

# Cost behaviour classification and cost behaviour structures of manufacturing companies

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## Abstract

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The purpose of this paper is to determine the cost structures of companies that formed part of an empirical investigation. Further aspects were investigated to determine why manufacturing companies classify cost behaviour into fixed and variable components and to determine how these companies classify specific cost items. It was found that there is a significant negative relationship between the fixed cost of a company and its degree of technological development. This means that labour intensive companies have more fixed cost as part of total costs and therefore a higher operating risk than technologically developed companies. It was also found that manufacturing companies classify cost items differently and this study provides some guidelines how to manage cost behaviour.

## Key words

*Cost behaviour*

*Cost behaviour classification*

*Cost behaviour structure*

## 1 Background and statement of the problem

This study investigates the cost behaviour classification and cost behaviour structures of manufacturing companies in the Vaal Triangle. It has been motivated by the steady decline in economic activity within the Vaal Triangle over the past three decades. In 1980, 1990 and 2000 the region contributed 9.1%, 8.3% and 6% respectively to the gross geographical product of Gauteng (Slabbert 2001). This obviously declining business climate, together with the

uncontrolled squatting allowed in the region (Van Rensburg 1999), caused the local unemployment rate to rise to approximately 48% in 2001 (Slabbert 2001).

The study focused on manufacturing companies because of their huge impact in this region. According to Slabbert (1999) manufacturing contributes 55% to the gross geographical product of the Vaal Triangle, while it also represents 17.4% of the total manufacturing output of Gauteng (Slabbert 2001).

In their work *Relevance Lost: The Rise and Fall of Management Accounting*, Johnson and Kaplan (1987) criticised the traditional cost allocation techniques that failed to reflect the production methods and cost patterns of the time. In the decade and a half that followed, a new focus on cost behaviour and patterns has developed. Cost behaviour studies are important due to the influence on the degree of operating risk, break-even point and safety margin, sensitivity, profit planning and control, and decision making (Correia, Flynn, Uliana and Wormald 2003; Horngren, Datar and Foster 2003). Knowledge of the cost behaviour structures of companies may be applied in other investigations, such as to determine the difference between the cost structure of labour intensive and that of technologically developed companies. This is done in order to draw a comparison between a company's cost structure and its level of technological development, since a technologically developed company is expected to have a higher operating risk than a labour intensive company (Garrison and Noreen 2000:300). Fritzsich (1998) supports the notion that, in the short run, most capital-related inputs are fixed costs, while an input such as labour is a variable cost. La Roy (2000) agrees that costs tend to become fixed if more technology is introduced into the business. Cost classification (into fixed and variable components) nevertheless differs for companies all over the world. Horngren *et al* (2003:328), and Garrison and Noreen (2000:202) also give examples of different manufacturing companies in different countries classifying similar cost items differently.

The problem investigated as part of this study involves determining the way in which the degree of technological development of manufacturing companies in the Vaal Triangle affects cost structure and operating risk. Although companies classify the cost behaviour of items differently, the results of this study could be compared with those of similar studies to determine any significant differences.

## **2 Objective of the paper**

This study was conducted as an aid to manufacturing companies in the Vaal Triangle. Its first objective has been to analyse the cost structure of manufacturing companies and to determine whether there is a relationship between the fixed cost of companies and their degree of technological development. The rationale behind the study is to determine whether the level of technological

development has any effect on a company's cost structure. The null hypothesis to be tested is formulated as follows:

$H_0$ : There is no significant relationship between the fixed cost and the technological development of a company.

To test the null hypothesis, the  $p$ -value was calculated to determine whether the linear relationship between two variables is significant.  $H_0$  will be rejected at a significance level of 0.05 if  $p < \alpha = 0.05$  (2-tailed). The  $p$ -value is a measurement indicating the confidence level at which the null hypothesis is rejected (not rejected).

The second objective of the study has been to investigate why companies classify costs as fixed and variable components and to determine the ranking order of the reasons given. The third objective has been to determine how companies classify certain cost items. The results of the last two objectives will be compared with the results of similar studies conducted in South Africa and elsewhere.

### **3 Relevance of the paper**

This paper will give accountants (and managers) in the Vaal Triangle, a region with a declining economy, an indication of how cost structures and cost behaviour classification differ among manufacturing companies in the sample. It also explains the effect of technological development on cost structures and on the operating risk of manufacturing companies, and indicates the reasons for classifying cost behaviour. The paper extends the boundaries of this research field because it compares empirical results of a single economic region with the whole of South Africa and other countries. Similar studies have investigated how manufacturing companies classify certain cost items, but this study goes further and adds more cost items to the list.

### **4 Method of the study**

Since the possibility of applying cost and management accounting is limited in smaller businesses, it was decided to focus only on larger businesses. Address lists were obtained from the Department of Public Relations at the Potchefstroom University for Christian Higher Education and the Vaal Research Group. These lists were used to identify all manufacturing companies in the Vaal Triangle. A total of 58 questionnaires were mailed to the management accountant or financial manager of these companies and after several phone calls, only 14 responded, resulting in a 24% response rate.

Although the study frequently refers to manufacturing companies in the Vaal Triangle, it must be kept in mind that these findings and conclusions are not necessarily applicable to all of them, due to the low response rate. It is even

possible that there will be a bias between the companies that responded and those that did not respond.

## **5 Cost behaviour and classification in practice**

The relationship between costs and activity is known as cost behaviour, while the cost structure of a company refers to the compilation or the nature of its production costs –whether fixed, variable or mixed (semi variable). Variable costs can be divided into true variable cost and step variable cost, whereas fixed costs can be divided into committed and discretionary fixed cost. (In this regard see Horngren *et al* 2003; Garrison and Noreen 2000; Blocher, Chen and Lin 2002; Hansen and Mowen 2000; Hilton 1997.) Companies with a high fixed cost component and low variable cost component are more sensitive to changes in activity than companies with a low fixed cost component and a high variable cost component (Correia *et al* 2003). Thus, it is the fixed cost component that is responsible for the operating risk of a company. Benedetti (2000) suggests that, when demand declines, a company should try to shift fixed cost to variable cost by means of flexible contracts, outsourcing, cost-led pricing and pay-for-performance plans.

Capital intensive companies are at greater risk than labour intensive companies because of their relatively high fixed cost and low variable cost components (Garrison and Noreen 2000:300; La Roy 2000). Thus, compared to labour intensive companies, capital intensive companies have a high contribution margin, high operating leverage and high volatile profit. The degree of technological development can be used to determine whether a company is capital intensive or labour intensive. In technologically developed companies, production processes are mainly automated and machines perform the bulk of the production processes. Some of these machines are controlled by computers, enabling companies to produce better quality products, deliver better services, keep a smaller amount of inventory and improve the adaptability of the production process. The costs involved in implementing such automated production processes are high, and therefore result in high fixed costs (Fry, Stoner and Hattwick 1998:465; Hilton 1997:253–254, 274). The degree of a company's technological development can be measured by considering its use of the following (Horngren *et al* 2003; Fry *et al* 1998; Hilton 1997):

- Computer-aided design (CAD).
- Computer-aided manufacturing (CAM).
- Automatic production process.
- Continuous assessment of production process.
- E-commerce.

For the purposes of this study, the respondents were asked to illustrate the degree of technological development by indicating on a four-point scale the

extent to which each of the above-mentioned aspects feature in their respective companies. The five aspects were combined and a factor was calculated for each company.

There are a variety of reasons why manufacturing companies classify costs as fixed or variable components. These reasons include price fixing, decreasing costs, profit planning, cost-benefit analysis, cost-volume-profit analysis and budgeting (Horngren, Foster, Datar and Uliana 1999:37). Manufacturing companies may also use different methods to classify cost behaviour, namely managerial judgement, engineering approach, quantitative analysis (such as the high-low method), visual fit and regression analysis (Horngren *et al* 2003; Drury 2000). (The sources mentioned could also be consulted for the advantages and disadvantages of each method.)

The method used to classify cost behaviour may affect the results. Other factors will also play a role, such as the experience of the person doing the classification, the unique nature of the company, social norms, managerial policy, accounting policy, cost object and production level (Oberholzer 1998:274–275). With so many variables involved it is quite understandable that different companies classify similar cost items differently. The following may be some of the reasons for this contradiction:

- Accounting policy:** Company A has an accounting policy that uses the straight-line method to calculate depreciation. This company will report depreciation as a fixed cost because a fixed amount is written off each period, regardless of the production activity. Company B has a policy to write off depreciation according to the use of the asset. This company will report depreciation as a variable cost.
- Cost driver:** A company pays a fixed salary to each of its quality controllers. Person A will use the number of units inspected as the cost driver and conclude that it is a fixed cost item, as the total salary cost of the controllers does not vary according to the number of units inspected. Person B will use the number of controllers as the cost driver and obviously conclude that it is a variable cost, as the total salary cost will change if the number of controllers changes.
- Term:** Most companies indicated that building occupancy is a fixed cost. This is probably the case if the focus is on the short term, because buildings are not occupied and evacuated on say a weekly, or monthly basis, according to production needs. If the focus is on the long term, building cost will be more variable, because in the long term it is easier to adjust the building space according to a permanent change in the production needs.
- Managerial policy:** The circumstances of Company A are such that it has a managerial policy to send a vehicle to the supplier on a daily basis to pick up materials. The company will report this part of the material handling cost as fixed, because the number of trips to the supplier is totally independent of

the production volume. Company B may have a managerial policy to send a vehicle to the supplier every time material is needed for a production unit. It will report this part of the material handling cost as variable, due to the linear relationship between the production quantity on the one hand and the number of trips and the cost thereof on the other hand.

- **Utilisation level:** Company A will report the cost of energy as a variable cost since there is a linear relationship between the production output and the kilowatts used. Company B uses its full capacity every time and consumes the same number of kilowatts during each period. This company will report these costs as fixed, because they remain unchanged from one period to the next. In this case the utilisation level therefore influences the classification.
- **Cost object:** Another possible reason why companies reported huge differences in their cost structures is because costs are calculated for different cost objects. Costs can be calculated to determine the expenditure for the whole company, for product (or job) profitability, for customer profitability or for channel profitability. (A channel is for example a specific process, department, selling point, etc., through which a product passes). The following is an example (Table 1) of four cost items classified differently according to the cost object concerned.

**Table 1 Cost classification for different cost objects**

Cost item	Whole company	Product	Customer	Channel
Direct labour	Fixed	Variable	Variable	Fixed
Rent for building	Fixed	Variable	Variable	Fixed
Design	Variable	Fixed	Variable	Not applicable
Quality controllers' salaries	Fixed	Variable	Variable	Variable

Direct labour will probably be a fixed cost for the company as a whole because there are a fixed number of workers who receive a fixed salary every month. Direct labour cost will be assigned to a product and to a customer by multiplying the direct labour rate by the time used, and therefore it will be classified as a variable cost. Direct labour will be fixed with regard to a production department (channel) because it is possible to determine exactly how many workers there are in the department. Rent for buildings is a fixed cost for the company as a whole because the amount is payable, regardless of the production activity. From a product and customer point of view it seems to be a variable cost, as it will be allocated as part as the overhead rate (for example by using direct labour hours as allocation base). The channel will report it as a fixed cost because it is possible to determine the exact floor space of a specific department relative to the whole company. The design cost will be variable to the company as a whole

if this job is outsourced and the company pays only for the number of designs, but the cost to design a product is fixed, because only one design is involved. The company as a whole will classify quality controllers' salaries as a fixed cost because there are a fixed number of controllers, each receiving a fixed salary. For a product, customer and channel, this cost will be variable, because the time multiplied by the rate will be charged to each one of these.

## 6 Results

### 6.1 Cost structures and technological development

The first objective of the study was to analyse the cost structure of the companies included in the sample so as to determine the percentage that fixed cost and variable cost make up of the total costs. Table 2 gives these results, as well as the descriptive statistics, and ranks the percentage value of the fixed cost components in ascending order.

**Table 2 Analysis of cost behaviour of manufacturing companies in the Vaal Triangle**

Company	Fixed cost %	Variable cost %	Fixed cost ranking
1	56	44	9
2	15	85	3
3	5	95	1
4	18	82	5
5	16	84	4
6	70	30	13
7	26	74	6
8	60	40	10
9	10	90	2
10	40	60	7
11	95	5	14
12	60	40	10
13	40	60	7
14	60	40	10
<b>Descriptive statistics</b>			
Average	39.6%	60.4%	
Standard deviation	25.9%	25.9%	
Coefficient of variances			

*continued*

Median	0.63	0.44
Skewness	40%	60%
Kurtosis	0.40	-0.40
Minimum	-0.67	-0.67
Maximum	5%	5%
	95%	95%

*Note:* Fixed cost plus variable cost equals 100%.

According to Table 2 variable costs constitute the largest cost component, with the fixed cost average being 39.6% and the variable cost average 60.4%. These averages are however not representative of all the data, as is clear from the large standard deviations and coefficient of variances. In the case of for example Company 3, only 5% of its total costs are fixed, while in the case of Company 11 only 5% of its total costs are variable.

A possible reason for this contradiction is that companies are not equally advanced with regard to their use of the latest available technology. A four-point scale was used to determine the factor of technological development of companies, where 1 indicates that a company is technologically well developed and 4 that it is totally underdeveloped. Table 3 shows these factors and their ranking order. Companies 3, 4 and 7 share the first place, meaning that these companies are those that are the most technologically advanced ones.

**Table 3 Degree of the technological development of companies**

Company	Factor	Ranking
1	1.6	5
2	3.4	11
3	1.0	1
4	1.0	1
5	1.4	4
6	2.4	7
7	1.0	1
8	3.2	10
9	3.0	9
10	3.8	14
11	3.4	11
12	2.8	8
13	3.6	13
14	3.2	6

The rank order correlation of Spearman may be used to determine whether there is a monotone dependence between the technological development of a company (see Table 3) and its fixed cost as a percentage of total cost (see Table 2). Rank order correlation is a non-parametric technique for qualifying the relationship between two variables. Non-parametric means that the correlation statistics are not



affected by the type of mathematical relationship between variables, unlike the least square regression analysis that requires the relationship to be linear (Vose 1996:33). The Spearman rank correlation coefficient is a more general measure of any kind of monotonic relationship between X and Y. This measure is based on ranks and therefore not as sensitive for outliers (Millard and Neerchal 2001:534). The null hypothesis to be tested is that there is no significant relationship between the fixed cost and the technological development of a company.

The results of the Spearman rank order correlation indicate a negative correlation between fixed cost ranking and technological development ranking, where  $r = (0.48)$ . The  $p$ -value is  $0.072 > \alpha = 0.05$ , which means that  $H_0$  is not rejected and runs a risk of less than 5% of being incorrect. The  $p$ -value = 0.072 indicates that  $H_0$  would have been rejected at a 10% level of confidence, which implies that some negative relationship exists between fixed costs and the degree of technological development.

## **6.2 Reasons for classifying costs into fixed and variable components**

The respondents were asked to indicate on a four-point scale their reasons for classifying costs as either fixed or variable components. Table 4 shows the calculated factor (2<sup>nd</sup> column) that was determined, based on a scale where 1 indicates that the classification is indispensable and 4 that it is completely unimportant. The data also reveal that cost-volume-profit analysis constituted the most important reason for classifying costs into fixed and variable components. Table 4 Reasons for classifying cost behaviour as fixed or variable, and a ranking comparison with other manufacturers

Reason	Factor (Vaal Triangle)	Vaal Triangle	South Africa*	Australia*	Japan*	U.K.*
Price fixing	2.00	4	1	1	5	1
Decreasing costs	2.31	6	2	6	3	5
Profit planning	1.85	2	3	3	1	2
Cost-benefit analysis	2.23	5	4	4	6	5
Cost-volume-profit analysis	1.67	1	5	4	4	4
Budgets	1.92	3	6	2	2	3

\* Source: Horngren *et al* 1999:37.

Table 4 furthermore shows the ranking order of companies' reasons for classifying costs as fixed or variable components, as well as the results of similar studies elsewhere. This ranking order differs significantly from the ranking order of manufacturers in Australia, Japan and the U.K., and especially from manufacturers in South Africa as a whole.

### **6.3 Classification of the behaviour of manufacturing cost items**

According to Table 5, the experience of manufacturers in the Vaal Triangle is that direct manufacturing labour is to a large extent considered to be a fixed cost (57%). This figure is not only higher than the 35% for the whole of South Africa, but also higher than the 43% of Japan. With regard to Japan one can expect that direct labour costs will be largely fixed, because of Japanese companies' custom to offer lifetime employment and their well-known aversion to the retrenchment of workers (El Kahal 2001). Direct manufacturing labour is much more flexible in the USA and Australia, thus indicating that it can easily be adjusted according to production needs. Indirect manufacturing labour follows more or less the same pattern as direct manufacturing labour. The fact is that the classification of direct and indirect manufacturing labour differs between countries and even between regions within the same country.

The comparison of the other cost items shows that building occupancy and depreciation tend to be a fixed cost for most companies. Items such as material handling cost, energy and quality control do not display a specific tendency – it is fixed for some companies, and variable for others. No other study has as yet attempted to find out how manufacturing companies classify direct and indirect materials. This investigation shows that the majority of manufacturers in the Vaal Triangle classify those cost items as variable, but a significant number have also indicated that those same cost items are fixed. The reason is probably that the companies who classify materials as a fixed cost work at the same capacity from one period to the next, and therefore its material usage remains the same from one period to the next.

**Table 5 Classification of the behaviour of manufacturing cost items and a comparison with manufacturers in other countries**

Cost item	Vaal Triangle			South Africa *			USA *			Japan *			Australia *		
	Vari-able %	Semi %	Fixed %	Vari-able %	Semi %	Fixed %	Vari-able %	Semi %	Fixed %	Vari-able %	Semi %	Fixed %	Vari-able %	Semi %	Fixed %
Direct manufacturing labour	29	14	57	51	14	35	86	6	8	52	5	43	70	20	10
Indirect manufacturing labour	43	14	43	49	16	35	60	25	15	44	6	50	45	33	22
Material handling costs	36	21	43	30	10	60	48	34	18	23	16	61	40	30	30
Energy (power)	71	14	14	46	25	29	26	45	29	42	31	27	-	-	-
Building occupancy	7	0	93	5	15	80	1	6	93	0	0	100	-	-	-
Quality control	21	7	71	21	8	71	34	36	30	13	12	75	21	27	52
Depreciation	14	7	79	6	13	81	1	7	92	0	0	100	-	-	-
Direct materials	64	0	36												
Indirect materials	71	7	21												

\* Source: Blocher *et al* 2002:74; Horngren *et al* 1999:361.

## **7 Conclusions**

The study firstly revealed that the classification of total costs as fixed or variable components differs markedly for the companies in the sample (Table 2). Furthermore, no significant positive relationship was found to exist between the fixed cost component of companies and their degree of technological development (Table 3). It is surprising that companies who reported a relatively low fixed cost component also reported a significantly high degree of technological development. This contradicts the theory that classifies labour as a variable cost (Garrison and Noreen 2000; Fritzsich 1998). If it is assumed that the cost behaviour classification of respondents is correct, then it may be concluded that highly technologically developed companies have a lower fixed cost component than labour intensive companies. The fact that the sample companies reported that direct and indirect manufacturing labour tend to be more fixed (in comparison with similar studies) means that it is very difficult for manufacturing companies in the Vaal Triangle to adjust their workforce according to production needs.

However, the main concern is that the contribution of labour cost to the fixed cost component is bigger than the contribution of cost for technological development to the fixed cost component. This implies that labour intensive companies have a higher operating risk than technologically developed companies. The reason for this is quite obvious – as a result of recently introduced labour legislation it is very difficult to retrench workers in South Africa. Garrison and Noreen (2000), Fritzsich (1998) and almost all the other textbooks used in this study are American. Because it is possible in some American states to fire any employee at any time, with or without reasons, they see labour as a variable cost.

Secondly, the study found that the companies in the sample indicated cost-volume-profit analysis to be their most important reason for classifying costs into fixed and variable components. A comparison with other manufacturers nevertheless indicated that, with the exception of Japanese manufacturers, price fixing is the most important reason (Table 4). This difference may possibly be attributed to the fact that the Vaal Triangle manufacturers are generally more sensitive to changes in cost and volume than manufacturers elsewhere. It is important to note that the accuracy of the cost-volume-profit analysis is a function of the accurate classification of total costs into fixed and variable components. If the classification is done poorly, the results will be misleading.

The third finding was that different companies over the world classify the same cost item differently. Only building occupation and depreciation tend to be fixed for almost all of the companies (Table 5). This finding is supported by the first (Table 2), namely that total costs behave extremely differently among the companies in the sample. Most of these companies indicated that depreciation and building occupancy are mainly fixed costs (as also indicated by other studies). However, some companies reported these costs as variable or semi

variable. Cost items like material handling cost, energy (power) and quality control differ sharply between companies. It is clear that this three-category classification (fixed, variable and semi-variable) is totally insufficient when it comes to explaining the behaviour of specific cost items, and it seems that a uniform classification for a specific cost item is impossible. This finding confirms the conclusion by Hough (1993) that some managers regard costs to be variable when output climbs and fixed when output falls. Also, costs are classified differently in order to report "different costs for different purposes". Bear and Mills (1994) explain this matter in their research, which shows that all costs are classified as variable for activity-based costing purposes and all costs, except direct materials, are classified as fixed for throughput costing purposes.

## **8 Recommendations**

Although the Vaal Triangle has a problematically high unemployment rate, the recommendation to manufacturing companies in this region is to make more extensive use of technological developments. Evidence has indicated that companies with a higher level of technological development also report a lower fixed cost component. This means that the operating risk decreases if a company can manage to increase its level of technological development and thus reduce its labour force.

Although respondents were asked in this and other studies to indicate how their company classifies specific cost items, it is not a fair question to ask anybody. There are too many variables that influence the classification, and the prescription of fixed rules to follow when classifying costs will be of no value. The following guidelines may however be used in the classification and management of costs:

- Since fixed costs are responsible for increasing the operating risk of a business, companies should manage the operating risk by determining, on an ongoing basis, the fixed costs as a percentage of total costs.
- Since the cost items of direct and indirect manufacturing labour are mostly classified as fixed costs, efforts must be made to shift them to variable costs by adopting flexible contracts, outsourcing and pay-for-performance plans.
- The three-category classification (fixed, variable and semi-variable) used in this study is insufficient to explain the behaviour of specific cost items. To sophisticate the cost behaviour classification, companies must rather use a four or five-category classification where fixed costs and variable costs constitute the extreme parts. This classification must be based on the amount of time or money it takes to get rid of the costs.
- Companies should analyse their fixed costs in order to distinguish between committed and discretionary costs. Discretionary fixed costs are able to suddenly change the operating risk and break-even point of a company, as they are the result of a single management decision, such as to spend a certain amount on an advertising campaign.

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