" in figure 2. In all cases where activity costs are other than proportional to the activity driver (e.g. progressive, digressive, or step-variable), it produces different results than the managerial economics model. And when it is taken into account that non-avoidable costs (e.g. depreciations) are also normally included in ABC, the difference is even more pronounced. While the ABC model does not claim that the calculation in question reflects an absolute minimum turnover, or, expressed per unit, an absolute minimum price to be achieved in the budget period, it is interpreted as an absolute minimum in the longer term. This argument is analytically impossible to defend, which has been recognized for decades, and underlined by Noreen and Burgsthaler (1998) and Balakrishnan and Sivarakrishnan (1996). However, Cooper and Kaplan's proposed identification of general ledger account codes for the recognized costs in ACPs gives the decision-maker the possibility for ad hoc elimination of imputed non-avoidable costs, e.g. depreciations.

Cooper and Kaplan (1991) show the allocation of common costs based on "value added", using a common mark-up percentage on all activity costs (excluding materials costs) assigned to the specific cost objects (i.e. products in figure 2), but they also add that this is an arbitrary choice *(see endnote 6)*. It is not easy to determine from Cooper and Kaplan whether they recommend an allocation of all common costs, or just the "used" costs *(see endnote 7)*. However, the intention behind this distinction in a product calculation context is interpreted as precisely to avoid burdening the products due to a less-than-full utilization of the capacities, and thereby having a detrimental effect on their pricing and, ultimately, sale. In figure 2, therefore, only the "used" common costs are included in the value added allocation. Finally, there is in figure 2 a mark-up of the assigned costs to cover the remaining costs, which are not included in the figures (non-avoidable costs, e.g. depreciations, net interest costs and profit).

A comparison of figures in figure 1 and figure 2 clearly shows that they are different, not least because the managerial economics model uses marginal cost in its calculations, whereas the ABC model uses average costs. The former does not make a distinction between "used" and "unused". Implicitly the model takes into account the degree of utilization, since marginal costs are determined in relation to the utilization of the activities, and with it the resources—the so-called "relevant range". Unlike the ABC model, the managerial economics model has no allocation of common costs to the specific cost objects, which, moreover, are also revenue segments. This is mainly to signal that the remaining contemplation belongs under marketing economics. Using the managerial economics model, there is only one possible way of allocating common costs, which does not portray misinformation, and this is to allocate these costs proportional to the contribution margin per segment. Thus, allocation cannot take place before the marginal costs and unique avoidable costs per segment are determined and the prices and expected sales are assessed and fixed. The allocation is therefore not misleading, but on the other hand nor is it of any decision-making value, and can therefore be dispensed with.

As mentioned above, in ABC, the costs assigned to the levels in the product hierarchies are average costs per unit of activity. The consequences for the evaluation of the actual profitability of the segments are also described above. However, the situation is worsened if there are differences in the productivity of the resources used in an activity. This can be illustrated by a simple extension of the example used.

Assume that all the firm's products can be produced on two machine groups, and that both groups can produce all products. Further assume that machine group B is newer than machine group A, and requires fewer resources to switch between products (less setup costs on machine group B than A), and is also cheaper in terms of product-direct production costs to use. Finally, assume that the loss of efficiency of producing on group A instead of group B is the same for all products. In this situation, the average cost per product in the budget period is a function of the budgeted utilization of the two machine groups. This is the case even with, as in ABC, a starting point in practical capacity (as opposed to, for example, budgeted capacity utilization) and when machine depreciations are ignored.

A managerial economics approach to the utilization of the machine capacity would be to first use machine group B, and if capacity needs were greater than this, then use A. Even if ABC used the same allocation of production on the two machine groups, the ABC system would show greater product unit costs the greater the expected capacity utilization. An attempt to solve the problem by defining the two machine groups as forming part of their own different activity is no help, since products planned to be produced on machine group A will be calculated higher. It gives a random lower profitability of these products, and also of the customers to whom they are delivered.

The managerial economics model would calculate all products at marginal cost on machine group A–provided, of course, that the least contributing product can "pay" for this. The total avoidable costs of the capacity supply minus the total capacity utilization times the marginal cost rate (and the result can be both positive and negative), is placed as a common cost for all products and all sales.

3. The Managerial Economics Budget and Mix Model versus ABC's Spending Model with Scarce Capacity (ex ante)

In the event of expected scarce capacity, the managerial economics model operates with opportunity costs. Figure 3, which is based on the same example, shows how the budget information can be organized. The example assumes just one scarce capacity, and this to be in the firm's production facility. This is judged to be a common situation I practice and therefore a relevant and realistic assumption with regard to the subsequent comparison with ABC. In situations where the firm is a "price taker", the support of the ABC calculation for pricing is irrelevant, and the managerial economics model will recommend an optimization of the sales and production program, taking into account a number of potentially scarce capacities. The method used will be mathematical programming. If, in such a situation, the absolute and relative prices of the firm's products fluctuate from period to period, the firm will find that first the one and then the other capacity is scarce, and that its product mix changes significantly between periods. This is not the case (or should not be) for the firm discussed here, namely one which, via its sales efforts – pricing, marketing initiatives, after-sales services, etc. – is able to influence its sales. It bodes ill for such a firm's strategic considerations if periodic optimization results in first the one and then the other "optimal" product portfolio. This view is also in complete agreement with many of the original reasons for introducing ABC, which is critical of the contribution calculation for being too short-term (Cooper and Kaplan 1988; Shank in: Robinson 1990). In figure 3, therefore, it is assumed that the firm has chosen a single – typically a financially and strategically important – capacity which, by continuously adjusting the other capacities, it ensures, is the real activity-determining key capacity, and which is here assumed to be scarce. This was also one of the main reasons for using the term "decisions about decisions" in the introduction of section 2. The expression requires that strategic decisions limit and focus the short-period decisions (reflected in one-period budgets) and that the short-period decisions do not undermine the strategic key capacity as the activity-determining and only (potential) scarce capacity.

< Insert figure 3 about here >

It can be seen from figure 3 that product 4 makes the lowest contribution per hour, and is therefore the product on which the calculation of opportunity costs is based. By multiplying throughout with this rate for this and all other products' expected utilization of capacity, and subsequently aggregating across the products' materials costs and marginal costs per batch and product-sustaining levels, we get the period's budgeted indifference net revenue per product. Converted to sales price per unit, this corresponds to a price at which the firm is financially indifferent whether it produces and sells the one product or the other. The numerical example is deliberately kept simple here in order to ease comparison with the other figures. In the figure, demand just manages to hit the capacity limit, leaving revenue and contribution precisely as in the managerial economics model under idle capacity. The presentation is different though, and this is the main point of the figure. Opportunity costs will only arise if an unsatisfied demand over and above the capacity limit can be assumed, of course. The example assumes that the batch activity (setup) of the scarce capacity occurs out-bound (i.e. the system is able to produce while switching to another/the next product), since batch costs would otherwise also have to be estimated at opportunity cost. The example also assumes that there is no significant sales dependency between products. If there is, optimization would have to take a starting point in contribution per customer per production hour instead, and the customer with the poorest contribution mix of products per hour would have his orders limited.

The idea behind the managerial economics model in situations where a capacity constraint has been detected during the budgeting phase is, of course, that it should give rise to calculations about the profitability of relieving the constraint. Typical alternatives are the use of subcontractors, production intensity adjustments (higher production speed against higher scrapping/wear), and temporary overtime. If it is possible and profitable it is incorporated in the re-calculated budget, of course. During the budget period, opportunity cost is regarded by the production department as useful information for making additional production intensity adjustments, and by the sales department for assessing the relative profitability of new sales opportunities not detected in the budgeting phase.

In the example, ABC's consumption model (see figure 2) would only just show zero in the "unused" column at the unit level under "processing costs". In the more realistic case of demand in excess of capacity, there would be a negative figure under "unused" and in the "used" column a higher figure than the costs available to the activity (Cooper and Kaplan 1992). In view of this, the user of the ABC model would be expected to assess whether the activity could in fact be undertaken anyway with the resources available. Where the activity is personnel-intensive, the idea is that greater efficiency than laid down in the standards can be assumed temporarily. If this is the conclusion, nothing further happens, i.e. the marginal cost of the extra effort is estimated at zero. Such thinking is foreign to the managerial economics model, which assumes that production is continuously taking place at optimal economic efficiency; cost management and Kaizen have no part in this (Christensen and Demski 1995). If the ABC user does not think that the activity can be undertaken with the current resource supply, it is a signal to examine the alternatives in ABC's spending model.

The hallmark of the spending model is – in principle – that for each of the model's activities it takes account of the quantum nature of the resources used to carry it out (Cooper and Kaplan 1998, 308-309). A variety of quantum patterns exist. At the one extreme we have resources which can at any time be adjusted and purchased in the quantities which the activity output requires. Cooper and Kaplan call these "flexible resources", but they could also be called (full) activity-variable costs. For these resources, total costs of their consumption are equal to total cost of their acquisition (or, cost equals spending) *(see endnote 8).* At the other extreme are resources which, within the contemplated/relevant activity range, do not result in further resource acquisition or disposal whatsoever. This type of resource is called "committed-fixed resources". In the middle are the "committed-step" resource needs, which are the most frequent, but also the most difficult to deal with. For both the latter types, costs are only equal to spending in extreme cases, i.e. where the consumption/use is equal to the resource's capacity.

For every ACP, therefore, or, for the sake of manageability, for every relevant ACP, the spending model contains technical coefficients capable of transforming the transaction driver units into resource utilization per resource type, and from the resource types to their quantum nature and spending. For a given simulated output—number of activity driver units per activity at the respective hierarchical levels—the model will, like the consumption model, show both the spending and consumption consequence, with associated calculations of "used" and "unused", based on newly calculated average costs estimated on the new, higher practical capacity. At the same time, the revenue model linked to the spending model will show the total revenue of the newly simulated product program. The result before and after lifting of the capacity limitation can then be compared and analyzed.

In principle, the managerial economics model does the same, but it presents the result to the user in a different way than ABC. It must of necessity also build on assumptions of technical coefficients between activity driver and resources, and between resources and their costs and expenses. On the other hand, it estimates the marginal cost per activity in relation to the activity range, multiplies this by the budgeted number of activity driver units, and places

the rest of the activity cost in the category "non-assignable to specific cost objects". This means, for example, that for a resource of the "committed step" type, the marginal cost will be zero as long as the activity remains within its capacity, and the entire cost of this will be placed under the category "non-assignable to specific cost objects" unless the activity only concerns one cost object, in which case it is direct to this cost object and assignable to this. The model therefore also shows total revenue less total cost, and a comparison of the situation before and after the capacity change makes possible an estimate of excess revenue less extra expenses *(see endnote 9)*.

In essence, therefore, the difference between the two models' handling of the financial consequences of a capacity expansion is that the managerial economics model gives direct information about whether enlargement is profitable. ABC's spending model does as well—but notably only with regard to the totals, i.e. total revenues less total spending before and after the expansion. Furthermore, the ABC model shows the average costs of expected resource consumption per segment/cost object. The ABC model, via its ability to break down ACP, and thus also ACP per transaction driver, into types of resource input (general ledger account codes), is able to show average costs per cost object for flexible resources, committed-step resources, etc. The model thus makes it possible to calculate margins on the additional revenue segments after the deduction of average flexible costs alone, or these and average committed-step costs, or after the deduction of all average expected costs.

The rationale of the ABC model that the revenue from each sales segment should be able to cover the average costs it consumes/uses, gives the user the possibility to, for example, accept a capacity expansion if the extra customers/products result in higher revenues than the average estimated costs they give rise to, even though the increased revenues cannot cover the overall rise in spending. Similarly, the user has the possibility of rejecting those products/customers in a portfolio which do not cover their average consumption costs, even though the portfolio as a whole covers its avoidable spending. In both cases, the argumentation is not accepted with the managerial economics model.

If it is assumed realistic that the individual firm can model a spending model (and the associated revenue segment model) which covers all the firm's activities and specific cost objects—and this seems to be ABB's ambition—then it has the presumably unexpected consequence that margins on single segments are uninteresting and can, with the use of cost assignment based on average cost calculations, be misleading. In fact, only expected total revenue less total avoidable spending in the various scenarios are relevant to decision-making.

A mini-ABC calculation, such as that described by Cooper and Kaplan (1998, 314), where, on the cost side, a contemplated sale of new products is ABC-simulated by means of incremental spending for both flexible resources and step resources, and a surcharge of average costs for existing resources, is a problematic calculation. Not only because of the average cost calculation used, but also because it ignores the alternative of restricted supply, i.e. the removal of some existing products/customers. As mentioned above, it is the least contributing product and customer which should be able to "pay" for the capacity expansion, so a calculation of the profitability of potential new products and customers will often be misleading. Taking this into account is an intrinsic part of the managerial economics model, since it always calculates "at the margin".

4. Secondary Activities in the Managerial Economics and ABC Model (both Consumption and Spending)

Up to now, the issue of the way in which the two models deal with secondary activities has been ignored. This is rectified here. In the ABC model, primary activities are activities which directly support products and/or customers, which are why the costs of these can be assigned directly, by means of activity drivers, to the various levels in the model's customer or product hierarchy. Secondary activities do not directly support products and customers, but are often necessary to the performance of primary activities. Typical examples are activities in HR, IT and building and machine maintenance departments, together with various corporate staff functions. There are also services – so-called reciprocal services – between these departments, of course. In ABC's consumption model, it is recommended that costs of secondary activities be allocated to the primary activities, after which (some of) these ultimately burden the relevant specific levels in the product and customer hierarchy (Cooper and Kaplan 1998, 264). The calculation procedure used, also in the case of the reciprocal services, is well-known from the standard literature. The result can very easily differ, however, since the ABC model is a lot more thorough in identifying relevant drivers—the ones that follow the so-called cause-and-effect relation. The fact that the ABC model is transparent with regard to the type of resource input per ACP means that the user can decompose costs per level in the product and customer hierarchies, into costs from primary and secondary activities, and within these also into flexible costs, step-costs, etc. The purpose of the allocation is to make the user aware of the products' and customers' utilization of these indirect (secondary) activities too, and of the fact that potential changes in the product/customer portfolio also reflects the consequences for resource use in the secondary activities, through the re-calculation of "used/unused" here. Worth noticing again, however, is that the costs are calculated at average costs, and thus have the same consequences and drawbacks as shown above concerning the primary activities.

In principle, the way the spending model handles secondary activities also makes it possible to simulate the spending consequences for these activities of changes in the product/customer portfolio. On the resource-demand side, this occurs as in the consumption model, via technical coefficients, by tracing customers' and products' activity demand across primary activities to secondary activities, and, in each case converting the activity demand into the equivalent resource demand. On the supply side, it takes place through modeling of the quantum nature of the resource supply and corresponding input prices.

The managerial economics model handles costs of secondary activities in basically the same way as for primary activities. To the extent that an activity demand, and the resulting resource demand, can be traced from products/customers through primary to secondary activities (as in the ABC models), these resource utilizations will be estimated at marginal costs and the remaining part of the one-period avoidable costs placed at the level in the product/customer hierarchies they are made available to. At this level, the cost appears as a direct and avoidable cost for the segment. For the great majority of realistic company cases, it results in a placing at a more aggregated level than in ABC. If, for example, the firm has a personnel function for all personnel groups, the bulk of the expenses are placed at the company level. If some of the firm's in-house components require the use of a relatively costly "clean room", and if the components are used in all the firm's products, the same happens. If, on the other hand, only part of the finished goods program uses the component, it is a direct and avoidable cost for this part only.

5. ACP and Activity Capacity Measurements when Resources are not Unique to Activities (ex ante)

The previous sections have assumed that resources are unique to activities. It is the subject of this section to analyze the consequences for measuring capacity constraints and activity cost pools when this is not the case.

ABC's consumption and spending model operates with capacity measurements, and thus capacity supply and capacity demand calculated at both the activity and resource level (Cooper and Kaplan 1998, 310-311). Measurement at the activity level is, of course, a requirement for being able to budget (ex ante) with the range of "used" and "unused" per activity. It is the quantity of planned resources assigned to the activity, together with the expected efficiency of these resources in carrying it out, which determines the activity constraint ex ante. The managerial economics model only identifies the need at the resource level.

In the simple case, where an activity uses unique resources only, i.e. resources which are not or cannot be used in other of the firm's activities, it makes no difference whether the capacity constraint is stated at the activity or the resource level. The practical capacity can be stated in number of driver units – here transaction driver units – which, at the given efficiency (and quality), can be contributed in the period, or practical capacity of the resource setting the constraint, provided that the conversion rate between transaction driver and resource consumption is known.

It is a different matter in cases where resources are common to several activities. Here, practical capacity per activity will show a higher output potential than a measurement at the resource level. Cooper and Kaplan express a different view, however (1998, 310). In order to illustrate this, assume that the firm performs only two activities X and Y. X uses the unique resource R1, which at the given supply is assumed to limit the number of transaction driver units to 1,000. Y uses the unique resource R3, which with its supply limits Y's output to 2,000 units. Both use the multi-functional resource, corresponding to Cooper and Kaplan's "fungible resource", R2. If this is supplied in smaller quantities than necessary to produce both outputs, but in sufficient quantity to produce both of them on its own, then R2 is the actual constraining factor. The practical capacity per activity is unchanged, since sufficient amounts of R2 can be allocated to X or Y. This provides the impression of being able to carry out a greater amount of activities than actually possible. Alternatively, like Cooper and Kaplan (1998, 310), the scarce R2 could be pre-allocated to the two activities. This seems to be inappropriate, however, since the allocation is an economic consideration, which should be an output of the model and not an input. Assume, for example, that activity X is the production of products, Y is a setup activity for this, and R2 is a (job-flexible) employee resource. The number of setups, batch sizes and stock holding is a simultaneous economic consideration as regards the allocation of labor to the two activities.

In general, it is worth noting that the more activities specified in the ABC model, and the more flexible the labor force – in all functions and processes – the more pronounced the problem.

The consequence of "fungible" resources for ACP estimations is that pools sharing resources cannot be estimated independently of one another, including the cost rate of the fungible resource. In the managerial economics model, the marginal cost of the fungible resource times the planned use per activity will be placed in the respective cost pools, and the remaining avoidable cost of the resource will be placed at an aggregate level above the cost objects using the resource, thus avoiding arbitrary allocation to specific cost objects.

6. Conclusion

The paper has discussed a number of differences between the ex ante treatment of costs and expenditures in ABC and the managerial economics

model. The differences in ex ante treatment are in the financial argumentation and budget layout under both idle and scarce capacity, due especially to the fact that the managerial economics model uses marginal costs in both primary and secondary activities and incorporates opportunity costs, which ABC does not. It is concluded – probably surprisingly – that a logical consequence of a full-blown Activity-Based Budgeting model is that ex ante profitability maps of the firm's various sales segments can result in misleading information about segment profitability due to ABC's use of average costs, even in cases where total revenues and total expenses are estimated correctly. It is also pointed out that it is impossible to calculate the capacity constraint per activity – unlike at the resource level – when the activity makes use of resources which are also used in other activities. And it is shown that the ABC cost calculation results in problematic average costs when substitutable resources have different efficiencies and prices – the latter despite the fact that the driver rates are calculated on the basis of practical capacity, and whether depreciations are included or not.

The paper's analysis has been based logic and analytical reasoning. In future research it will be of interest to incorporate behavioral aspects of the decision-makers as well, and investigate the decisions made using an information layout based on managerial economics, ABC, and both. This type of study will be of interest in controlled experimental setting as well as in practice.

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Appendices

Figure 1: Cost and revenue assignment in the hierarchical product dimension using managerial economics; no capacity constraints

Budget - Period 1; Currency Euro										
							Marginal cost per unit of driver (Italic numbers are number of driver units at the corresponding level)			
	Section A Specific cost objects				Section B		Section C			
	Product 1	**Product 2**	**Product 3**	**Product 4**	**Non-product assignable avoidable expenses**	**Total**	Product 1	Product 2	Product 3	Product 4
Planned net revenue	122.031	172.870	389.007	301.665		985.573				
Planned net margin	70.811	96.770	229.927	148.465		221.563				
	---------- marginal cost ----------									
Required minimum net revenue	51.220	76.100	159.080	153.200	324.410	764.010				
Costs in other dimensions:										
Common sales & admin. costs					17.200	17.200				
Customer costs (common to product)					4.150	4.150				
Customer order costs (common to products)					5.560	5.560				
Facility-Sustaining Level Costs:										
All other common one-period mfct. costs					251.500	251.500				
Product-Sustaining Level Costs	500	500	500	800	18.000	20.300	500	500	500	800
							1	*1*	*1*	*1*
Production Batch Level Costs	720	600	1.080	2.400	11.000	15.800	60	50	60	100
							12	*12*	*18*	*24*
Unit Level Costs:										
Processing costs	10.000	15.000	45.000	40.000	12.000	122.000	10	15	30	20
Materials costs	40.000	60.000	112.500	110.000	5.000	327.500	40	60	75	55
							1.000	*1.000*	*1.500*	*2.000*

Figure 2: Cost and revenue assignment in the hierarchical product dimension using ABC-consumption model principles; no constraining capacity

Budget - Period 1; Currency Euro								
	Section A Specific cost objects				Section B			
	Product 1	**Product 2**	**Product 3**	**Product 4**			**Total**	
Reference point of required net revenue	114.713	160.216	355.954	354.690			985.573	
Profit mark-up, same percentage across products	27.423	38.300	85.092	84.790			235.604	
Reference point of required net revenue after VA allocation	87.291	121.916	270.862	269.900			749.969	
Value added allocation of used common cost	30.589	39.972	102.652	103.686			276.899	
	---------- average cost used ----------				**Used**	**Unused**		**% unused**
Required minimum net revenue	56.701	81.944	168.210	166.215	749.969	14.041	764.010	
Costs in other dimensions:								
Common sales & admin. costs					17.200	n/a	17.200	
Customer costs (common to product)					3.362	789	4.150	
Customer order costs (common to products)					4.837	723	5.560	
Facility-Sustaining Level Costs:								
All other common one-period mfct. costs					251.500	n/a	251.500	NA
Product-Sustaining Level Costs	3.530	3.530	3.530	5.649	16.240	4.060	20.300	20,0%
Production Batch Level Costs	2.015	1.679	3.022	6.715	13.430	2.370	15.800	15,0%
Unit Level Costs:								
Processing costs	10.536	15.805	47.414	42.145	115.900	6.100	122.000	5,0%
Materials costs	40.620	60.930	114.244	111.705	327.500	n/a	327.500	NA

Figure 3: Cost and revenue assignment in the hierarchical product dimension using managerial economics; constraining capacity

Budget - Period 1; Currency Euro										
							Marginal cost per unit of driver (Italic numbers are number of driver units at the corresponding level)			
	Section A Specific cost objects				Section B		Section C			
	Product 1	**Product 2**	**Product 3**	**Product 4**	**Non-product assignable avoidable expenses**	**Total**	**Product 1**	**Product 2**	**Product 3**	**Product 4**
Planned net revenue	122.031	172.870	389.007	301.665	n/a	985.573				
Planned margin above indifference net revenue	33.695	41.096	62.904	0	n/a	137.695				
	-- opportunity cost at constraining factor -- ---------- otherwise marginal cost ----------									
Indifference net revenue	88.336	131.774	326.103	301.665	n/a	847.878				
Costs in other dimensions:										
Common sales & admin. costs					17.200	17.200				
Customer costs (common to product)					4.150	4.150				
Customer order costs (common to products)					5.560	5.560				
Facility-Sustaining Level Costs:										
All other common one-period mfct. costs					251.500	251.500				
Product-Sustaining Level Costs	500	500	500	800	18.000	20.300	500	500	500	800
							1	*1*	*1*	*1*
Production Batch Level Costs	720	600	1.080	2.400	11.000	15.800	60	50	60	100
							12	*12*	*18*	*24*
Unit Level Costs:										
Opportunity costs	47.116	70.674	212.023	188.465	n/a	518.278	47,1	70,7	141,3	94,2
Materials costs	40.000	60.000	112.500	110.000	5.000	327.500	40	60	75	55
							1000	*1000*	*1500*	*2000*
Hours on constraining capacity							1	1,5	3	2
Contribution margin per hour on constraining factor							80,8	74,5	61,1	47,1

Endnotes

[1] The main focus of this paper is on the papers, books and cases on ABC by Professor Robin Cooper and Professor Robert S. Kaplan.

[2] The seven conditions for ABC to show relevant costs are due to Bromwich & Hong (1999, 55):

1. That technology is non-joint in inputs meaning that there are no economics or diseconomics of joint production.
2. That the inputs within a cost pool can be aggregated into a single overall input; that is inputs are locally separable.
3. That technology for each cost pool is homothetic meaning that the input mix is fixed irrespective of the volume of output.
4. That the aggregate input or cost driver for a cost pool is linearly homogeneous in the elementary inputs of the cost pool.
5. That the definition of activities requires that technology be separable.
6. That there are perfect input markets (what might be called non-jointness in prices).
7. That the price index for a cost pool is invariant with volume and is a linear homogeneious function with regard to elementary input prices.

[3] There is interdependency between which of the period's costs that are characterised as avoidable and the time prior to the start of the budget period at which the budget is drawn up. The earlier before the start of the budget period the budget is drawn up, the more of the period's costs can be characterised as avoidable, and vice versa.

[4] In the event that the cost-benefit of calculating the individual products' and customers' avoidable cost are deemed positive, it will still be advantageous to show the marginal cost and remaining avoidable cost separately, since the layout then supports decisions on both incremental changes in the amount of product units produced and the consequence of discontinuation of a specific product/customer.

[5] If the depreciations are a function of use, then they are also included in the managerial economics model, which is why in this case it does not result in differences between the two models.

[6] While they reject such an allocation in the text (Cooper and Kaplan, 1991, p.133), an illustrated example (p.134) uses just this.

[7] For example, in the ABC case on John Deere Component Works, all common costs are allocated (the hierarchical ABC model's numerical calculation of this is shown in Cooper and Kaplan (1991)). On the other hand, these sources are from a time when the distinction between "used" and "unused" was still in its infancy.

[8] But, as it was seen in the description of the managerial economics model, not necessarily such that marginal costs are equal to average costs.

[9] For the sake of completeness, it should be repeated that the managerial economics one-period budget model only incorporates avoidable costs, while ABC, including the spending model, also includes non-avoidable costs. This applies to resources already acquired (e.g. machines, and here in the form of machine depreciations), but also to new machines as a potential means of eliminating the capacity constraint, and here again in the ABC model represented by budgeted depreciations assigned to the period.