THROUGHPUT AND BACKFLUSH

RELEVANT TO ACCA QUALIFICATION PAPER F5

Throughput accounting and backflush accounting have been developed in response to relatively modern advances in manufacturing:

1 The increased reliance by manufacturing businesses on sophisticated and expensive facilities and machinery. This greatly increases the proportion of costs which are fixed. (This was one reason why activity-based costing has become more important: if fixed costs are more significant they should be dealt with more accurately.)
2 A recognition that holding inventory is likely to be a waste of resource.
3 The increased use of just-in-time manufacturing, so that inventory (particularly work-in-progress) is much reduced and its valuation is therefore less important.

Throughput accounting

Throughput accounting has a very direct relationship with decision making and performance management. It begins by focusing on what an organisation's purpose is – its goal – and seeks to help organisations attain their purpose by increasing their 'goal units'. The approach can be applied to both profit-seeking and not-for-profit organisations, provided meaningful goal units can be identified.

THROUGHPUT ACCOUNTING HAS A VERY DIRECT RELATIONSHIP WITH DECISION MAKING AND PERFORMANCE MANAGEMENT. IT FOCUSES ON WHAT AN ORGANISATION'S PURPOSE IS – ITS GOAL – AND HELPS ATTAIN IT BY INCREASING THEIR 'GOAL UNITS'.

EXAMPLE 1

Take a not-for-profit organisation which performs a medical screening service in three sequential stages:

1 Take an X-ray.
2 Interpret the result.
3 Recall patients who need further investigation/tell others that all is fine.

The 'goal unit' of this organisation will be to progress a person through all three stages. The number of people who complete all the stages is the organisation's throughput, and the organisation should seek to maximise its throughput. However, there will always be a limit to throughput, and the resource which sets that limit is called the 'bottleneck resource'.Adding more detail to the medical screening process above:

Process	Time/patient (hours)	Total hours available/week
Take an X-ray	0.25	40
Interpret the result	0.10	20
Recall patients who need further investigation/ tell others that all is fine	0.20	30

You can easily see from this table that the maximum number of patients (goal units) who can be dealt with in each process is:

X-rays:	40/0.25 = 160
Interpret results:	20/0.10 = 200
Recall etc:	30/0.20 = 150

Studying Paper F5?
Performance objectives 12, 13 and 14 are linked

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So, the recall procedure is the bottleneck resource. Throughput, and thereby the organisation's performance, cannot be improved until that part of the process can deal with more people. Therefore, to improve throughput:

1 Ensure there is no idle time in the bottleneck resource, as that will be detrimental to overall performance (idle time in a non-bottleneck resource is not detrimental to overall performance).
2 See if less time could be spent on the bottleneck activity.
3 Finally, increase the bottleneck resource available.

In **Example 1**, increasing the bottleneck resource, or the efficiency with which it is used, might be relatively cheap and easy to do because this is a simple piece of administration while the other stages employ expensive machinery or highly skilled personnel. There is certainly no point in improving the first two stages if things grind to a halt in the final stage; patients are helped only when the whole process is completed and they are recalled if necessary.

The traditional approach to decision making in a profit-seeking organisation is to use contribution analysis. The contribution per unit is the difference between the selling price of a unit and the marginal cost of a unit, where marginal cost consists of the material, variable labour and variable overhead per unit. **Example 2** will remind you of this approach.

A typical cost card for a product is as follows:

	$	**$**
Selling price		140
Material	20	
Labour	30	
Variable overhead	10	
Fixed overhead	25	
Total absorption cost		85
Profit per unit		55

The cost card is based on a budgeted output of 10,000 units.

In this example, the marginal cost (the additional cost *caused* when one more unit is made) is $60 per unit ($20 + $30 + $10). The contribution per unit is:

$140 · $60 = $80

The contribution is the amount by which you 'win the race': each extra unit sold brings in $140, but each extra unit made causes costs of $60, so after making and selling one more unit the business is better off by $80, the contribution.

The fixed cost element is independent of the number of units actually made. It is based on budgeted output and budgeted fixed costs and, working backwards, the total budgeted fixed costs must have been:

$25 x 10,000 = $250,000

A typical calculation then made using this information is to find the break even point, which is this example is 250,000/80 = 3,250 units.

THE TRADITIONAL APPROACH TO DECISION MAKING IN A PROFIT-SEEKING ORGANISATION IS TO USE CONTRIBUTION ANALYSIS. THE CONTRIBUTION PER UNIT IS THE DIFFERENCE BETWEEN THE SELLING PRICE OF A UNIT AND THE MARGINAL COST OF A UNIT.

IN EXAMPLE 2, THE CONTRIBUTION APPROACH IS NOT WRONG IN PRINCIPLE, BUT THE ASSUMPTIONS IT MAKES ABOUT COST BEHAVIOUR OFTEN DO NOT ACCURATELY REFLECT THE REALITY OF A MODERN MANUFACTURING BUSINESS. THE NOTION THAT THERE ARE SIGNIFICANT VARIABLE LABOUR AND OVERHEAD COSTS IS SUSPECT.

In **Example 2**, contribution is the goal unit. If that is maximised, so is profit, which is the goal of a profit-seeking organisation.

The contribution approach is not wrong in principle, but the assumptions it makes about cost behaviour often do not accurately reflect the reality of a modern manufacturing business. In particular, the notion that there are significant variable labour and overhead costs is suspect. Many of these businesses rely on sophisticated automated systems that run continuously with relatively little manual involvement. Even when production is slack, provided the downturn is expected to be short lived, most employees will still be paid because it is expensive to dismiss workers and then to rehire and retrain them. For short-term fluctuations in production it would be more accurate to consider labour costs and all overheads to be fixed, leaving material as the only truly variable cost.

If all costs except material are fixed, businesses will become richer provided the sales revenue per unit exceeds material price per unit. In effect, sales price less material price is the new contribution per unit, but to make clear what we are talking about this is not called ‘contribution’: it is called ‘throughput’.

In fact, ‘throughput’ is sometimes usefully known as ‘throughput contribution’:

Throughput per unit = selling price per unit – material per unit

Throughput = sales revenue – cost of materials

Throughput is generated only when a sale is made. Increasing inventory does not increase throughput.

See **Table 1** in **Example 3** below. Available hours: 5,000 machine hours, 6,000 labour hours, 2,500 quality control hours.

The factory is modern and highly automated. Despite the presentation of the information, it is considered that all costs, except material, are effectively fixed. The first step in managing the performance of an organisation is to discover the limits to its performance. What is the bottleneck resource here?

From the data we can identify the bottleneck resource as seen in **Table 2** opposite. So the bottleneck resource, the one which limits output, is machine hours. There is more than enough of the other two resources.

If the company can’t make everything it wants to, it has to decide on an optimum production plan. Because the factory is highly automated and material is the only truly variable cost, throughput will be the appropriate measure to use when calculating how much the manufacture and sale of each unit increases the company’s wealth (see **Table 3** opposite).

TABLE 1, EXAMPLE 3

	Product A	Product B	Product C
Expected demand/budgeted output (units)	8,000	10,000	6,000
Selling price per unit ($)	130	100	135
Material cost per unit	33	20	40
Labour cost per unit	30	24	36
Variable overhead cost per unit	25	20	30
Fixed overhead cost per unit	15	12	18
Machine hours/unit	0.25	0.2	0.3
Labour hours per unit	0.25	0.2	0.3
Quality control time per unit	0.1	0.1	0.1

TABLE 2, EXAMPLE 3

	Needed for full production	Available
Machine hours	0.25 x 8,000 + 0.2 x 10,000 + 0.3 x 6,000 = 5,800	5,000
Labour hours	0.25 x 8,000 + 0.2 x 10,000 + 0.3 x 6,000 = 5,800	6,000
Quality control hours	0.10 x 8,000 + 0.1 x 10,000 + 0.1 x 6,000 = 2,400	2,500

TABLE 3, EXAMPLE 3

Product	Selling price ($)	Material ($)	Throughput/unit ($)
A	130	33	97
B	100	20	80
C	135	40	95

TABLE 4, EXAMPLE 3

Product	Throughput/unit ($)	Machine hours/unit	Throughput/machine hour = return/factory hour ($/hour)	Rank
A	97	0.25	388	2
B	80	0.20	400	1
C	95	0.30	317	3

We can't simply conclude from this that Product A must be best because it earns more per unit than the other products. It is essential to take into account the use that each product makes of the bottleneck resource. Here, machine hours have been identified as the bottleneck resource. These are uniquely precious and must be used up in the best possible way.

This can be done by calculating for each unit:

$$\frac{\text{Throughput}}{\text{Time in bottleneck resource}}$$

and then using the answers to rank the products as shown in **Table 4** above.

This shows that priority should be given to making Product B, the highest earner per machine hour, then to Product A, and finally to Product C. The production plan would therefore be as seen in **Table 5** on **page 5**.

IN EXAMPLE 3, MACHINE HOURS HAVE BEEN IDENTIFIED AS THE BOTTLENECK RESOURCE. THESE ARE UNIQUELY PRECIOUS AND MUST BE USED UP IN THE BEST POSSIBLE WAY.

TABLE 5, EXAMPLE 3

	Units	Machine hours/unit	Machine (bottleneck) hours used	Throughput ($)
Product B	10,000	0.20	2,000	10,000 x 80 = 800,000
Product A	8,000	0.25	2,000	8,000 x 97 = 776,000
Product C (balance)	3,333	0.30	1,000 (balance)	3,333 x 95 = 316,635
	Maximum machine hours available		5,000	1,892,635

Total expected non-material costs (from the original budget) =

Product A: 8,000 x (30 + 25 + 15) = 560,000
Product B: 10,000 x (24 + 20 + 12) = 560,000
Product C: 6,000 x (36 + 30 + 18) = 504,000

(1,624,000)
Profit 268,635

The throughput/machine hour (or return/factory hour) shows the rate at which throughput can be earned when making and selling each product. Similarly, if the total expected non-material costs are divided by the available machine hours then the cost per factory hour is obtained:

$1,624,000/5,000 = $324.80

So, for every hour the machine operates (which really means for every hour the factory operates as nothing else matters if the machine is the bottleneck resource), running costs accrue at the rate of $324.80/hour. The products the factory makes earn a net $388 for Product A, $400 for Product B and £317 for Product C.

Products A and B are clearly worth making and selling because their earning rates (return/factory hour) exceed the factory spending rate on fixed costs (cost/factory hour). Product C is more difficult to deal with. If the factory costs are truly fixed then Product C is still worth making as it earns a throughput amount of $317/factory hour – which is a lot better than earning nothing. However, if the fixed costs identified with Product C ($504,000) could actually be avoided, then Product C should be abandoned as it costs more to run the factory to make the product than the product can earn.

Instead of directly comparing return/factory hour to costs/factory hour, it is common to express these amounts as ratios, known as throughput accounting ratios (TAR), as shown in **Table 6** opposite.

INSTEAD OF DIRECTLY COMPARING RETURN/FACTORY HOUR TO COSTS/FACTORY HOUR IN EXAMPLE 3, IT IS COMMON TO EXPRESS THESE AMOUNTS AS RATIOS, KNOWN AS THROUGHPUT ACCOUNTING RATIOS (TAR), AS SHOWN IN TABLE 6 .

TABLE 6, EXAMPLE 3

	Throughput accounting ratios		
	Product A	Product B	Product C
Return/factory hour	388.00	400.00	317.00
Costs/factory hour	324.80	324.80	324.80
Throughput accounting ratio	1.17	1.21	0.93

The TAR tells us nothing that we have not worked out already. Its interpretation is:

1. The higher the better (but we already knew the ranking of the products from the return/factory hour)
2. The TAR should be greater than 1 if a product is worthwhile (earning rate greater than spending rate).

Organisations should focus on how they can increase their TAR. Obvious routes are to increase selling prices, decrease material costs, or decrease factory costs. Provided a TAR is greater than 1 it will be worth trying to increase throughput, and this must be done by eliminating idle time in the bottleneck resource, increasing the bottleneck resource (until another resource becomes the bottleneck), or decreasing the use the product makes of the bottleneck resource.

Backflush accounting

Backflush accounting is a costing short cut. It relies on a business having immaterial amounts of work-in-progress and is therefore particularly suitable for businesses operating just-in-time inventory management. If the amount of work-in-progress is negligible, what is the point in meticulously valuing it? Fretting that some products might be 25% complete and others 60% complete, and then adding carefully calculated labour and overheads to these (immaterial) items, is a complete waste of time and effort.

In backflush accounting, costs are not associated with units until they are completed or sold. Backflush accounting is sometimes called delayed costing, which is a helpful name, as costs are not allocated to production until after events have occurred. Standard costs are then used to work backwards to flush out manufacturing costs into production, splitting them between stocks of finished goods (if any) and cost of sales. No costs, whether material or conversion costs, are allocated to work-in-progress.

The traditional and backflush approaches can be illustrated by **Figures 1** and **2** on **page 8**.

Variants of backflush accounting

There are two variants of backflush accounting and they differ according to what are called 'trigger points'. Trigger points are the events which cause costs to be moved into inventories.

IN BACK-FLUSH ACCOUNTING, COSTS ARE NOT ASSOCIATED WITH UNITS UNTIL THEY ARE COMPLETED OR SOLD. BACK-FLUSH ACCOUNTING IS ALSO CALLED DELAYED COSTING, AS COSTS ARE NOT ALLOCATED TO PRODUCTION UNTIL AFTER EVENTS HAVE OCCURRED.

VARIANT 2 OF BACKFLUSH ACCOUNTING IS MORE RADICAL BECAUSE NO RECORDS ARE KEPT OF WORK-IN-PROGRESS OR RAW MATERIALS, SO IF THIS METHOD IS TO BE USED, STOCKS OF BOTH RAW MATERIALS AND WORK-IN-PROGRESS MUST BE NEGLIGIBLE. IT HAS ONLY ONE TRIGGER POINT.

Variant 1

This is the less radical variant. There are two inventory accounts, raw materials and finished goods, and there are two trigger points:

1 Purchase of raw materials

Dr Materials account
Cr Creditors

The cost of labour and other manufacturing expenses are debited to a conversion cost account and credited to cash or creditors. The conversion cost account can be thought of as a suspense account where amounts are placed temporarily.

2 On completion of units

Dr Finished goods account with the standard cost of goods produced
Cr Materials account with the standard cost of materials
Cr Conversion cost account with the standard cost of conversion.

Variant 2

This is more radical because no records are kept of work-in-progress raw materials, so if this method is to be used, stocks of both raw materials and work-in-progress must be negligible. It has only one trigger point.

As before, the cost of labour and other manufacturing expenses are initially debited to a conversion cost account and credited to cash or creditors.

Entries into the finished goods inventory account are made only when goods are completed, and the journal entries will be:

Dr Finished goods account with the standard cost of goods produced
Cr Creditors with the standard cost of material used in goods produced
Cr Conversion cost account with the standard cost of conversion.

Note that at some point the creditors account will have to record correctly what is owing to them so, from time to time, this will be adjusted by a cost variance. Thus, if the standard cost of raw materials used was $50,000, but the actual cost of materials was $52,000, an adverse variance of $2,000 has to be recognised and the creditors account would have two entries Cr $50,000 (and Dr $50,000 to finished goods), then Cr $2,000 and (Dr $2,000 to profit and loss account).

So, are there any benefits in adopting backflush accounting other than avoiding complex recording and calculations to value immaterial amounts of inventory? Let's consider the trigger point found in both variants: costs are transferred when goods are completed. What would happen if that trigger point were changed to permit cost transfer only when goods were *sold*?

That would mean conversion costs would remain as costs until goods were sold, rather then being transformed into finished stock when goods were completed. Managers would then have no incentive to make goods unless they were going to be sold imminently, otherwise they would simply be incurring more expense, and that would make their performance look bad. The purpose of a manufacturing business is *not* to make goods; its purpose is to make and *sell* goods. Only then is there throughput, and backflush accounting can be set up so that costing records encourage managers to adopt this goal-orientated behaviour.

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FIGURE 1: TRADITIONAL COSTING

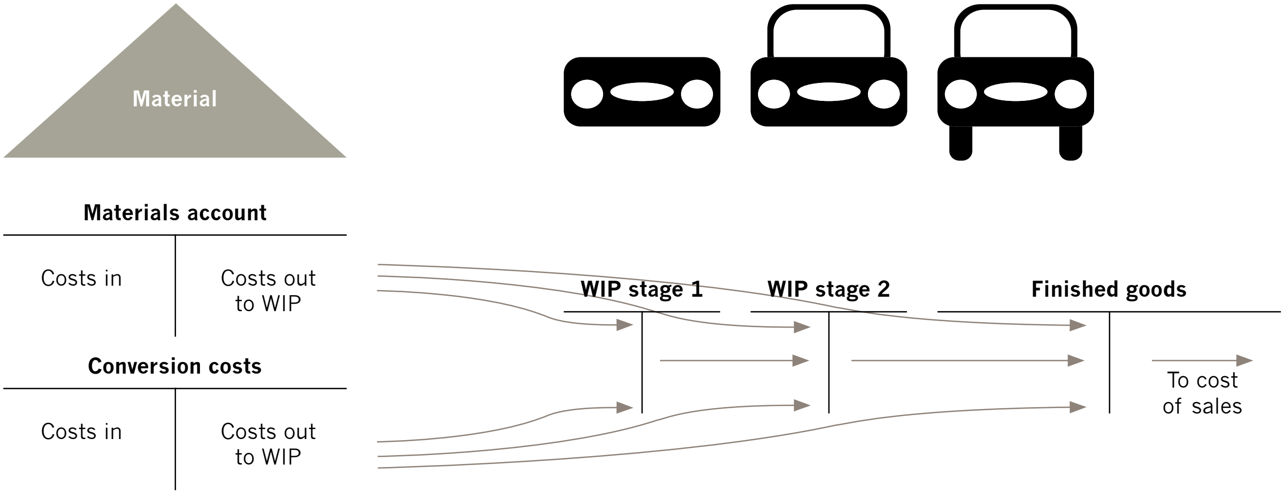

FIGURE 2: BACKFLUSH ACCOUNTING