An Introduction to Standard Costing:

1. Introduction

Standard costing and activity based costing (ABC) are simple yet powerful techniques used to manage and improve the performance of an organisation. The two are very similar in their approach yet proponents of ABC have often criticised standard costing as outdated and lost its relevance. The truth is probably that each technique is suited to solving a different problem but the best technique for cost control and routine performance management is to combine the two and use the ABC approach to definition standards.

What I have tried to do in this paper is introduce the reader to the both techniques describing their history, explaining the techniques and their benefits and showing how an ABC approach to standard costing gives managers a practical and valuable tool for performance management.

2. History of standard costing

Standard costing has been used for over a 100 years. Early last century financial accountants were interested in finding a better way of valuing stocks and work-in-progress, important elements the calculation of profit and the concept of standard costing was born. Some historians say the origins of standard costing go back even further and have found evidence it was used in the American Civil War by quarter masters as a means of controlling costs. It doesn't really matter when the technique was invented what is more relevant is that it is still in use today.

A survey conducted in 1989 reported that standard costing was being used by more than 75% of British industrial companies and in a range of different industries e.g. brewing, textiles, electronics and pharmaceuticals. The survey was conducted because many articles and books had started to criticise the technique as being inappropriate as capital intensive industries with high levels of fixed overheads. The survey in fact reported that only a handful of respondents had abandoned their standard costing systems whereas the majority had either introduced or enhanced their systems in the previous ten years. Another survey of Australian and Japanese firms conducted in 1997 reported that 56% of large firms use if for production costing. Unfortunately there appear to be no more recent surveys but journal articles from the US in the last couple of years indicate that the technique is still very much in use and although a 100 years old has definitely survived the test of time.

3. A simple example of standard costing

A standard cost is a pre-determined cost of a product, product part, operational activity or service. An example of a standard cost for product P is given in Figure 1a and for vehicle mileage costs in Figure 1b.

In both these examples the standard costs are expressed as a cost per unit. In Figure 1a it is the standard cost of one unit of product P. In Figure 1b it is the standard mileage cost for vehicle V to travel one mile.

Figure 1a: Standard cost of product P

	£ per unit	£ per unit
Raw material A	5.00	
Raw material B	1.75	
		6.75
Process I	1.50	
Process II	2.25	
Process III	7.00	
		10.75
		17.50

Figure 1b: Standard mileage cost of vehicle V

	£ per mile
Fuel	0.15
Oil	0.01
Tyres	0.03
Maintenance	0.04
	0.23

In fact it is more common for the standards to be developed in terms of physical units and standard cost calculated from the individual unit costs of each element. Figure 2 illustrates this for product P.

Figure 2: Standard cost of product P

	Physical unit		Unit cost	£	£
Raw material A	2.50 kg	@	£2.00 per kg	5.00	
Raw material B	.25 kg	@	£7.00 per kg	1.75	
					6.75
Process I	0.10 hr	@	£15.00 per hr	1.50	
Process II	0.05 hr	@	£45.00 per hr	2.25	
Process III	0.75 hr	@	£9.33 per hr	7.00	
					10.75
					17.50

4. Activity based costing (ABC) criticisms of standard costing

The examples given in Figures 1a, 1b and 2 do not include any overheads. When standard costing was originally used for the valuation of stock and work in progress the standard for a product always included elements for fixed overheads. This was necessary as the financial accounting conventions demanded that these items were valued in the balance sheet on the basis of full absorption of overheads.

As manufacturing became more capital intensive overheads became a larger percentage of the total cost of a product yet the methods for apportioning overheads to products remained quite crude. They were often based on machine hours or labour hours the most commonly collected measurement of activity in manufacturing industry. Misguidedly advocates of ABC saw this as a weakness of standard costing rather than full absorption costing and when using standard costing for purposes of management accounting or in industries where there are not significant amounts of stocks there can be a choice in the treatment of overheads. Further explanation of this point will be given in a later section of this document.

As mentioned in the previous paragraph because standard costing was, and is, used extensively in manufacturing industry it is common for standards to be expressed in machine hours or labour hours. However standard costing doesn’t demand this and standards can be expressed in any type of unit. The transportation industry uses miles and kilometres, or tonnes; the healthcare industry uses length of stay and episodes or in ABC parlance the standards can be expressed in units of any costs driver. This is explained in more detail in the following section.

5. Activity based costing (ABC)

ABC was developed in the 1990s when overheads were becoming a larger percentage of total cost of a product than the direct material and manufacturing costs. It was developed by management accountants rather than financial accountants as it purpose was to improve internal decision making, for example the pricing of product and services, the identification of product and customer profitability.

ABC’s approach to costing is to identify a series of cost drivers: a cost driver being an activity that consumes resources. In manufacturing obvious cost drivers are machine hours and labour hours. However in ABC which is more focused on the apportionment of overhead costs to products, cost drivers might include the number of invoices, the number of customers, the number of purchase orders, the mileage of the truck fleet etc. Overhead costs are then analysed into various cost pools, one cost pool for each cost driver and unit costs calculated. Product costs are then calculated from building up a series of unit costs in a similar way to standard costing. This more refined method of overhead apportionment gives a better idea of product profitability. It also allows the calculation of customer profitability.
The draw back to ABC is that as it requires the collection of lot of data that is not normally recorded, and if it is, is not often recorded electronically. The cost of this data collection

therefore becomes so high that it can not be justified to be done every month and usually ABC is a once off exercise and its findings not incorporated into monthly management accounts.

6. Activity Based Costing with standards

The output from an ABC exercise is not usually expressed in the form of standards, but there is no reason why not. Each cost pool / cost driver combination can represent an element within the standards for a product or service and ABC can be viewed as another technique for obtaining accurate standard costs.

7. The benefits of using standard costing

There are six principal uses of standard costing and ABC:

- for performance management;
- for cost control;
- for budgeting and planning;
- benchmarking;
- for generating information for decision making;
- for valuation of stock and work in progress.

This paper focuses only on the first four uses. A description of how standard costing can be applied to each of these activity and the benefits it can bring follows.

7.1 Performance management

Standards can be used by managers as benchmarks against which the performance of an organisation or of a department can be measured. Because standards are developed in both physical units and unit costs they can be used to measure both the efficiency and cost of an activity.

Figure 3 gives an example of the actual performance for the month for the manufacture of product P. The actual costs, consumption of raw materials and machine time taken to produce product P can be measured against the standards shown Figure 2.

Comparing the two sets of figures you can see that the weight of raw materials and the processing times has changed. The actual weight of raw materials used is only 2.60 kg some 0.15kg lower than the standard of 2.75 kg. Managers looking at these figures may start to ask questions the impact of this weight reduction on product quality or distribution costs.

Actual processing time has dropped too compared to the standard: 0.83 hours compared to 0.90 hours. This reduction in unit processing time may have implications for production planning and allow other products to be produced in the spare processing capacity.

Figure 3: Actual cost of product P

	Physical unit		Unit cost	£	£
Raw material A	2.15 kg	@	£2.00 per kg	4.30	
Raw material B	.45 kg	@	£7.00 per kg	3.15	
					7.45
Process I	0.11 hr	@	£19.00 per hr	2.09	
Process II	0.06 hr	@	£47.00 per hr	2.82	
Process III	0.66 hr	@	£9.00 per hr	5.94	
					10.85
					18.30

Material usage, machine/ vehicle/ labour/ facility utilisation can all be compared against a standard. Standard costing is not just about costings, any KPI a company uses is de facto a standard and can be incorporated into a standard costing system.

The previous examples have focused on expenditure but standard costing principles can equally well be applied to sales and revenues. Standards can be set for the expected sales price of different goods and services and then used to monitor the performance of the sales staff.

The key point is that a standard costing system is more than a tool for accountants and it produces information that it is of direct benefit to the operational managers. The creation of standards and the investigation of variances of actual performance from standards is a trigger for useful discussions between accountants and operational staff and this dialogue can be very powerful.

7.2 Cost control

There are three aspects of a standard costing system that will help to improve the cost control in any organisation. The first is the whole process of setting the standards: the second is the routine reporting of performance and expenditure against these standards: and the last is ability to express all variations in performance in monetary terms. This last is perhaps the most powerful as it gives operational managers a better understanding of the financial consequences of their decisions. This can be illustrated by looking at figures 2 and 3.

It can be seen that has overall cost of product P is £0.80 greater than the standard. Most of this difference can be explained by an increase in the total cost of raw material which is now £7.45 against a standard of £6.75, but interestingly this is nothing to do with the cost of the raw materials themselves rather it is due to a different mix of raw materials. Although less of A has been used this has been more than outweighed by greater use of the more expensive B.

The processing time is also different from the standard. Processes I and II are greater than the standards by some 10% longer but fortunately this has been more than offset by the reduction in time spent in process III.

Figure 4: Monthly management report for product P

Actual £	Budget £	Total Variance £		Volume Var £	Efficiency Var £	Rate Var £
5,160	5,000	(160)	Raw material A	(1,000)	840	
3,780	1,750	(2,030)	Raw material B	(350)	(1,680)	
8,940	6,750	(2,190)		(1,350)	(840)	
2,508	1,500	(1,008)	Process I	(300)	(180)	(528)
3,384	2,250	(1,134)	Process II	(450)	(540)	(144)
7,128	7,000	(128)	Process III	(1,400)	1,008	264
13,020	10,750	(2,270)		(2,150)	288	(408)
21,960	17,500	(4,460)		(3,500)	(552)	(408)
			KPIs			
1,200	1,000	+ 200	Units			
			Raw materials usage per unit of P			
2.15	2.50	- 0.35	A in kg			
0.45	0.25	+ 0.20	B in kg			
			Processsing time per unit of P			
0.11	0.10	+ 0.01	I in hr			
0.06	0.05	+ 0.01	II in hr			
0.66	0.75	- 0.09	III in hr			

This type of analysis is called variance analysis and is invariably associated with standard costing. Variance analysis sub-divides the total difference between actual and budgeted expenditure into a series of variances. Figure 4 shows the variance analysis for the actual production of 1,200 units of product P.

The volume variance is the financial impact of actual production being 1,200 units i.e. 200 more units than budget: the efficiency variance is the financial impact of using more / or less raw material than set out in the standard and more or less processing hours than the standard: and the rate variance is the financial impact of raw material prices and processing time being higher/ or lower than the standards.

The convention used in Figure 4 is that all adverse, or unfavourable variances, are shown in brackets and in red. A quick glance at the figure shows that most of the £4,049 over run against budget can be accounted for by the additional production of 200 units. The efficiency of the production line has dropped mainly due to the increase use of raw material B which has completely off-set the efficiencies made in the use of raw material A and the processing time. The improvement made is in the unit cost of process III has been almost outweighed by the increased costs of processes I and II.

Volume, efficiency and rate (or price) variances are the most commonly used by accountants and managers but the choice is up to the user. Sometime the volume variance is further analysed into volume and product mix and other times the price and efficiency variance combined. (For those who are mathematically minded further details of the calculation of these variances are set out in Appendix 1.)
Figure 4 shows a very simple analysis as it assumes the production line is only manufacturing one type of product. Usually variance analysis covers all products handled by a production line or department and in these cases the overheads associated with the production line or department would also be included in the analysis.

Variance analysis can help focus managers' attention on those elements of performance which they can control. For a particular manager the different elements of a standard can be classified as controllable and non-controllable. For example the production manager may only have control over the usage of raw materials and the efficiency of the production process, or in other words the efficiency variance. If the production line is operating below maximum capacity he may be unable to influence the volume variance as this is a function of the success or otherwise of the sales force. Similarly the rate variance may be the responsibility of the purchasing managers who negotiates the contracts with the various suppliers. What is important to understand is that the classification of controllable and non-controllable will change according to whose costs and performance is being reported.

Variance analysis provides valuable feedback on performance and can be an important part of the management process. Although it can not change past events it can help managers identify inefficiencies and so take remedial action ot ensure they are not repeated in the future.

To summarise, variance analysis is a powerful tool for:

- identifying those operational activities whose under or over performance is having the greatest impact on profitability;
- identifying who is responsible for the under of over performance; and
- separating the element of the total variance from budget which can not be controlled by departmental manager from that element for which the departmental manager has total responsibility.

7.3 Budgeting and planning

Figure 4 has shown how a budget can be derived by multiplying a standard by the budgeted volume and the same logic can be used in preparing forecasts for the rest of the year and five year plans.

Care must be taken that only the variable cost elements of the standard are used and overheads which are fixed must be excluded. Inflation can be introduced by changing the unit costs by a specified percentage. Different rates can be applied to different types of standards. Labour rates may only be increased by 2% but certain types of raw material may need to be uplifted by 15%. Efficiency improvements can be incorporated into standards too. For example it may be decided that the use of a different trailer may improve the fuel consumption of the vehicle and the standard fuel consumption of the vehicles can be changed.

A good standard costing system should make it simple and easy for these adjustments to be made to the standards.

7.4 Benchmarking

Standard costs are the ideal basic data for internal and external benchmarking. Standards developed for a fleet of trucks operating out of one depot can be compared to the standards at another depot. Production standards at one plant can be compared with those at a different plant.

7.5 Information for decision making

Standard costing provides planners with a wealth of cost information, easy to obtain and which is accepted as validity as it used in routine monthly reporting. Planners will be able to use the unit costs of all activities and raw materials, standard processing times, and the expected utilisation of production lines, machines, vehicles etc. Use of this data should make it easier to the estimate the cost of new production facilities, savings to be made from different raw materials, the cost of new pay deals for staff and so on. Less time should be lost in trying to find the data or arguing with operational staff or accountants about its accuracy.

8. The treatment of overheads

There are two methods of treating overheads when using standard costing in management reporting: either they can be ignored completely or they are assumed to be fully absorbed and the standards calculated accordingly.

Extending the simple example of product P to a plant that manufactures products P and Q, Figure 5 shows an example of the monthly management report for the whole plant if overheads were completely ignored in the product standards.

Any variance on overheads is reported as a rate variance and no volume variance or efficiency variance is calculated.

Figure 5: Monthly management report for whole plant

Actual £k	Budget £k	Total Variance £k		Volume Var £k	Efficiency Var £k	Rate Var £k
162.0	**155.0**	**7.0**	**Sales**	**(2.0)**		**9.0**
			Cost of goods sold			
11.5	11.0	(0.5)	Raw material A	(0.4)	(0.1)	
15.1	12.3	(2.9)	Raw material B	0.7	(3.6)	
26.6	23.3	(3.3)		0.3	(3.6)	
19.6	15.0	(4.6)	Process I	1.1	(1.5)	(4.1)
11.8	20.3	8.4	Process II	1.4	7.6	(0.5)
11.2	12.6	1.4	Process III	(0.8)	1.8	0.4
42.6	47.8	5.2		1.6	7.9	(4.2)
69.2	**71.1**	**1.9**		**1.9**	**4.2**	**(4.2)**
92.8	**83.9**	**8.9**	**Gross profit**	**(0.1)**	**4.2**	**4.8**
57%	54%					
			Overheads			
16.0	14.5	(1.5)	Department overheads			(1.5)
12.0	13.0	1.0	Plant overheads			1.0
64.8	**56.4**	**8.4**	**Profit**	**(0.1)**	**4.2**	**4.3**

Under full absorption costing overheads are included in the standards for the goods and/or service. An example is shown in Figure 5 with the overheads for Department P and the plant added to the direct cost of materials and indirect processing costs.

Figure 6: Standard cost of product P under full absorption costing

	Physical unit		Unit cost	£	£
Raw material A	2.50 kg	@	£2.00 per kg	5.00	
Raw material B	.25 kg	@	£7.00 per kg	1.75	
					6.75
Process I	0.10 hr	@	£15.00 per hr	1.50	
Process II	0.05 hr	@	£45.00 per hr	2.25	
Process III	0.75 hr	@	£9.33 per hr	7.00	
					10.75
					17.50
Department P overhead				14%	2.50
Plant overhead				15%	3.00
Total					20.00

The monthly management report for the plant would now look the example in Figure 7.

Figure 7: Monthly management report for whole plant under full absorption costing

Actual £k	Budget £k	Total Variance £k		Volume Var £k	Efficiency Var £k	Rate Var £k
162.0	**155.0**	**7.0**	**Sales**			**9.0**
			Cost of goods sold			
11.5	11.0	(0.5)	Raw material A	(0.4)	(0.1)	
15.1	12.3	(2.9)	Raw material B	0.7	(3.6)	
26.6	23.3	(3.3)		0.3	(3.6)	
19.6	15.0	(4.6)	Process I	1.1	(1.5)	(4.1)
11.8	20.3	8.4	Process II	1.4	7.6	(0.5)
11.2	12.6	1.4	Process III	(0.8)	1.8	0.4
42.6	47.8	5.2		1.6	7.9	(4.2)
69.2	**71.1**	**1.9**		**1.9**	**4.2**	**(4.2)**
92.8	**83.9**	**8.9**	**Gross profit**	**(0.1)**	**4.2**	**4.8**
0.57	0.54					
			Overheads			
16.0	14.5	(1.5)	Department overheads	(0.7)		(0.8)
12.0	13.0	1.0	Plant overheads	(0.4)		1.4
64.8	**56.4**	**8.4**	**Profit**	**(0.1)**	**4.2**	**4.3**

9. Setting standards

Standards are pre-determined unit costs or performance measures e.g. average hourly cost of a driver, litres per kilometre, machine utilisation etc. They usually represent the expected performance under normal efficient operating conditions and so make some allowance for lost time, equipment breakdown etc.

When setting standards for the very first time accountants and operational managers usually use historical records of performance. Often this exposes weaknesses is the data and comparison of the unit costs of different activities or the material usage of different product highlight anomalies that need investigation. Unless this is done the standards will include past inefficiencies and may also be deemed invalid and derided by operational staff.

Sometimes standards are set to allow for desired improvements in productivity, for example all new trucks could have their fuel consumption improved by 5%. However the degree of challenge in the standards is definitely an executive decision. Standards set too high that they are impossible to achieve are highly demotivating.

If new ways of working are being introduced historical performance data and old standards will not be appropriate. The new standards will have to be calculated from an analysis of the proposed changes to working practices; in manufacturing industry this could be through the use of engineering studies.

10. Information on actual performance required for monthly reporting and variance analysis

A common misunderstanding when considering implementing a standard cost system is that data has to be collected on a monthly basis to the same degree of detail as is present in the standards. But this is not the case.

Figure 8 gives an example of a set of standards from the healthcare industry and the associated unit costs. (DRG stands for Diagnostic Related Groups.) The standards contain elements for clinicians' time, length of stay, drug costs and pathology tests.

Figure 8: Set of standards from the healthcare industry

Budget standards

	Std unit cost	**DRG A**	**DRG B**	**DRG C**	**DRG D**
Clinical time	£55.50 per hour	10.0 hr	7.5 hr	12.0 hr	6.3 hr
Length of stay	£140.45 per day	2.0 day	3.0 day	2.5 day	3.0 day
Drugs		£100.00	£30.00	£120.00	£75.00
Weighted pathology tests	£25.25 per test	6 test equiv	10 test equiv	5 test equiv	15 test equiv
Std cost of DRG		£1,087.40	£698.75	£917.25	£812.40

Note that the pathology test standards are recorded in test equivalents. This is often done when there are many different types of tests and it is considered easier to record the usage of a theoretical standard test for each DRG.

Figure 9 shows the budgeted number of patients for each DRG and total budget.

Figure 9: Budget numbers

	DRG A	**DRG B**	**DRG C**	**DRG D**
Budget patient numbers	100	50	250	300

Budget	**£**
Clinicians	347,708
Ward costs	263,344
Drugs	64,000
Pathology	172,963
	848,014

Figure 10 gives an example of the actual data collected each month. It shows that only patient numbers and bed days are collected by DRG. Clinicians' time is not recorded at all and pathology tests are only recorded in total.

Figure 10: Actual results for one month

		DRG A	DRG B	DRG C	DRG D
Clinicians time					
Bed days	1,760	180 days	160 days	550 days	870 days
Pathology tests	7,100				
Patient numbers	687	85	52	237	313
Actual costs	**£**				
Clinicians	410,000				
Ward costs	280,000				
Drugs	87,000				
Pathology	185,000				
	962,000				

Despite this seemingly paucity of data useful variance analysis can still be performed as shown in Figure 11.

Looking at the cost of clinicians, you can see it has been decided to record any residual variance remaining, once the volume variance has been calculated, as an efficiency variance. This residual figure could equally as well been classified as rate variance since neither the actual hours worked nor the actual unit cost of a clinical hour are known.

It is a mathematical fluke that the drugs' volume variance comes to zero. However since the standard for drugs in expressed in monetary terms (£s) and not in a physical unit, it is impossible to calculate an efficiency variance. The residual variance after calculating the volume variance is therefore classed as a rate variance.

The variance analysis for pathology has a volume, efficiency and a rate variance even though the data on the number of pathology test equivalents was known only in total and not by DRG. This analysis shows that clinicians ordering more tests than predicted by the budget standard at a cost of £5k. What can not be shown until the pathology tests are collected by DRG is whether it was one particular DRG which had more than the expected number of test or whether the variance was spread uniformly across all DRGs.

This is an important aspect of standard costing as it means that even with limited data on actual performance useful variance analysis can be prepared each month. And as operational managers begin to grasp the powerfulness of the analysis and ask more questions around the performance of their department they understand the usefulness of more detailed information. The impetus for better quality information then comes from operational managers rather than the accountants.

Figure 11: Variance analysis

Actual £k	Budget £k	Total Var £k		Volume Var £k	Efficiency Var £k	Rate Var £k
410	348	(62)	Clinicians	12	(74)	
280	263	(17)	Ward costs	2	14	(33)
87	64	(23)	Drugs	0		(23)
185	173	(12)	Pathology	(2)	(5)	(6)
962	848	(114)		13	(65)	(62)

11. Behavioural effects

Because standard costing is a powerful tool and can give managers valuable insights into costs and activities it needs to be used with care. The first warning is that standard costing can only be successfully implemented is there is a general acceptance of the standards. If standards aren't recognised as valid by the staff whose performance is being measured then the whole system will quickly fall into disrepute and more energy will be spent in defending the standards that identifying opportunities for improving performance. This is especially true if standards are set too high and are impossible to achieve.

Secondly Variances should be investigated to understand reasons for under (and indeed over) performance, so that inefficiencies can be corrected rather than for the apportionment of blame.

Finally be aware that once people know that their performance will be monitored against a standard they are likely to act differently. Of course if this means that they more efficiently and effectively that is great, but managers must be vigilant that standards are not encouraging the wrong behaviour and people are not playing the system.

12. Some common misunderstanding

There are quite a few misconceptions about standard costing that need to be refuted. These are:

1. It is old fashioned and not suited to factories using advanced manufacturing techniques or where the emphasis is on quality rather than costs.

   False: Standard costing system is very flexible and can be designed to measure any KPIs. An innovative variance for just-in-time manufacturing is a raw materials inventory variance that measures the financial impact or purchasing more (or less) raw materials than was actually used in production. A quality variance might be defined as the standard cost of units produced that did not meet the quality specifications.

2. It has been overtaken by activity based costing.

   False: Standards can be derived using activity based costing techniques. The two types of costing are totally compatible.

3. It can't be implemented because actual costs aren't recorded to the same degree of detail as the standards.

   False: See section 10. As long as both the cost and a physical measure of an activity are collected a full variance analysis can be produced. Even if only the cost of an activity is recorded there is the possibility of calculating a volume variance and then showing the residual variance as either an efficiency or rate variance, whichever is deemed to be more appropriate.

4. Standard costing require additional book-keeping entries to record all the standards and variances.

   False: Only if standard costing is being used to value stocks and work in progress do some book-keeping entries need to be made. Using standard costing for management reporting and variance analysis does not necessitate any entries into the books of account.

13. Summary

Standard costing is not a fad. Its use has stood the test of time and as a technique it is over 100 years old.

It can be used in all types of industries. Although it is best suited to organisations that have many repetitive operations is not limited to manufacturing. Large organisations in transportation, retailing, banking, healthcare, mining and service industries are all suitable candidates and indeed already use it.

The benefits it brings are varied ranging from the improved cost control and performance management, more effective use of accountants' and planners' time to better dialogue and understanding between accountants and operational mangers.

Appendix 1:
The mathematics of variance analysis

Variance analysis is the comparison of actual performance against the relevant standards. The calculations of the different variances are shown below using as a worked example the figures from Figure 4. For ease of reference this figure is also reproduced below.

Figure 4: Monthly management report for product P

Actual £	Budget £	Total Variance £		Volume Var £	Efficiency Var £	Rate Var £
5,160	5,000	(160)	Raw material A	(1,000)	840	
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13,020	10,750	(2,270)		(2,150)	288	(408)
21,960	17,500	(4,460)		(3,500)	(552)	(408)
			KPIs			
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			Raw materials usage per unit of P			
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0.11	0.10	+ 0.01	I in hr			
0.06	0.05	+ 0.01	II in hr			
0.66	0.75	- 0.09	III in hr			

Volume variance

This the difference between the budgeted and actual volume of product or service delivered valued at the standard unit cost of the product or service.

Volume variance = (budget vol. – actual vol.) X standard cost.

From Figure 4:

Volume variance for product P = (1,000 – 1,200) X £17.50 = (£3,500)

Volume variance for raw material A in product P = (1,000 – 1,200) X £4.30
= (£860)

Appendix 1:
The mathematics of variance analysis

Efficiency variance

This is the difference between the budgeted and actual use of materials and/or processing time, for the actual volume of product made, valued at the standard unit cost of the raw material or processing time.

Efficiency variance

= (std. usage of raw material per unit – actual usage of raw material per unit)

X actual volume of product made X standard unit cost of the raw material

From Figure 4:

Efficiency variance for raw material A in product P

= (2.50 – 2.15)kg X 1,200 X £2.00 per kg = £0.35 X 1,200 X 2.00 = £840

Similarly the efficiency variance for raw material B in product P

= (0.25 – 0.45)kg X 1,200 X £7.00 per kg = £(-0.20 X 1,200 X 7.00) = (£1,680)

And the efficiency variance:

For Process I

= (0.10 – 0.11)hour X 1,200 X £15.00 per hour

= £ (-0.01 X 1,200 X 15.00) = (£180)

For Process II

= (0.05 – 0.06)hour X 1,200 X £15.00 per hour

= £ (-0.01 X 1,200 X 45.00) = (£540)

For Process III

= (0.75 – 0.66)hour X 1,200 X £15.00 per hour

= £ (0.09 X 1,200 X 9.33) = £1,008

The total efficiency variance for product P

= £840 + (£1,680) + (£180) + (£540) + £1,008

= (£552)

Appendix 1:
The mathematics of variance analysis

Rate variance

The rate, or price, variance is the difference between the budgeted and actual unit cost of the raw materials multiplied by the actual usage of the raw materials multiplied by the actual volume of product made.

Rate variance

= (std. unit cost of raw material – actual unit cost of raw material)

X actual usage of the raw material X actual volume of product made

From Figure 4:

Rate variance for raw material A in product P

= (2.00 – 2.00) X 2.15 X 1,200 = £0

Similarly the efficiency variance for raw material B in product P

= (7.00 – 7.00) X 0.45 X 1,200 = £0

And the rate variance:

For Process I

= (15.00 – 19.00) X 0.11 X 1,200 = £(- 4.00 X .11 X 1,200) = (£528)

For Process II

= (45.00 – 47.00) X 0.06 X 1,200 = £(- 2.00 X .06 X 1,200) = (£144)

For Process III

= (9.33 – 9.00) X 0.09 X 1,200 = £(0.33 X .09 X 1,200) = £264

The total rate variance for product P = £0 + £0 + (£528) + (£144) + £264

= (£408)

Summation of volume, efficiency and rate variances

As a check you can see that the sum of the volume, efficiency and rate variances add up to the total variance.

Volume variance + efficiency variance + rate variance

= (£3,500) + (£552) + (£408)

= (£4,460)