

THROUGHPUT ACCOUNTING FORMULA AND EXPERIENCE

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*Though their particulars are those
That each particular artist knows,
Unique events that once took place
Within a unique time and space,
In the new field they occupy
The unique serves to typify,
Becomes, though still particular,
An algebraic formula,
An abstract model of events
Derived from dead experiments,
And each life must itself decide
To what and how it be applied.*

W. H. Auden, "The New Year Letter", 1940

W. H. Auden's poem sums up nicely the spirit with which this article is submitted.

The experiments and experiences I have been exposed to working in manufacturing over the last 10 years have led me to conclude that a 'Throughput' driven approach to accounting is the most relevant in that discipline's attempt to assist in achieving the organisation's goal.

Although I may describe these conclusions as 'formula' it is up to the reader to decide whether or not the experiments should be considered 'dead' or capable of rebirth in their own organisation. I begin by quoting from an article which I recently came across and delivers a historical context to this paper.

The author begins as follows:

"Manufacturers in general recognise the importance of a knowledge of the cost of their product, yet but few of them have a cost system on which they are willing to rely under all conditions.

While it is possible to get quite accurately the amount of material and labour used directly in the production of an article, and several systems have been devised which accomplish this result, there does not yet seem to have been devised any system of distributing that portion of the expense, known variously as indirect expense, burden or overhead, in such a manner as to make us have any real confidence that it has been done properly.

As an illustration, I may cite a case which recently came to my attention. A man found that his cost on a certain article was 30 cents. When he found that he could buy it for 26 cents, he gave orders to stop manufacturing and to buy it, saying he did not understand how his competitor could sell at that price. He seemed to realise that there was a flaw somewhere but he could not locate it. I then asked him what his expense consisted of. His reply was labour 10 cents, material 8 cents, and overhead 12 cents.

The next question that suggested itself was how the 12 cents overhead would be paid if the article was bought. The obvious answer was that it would have to be distributed over the product still being made, and thereby increase its cost. In such a case it would probably be found that some other article was costing more than it could be bought for; and, if the same policy were pursued the second article should be bought, which would cause remaining product to bear a still higher operating expense rate.

If this policy were carried to its logical conclusion, the manufacturer would be buying everything before long, and be obliged to give up manufacturing entirely.

Fortunately.....people as a whole will finally discard theories which conflict with common sense and, when their cost figures indicate an absurd conclusion, most of them will repudiate the figures. A cost system, however which fails us when we need it most, is of but little value and it is imperative for us to devise a theory of costs that will not fail in use" [1].

Wise words you might think and well written. The whole subject requires more analysis and discussion you may feel. However, the point of the text was not to give the platform to launch into a 'make versus buy' debate. The point of the text was that this debate about product cost, its calculation, relevance and application was written in 1897!

Yes 1897.

It is not an error - the piece you have just read was written 100 years ago and yet it would most probably grace the pages of any accountancy magazine you might pick up today if you had the energy and inclination.

Now call me irreverent, call me rude, call me Shirley but surely to goodness in the time span of 100 years you would have thought that the accountancy question posed so long ago would have been capable of being answered quickly and comprehensively today. Is it not reasonable to expect that there be three or five or seven well defined things that should be taken into account when a make versus buy issue becomes prevalent? Maybe just maybe we should divide one of those things by another thing and add the result to a third.

Maybe some multiplication would get us off to a good start.

BUT surely by now, 100 years later you would expect a methodology or formula to have been devised to explain in what circumstances it is better to make than buy. Well wouldn't you?

Some people will tell you that there is a methodology called fully absorbed standard costing which deals perfectly well with the issues involved whilst others will insist that a marginal cost approach is crucial. These two latter techniques have been with us for some considerable time but more recently variations on these themes are Activity Based Costing and Throughput Accounting. Still more people try to deal with the subject matter strategically by defining their 'core business' although this sometimes appears as a euphemism to reduce the internal arguments which may rage regarding the cost consequences of make versus buy.

Of course make versus buy is irrelevant, it is only a convenient peg on which to explore the contradictions and varieties of methods applied by accountants in the pursuit of product cost accuracy and therefore a value system which allows for decision making.

I would suggest that in the absence of any consensus on approach and in the vacuum left in terms of time since our article of 1897 to today it is little wonder that there has grown the seeds of the idea that accountancy is more art than science.

Perhaps the reader too believes that everything in accountancy is entirely subjective, a personal vision of experiences and that as one moves from one organisation to another those rules correct in one instance have to be rewritten.

I would disagree with that view and set out my stall to show that management accountancy should be considered as a

science despite the diversity of opinion and the scale of time in which these views have remained different. That they have remained different for so long, that it is such a persistent problem to ensure that the company information system can be relied upon in all circumstances is a clear sign that the problem is misunderstood. We are going to take our cue then from Gantt's [1] article of 100 years ago and make sure that in the construction of our accountancy information system we do not allow anything to become an output if it does not follow a common sense principle.

We hope the reader will agree that this is no small task because of course common sense is not so common at all !!

WHY THROUGHPUT?

In late 1988 the Allied Signal plant in which I worked was engulfed in a European reorganisation. At the same time we were consolidating onto one site from three and we had at the commencement of 1989 introduced some new production scheduling software called OPT.

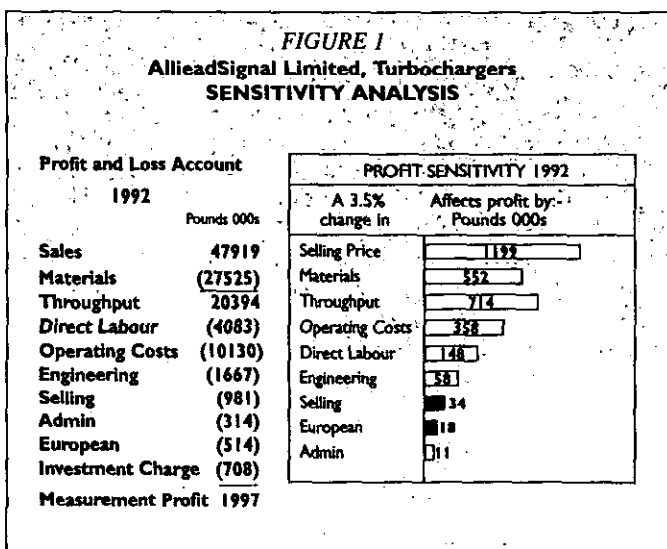
The reorganisation of products produced in the plant had a huge impact on our local profitability. We were within a six month period asked to change to making for a market segment requiring many more product lines and parts than before and in much smaller batches than in the past.

Plant performance plummeted as did due date delivery to customers. Expenses increased all over the plant as we made huge efforts to expedite and retrieve late orders. Although as a Finance Department we had done our analysis and concluded rather conventionally that it was sales mix that was to blame we became acutely aware that this information although useful up to a point was not getting us out of our problems. It was also an increasing source of embarrassment to me the new plant controller to be telling production month after month that mix was the problem.

They already knew! Everyday, they were the ones who were struggling to come to terms with the set ups and batch sizes! Each month's underperformance led to more cries for 'headcount' reductions. Wishing to seem pro-active the Finance Department threw itself into the encouragement of that programme for at least the 1st half of 1989.

My conclusion at the end of about 8 months of trying to chase people out of the plant was that **they didn't want to go!!!** I don't mean to be flippant about such a serious topic but people's natural resistance meant that huge amounts of management time was consumed in analysis of who should go and when.

Against that background the Finance Department finally came up with what we considered to be a piece of analysis of some 'depth' see Figure 1.



SENSITIVITY ANALYSIS

The summarised profit and loss account on the left hand side of Figure 1 should be examined first. It was actually an early 1990 budget attempt. We had decided to call the difference between sales and material cost throughput; all other headings are relatively conventional. To each of those profit and loss items a sensitivity factor was applied of 3.5%. This figure was chosen because it was the amount that a major customer was demanding as a cost reduction if we were to retain 100% of their business. Thus it was a very relevant figure.

The effect of a 3.5% improvement on different elements in our profit and loss account is shown in the right hand side of Figure 1.

The conclusion was that selling price, material cost and throughput were the most sensitive variables. Although produced originally just to emphasise the folly of concentrating too hard on labour reduction as a profit cure, the slide was revisited shortly after when Activity Based Costing was proposed as a new costing system to help the plant focus on product profitability.

ABC was rejected because it gave itself over to the assignment of operating costs and did not mention the most wealth producing aspects of the company's business. Neither did ABC mention Throughput which is really controlled by a understanding of real or potential constraints and bottleneck within an organisation.

In parallel with the work of the Finance Department who were conceding that operating expense should be subordinate to throughput, our material planners were using the OPT logic to make only those products and parts which the customer wanted to purchase in a particular time period.

We were fortunate indeed to have such software running the plant and it's rules are listed in Table 1 opposite, together with the alternatives from MRP systems.

Flushed as we were from the success with which our sensitivity report was received and made curious by the OPT rules, we looked around for any other measurement which could be changed in the name of productivity.

STANDARDS AND EFFICIENCY

Capacity in our plant had been defined as follows:

$$\text{Capacity} = T \times E \times U$$

where C = capacity available or required

T = the time available

E = the efficiency factor as a proportion

U = the utilisation factor as a proportion

This definition fits well into the most accepted body of knowledge. Armed with the above definition of capacity, efficiency becomes a measure of how closely predetermined standards are achieved and utilisation a measure of how intensely a resource is being used.

At the time in question the factory was organised physically in 'cells', each devoted to the production of a major component within the turbocharger. Every component had a standard time and each time one was produced, it was re-ordered by finance who used this information for labour and overhead recoveries and for the allocation of costs. Thus each week, one of the major outputs of the department had been the production of an 'efficiency' report by cell. This was an important document in the plant. It recorded the activity of the labour within each cell.

Total available hours less holidays and absenteeism plus over-time were logged against the hours worth of parts that had been produced. Should a cell's efficiency fall below what

TABLE 1

OPT

- Balance flows, not capacity.
- Utilisation of a non constraint is not determined by its own potential, but by some other constraint in the system
- Utilisation and activation of a resource are not synonymous
- An hour lost at a constraint is an hour lost for the total system
- Constraints govern both throughput and inventory
- An hour saved at a non-constraint is just a mirage
- The transfer batch may not and many times should not be equal to the process batch
- The process batch should be variable not fixed
- Schedules should be determined by looking at all the constraints simultaneously. Lead times are the result of a schedule and cannot be predetermined.

MRP II

- Balance capacity, maintain flows
- Potential is self determined
- Utilisation and activity of a resource are the same
- Impact is not realised
- Little impact on inventories, temporary impact on throughput
- All savings have equal impact
- Lot splitting should be discouraged
- Lot sizes should be fixed
- Pre determine lot size and lead time, assign priorities, schedule by longest lead time first; adjust capacity by the above steps.

was considered an acceptable standard the managers and supervisors would understand that there was going to follow an investigation regarding 'what's gone wrong?'

We looked carefully at that weekly report in the light of the OPT rules and began to have major misgivings regarding its common sense. We were also quite desperate to produce something which could be the guiding principle for shop floor employees as our sensitivity analysis was aimed more at senior management.

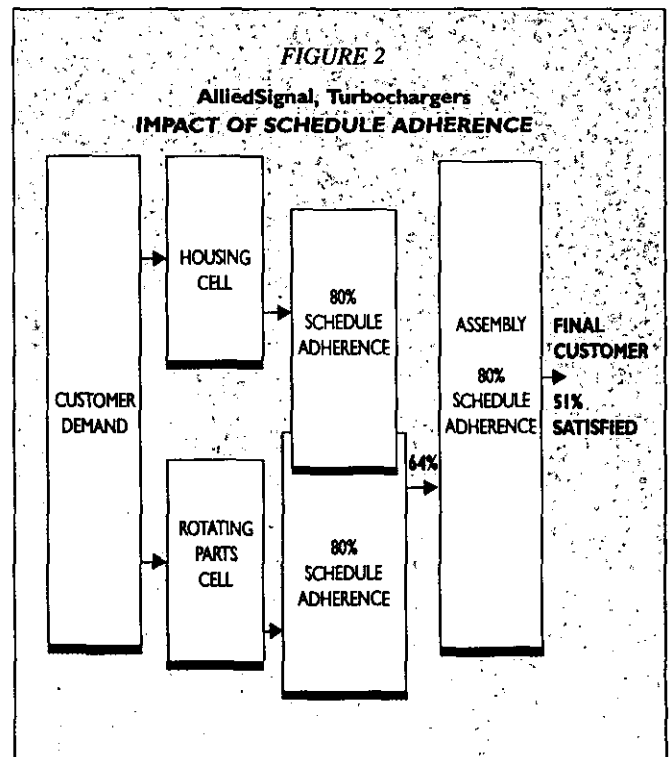
Our major reservation regarding the efficiency report was that it actively encouraged the build up of unwanted inventories. Of course in theory it shouldn't but shop floor supervision confronted by senior managers demanding to know why efficiency is down one week would have to display 'saint' like qualities to stick, in the following week, to production schedules that call for fewer parts than normal or include many set ups and therefore downtime which would reduce perceived efficiency.

Finally after a number of 'dead ends' we discovered a material planner who was periodically measuring something called 'schedule adherence'. It was like a light being turned on in our heads. We quickly dropped the local efficiency report and substituted a schedule adherence report in its place. In hindsight, we should have taken more time explaining the change, but in our enthusiasm we made the substitution quickly and took ownership for the production of the report ourselves. Each week for each production cell we would log the parts demanded by OPT and compare those actually produced to that list. The key measurement then became **mix adherence**, ie. how closely a cell had followed the requirement. Variance analysis would now question over production as well as under production or both!!

Recognising that utilisation was really made up of two elements, (availability and activation) we incorporated them as well into our measuring system at least in constraint areas. Figure 2 shows how the impact of schedule adherence of 80%

can detract from the achievement of customer demand which in this instance is only satisfied up to 51%.

Over the next 3 years the inventories in the plant fell to a third of their start balances as did days inventory on hand. Customer deliveries improved dramatically and many things became easier to control and predict as the synchronisation of the plant improved. There were however downsides to the inventory reduction which caught us unawares at first.



INVENTORY AND PROFIT

During all this time we had for statutory and reporting purposes been required to carry on maintaining our standard costing system. The profile of the typical turbo in those days was that material cost was 50% and labour and overhead the remainder.

Each time we made something the standard cost system demanded we debit inventory and credit the profit and loss account. On selling the product we credited inventory and debited the cost of sales. All good conventional standard cost stuff that goes on in finance departments all over the world.

The problem really occurs in a well run plant because of some small timing differences. Perhaps a product was made a few minutes or hours before a month end and could not be sold in time for recording in that period. In less well run plants the inventory may sit around for days or weeks and in badly run plants it sits around for months or even years.

However, in our circumstances driven by OPT the system decided that it had sufficient of some parts and required no more for the production period. Unfortunately our standards were written around a level of activity much higher than OPT originally demanded. When in a financial period, final inventories are exploited for sales and there is no equivalent replacement then the resulting variances only have one method of escape **through the profit and loss account.**

This means quite literally that a reduction of end inventories without their replacement will result in improved cash flow although the profit and loss account will most likely show poorer performance if not a loss. It is interesting albeit a little scary, to speculate how many good inventory reduction initiatives have floundered on that particular rock of accountability, and have been abandoned.

I would like to record that we were well prepared for such phenomenon, but it took us an embarrassingly long time to see that the very thing we liked about OPT. This was the cash flow it released by reducing unwanted inventories. The associated activity was also manifesting itself in our profit and loss account as poor performance. If we were slow to catch on to this relationship, I am pleased to say we were swift in countering its ramifications for the plant focus.

We decided that our maxim would change:-

from

"EACH TIME I MAKE SOMETHING
I AM ADDING VALUE"

to

"EACH TIME I SELL SOMETHING
I AM ADDING VALUE"

We did this by simply dropping the value added concept from our profit and loss account. I say simply – in fact it was not so straightforward. I will not trouble the reader any more than to say that it meant that if inventory reduced the other side of the double entry was in the bank account as cash had been increased.

As a footnote to accountants I must add that we still maintained the standard cost system – we just didn't let anyone see or use it for decision making purposes. This resulted in us having to do more work to maintain two systems but the plant stayed focused on inventory reduction to gain response to market place.

SUMMARY AND THE WAY FORWARD

I set out to make this short article distinctive in two ways.

Firstly, to ensure that the accounting information made common sense and the formula could be applied anywhere.

Secondly, that my organisation flawed as it was and still is (for I do not pretend to work in a company which is perfect), went about a product mix problem, not by cutting out some products which appeared as the 'culprits', but by mastering capacity issues such that all products could be made on time.

I hope that these two objectives are met at least enough for the reader to want to understand more. It is not possible in the allotted space to explain other aspects of **Throughput Accounting**, which may be of interest such as why standard costs often increase after a bottleneck is broken or how to use sub-contract per constraint minute to lever advantage from a vendor.

However, these and other subjects are almost completely new ground to the enquiring mind of the management accountant. It is not true that everything is dealt with because someone has worked out a more complex cost allocation system and labelled it Activity Based Costing. Anyone can make a contribution to the science of management accounting and those contributions are urgently needed.

If you consider the way in which other disciplines in the business world have moved forward:

- computers are so much smaller and more powerful
- ideas of quality have been revolutionised
- perceptions of customer service have changed out of all recognition.

Then it has to be said that management accounting's contribution seems woefully inadequate. A lot of catching up is required before it can be said that management accounting is a leader in the provision of information relevant for decision making.

REFERENCE

- [1] Gantt (1861-1919) originally a presentation of 1915 to The American Society of Mechanical Engineers in Buffalo, New York.

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