e-Journal of Business Education & Scholarship of Teaching
Vol. 9, No. 1, 2015, pp: 43-60.
"http://www.ejbest.org"

Recognising the effects of costing assumptions in educational business simulation games

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ABSTRACT

Business simulations are a powerful way to provide experiential learning that is focussed, controlled, and concentrated. Inherent in any simulation, however, are numerous assumptions that determine feedback, and hence the lessons learnt. In this conceptual paper we describe some common cost assumptions that are implicit in simulation design and discuss the implications for the lessons that are learnt from the simulation. In particular, concerns are raised about misconceptions that may arise when the assumptions are not recognised. Examples are drawn from a popular business simulation. We conclude that, while there are advantages from both simple and sophisticated approaches to costing, the impact on profits can be huge. When the assumptions are not explicit, they can send signals about cost behaviour which are inconsistent with reality. We recommend that when using a business simulation the facilitator explicitly recognise the assumptions, and thereby recognise the generalisations that can, or can't be drawn from the simulated experience.

Keywords: Business simulation games; costing assumptions; learning; assessment strategies.

JEL Classification: I21
PsycINFO Classification: 3550
FoR Code: 1302; 1503
ERA Journal ID#: 35696

Introduction

Recent economic recession has highlighted the fragility of profits in the face of falling demand. In these periods of contraction it is imperative that organisations have a good understanding of their cost drivers so that appropriate actions can be taken. Traditional, volume-based cost systems send misleading signals which can focus cost reduction on eliminating profitable products or services, or keeping unprofitable ones. Similarly, the ‘sticky’ nature of some costs mean that even appropriate actions may not achieve the intended results immediately (Malcom 1991; Mak and Roush 1994; Balakrishnan et al. 2011b).

It has long been argued that cost estimation and cost allocation are often not well understood by management (Kaplan 1990). Even with increasing understanding and the cost-effective technology necessary to provide more accurate costing, the adoption of sophisticated costing systems, such as Activity Based Costing (ABC), has been lower than might be predicted. This may be attributed to the very complex nature of cost behaviour. Organisations face a difficult balance between the benefits of more precise information and the financial and cognitive investment necessary to trace overhead costs to cost objects (Brierley 2010).

There is a danger that managers will accept the costing system as a representation of actual cost behaviour. Similarly, over-simplified cost behaviour in business simulations may lead to misconceptions when applying the learning from the simulation to real organisations. Whereas accounting-specific education recognises the complex nature of cost behaviour, business simulations often target a wider audience and have different learning objectives. Naïve or incorrect cost assumptions and calculations which may apply to the simplified relationships inherent in a business simulation may fail to generalise to more complicated competitive environments. Examples include the confusion between an “average” and a “marginal” cost; or opportunity costs such as the opportunity cost of capital, which is dynamic in nature and context specific, but not always applied in this way. This is in addition to lack of clarity regarding when to (or not to) apply well-known costing systems, such as ABC, volume-based costing, and throughput costing.

Business Simulation games nowadays are often used for teaching and training purposes (Tunstall and Lynch 2010; Armer 2011; Alsaaty 2014). Interestingly, managerial costing options in such educational games are often limited to working with, and interpreting, fixed and variable cost; along with cash flow; leaving the above potential misconceptions about marginal and average cost, along with opportunity costs, unattended.

This conceptual research illustrates a number of important cost “mis”-estimations, and argues for greater transparency and sophistication around various managerial costing issues in today’s business simulation games. As such, business students and professionals alike will be better informed when trained up using business simulation games in which strategic, tactical, and operational decisions are made, argued and justified, and implemented; while avoiding over-simplification of the business context at hand through the use of a single cost paradigm.

This paper is organised as follows. First, a brief literature review addresses the complexity of identifying and implementing a holistic product costing paradigm across the organisation, and refers to the prevalent costing methods available today. This is followed by a few numerical examples that illustrate the potential misuse of particular costing approaches. Next, costing within a typical business simulation game application is illustrated, showing the limitations of current practice in educating business students and professionals in their treatment of costing for making (simulated) business decisions. This leads to a set of recommended approaches and parameter settings in business simulation education to widen the relevant cost paradigms taught for particular business scenarios. Finally, limitations of the research and areas for future research are identified.

Literature Review

Applying a uniform and universally agreed costing methodology across all organisations has proven elusive. Balakrishnan et al (2012a) note the difficulty associated with product and capacity planning decisions:

> "… *product and capacity planning decisions are among the most informationally demanding and complex decisions that firms encounter. Because of the complex interactions among products and resources, it is almost impossible to formulate a conceptually complete decision problem (the ''grand'' problem that jointly models the capacity acquisition, capacity allocation, pricing, and product-mix decisions), let alone solve it*.".

It is no wonder, therefore, that organisations make simplifying assumptions when designing their product costing systems. A balance has to be struck between the costs and benefits of system design choices. Therefore, features of the organisation and the competitive environment will be important in determining that balance (Brierley 2010).

Some of the important features that indicate the need for a sophisticated cost allocation system include (Cooper and Kaplan 1991; Brierley 2010; Cohen and Kaimenaki 2011; Pavlatos 2012):

1. A high proportion of indirect costs shared between multiple cost objects.
2. Heterogeneity in cost drivers
3. Heterogeneity in the demands from different cost objects
4. The cost-competitiveness of the market
5. The availability of information systems to gather information about costs and cost drivers.

Product costing systems allocate shared capacity resources to products, services, customers, or any other cost object of interest (such as organisational departments or processes). The intent, *inter alia*, is to identify the factors that drive costs for product planning and resource planning. The allocation of costs is also important in influencing behaviour throughout the organisation (Demski and Feltham 1976) as decisions are made based on the impact that they have on the costs for which individuals are held responsible (Bulloch 1964). The objective for this behavioural function of cost allocation is not necessarily to accurately determine the actual cost relationships, but rather, cost allocations may be made to achieve other strategic imperatives (Merchant and Shields 1993). Even when accurate cost allocation is the objective, various features of the decision context may determine the practicality and potential benefit of a sophisticated cost control system (Speklé 2001).

Other purposes for cost allocation include inventory valuation and profit calculation for financial accounting purposes (Johnson and Kaplan 1987). In these cases the emphasis is not on forward decision-making. There are numerous examples, however, of the dysfunctional effects of inadvertent misallocation caused by a lack of understanding of the cost drivers (e.g., Cooper and Kaplan 1988), and much has been written about the planning and decision-making role of product costs (Balakrishnan and Sivaramakrishnan 2002).

Shared capacity resources are sometimes (inappropriately) referred to as 'fixed costs'. If costs were truly 'fixed' and not controllable there would be no point in allocating them for cost management. Indeed, it can be argued that they should not be allocated because they can distract attention from the real cost drivers (Balakrishnan and

Sivaramakrishnan 2002). To the extent, however, that these capacity resources are significant, and their determinants can be identified and managed, allocating their cost between cost objects is a powerful means of informing decision –makers of the cost-implications of the decisions being made so that costs can be reduced in the future. It should also be noted, however, that there is typically a lag between the resource capacity and resource consumption decisions. Capacity resources are 'sticky' (Balakrishnan et al. 2011b). Therefore, reducing the demand for the resource does not immediately reduce the spending on that resource, rather it creates unused capacity until the level of resource can be reduced (for example, reducing the demand for a quality inspector does not reduce the salary until the inspector can be reassigned or moved on).

Given the difficulty in dealing with product and capacity planning decisions organisations engage heuristics (Balakrishnan et al. 2011a) in order to find acceptable, cost-effective, decision-support systems. As with any heuristic, however, it comes with a risk that the underlying assumptions will not continue to hold under changing circumstances, or be transferrable to other circumstances. It is important, therefore, when using a heuristic, to understand those assumptions so their validity can be considered and the output interpreted appropriately.

Balakrishnan et al. (2012a) compared alternative product costing approaches from a decision-making perspective with specific reference to long-term product planning and resource planning decisions. They consider:

1. Traditional Volume-Based Allocations
2. Activity-Based Costing (ABC) Systems
3. Resource Consumption Accounting (RCA)
4. Time-Driven Activity-Based Costing

Table 1 compares the above mentioned cost paradigms across numerous decision making dimensions for management.

Table 1: *Comparison of most common product costing systems*

	Traditional Volume-Based	**Activity-Based Costing**	**Resource Consumption Accounting**	**Time-Driven Activity Based Costing**
Implementation				
Initial design	Easy and straightforward.	Requires great deal of operating and financial data. Interviews to allocate resource costs across activities. Estimates of practical capacity.	More information than ABC Need data on variable/fixed as well as primary and secondary costs. Estimates of theoretical capacity.	Extra relative to ABC is the resource consumption pattern for each activity. Interview data (for first-stage allocation) is not required.
Ease of updating	Difficult to update, particularly if actual volumes are used. Adding a resource/cost pool/ product requires recalculating rates in entire system.	Difficult to update. Number of links increases *exponentially* with system complexity.	More difficult to update. The number of links to update is substantially greater than the change required in an ABC system.	Quite easy to define variations of activities. Can add new resources/cost objects easily. Number of links to be changed increases *linearly* with system complexity.

Measurement error in inputs (e.g., driver quantities, prices)	Relatively low. Total costs are measured well. Few, standardized drivers are also often used for other purposes (payroll) and thus have high integrity.	Many more measurements needed. Many subjective allocations. Data hard to collect (interviews). Practical capacity is hard to define for some cost pools.	More measures required than in ABC. Classification into fixed and variable costs introduces more error.	Need many measures of small discrete activities. While smaller acts have more (percentage) error, can employ better techniques than subjective estimation. Net effect is unclear.
Decision relevance				
Ease of changing the unit of analysis	Product is only unit of analysis.	Use of cost hierarchy helps distinguish unit-, batch-, and product-level activities. Can make product and product-line decisions.	Similar to ABC.	Can aggregate to any desired level of analysis by suitably aggregating terms in the time equation.
Helps in identifying controllable costs	Ignores the issue, focusing on distinguishing product from period costs.	Includes pre- and postproduction costs. Does not distinguish by level of controllability.	Similar to ABC. Distinguishes by controllability and ''line of sight'' to activity.	Can roll up time equation to desired degree of aggregation.
Alternative measures of opportunity costs	Not possible to model.	Conceptually possible. Practical applications are rare.	Explicitly considers replacement costs.	Similar to ABC.
Cost management				
Helps identify unused capacity	No. Use of actual (or, more common, normal, or expected capacity used) means that all costs are allocated.	Use of practical capacity and can thus help identify unused capacity. Difficult to determine for transaction cost pools.	Uses theoretical capacity Potentially lower measurement error than practical capacity. Difficult to determine for transactions.	Uses practical capacity to determine resource rates. Measure can be tailored to resource characteristics (e.g., time/space).
Incentives to reduce number of transactions	None.	Yes. Doing so reduces the cost allocated to the product.	Yes. Same as ABC.	Yes. Same as ABC.
Incentives to increase efficiency of transactions	None.	No. Revising the rate to reflect increased capacity is non-trivial.	No. Same as ABC.	Yes. Managers can reduce reported costs by increasing efficiency of transaction.

Source: (Balakrishnan et al. 2012b)

Other important costing approaches may include Lean Accounting and Throughput Accounting. Lean Accounting, with its focus on value-streams, makes it more difficult to

> "d*rill down to the product level (within a product line). This macro view also makes it more difficult to identify and manage the costs of unused capacity. The cost-benefit trade-off depends on whether the firm believes a product or the*

> *product line is the right ''unit of analysis'' for making economic decisions.*" (Balakrishnan et al. 2012b).

Throughput Accounting, with its foundations in the Theory of Constraints (TOC) (Goldratt 1990), stands in stark contrast to ABC. Rather than focusing on precisely attributing activity costs (overheads) to products, services and other costs objects, throughput accounting emphasises those costs that can be influenced in the short term. Fixed costs are not allocated to products or services. The emphasis of throughput accounting is on maximising throughput (revenue less the cost of raw materials). Importantly, the notion of variable cost is limited to costs that will be avoided in the short term. Costs, such as direct labour, which are generally considered to be variable are considered to be fixed in the very short timeframe considered in TOC. This stems from the fact that only the units that pass through the bottleneck resource(s) (i.e, the constraint) can be sold to generate revenue. Minimising inventory (valued at raw material cost only), and decreasing operating expenses (which include direct labour) are secondary to maximising throughput (Goldratt 1990; Dugdale and Jones 1998; Bowhill and Lee 2002; Lockamy 2003; Sheu et al. 2003; Souren et al. 2005).

When trying to make sense of this myriad of available costing paradigms, one should keep in mind that an effective cost system is "one that presents a parsimonious model of the underlying production environment." (Balakrishnan et al. 2012b). Paraphrasing Einstein out of context, in our costing paradigm – "the (cost) system should be as simple as possible, but not too simple". Yet, when educating business students and professionals, the operation of the costing system needs to be explicit, so that the decision-makers will understand when the insights drawn from one situation will, or will not, apply to other circumstances.

Numerical Examples of Incorrect Product Costing Estimations

Referring to the costing paradigms discussed above, a number of specific numerical examples are elaborated to illustrate how business students and management professionals may become confused when incorrectly applying a particular costing methodology, with potential devastating effect on resulting (incorrect) decision making. The first example illustrates the potential confusion between a traditional volume based cost allocation that at first sight may be empirically validated, but proves incorrect when applying a more detailed activity based costing analysis. This is followed by the application of throughput costing within a bottleneck capacity environment, leaving business students and management professionals wondering whether to allocate costs over the nominal capacity available, actual capacity used, or only focus on the bottleneck resource that constrains overall system output. Finally, an example illustrates potential confusion between average and marginal cost in inventory cost estimation.

Example 1: Volume Based and Activity-Based Costing

A company carries a product line with three products A, B, and C. Estimated cost data for the three products, each of which requires activity of two departments, were based on the following production rates per hour:

	Product		
	A	B	C
Department 1	2/hour	4/hour	3/hour
Department 2	4/hour	8/hour	1.333/hour

Management has ordered a profit analysis for each product and has available the following information:

		A	B	C
Materials	AU$	7.00	3.75	16.60
Labour		2.00	1.00	3.50
Factory Overhead		5.00	2.50	8.75
Selling and Administrative		3.00	1.50	4.50
Total Costs		17.00	8.75	33.35
Selling Price		20.00	10.00	30.00
Profit		3.00	1.25	-3.35

Factory overhead has been applied on the (traditional) basis of direct-labour cost at a rate of 250 percent; and management asserts that approximately 20 percent of the overhead is variable with labour costs. Selling and administrative costs have been allocated on the basis of sales at the rate of 15 percent; approximately one-half of this is variable and does vary with sales dollars. All the labour expense is considered to be variable.

Practical capacity in Department 1 is 67,000 hours and 63,000 hours in Department 2; and the industrial engineering department has concluded that this cannot be increased without the purchase of additional equipment. While last year Department 1 operated at 99 percent of its capacity and Department 2 at 71 percent of capacity, anticipated sales would require operating both departments at more than 100 percent capacity. These solutions to the limited-production problem have been rejected:

a. Subcontracting the production out to other firms is considered to be non-profitable because of problems maintaining quality;

b. Operating a second shift is impossible because of a shortage of labour;

c. Operating overtime would create problems because of unionized employees refusing to work more than a 40-hour week.

d. Price increases have also been rejected; although they would result in higher profits this year, the long-run competitive position of the firm would be weakened, resulting in lower profits in the future.

It was subsequently suggested that Product C has been carried at a loss for too long, and that now was the time to eliminate it from the product line. If all facilities are used to produce A and B, profits would be increased. Relevant costing and sales data for this scenario are provided in appendix A.

Table 2 shows that data analysis, using linear regression, confirms at first sight the rough volume based overhead cost allocation of 250%, of which 20% is variable, as follows:

Table 2: *Regression results of Total Overhead Costs to Total Labour Hours*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	617.413	3.173		194.590	.000
	totaDL	.509	.011	.998	44.377	.000

a. Dependent Variable: totalOH

Volume based allocation rule tells us that for every 1 dollar labour, 1*(250/100)*0.20 = $ 0.50 variable overhead cost. Table 2 uses regression to estimate overhead costs in an ABC methodology, using mfg hr/product as a cost driver. Results show a regression slope of 0.509 or $ 0.509 estimated overhead cost for every dollar of labour, which is a close estimate of the allocated overhead cost. As such, at first sight, when using an ABC costing methodology, product C also shows up as loss-making, and should be discontinued by management.

Yet, such conclusion would be totally incorrect, as a more complete ABC-analysis, focusing on mfg hr/product per department, as well as general, selling and administrative overheads, would show very unequal resource usage by the various products. For decades the rising proportion of non-manufacturing overheads has been recognized (Kaplan and Cooper 1998).

The implication in our illustration is that, correct and deeper ABC analysis of the data in appendix A (not elaborated on in this paper) shows that product C is not loss making at all, and in fact yields the second best profit contribution. Yet, this was not evident by a first ABC round, using mfg hr/product in each department as a cost driver. This example shows that fundamental product mix decision errors may occur if significant overhead costs are not traced to the products, particularly when those products differ in the demands that they place on those resources.

Example 2: Throughput Costing and cost/capacity allocation

A company produces two products P and Q through a process with three machining steps (use of machine 1, 2, and 3, respectively), followed by a final assembly step. Each machine and assembly resource is available for 40 hrs/week, or a total of 9,600 min across all manufacturing and assembly steps. Overhead costs to produce P and Q are estimated at $ 3,000/week. It is shown that machine 2 makes up a bottleneck in the overall process, with one hundred percent of its capacity used, and constraining how much product P and Q can be made.

P uses a total of 55 min on all resource steps for the manufacture and assembly of one unit, and Q takes a total of 35 min/unit. Management has three options to allocate the overhead cost:

1. Spread the overhead cost over the *nominal capacity* of 9,600 min/week
2. Spread the overhead cost over the *actual capacity used* to produce as many P and Q as possible
3. Spread the overhead cost over the minutes used on the *bottleneck resource only*

Goldratt (1990) has shown that allocating overhead cost over the minutes used on the bottleneck resource only is correct in this scenario if the focus is on maximising short-term profitability (throughput). The other costing methodologies are incorrect, in that they prefer the wrong product to be produced first, resulting in inferior profit results. Yet, often management has limited understanding of bottlenecks in their production or service processes, and how such bottlenecks may “shift” over time as parameters change, or as a result of varying product mix offerings.

Example 3: Average versus Marginal Costing in inventory management
For decades, business textbooks have taught the Economic Order Quantity (EOQ) methodology in inventory management. EOQ is still widely used in many software and ERP applications. In EOQ the total cost of an inventory policy is determined by the balance between the marginal cost of carrying inventory and the marginal cost of placing an additional order (which decrease inventory carrying). Those who advocate a Just In Time (JIT) philosophy recognise, however, that the cost system often underestimates the true cost of carrying inventory. Many costs, such as product obsolescence, are opportunity costs not captured by the costing system. Costs, such as insurance and warehousing, are captured but may not be traced to individual products (as per example 3.1).

In contrast to carrying costs, as ordering costs decrease the EOQ model suggests more frequent orders, and lower inventory levels. An important question is the extent to which ordering costs are fixed and committed. Costs, such as physical infrastructure and full-time employees, are fixed in the short term at least. They are examples of 'sticky' costs in that reducing the number of orders will decrease the demands on these resources (i.e., increase unused capacity), but cost savings will only be achieved if and when resource provision has been reduced. In terms of inventory management, however, it would make sense to focus on the marginal cost of making an order that will immediately change with minor adjustments to the inventory policy (i.e., ignore these fixed costs), partly because of its "robustness" to cost parameter input errors. Yet, we will demonstrate that this is in fact a fallacy, and a wider discussion needs to take place.

The problems of including fixed ordering costs and including an average cost in the EOQ calculation, are demonstrated in the following example.

Suppose we have gathered relevant cost data for processing orders in Table 3 below, and would like to estimate the cost per order, to be used in optimizing inventory.

Table 3: *Expenditures Number of Orders Processed*

Year one	$ 253,355	1,995
Year two	250,214	1,845
Year three	256,337	2,137
Year four	261,440	2,259
Total	$1,021,346	8,236

Table 4: *Regression results of marginal cost estimation*

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	201236.262	6927.341		29.050	.001
	orders	26.275	3.355	.984	7.832	.016

a. Dependent Variable: cost

If management mistakenly focus on average cost, rather than marginal cost, the average across the four years is $ 1,012,346 / 8,236 = $ 124/order. In this example, the fixed costs are approximately $200,000 and the variable cost over the four years is $ 26.3/order (see Table 4). Assuming the cost relationships that underlie the relevant expenditures shown in Table 4, the "average" cost overestimates the relevant "marginal" ordering cost by 472% (or 124/26.3). When educating and training business people, it is interesting to see that common practice assumes such average cost figures (like cost per order) as given or assumed. The example above illustrates that it is time to go back to basics, and highlight the importance of differentiating between average (easy to calculate, but incorrect), and (correct) marginal costs, for these types of business situations, while at the same time recognising that those fixed costs could be considered. The argument for JIT stems from the fact that the benefits of low inventory are not incorporated into the EOQ model, and that the costs of holding inventory are vastly underspecified. Furthermore, that ordering costs are dramatically falling with new technologies and closer relationships with suppliers. The more fundamental question of the relative costs and benefits of an EOQ model and a JIT model remain outside the ambit of such a simulation. The point to note, however, is that numerous assumptions such as this are made and must be considered when generalizing the lessons learnt from a business simulation.

Product Costing paradigm in a typical Business Simulation Game

Nine central themes can be identified as to why educators use business simulation games: the experience business simulation games bring to the participants, instructing participants on strategy, teaching decision making, accomplishing course learning outcomes and objectives, promoting teamwork, motivating students, applying theory in a practical fashion, involving students (active learning), and integrating ideas (Faria et al, 2009 p. 477-478). Moreover, business simulation games can be classified based on several criteria: the learning goals and content (top or general management games, functional games, and concept simulations), the learning environment (class room vs. distance/blended learning), the way of decision making (individually vs. group), the type of interaction to other participating individuals/groups (competitive vs. non-competitive), and the use of technology (hand-scored, PC-based, internet-based).

Combinations of the above mentioned criteria and uses highlight that business simulation games are being used pedagogically for many different reasons. For example, in top management or general management simulations the participants take on the role of the top executives of a company and are responsible for the operation of the entire organisation. Functional simulation games set a focus on one area of business operation, e.g. procurement, production, marketing etc. In a concept simulation the focus is on one small area of business operation, e.g. traffic management, advertising management, sales management, change management etc. (Wolfe, 1993).

Advances in technology, especially computing power, have resulted in more complex (more realistic) business simulation games. Many preferred general management games cover and allow for complete strategy developments (Faria et al, 2009, 482), as well as related operational decision cycles to implement these strategies. This has resulted in acceptance of such games as being a reflection of real business scenarios. Yet, despite the increasing complexity of the game scenario, it is still only a model of reality with embedded simplifications, which may possibly lead to an unrealistic and overly simplistic understanding of (parts of) the real business world.

Due to the necessity to keep such complexity manageable for game participants, business simulations games often lack a focus on specific issues in several parts of the business (e.g. specific issues in procurement, operations, logistics, sales management etc.). Because of the general management orientation of the game, the simplification very often relates to a part of operations and cost accounting, in particular relating to the number of products/services, number and variations of operations steps, bottleneck issues, etc. Such pitfalls, however, do not mean that management games cannot support learning experiences in these simplified parts of the simulated business; but it does require that educators provide complementary insights in relation to these simplifications through additional simulations, exercises and other learning tools to facilitate effective learning. This is particularly true in cost accounting (product costing), and is elaborated on next.

Before engaging in a detailed discussion of the product costing scenario of a popular management game, some pedagogical observations are made. Cost-related reports (e.g. cost type accounting, cost centre accounting) and analysis (e.g. contribution margin analysis) are set by the developer of the game, as in the real world by the responsible accountant or executive. In management games and the real business world alike, reflection about underlying assumptions and approaches as to how they may impact on decisions often does not happen – either because of a lack of time, or a lack of understanding. Yet, the use of management games in an educational environment provides the opportunity to develop an understanding about the importance of the underlying assumptions and approaches, as well as their influence on decision-making and outcomes (sensitivity analysis).

Instructors can use two approaches. In the first approach, they can refrain from the use of general management simulations, and instead use only games and simulations with a specific focus on the selected issues, but missing out on teaching the holistic and complex nature of the issues at hand and their interactions. A second, and preferred, approach calls for the trainer or lecturer to focus on these topics through complementary learning approaches such as role plays (e.g. discussion between executives and accountants), simulation exercises, group discussions, and the like. Good business simulations may also illustrate effective cause-and-effect-analysis- exercises that may result in a changed behaviour towards underlying costing methodology approaches.

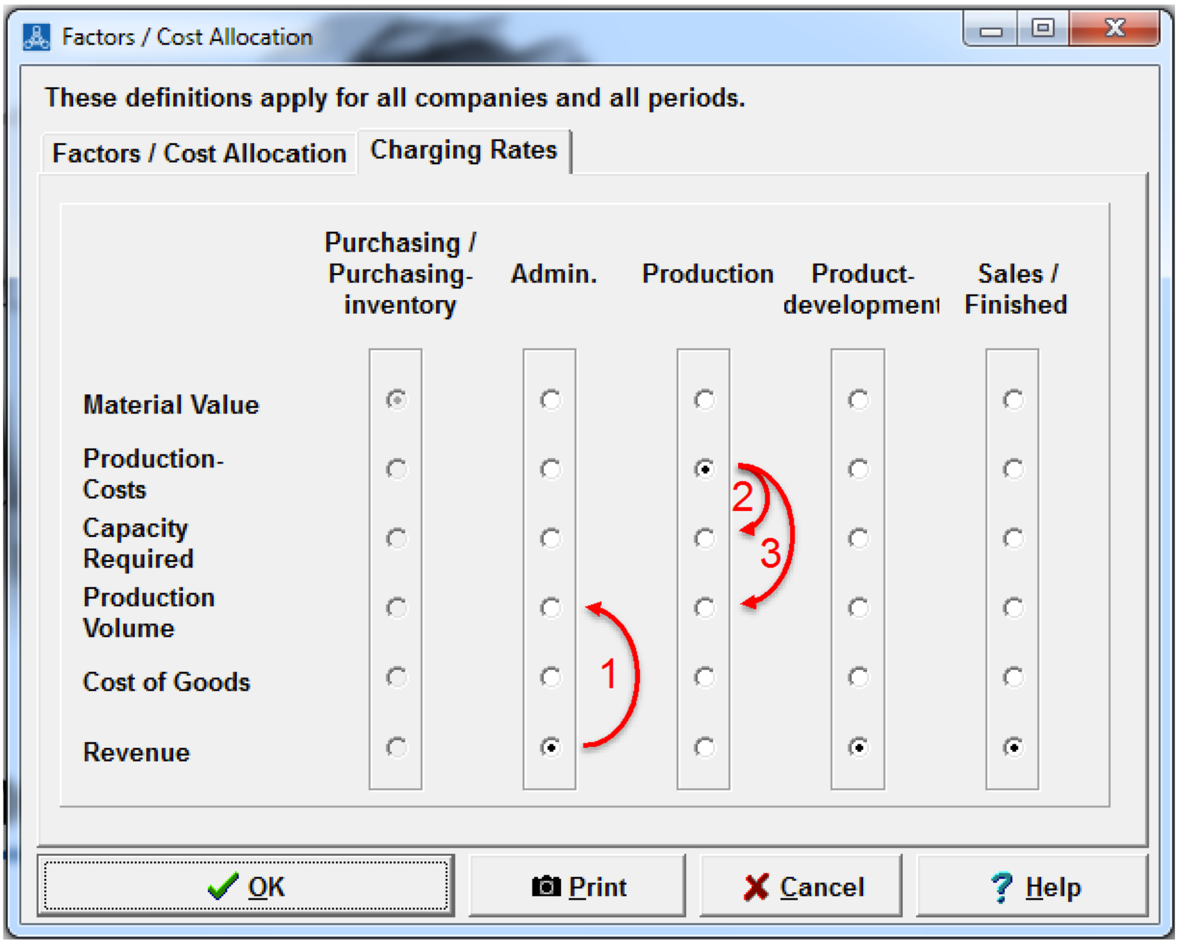
Next, we focus on the main cost accounting reports of a popular business management simulation game “TOPSIM - General Management”, developed by TATA Interactive Systems in Tübingen, Germany (www.topsim.com) to illustrate potentially misleading cost related interpretations and conclusions. Examples of exercises that can assist to develop a deeper understanding in this regard are provided as well.

Appendix B displays the main cost accounting reports for a particular simulated company XYZ which produces and sells two products: “Copy I” and “Copy II”. “Report no. 5” contains the cost-type- and the cost-centre-accounting, whereas “report no. 6” displays the cost accounting approach (unit of output-costing) for both products, and “report no. 7” the respective contribution margin calculations.

The product costing approach used in this game (and most management games) is based on a traditional volume-based allocation of overhead costs. Based on a selling price of € 3,150 for Copy I and € 9,000 for Copy II, the contribution margin analysis shows at first impression that Copy I is a profitable product, while Copy II is not. Taking this information at face value may lead to the decision that the production and sales of Copy II should be reduced, or – if no impact on the Copy I sales is expected – the product should be deleted and no longer offered in the market. Yet, some basic questions in relation to the costing methodology should be addressed. Firstly, what is the underlying philosophy for the cost allocation method used? Secondly, how (on what basis) are the overhead costs (shown in report No. 5) assigned to the two products? This is in addition to many other important queries as to the market (e.g. volume, potential, customer expectations) and business parameters (e.g. capacities and bottlenecks in procurement, inventory, logistics, sales etc.). Yet our focus, as discussed earlier, pertains to the cost-related issues.

While the answer to the first question is simple (Traditional-Volume-Based-Approach for the allocation of all non-direct- and overhead-costs), experience has shown that the second question is often not asked by participants, or the information/situation provided is “blindly” accepted. Yet, the instructor’s-software interface of the chosen simulation provides the possibility to select and change these cost allocations. The relevant input screen is shown in Figure 1. The arrows and numbers relate to allocation changes that are illustrated below, along with their impact on the profitability of either product.

Figure 1: *Input screen "selection of the cost allocation approach for overhead costs"*



Alterations in cost allocation method (Example 1-3):

The following three examples are based on a given scenario as shown in appendix B. This scenario assumes production and sales of 56,500 units of Copy I and 4,270 units of Copy II at their respective price levels across various sales channels.

Example 1: Change of the *cost allocation for administration from revenue-based to production-volume-based*

Example 1 illustrates a change in the selected approach for the allocation of administration costs, shown as fixed costs for the company as displayed on the bottom row of report No. 7 "contribution margins". In example 1, the default setting to allocate administration costs based on revenue, was changed to an allocation based on production volume. The results, as shown in Figure 2 below, show a positive contribution margin IV for CopyII of € 84, compared to € -82 before the change. Copy I still looks very good and more attractive, but the possible conclusion of a removal of Copy II no longer appears obvious.

Figure 2: *Contribution margins after changing the approach of the cost allocation of administration costs from revenue-based to production volume-based*

	Copy I					Copy II		
	Market 1	Bulk Buy.	Bids	Market 2	Ø	Market 1	Market 2	Ø
Price	**3,150**	**2,700**	**1,999**	**3,240**	**2,953**	**9,000**	**0**	**9,000**
- Direct Material Costs	372	372	372	372	372	2,299	0	2,299
- Direct Prod. Costs	1,027	1,027	1,027	1,027	1,027	2,894	0	2,894
- Transport Costs	70	0	0	165	80	255	0	255
= Contribution Margin I	**1,681**	**1,301**	**600**	**1,676**	**1,474**	**3,551**	**0**	**3,551**
- Material Costs (FC)	75	75	75	75	75	464	0	464
- Total Production Costs (FC)	441	441	441	441	441	1,243	0	1,243
- Sales FC (Product)	152	0	0	62	88	468	0	468
- Admin. FC (Product)	132	132	132	132	132	679	0	679
= Contribution Margin II	**880**	**653**	**-48**	**966**	**737**	**697**	**0**	**697**
- R & D FC (Product)	0	0	0	0	0	0	0	0
= Contribution Margin III	**880**	**653**	**-48**	**966**	**737**	**697**	**0**	**697**
- FC (Company)								
Research Costs					13			39
Sales Costs					169			516
Administration Costs					84			84
= Contribution Margin IV					**471**			**58**

Example 2: Change of the *cost allocation for production overhead from production-cost-based to capacity-based*

Example 2 changes the default setting of the allocation of production overhead costs from production cost-based to capacity-based. The resulting effects on the contribution margins of the two products are shown in Figure 3. Contribution margin II, III and IV of Copy II are looking much better now. In fact, looking at contribution margin II and III, Copy II is much more attractive now than Copy I. Also contribution margin IV has improved by an amount of € 225, as compared to the initial (default) scenario.

Figure 3: *Contribution margins after changing the approach of the cost allocation of production overhead costs from production cost-based to capacity-based*

	Copy I					Copy II		
	Market 1	Bulk Buy.	Bids	Market 2	Ø	Market 1	Market 2	Ø
Price	**3,150**	**2,700**	**1,999**	**3,240**	**2,953**	**9,000**	**0**	**9,000**
- Direct Material Costs	372	372	372	372	372	2,299	0	2,299
- Direct Prod. Costs	1,027	1,027	1,027	1,027	1,027	2,894	0	2,894
- Transport Costs	70	0	0	165	80	255	0	255
= Contribution Margin I	**1,681**	**1,301**	**600**	**1,676**	**1,474**	**3,551**	**0**	**3,551**
- Material Costs (FC)	75	75	75	75	75	464	0	464
- Total Production Costs (FC)	458	458	458	458	458	1,018	0	1,018
- Sales FC (Product)	152	0	0	62	88	468	0	468
- Admin. FC (Product)	132	132	132	132	132	679	0	679
= Contribution Margin II	**863**	**636**	**-65**	**949**	**720**	**922**	**0**	**922**
- R & D FC (Product)	0	0	0	0	0	0	0	0
= Contribution Margin III	**863**	**636**	**-65**	**949**	**720**	**922**	**0**	**922**
- FC (Company)								
Research Costs					13			39
Sales Costs					169			516
Administration Costs					73			224
= Contribution Margin IV					**464**			**143**

Example 3: *Change production volumes*, while allocating *production overhead based on production volume*

Example 3 illustrates the effect of changing production volumes when overhead costs are allocated on the basis of production volume. With a large difference in number of products produced, Figure 4 shows that the contribution margin of Copy II is much higher now on all levels. Margin II, III and IV of Copy II are now all more than 50% higher than those of Copy I. Compared to the initial default scenario, conclusions drawn are now very different.

Figure 4: *Contribution margins with allocation of production overhead costs based on production-volume under different production volumes*

	Copy I					Copy II		
	Market 1	Bulk Buy.	Bids	Market 2	Ø	Market 1	Market 2	Ø
Price	**3,150**	**2,700**	**1,999**	**3,240**	**2,953**	**9,000**	**0**	**9,000**
- Direct Material Costs	372	372	372	372	372	2,299	0	2,299
- Direct Prod. Costs	1,027	1,027	1,027	1,027	1,027	2,894	0	2,894
- Transport Costs	70	0	0	165	80	255	0	255
= Contribution Margin I	**1,681**	**1,301**	**600**	**1,676**	**1,474**	**3,551**	**0**	**3,551**
- Material Costs (FC)	75	75	75	75	75	464	0	464
- Total Production Costs (FC)	497	497	497	497	497	497	0	497
- Sales FC (Product)	152	0	0	62	88	468	0	468
- Admin. FC (Product)	132	132	132	132	132	679	0	679
= Contribution Margin II	**824**	**596**	**-105**	**909**	**680**	**1,443**	**0**	**1,443**
- R & D FC (Product)	0	0	0	0	0	0	0	0
= Contribution Margin III	**824**	**596**	**-105**	**909**	**680**	**1,443**	**0**	**1,443**
- FC (Company)								
Research Costs					13			39
Sales Costs					169			516
Administration Costs					73			224
= Contribution Margin IV					**425**			**664**

Alterations in the number of products produced/sold (Example 4)

Example 4: No change of cost allocation; but *change of the number of products produced and sold*

Example 4 retains the cost allocation of the default setting of the simulation, while the number of products produced and sold was decreased from 56,500 to 50,000 pieces of Copy I, and increased from 4,270 to 7,000 pieces of Copy II. The result is shown in Figure 5.

It is apparent that most of the direct costs, as well as the allocated costs, have changed because of the changed number of products produced and sold. It also becomes apparent that the level of contribution margin I has a big impact, especially in combination with changes in volume and the volume-based spread of costs. Copy II, as compared to Copy I, now looks very attractive. Only margin IV is lower, mainly because of the chosen approach for the allocation of administration costs (see example 1). This leads to a totally opposite decision regarding the relative attractiveness of Copy I and Copy II as compared to the default scenario, while the cost allocations were done in an identical manner.

Figure 5: *Change of the number of products produced and sold*

	Copy I					Copy II		
	Market 1	Bulk Buy.	Bids	Market 2	Ø	Market 1	Market 2	Ø
Price	**3,150**	**2,700**	**1,999**	**3,240**	**2,915**	**9,000**	**0**	**9,000**
- Direct Material Costs	372	372	372	372	372	2,299	0	2,299
- Direct Prod. Costs	1,027	1,027	1,027	1,027	1,027	2,890	0	2,890
- Transport Costs	70	0	0	165	69	255	0	255
= Contribution Margin I	**1,681**	**1,301**	**600**	**1,676**	**1,447**	**3,555**	**0**	**3,555**
- Material Costs (FC)	70	70	70	70	70	435	0	435
- Total Production Costs (FC)	418	418	418	418	418	1,177	0	1,177
- Sales FC (Product)	152	0	0	103	100	286	0	286
- Admin. FC (Product)	138	138	138	138	138	571	0	571
= Contribution Margin II	**902**	**674**	**-27**	**946**	**720**	**1,087**	**0**	**1,087**
- R & D FC (Product)	0	0	0	0	0	0	0	0
= Contribution Margin III	**902**	**674**	**-27**	**946**	**720**	**1,087**	**0**	**1,087**
- FC (Company)								
Research Costs					12			38
Sales Costs					164			507
Administration Costs					73			227
= Contribution Margin IV					**470**			**315**

Alteration through the inclusion of a subcontractor (Example 5)

Example 5: No change of cost allocation; but *full capacity used for Copy I with production of Copy II outsourced*

Example 5 deals with the situation of a high demand for both products and a bottleneck in capacity of production. In this scenario, it is assumed that the entire capacity of 62,000 pieces is used for the production of Copy I, with the production of 7,000 Copy II outsourced to a subcontractor. The result is shown in Figure 6. Since the entire fixed costs for material and production have to be carried by product Copy I, the contribution margins II, III and IV are now much lower as compared to the initial default scenario. Copy II now looks more than attractive on all levels of contribution margins. Would this now mean that the company should think about selling all production facilities and focus solely on trading Copy II?

Figure 6: *Use of the whole capacity to produce Copy I and subcontract production of Copy II*

	Copy I					Copy II		
	Market 1	Bulk Buy.	Bids	Market 2	Ø	Market 1	Market 2	Ø
Price	**3,150**	**2,700**	**1,999**	**3,240**	**2,978**	**9,000**	**0**	**9,000**
- Direct Material Costs	372	372	372	372	372	4,900	0	4,900
- Direct Prod. Costs	1,026	1,026	1,026	1,026	1,026	0	0	0
- Transport Costs	70	0	0	165	87	255	0	255
= Contribution Margin I	**1,682**	**1,302**	**601**	**1,677**	**1,493**	**3,845**	**0**	**3,845**
- Material Costs (FC)	103	103	103	103	103	0	0	0
- Total Production Costs (FC)	587	587	587	587	587	0	0	0
- Sales FC (Product)	152	0	0	46	81	286	0	286
- Admin. FC (Product)	128	128	128	128	128	571	0	571
= Contribution Margin II	**712**	**484**	**-217**	**813**	**595**	**2,988**	**0**	**2,988**
- R & D FC (Product)	0	0	0	0	0	0	0	0
= Contribution Margin III	**712**	**484**	**-217**	**813**	**595**	**2,988**	**0**	**2,988**
- FC (Company)								
Research Costs					11			32
Sales Costs					141			427
Administration Costs					67			201
= Contribution Margin IV					**376**			**2,327**

The examples clearly show two things: First, using costing reports without questioning the underlying costing approaches can lead to serious misinterpretations and incorrect decisions. Second, without a deeper reflection on such costing assumptions and implications, instructors of business simulation games forego profound and very important learning opportunities.

The above can be countered with well thought through sensitivity analyses of various costing approaches on the quality of information. In combination with the simulation background, such examples (used as exercises combined with teaching discussions) provide a very effective way to achieve a better understanding of costing approaches and potential pitfalls, leading to improved higher level decision-making by (future) executives.

Widening relevant cost paradigms in business simulation education

A simulation's underlying approach to cost allocation significantly influences the impact of the decisions made by the student (such as production volume, product mix, and capital investment). It is essential, therefore, that the choices made in cost system design are explicit and understood by those who use the simulation.

In some instances cost allocation may be designed to reinforce particular strategies. Similarly, Merchant and Shields (1993) provide examples of organisations that deliberately introduce systematic biases or imprecision into cost allocations in order to achieve strategic objectives. For example, Japanese managers who use direct labour as a single allocation base in order to motivate design engineers to reduce the constraining resource of product labour. They also note that a cost system may be (appropriately) less accurate in order to implement the organisation's competitive strategy. Furthermore, they argue that: "…implementation success is increased by cost systems used to direct employees' attention, to **help them learn**, and to motivate them." (Merchant and Shields 1993, emphasis added). In organisations, just as in university and executive education, the complexity of cost behaviour can make feedback from the accounting system incomprehensible.

Despite these legitimate reasons for a biased, imprecise, or unsophisticated cost allocation system, it is important that the consequences of cost system design be understood. Feedback from the simulation may focus attention on specific principles or particular strategies, but it is important that participants understand that the cost behaviour programmed into the simulation is specific to the assumptions and programming of the simulation. Many simulations focus on strategic decision making. Cost system design is integral to the principles being taught, such as production volume, pricing, product mix, and capital investment. The allocation of costs, however, is often a black box which means that the feedback from the simulation reinforces decisions that would lead to very different outcomes in real organisations.

Furthermore, the ‘stickiness’ of fixed costs mean that costs are unlikely to fall in the manner predicted by an allocation system with few overhead cost pools and no distinction between resource demand and resource provision. Short term decision-making must be distinguished from long-term decisions. In some instances it is appropriate to maximise short term profitability by focussing on throughput. Again, however, it is important that students understand the assumptions underlying throughput accounting (Souren et al. 2005).

Research Limitations and Areas for Future Research

The scenarios relate to the application of a single, albeit representative, management game. This is an inherent limitation of this research as other management games may address cost allocations in varying ways. Future research may compare the use of cost allocation paradigms across a multitude of popular management games.

Research opportunities exist in further embedding important assumptions that need to be explicated and understood:

- Full-cost versus marginal/ variable or throughput costing. (Balakrishnan and Sivaramakrishnan 2002)

Where full costing is employed:

- The assumed casual relationships between cost drivers and cost pools (Lebas 1999)
- Assumptions about the controllability of fixed costs
- Assumptions about distinctions between resource consumption and resource provision (Theeuwes and Adriaansen 1994)
- Assumptions about any lags for resource acquisition/ disposition (Balakrishnan et al. 2011b)

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