CHAPTER 4

RESEARCH METHOD

4.1 FOREWORD

This chapter explains why the particular research method has been chosen and how it is used. The cross sectional survey is appropriate to determine broadly based empirical evidence, as outlined in Chapter 2.7 (Search for Broadly Based Evidence). There is substantial prior use of this method to measure the variables and determine management accounting use(fulness).

It is acknowledged that in using surveys there are limitations concerning internal and external validity. In addition to these specific limitations, it is not universally agreed that such surveys are the best method to demonstrate actual ABC effectiveness, although a need for such research was discussed in Chapter 2.

The chapter specifically addresses the issue of instrument reliability. This is a concern of critics of those using statistical methods to investigate the adoption and advantages of ABC. The details of the survey instrument are examined along with associated issues of mail survey methods: design, sampling and logistics, distribution, and analysis of the survey's response.

4.2 SELECTION OF METHOD

ABC is sometimes criticised as a classic example of the gap between theory and practice (Fox, 1991, p.32). ABC is generally acknowledged as having some success in practice, but lacking broadly based empirical support. Piper and Walley (1990) identify the problem with ABC as a difficulty in using traditional accounting or economics to justify the practice. It is regarded as convenient, by critics of ABC like Piper and Walley, that proponents have used case studies to argue their cause rather than alternate forms of empirical evidence.

Holzer and Norreklit (1991, pp.3-4) refer to many criticisms of current cost accounting systems and the interest in evaluating methodologies. They state that as reliable survey data is lacking, cost accounting practices used in industry are difficult to verify. The authors conclude that the Kaplan, Johnson hypothesis can not be accepted as generally valid because it lacks strong empirical evidence.

Bromwich and Bhimani (1989), and Young and Selto (1991) agree that there is only limited anecdotal claims concerning the implementation of ABC systems. There is a need for systematic evidence based or careful measurement.

Spicer (1992, p.22) notes similar concerns with the case for ABC, "... handful of documented case studies ..... over a relatively short time horizon". His concern is that the data evidence is not systematic and it is incomplete. Spicer calls for additional numerical comparisons, like Foster and Gupta (1990), and systematic studies of cost behaviour (Noreen, 1991; Foster and Gupta, 1989; Banker and Johnson, 1993; Banker et al, 1994). This is a potentially rich area for future research (Spicer, 1992, p.23).

The research method employed by this study is consistent with the calls for broadly based empirical evidence into ABC. It uses a mail survey method of manufacturing plants, as outlined in Chapter 3.2, and established measurement items based on similar surveys. Plants are surveyed, because they are the closest to actual production decisions and the supporting operating system. The survey extends the prior research by including a measure for obstacles to managers ability to use their cost systems to the perceived potential. An information gap (Chapter 3.4) is calculated, measuring the difference in actual and potential cost system use. This is further specifically discussed in section 4.3.

Kaplan (1993) believes surveys are not very promising methods for explaining the advantages of ABC. Such traditional research methods use statistical analysis for validating the assumptions underlying ABC systems. Kaplan (1993, p.3) comments that the search for correlation with complexity and variety factors is misplaced. In particular, standard correlation or regression analysis of overheads provide mis-specified tests of ABC theory.

Kaplan does not claim that empirical analysis is useless, but rather that it is difficult. He cites the study by Banker and Johnson (1993) as demonstrating that variety and complexity factors can still shine through a mis-specified model. It is a timely warning that, in Kaplan's view, regressions and correlation studies are unlikely to be powerful methods to test ABC theory.

4.3 QUESTIONNAIRE DESIGN

The questionnaire and a copy of the letter sent to the survey firm are appended to this dissertation (Appendix A).

The survey approach is a generally recognised method for collecting data by a structured set of questions revealing information about selected variables. As the survey follows a recognised format, there are a variety of statistical tools with which to analyse and test. These provide comparative statistics and benchmarks for evaluation.

The survey is divided into 4 discrete parts:

A. Plant production and cost system details;
B. Important activities for plant success;
C. Actual and potential cost system use;
D. Contextual factors believed to impact upon the plant.

The survey form was designed taking into account the advice from Emory and Cooper (1991); Rea and Parker (1992); Foddy (1993); and de Vaus (1995). The survey was distributed on A3 paper in a convenient folded booklet form, for ease of completion. There were 46 responses required, using closed ended questions which avoided an infinite variation of answers. The responses were coded from a seven point closed Likert scale, considered suitable for surveys similar to the one contained in this paper (de Vaus, 1995, ch.6). Rankings at point 7 indicated high use or importance of the item, while low rankings indicated low use or low importance for Parts B, C and D of the survey instrument.

Part A of the survey instrument sought plant characteristics comprising four questions, designed to discover:

1) the type of production method used in the plant;

2) homogeneity of cost accounting practices for the products;

3) type of cost system utilised by the plant for cost allocations;

4) satisfaction with the cost system for overhead allocations.

These items are mostly aimed at providing general information about the surveyed population by allowing comparisons with the item determining cost system type. This allows some preliminary analysis from the survey for comparison with theoretical expectations of ABC. None of these Part A items are combined mathematically together to produce other measures.

Items A1 and A2 have had prior survey use (Joye and Blayney, 1990) and were included in order to classify production methods and overhead cost behaviour. The first item is used to classify the type of production methods used and is anchored at the poles by 'small customised' and 'continuous process'. The responses indicate whether the population sample has the range of expected production conditions, including customised and smaller batch processes (Howell and Soucy, 1989b, p.24), and conform to the expectations that activity-based systems are likely to operate in such conditions (Smith, 1995, ch.3). There is a correlation coefficient of -0.236 ($p \leq 0.05$) between production method and cost system type which is consistent with expectations that ABC systems are associated with more varied production methods.

The second item aimed to discover whether volume-based systems are likely to have more consistent cost accounting practices for units of production than plants using activity-based methods. The correlation did not gain evidence of significant difference between systems ($p > 0.05$).

The type of cost system utilised by a plant is identified by a ranking between 1-7, anchored at the poles between 'volume-based' and 'activity-based' cost systems. Item A3 was designed specifically for this study and was preceded by an explanation on the survey instrument, of the two broad cost system types:

a) Volume-based cost system: volume-based overhead cost allocation methods assume that individual products cause costs and therefore make the individual products the focus of the cost system. These systems use cost driver(s) that are attributes of the product item, such as direct labour hours, machine hours, or material cost. Typically, volume-based systems collect costs in cost pools of similar cost type and then attribute those costs to products using product attributes like the ones mentioned above (direct labour hours, etc).
b) Activity-based cost system: an activity-based system collects overhead costs into many separate cost pools. These cost pools represent activities like setups, number of inspections etc., rather than being defined as departments or work centres. In a second stage these costs are assigned to jobs and products according to the number of these activities required to complete the job or product.

The classification is based on a single response item, designed to elicit the method used for the allocation of overhead at the respondent's plant. Chapter 2.7 revealed the significant attention ABC has received through seminars, training and by consultants. Surveys in Chapter 2 have indicated that many firms have considered adopting ABC methods. After considering the above, it is very likely that senior employees, like financial managers, would be able to discriminate and rank their systems accurately. Studies performed on cost systems have used broad self classification before (Bromwich and Bhimani, 1994, p.213; Innes and Mitchell, 1995, pp.137-138; Swenson and Flesher, 1996, p.50). After searching the literature for methods of classifying overhead allocation systems, the foregoing was considered the best way to classify each plant's type of cost system. The responses to the item for classifying cost systems are consistent with the results of other surveys. Correlation with expected results from some other items in Part A give some support to the validity of the measure.

Item A4 (satisfaction with current cost system of overhead allocations to products) aims to indicate the general satisfaction for allocating overheads with plant cost systems. The responses to this question can be compared with the results of more detailed items which aim to report differences between the actual and potential use of the cost systems. This item may reveal information if a correlation is found between the level of general satisfaction and differences between actual and potential use for decision making.

Theoretical expectations of the use of ABC, indicate dissatisfaction should be relatively low in systems using activities as their basis. These items should all contribute to providing quantifiable evidence of the extent of the expected relationships which has been part of the debate concerning ABC and VBC systems.

By comparing cost system type with the other items in Part A of the survey instrument, a comparison can be made of plant characteristics of the population sample with theoretical expectations. The study will gather evidence of the extent that users of cost systems believe there is a problem in the allocation of manufacturing overheads at all (Joye and Blayney, 1990). The belief that this problem has caused the decline in importance of cost systems, has been central to the advantages claimed of ABC.

Part B and C of the questionnaire ask identical questions but from differing views: Part B- the importance of the activity to the firm's success; and Part C- the current use (a), and potential use (b), of the plant's cost system. It is a modified version of prior established instruments which have taken a broad view of management accounting's (i) usage (Khandwalla, 1972; Simons, 1987), (ii) importance (Gordon and Narayanan, 1984), (iii) usefulness (Chenhall and Morris, 1986), and (iv) sophistication (Gul, 1991). The theoretical basis for each of the questions can be found by reviewing management accounting texts referred to in Chapter 1: Kaplan and Johnson (1987), and Horngren et al (1994, 1996). As these are established items, their use should enhance validity.

Part B of the instrument is a critical component of the measurement scale developed later in this section. It provides a weighting factor, for inclusion with Part C, which assesses the use of the cost system. This weighting capability allows the combination of cost system use, with importance in achieving success for the plant. The inclusion of Part B ensures that, whatever use is made of the cost system for any of the activities, the instrument always combines that usage to its importance for the plant's success. It is likely with any examination of a cost system, and the possibility of change, that the contribution to success via management action will be of paramount consideration. The very essence of the advantages of adopting ABC is to improve guidance for management action (Cooper and Kaplan, 1991, pp.130-133).

The ten items in Part B of the survey instrument each require a judgemental response on a seven interval Likert scale, concerning the importance of the activity to the success of the respondent's plant. The scale is anchored at the poles by 'relatively unimportant', and 'extremely important'. Part C of the survey instrument requires two responses evaluating (a) the actual use and (b) the potential use that could be made of information for each activity. The seven interval Likert scale is anchored at each pole by 'none', and 'very extensive'. The survey instrument provided explanations defining cost systems, and actual and potential use, as they relate to the activities being examined.

Some studies into cost systems referred to in Chapters 2 and 3 asked respondents to provide indications of their perceived usefulness of the cost system. The problems of obtaining significant results with these studies has also been addressed. This study attempts to firstly, narrow the scope of the judgement required only to the extent of actual use, and then requires a broader evaluation, of perceived potential use. Actual use is defined as management's referral, for decision purposes, to their system. Potential use is defined as how much use could be made for decision making, of the current system.

Chapter 3.4 discussed the need for potential use information about cost systems. Very little analysis has been provided of the reason why studies have found that ABC is not being adopted as expected, or not attaining expected levels of use or usefulness. It is possible that the newness of the systems and inexperience in using ABC may be reflected by the data gathered from Part C (a) and (b). Comparison can be made of the differences between the actual and potential use according to cost system type, while controlling for other factors.

The scale is constructed by a summation of the product of each item from Part B, on the activity's importance, with the corresponding judgement from Part C. This gives a score where the use of the system for each decision making activity is weighted by the importance to plant success of that activity. The weighted scale ensures comparability of results from both instrument Parts B and C. A ranking of 2 for plant success and 6 for use would result in the same score as another respondent who ranked 6 for plant success and 2 for use. Using such a weighted scale corrects the extremes in score that

would result from using only the use ranking, which may give a misleading impression concerning that activity's role. The score is calculated separately for actual use and potential use, so that each is without the influence of the other. This will allow comparison of this study's results with other studies, while allowing the extra dimension of potential use to reveal additional information.

A final calculation is made by taking the square root of the product determined above, for each item from the survey instrument, [$\sqrt{Bx*Cx}$]. The ten items are then added and divided by ten to obtain mean scores of (i) actual use and (ii) potential use of the system. The method achieves the weighted importance of that management activity. This is similar to the treatment by Foster and Gupta (1994) for the multiplicative scale. The additional calculation of a mean provides a single score for simplicity of comparison.

The development of hypothesis H4 is to investigate whether a systematic relationship exists between cost system type and the differences between actual and potential system usage, irrespective of particular contextual factors. Chapter 3.4 detailed the possibility of some implementation and experience problems of using ABC, which may give rise to an information gap. If such a 'gap' is found, it could offer some explanation for survey results not having supported theoretical expectations of ABC. There is very little evidence collected which could yield information about this likelihood.

Foster and Gupta (1994) calculated an information gap for accounting information as it related to marketing managers. They conducted two tests for types of information gaps: (i) accounting information as it is used, and could potentially be used, for decision making; and (ii) accounting tools or techniques as they are used, or potentially could be used, for decision making. The first test for accounting information relates to decisions such as pricing, product mix, and cost allocations. The second relates to decisions like fixed versus variable costs and various ratio analyses.

This study examines the management activities contained in standard management accounting texts, for which the use of a cost system is assumed. In particular, there will be an examination for differences between actual and potential use, according to cost

system type. If evidence emerges that ABC systems have comparatively larger differences between actual and potential cost system use than VBC systems, then the exploratory finding may partly explain the lack of clear evidence supporting ABC.

Foster and Gupta (1994, p.65) calculated the perceived information gap by:

i) the score on the survey instrument for potential use of cost system information of activity x,

less

ii) the score on the survey instrument for actual use of cost system information of activity x;

iii) multiplication of the difference between (i) and (ii) by (i).

ie information gap of activity x: from Part C of this survey instrument]

b - a = y [difference between potential use (Cb x) and actual use (Ca x)]

y * b = z, [multiplied by Cb x]

where z = information gap.

A ranking of 1 for use and 3 for potential results in a score of 6 [3-1*3=6], where a ranking of 5 for use and 7 for potential results in a score of 14 [7-5*7=14][1]. This method captures the relative importance of the accounting activity. This is similar in effect, to the method used in this study for the weighted scale measuring use and potential use, related to the importance of each activity for plant success [Parts B and C of survey instrument]. It differs in that it specifically relates the difference between actual and potential use, not to importance for plant success, but to the respondent's belief in what their system should be able to provide for decision making. As such it provides an established method of determining differences between the use of a cost system, and that same cost system's perceived potential contribution to decision making.

The information gap is discussed specifically in Chapter 3.4. In order to determine a single measure for each plant, this study will adopt the same method of calculating the information gap as Foster and Gupta (1994) and then calculate the mean of the items.

[1] A practical range of score possibilities is between 0 and 42 (assuming the positive quadrant as the potential of an item should not be less than actual).

Part D obtains responses to twelve questions on contextual factors identified in Chapter 3.3 and 3.5. The questions used are identical, or as close as possible, to the identified surveys to promote consistency and reliability.

a) Intensity of Competition

The first five items of Part D are combined to provide an indication of the competitiveness of the operating environment of the plant. The mean of the five items is calculated to represent a single measure of the factor. The questions are derived from the sources indicated in Chapter 3.3.1 and include the attributes:

i) Product price (Khandwalla, 1972; Innes and Mitchell, 1993);

ii) Product inputs (Gordon and Narayanan, 1984); and

iii) Competitive behaviour predictability (Gordon and Narayanan, 1984; Foster and Gupta, 990).

b) Production Complexity

Items 6-9 are combined to indicate the production complexities involved in producing the plant's products. All the questions concern actual production method issues, before a product is completed. The mean of these items is calculated to represent a single measure of the factor. The question on outsourcing was eventually eliminated in order to increase instrument reliability, and is discussed in section 4.4. The questions are derived from the sources indicated in Chapter 3.3.2 and include the attributes:

i) Number of different processes products pass through (Foster and Gupta, 1989);

ii) Product completion predictability (routineness) (Karmarkar et al, 1990); and

iii) Subcontracting (contracting out) relative to direct materials purchases (Foster and Gupta, 1989).

c) Product Diversity

Items 10-12 indicate the level of production diversity as a complexity of the operating environment. Similar measures of the factor have been extensively used in prior surveys. The mean of the items is calculated to represent a single measure of product diversity. The questions are derived from the sources indicated in Chapter 3.3.3 and include the attributes:

i) Production setups (Cooper, 1986; Cooper and Kaplan, 1987);

ii) Production volume (Cooper and Kaplan, 1990; Turney and Reeve, 1990); and

iii) Materials input (Cooper, 1988; Turney, 1989).

The questionnaire contained brief descriptions for item responses where necessary (cost system type used, and competition) in order to clarify and specify terms. It required around 15-20 minutes to complete, and was designed in line with recommendations that such instruments be fairly brief (de Vaus, 1995; Emory and Cooper, 1991).

In order to attract the attention of respondents, a letter explaining the survey was sent to plant finance managers. This was identified as the person believed to possess the requisite skills to interpret and complete the questionnaire. The letter assured confidentiality and offered a summarised report of the findings to interested parties. A reply paid envelope was provided to facilitate returns. It is regarded, along with a letter, as an integral part of a mail survey (Emory and Cooper, 1991, p.335).

4.4 SAMPLE

An aim of this study is to extrapolate the findings to the population of similar plants. Guidance was sought from recognised authorities including: Cohen (1988), Emory and Cooper (1991), and de Vaus (1995). Prior mail questionnaires have response percentages which vary greatly. De Vaus (1995) advises that approximately a 20% and above response rate is not uncommon. In a Queensland study Gul (1991) achieved around a 21% response rate. It was considered that as this questionnaire was aimed at production plants, that a certain leakage of the instrument reaching the intended recipient would occur. This was anticipated due to the difficulty in specific targeting of organisations and ensuring the questionnaire reached the intended plant destination. Accordingly a return rate at the lower end of the range was allowed for. 30 responses is generally considered the minimum for valid analysis (Krishef, 1987, p.183).

To minimise sample error bias and to ensure that sufficient responses were received to reflect the population it was drawn from, as well as achieve statistical power, the sample size was eventually set at around 350. Drawing on Cohen (1988, ch.3), a fairly standard statistical power calculation was made.

There are three general parameters to consider in selecting the sample size for correlation and regression statistical analysis (Cohen, 1988).

a) The population effect accounts for the variance in the population accounted for by the variables. Prior research has indicated that the variables in this study have not been statistically associated with a large effect. As a result a medium effect of 15% ($R^2 = 0.13$) was chosen, which allows for a more than trivial effect, but requires the sample size to be enlarged.

b) The power of the test (Type II error) relates to the ability to reject the hypothesis when it is false [1-(Probability of Type II error)], (Krishef, 1987, ch.9). The power is set at a fairly standard 0.8, which is within the range 0.7 to 0.9, suggested by Cohen (1988, p.162). A statistical test is powerful if it is sensitive to differences amongst the groups that are being compared (Huck, Cormier, Bounds, 1974, p.135).

c) The level of significance was set at 0.05, which is consistent with recommendations for studies of this type (Huck, Cormier, Bounds, 1974, p.42).

Use is made of Cohen and Cohen's Table (1983, p.527) and the formula

$$n^* = (L / f2) + k + 1,$$

where f2 is the power,

k is the number of variables

L is the table value figure

The required cases for the specified hypothesis probability at 0.05 significance can be determined. From the table, L is determined for three variables in the multiple regressions of Chapter 5.

$$n^* = (10.9 / 0.15) + 3 + 1 = 77$$

At the specified test powers and significance seventy seven useable questionnaires were required from the survey sample. If the large effect, 35% of population variance, had been adopted, the number of cases needed to be only 35. On the basis of the results of the other surveys referred to in Chapters 2 and 3, this survey has adopted a more demanding requirement.

Manufacturing plants situated within NSW border regions, including the ACT, were the target of this survey. The companies selected were coded as manufacturing and addresses obtained from the 'Kompass Australia 1996' (1996) business directory. They were randomly selected, subject to sales being over $5 million, and employees in excess of 30. This maintains broad comparability to the literature presented in Chapter 2.

4.5 SURVEY STATISTICS

Table 4-1 provides a descriptive analysis of the questionnaire. The effective response rate was 25%. Non response bias (Table 4-2) was tested by an analysis of the first and last 21 responses for differences in means and standard deviations. No significant differences were found between the means and the standard deviations of the two groups. At a level of significance of 0.05 for a two tailed test, the t-distribution needed to exceed the critical t-statistic of 2.02 at 40 degrees of freedom (Krishef, 1987, p.339), in order for the two groups to be significantly different.

SURVEY STATISTICS

TABLE 4-1

	Number	%
Mailed:	347	100
- not at address	24	6.6
- receiver/liquidation notice	3	0.9
- do not manufacture (in Australia)	4	1.2
	31	8.4
Adjusted sample size	316	100
questionnaires returned	83	26.2
- not useable	2	0.6
- received after data analysed	2	0.6
Total useable questionnaires	79	25.0

The highest t-statistic was 1.0 for controlling production costs (C8a, on survey instrument), which is well within the allowable range. This indicates that the two sub samples are likely to have come from the same two underlying populations.

The replies were coded onto SPSS 6.1 for statistical analysis, and the data exported to Excel 5 for some graphing. The coded replies are reproduced as Appendix B.

Parametric tests are used to analyse data because the hypotheses are based on the assumption that the samples come from populations that are normally distributed and that the variances between groups (homogeneity) is the same (Huck, Cormier, Bounds, 1974, pp.196-197).

NON RESPONSE BIAS

TABLE 4-2

Question	Means 1-21	Means 59-79	t-statistic	Question	Means 1-21	Means 59-79	t-statistic
QA1	3.75	4.25	0.23	QC5b	4.79	5.40	0.20
QA2	4.10	3.75	0.82	QC6a	5.20	4.75	0.24
QA3	2.50	3.30	0.15	QC6b	5.80	5.40	0.19
QA4	3.90	3.70	0.50	QC7a	4.35	5.25	0.18
QB1	5.40	5.20	0.47	QC7b	5.50	6.05	0.35
QB2	5.25	5.45	0.71	QC8a	4.95	5.10	1.00
QB3	4.55	4.20	0.62	QC8b	6.00	5.85	0.30
QB4	3.50	3.50	0.93	QC9a	4.35	4.35	0.82
QB5	4.40	4.70	0.66	QC9b	5.15	5.25	0.89
QB6	5.10	5.20	0.77	QC10a	4.50	4.45	0.83
QB7	4.90	5.80	0.05	QC10b	5.15	5.10	0.70
QB8	6.35	6.05	0.20	QD1	5.85	6.05	0.90
QB9	5.55	5.35	0.59	QD2	4.60	5.40	0.13
QB10	5.40	5.65	0.45	QD3	3.79	4.05	0.60
QC1a	4.75	4.50	0.53	QD4	5.25	4.95	0.65
QC1b	4.85	5.25	0.43	QD5	5.35	5.50	0.91
QC2a	4.45	5.10	0.12	QD6	4.40	4.37	0.87
QC2b	5.35	5.65	0.43	QD7	3.90	4.35	0.27
QC3a	3.60	3.80	0.51	QD8	3.80	2.95	0.12
QC3b	5.00	5.15	0.62	QD9	2.35	2.60	0.39
QC4a	3.70	3.50	0.93	QD10	4.30	3.70	0.28
QC4b	3.65	4.00	0.52	QD11	4.90	4.55	0.39
QC5a	4.42	4.45	0.95	QD12	3.53	3.85	0.56

Reliability refers to a return from an instrument of a similar scale score on any two different occasions (de Vaus, 1995). If an instrument is reliable, it will behave in a similar manner when administered on different occasions and under different circumstances. The instrument is valid when it measures the specific trait it is supposed to measure (Huck, Cormier, Bounds. 1974, p.9).

Cronbach's alpha statistic is a reliability measure which can be used for survey instruments containing variable items. It indicates a level of significance which is a probability that defines how rare or unlikely the sample data must be to reject the hypothesis. Cronbach's alpha statistic shows a correlation between this scale and all other possible scales containing the same number of items, which could be constructed from a hypothetical universe of items measuring the same thing.

Alternatively, alpha can be interpreted as a squared correlation between the score someone obtains, and the score they would have obtained if questioned on all of the possible items in the universe. This study will use the common level of significance of 0.05 which is consistent for similar studies (Huck, Cormier, Bounds, 1974, pp.41-41).

An instrument of modest reliability may have an alpha of 0.6 or 0.5 which is satisfactory for early stages of research (Nunnally, 1967, p.226). If significant correlations are found, adjustments can be made to estimate how much the correlations will increase when reliability of measures are increased (Nunnally, 1967, p.226). An often used standard is 0.7, but Nunnally believes that increasing reliability beyond 0.8 for exploratory research is often wasteful (p.226).

Survey research is argued to uniformly possess fairly low validity. It is often viewed as an exploratory technique which can lead to more refinements using different techniques later. Table 4-3 depicts the validity of survey research findings as being of a medium strength. This indicates that the results of a survey should always be treated with some caution, unless other evidence substantiates the findings.

TABLE 4-3[2]

SURVEY RESEARCH METHODS

Validity	**Strength**
Statistical conclusion	Medium
Internal	Low to Medium
Construct	Low to High
External	Medium

Source: Birnberg, Shields and Young Table 1.

[2] Adapted from Birnberg, Shields and Young (1990) Table 1, p.36.

Measures of unidimensionality indicate the extent to what each instrument item measures the same underlying factor (independent variable). It is assessed using instrument item to scale total coeffic ent of correlation.

In this study factor analysis is under aken after the initial reliability analysis, in order to thoroughly examine the data to reveal and identify underlying constructs or any labels characterising instrument responses. The aim is to use another technique to identify a small number of factors that can be used to represent relationship sets of interrelated variables.

Table 4-4 presents the summary results of means and standard deviations (std dev), for: cost system type and cost system use, both (a) actual, and (b) potential; (i) intensity of competition; (ii) production complexity; and (iii) product diversity. Use is measured for both the actual use of the cost system by those who make decisions for the specified activities, and assessment of potential use for the decision activity. This study measures potential use to increase knowledge compared to other studies which examine current usefulness or use of ABC.

DESCRIPTIVE STATISTICS

TABLE 4-4

Variable	**Range**		**Mean**	**Std Dev**
	theoretical	actual		
cost system type	1 - 7	1.0 - 7.0	2.8	1.89
cost system use:				
- actual	1 - 7	2.3 - 7.0	4.6	1.30
- potential	1 - 7	2.9 - 6.7	5.1	1.20
Intensity of Competition	1 - 7	2.4 - 6.4	5.0	0.94
Production Complexity[3]	1 - 7	1.5 - 5.5	3.6	1.09
Product Diversity	1 - 7	2.0 - 6.3	4.2	1.01

The first stage of calculation involves computing some new measures of variables from the data gained on the 7 point scale used in the survey instrument[4]. Tables 4-5 (cost system actual use and potential use); and 4-6 (information gap) present the statistics for the calculated variables from the survey instrument Parts B and C:

RECODING FOR CONTINUOUS VARIABLES

ACTUAL AND POTENTIAL COST SYSTEM USE

TABLE 4-5

	Actual use			Potential use	
No.	Mean	Std Dev	Variable	Mean	Std Dev
1	4.87	1.33	selling prices	5.22	1.28
2	5.00	1.16	product profit analysis	5.49	1.03
3	3.85	1.28	customer profit analysis	4.51	1.17
4	3.58	1.65	outsourcing	3.80	1.67
5	4.30	1.40	product discontinuance	4.61	1.42
6	4.85	1.26	potential product	5.26	1.23
7	5.06	1.28	production costs	5.57	1.00
8	5.41	1.08	controlling costs	5.92	0.83
9	4.62	1.24	planning and goals	5.16	1.13
10	4.65	1.37	capital expenditure	5.08	1.28
Mean total use =	4.62	0.80	Mean potential use =	5.06	0.70

The contextual factor, intensity of competition, is measured by the survey instrument items D1 through D5 and is expressed as a mean. Production complexity is measured by the mean of items D6, D7 and D9 (item D8 outsourcing, will be eliminated), whilst product diversity is the mean of items D10 through D12.

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[3] The instrument item on outsourcing (D8) was deleted for the reasons discussed in this chapter.

[4] The information gaps were calculated as outlined in section 4.3. 'Mean total information gap' is the mean of the 10 separate calculations of instrument items.

'Actual use' 1 through to 'Actual use' 10 is the measure of the actual use of the cost system for each of the different activities. ie., the square root from the product of each question from the survey in Part B multiplied by the equivalent question from Part C ($\sqrt{Bx*Cax}$) as explained in section 4.3. 'Mean total use' is the mean of the 10 calculations of instrument items. 'Potential use' is measured using the same method to achieve consistency as 'actual use' above: from Parts B and C ($\sqrt{Bx*Cbx}$).

'Intensity of Competition (IC)*Cost System Type (CST)', 'Production Complexity (PC)*CST' and 'Product Diversity (PD)*CST are each of the contextual factors respectively multiplied by the cost system type, as determined from the survey instrument. These computations will be used in the regression models in Chapter 5.

RECODING FOR CONTINUOUS VARIABLES

INFORMATION GAP

TABLE 4-6

No.	Variable	Mean	Std Dev
1	selling prices	3.66	5.35
2	product profit analysis	5.57	7.45
3	customer profit analysis	6.84	8.17
4	outsourcing	2.24	3.82
5	product discontinuance	3.46	5.46
6	potential product	3.89	5.57
7	production costs	5.75	7.43
8	controlling costs	5.15	6.80
9	planning and goals	5.09	5.54
10	capital expenditure	3.81	5.41
	Mean total information gap	4.5	3.5

Table 4-7 presents a correlation matrix of the study variables. There is an expected high correlation between the type of cost system and all of the interaction terms. In part this is because the interaction term also includes cost system type.

Survey instrument Part C(a) (actual current cost system use) has an alpha of 0.848, and Part C(b) (potential use of cost system), an alpha of 0.773. These showed good degrees of significance. All questions were retained as it indicated that the scale of items from the survey instrument and other possible item scales measure the same thing.

The Cronbach alpha is calculated for the three contextual factors being examined. The alpha coefficient for the factor intensity of competition was 0.643. This has been identified as acceptable for exploratory survey research (Nunnally, 1967, p.226). All questions from the survey instrument D1 to D5, measuring this factor were retained.

CORRELATION MATRIX

TABLE 4-7

	cost system type	intensity of competition	production complexity	product diversity	mean total use
cost system type	1 79 P= .	0.23 7 '9 P= .0 5	0.2436 78 P= .032	0.2458 79 P= .029	-0.0036 78 P= .975
intensity of competition	0.2377 79 P= .035	1 '9 P= .	-0.1365 78 P= .233	0.3813 79 P= .001	0.3906 78 P= .000
production complexity	0.2436 78 P= .032	-0.13 5 '8 P= .2 3	1 78 P= .	0.4509 78 P= .000	0.323 78 P= .004
product diversity	0.2458 79 P= .029	0.38 3 '9 P= .0 1	0.0841 78 P= .464	1 79 P= .	0.2350 79 P= .037
mean total use	-0.0036 79 P= .975	0.39 6 '9 P= .0 0	-0.3744 78 P= .001	0.2350 79 P= .037	1 79 P= .
intensity of competition* CST	0.9761 79 P= .000	0.40 4 '9 P= .0 0	0.1976 78 P= .083	0.2848 79 P= .011	0.0556 79 P= .626
production complexity* CST	0.8873 79 P= .000	0.24 5 '9 P= .0 0	0.1408 78 P= .219	0.3788 79 P= .001	0.1369 79 P= .229
product diversity*CST	0.9386 79 P= .000	0.28 3 '9 P= .0 2	0.2294 78 P=.043 .	0.4893 79 P= .000	0.0491 79 P= .667
mean information gap	.2448 78 p= .031	-.14 2 '8 p= .22 1	.9873 77 p= .000	.0506 78 p= .660	-.3558 78 p= .001
mean total potential use	.0744 79 p= .515	.34 1 '9 p= .0 2	.0591 78 p= .607	.2662 79 p= .018	.8920 79 p= .000

[note: a printed result of 'p=.' indicates a coefficient cannot be computed]

When 0.6 would suffice as an indication of a reasonably reliable instrument, the Cronbach alpha for production complexity is considered low at 0.388. The Cronbach alpha could be improved to 0.451 by deleting the survey item on outsourcing (D8). If the survey item 'number of production support functions' (D10) is eliminated from the factor product diversity the Cronbach alpha is only slightly higher at 0.37 instead of 0.357. The item was retained as the increase in alpha was marginal.

4.6 DEVELOPMENT OF SCALE

With the Cronbach alpha for production complexity and product diversity factors as discussed, the reliability of using this test alone is not high. In order to develop a new scale, factor analysis is used on the survey instrument Part D (contextual factors). It is reproduced in Table 4-8. Factor analysis is appropriate for studies in which there are several independent variables (Huck, Cormier, Bounds, 1974, p.74). As the hypotheses are developed with three factors influencing cost system use and potential use, the next step using factor analysis, is to force an extraction of three factors.

ROTATED FACTOR MATRIX

TABLE 4-8

Item	Factor 1	Factor 2	Factor 3
price competition	.02464	.70485	-.20098
price variation	.26731	.53319	.11575
labour competition	.54650	.35877	.07613
product competition	.03001	.52347	.50261
customer competition	.02346	.70167	.26307
product lead times	.57009	-.47158	.06723
separate processes	.76478	.10768	.03099
machine reliability	.02800	-.13733	.80774
outsourcing	.60619	-.11168	.01878
support functions	.08878	.25838	.68264
production vol. variation	.40015	.29138	-.29783
input numbers	.81480	.21499	.06399

Unrotated factor loadings are often not enlightening (Emery and Cooper, 1991, p.650). In order to identify which variables loaded on factors (high r values), rotation is performed to enhance the interpretation of individual factors. In this study a varimax rotation is undertaken, so that the factors are interpreted by examining the variables that weigh heavily on the factor solution. This procedure is similar to that undertaken by Anderson (1995), when he examined the impact of product mix heterogeneity on manufacturing overhead costs. To allow the factors to maintain independence (uncorrelated),[5] an orthogonal rotation is performed.

Factor analysis grouped together the variables designed to measure competition intensity except for the competitive labour skills variable. The reliability score was similar to the original scale measure for the factor intensity of competition in section 4.5. Factor 1 did not reveal useful information.

VARIABLES - FACTOR 3

TABLE 4-9

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
machine reliability	9.2468	4.7409	.4013	.1746	.3483
support functions	8.4416	5.2761	.3849	.1645	.3817
product competition	7.2727	5.9904	.2695	.0729	.5561

Factor 3 (Table 4-9) showed reasonable correlations with the variables 'machine reliability', and 'support functions' The variable 'product competition', also loaded highly on the factor although better suited to Factor 2. It was used to allow the performance of statistical reliability tests after which it was discarded. When the 'product competition' variable is deleted the Cronbach alpha of Factor 3 is 0.56. This is

[5] The rotation alters the axis by shifting to improve loadings. Loadings refer to the correlation coefficient between the factor and the variables.

around the benchmark for exploratory research. The relevant statistics are reproduced as Table 4-9. Factor analysis assisted in determining underlying constructs and was useful in terms of searching for a reliable instrument. After consideration of the foregoing, and when compared to section 4.5, factor analysis was not viewed as adding significantly to the grouping of variables.

4.7 REGRESSION

Multiple linear regression (ordinary least squares) is a common method for data analysis in comparable studies (Chenhall and Morris, 1986; Gul, 1991; Banker and Johnson, 1993; Anderson, 1995). It is possible to debate the validity of using attribute measures such as reflected in the Likert scales used in this study. Notwithstanding, there is considerable support to use parametric tests in studies similar to this (Cohen and Cohen, 1983, p.239; Emory and Cooper, 1991, p.618), where the analysis is bivariate regression.

Correlations describe the statistical interaction between one variable and another. Regression analysis provides an estimate of the causal effect that a variable has on another. Although correlations and regressions are linked, there are comparative differences:

a) x - y relationships are symmetric in correlations, but if regression y is dependent and x is independent, producing a regression of x on y is different from that of y on x.
b) the coefficient of determination explains the common variance of x and y in correlation, whereas the proportion of variability of x is explained by its ordinary least squares regression on y.

The four independent variables were cost system type and the three contextual factors: intensity of competition, production complexity, and product diversity. In Chapter 5 regressions are used to test the impact of the three contextual factors, in addition to cost system type, on the use of cost systems. As a corollary, the same independent variables were formulated as a regression to test each alternate hypothesis (Ha) for hypotheses H1 to H3. The alternate hypothesis is designed to provide statistical information which may

indicate a variation between contextual factors with use, and/or potential use of cost systems, according to whether they tend towards being VBC or ABC orientated.

H4 will be tested to determine whether there is a cost system type relationship and any discernible difference between (a) the actual use, and (b) the potential use of cost systems. The result (an information gap) will measure differences for decision making activities, irrespective of contextual factors.

Some problems exist with multiple regression reliability. The problem of auto correlation would mean that cost system use predictions would be compromised. Auto correlation refers to whether the residuals, the difference between the predicted dependent variable Y' and actual Y, are independent of one another. If each residual is correlated to the residual immediately proceeding it, then the set of data may be in doubt. This would affect the validity of the regression line as it would not be an equally accurate predictor of the effect of contextual factors at varying levels. The Durban-Watson statistic calculates a value between 0 and 4 for auto-correlation. If the residuals are not correlated the value of the statistic is close to 2 (Berenson and Leving, 1996, ch.17).

4.8 CONCLUSION

This chapter concluded that a cross sectional mail survey instrument of manufacturing plants is a suitable method for collecting evidence which may confirm the hypotheses contained in Chapter 3. It was acknowledged that the method chosen has limitations. Although it has specific critics who argue that it is conceptually flawed as a measure and test of the success/value or benefits of ABC, there is also considerable demand for the collection of such broadly based empirical evidence. This is irrespective of the apparently unresolved issue questioning the specification validity of such research.

The design of the test instrument was carefully considered and based on established measures, and the target population was identified. Some broadly similar surveys, have found small degrees of exploratory power when testing the assumptions associated with ABC and relevant contextual variables. The survey instrument is also designed to

measure any perceived shortcoming in the actual use of cost systems compared to their potential use. A specific measure for determining an information gap, which is weighted for the importance of decision activities between actual and potential cost system use, was adopted from an established study. It will be used to test for any systematic differences in magnitude between ABC and VBC systems.

A representation of important statistics is presented where appropriate statistical tests on the data are performed. Due to some initial weak associations in some contextual factor associations, factor analysis is undertaken. This is an attempt to thoroughly analyse the data by devising another measurement scale for producing a reliable instrument. To enhance the interpretation of individual factors an orthogonal rotation is performed to reveal underlying construct associations. After factor analysis, it was decided to use the original item relationships from the survey instrument because it was unable to significantly improve the grouping of the survey instrument items. The earlier warnings of difficulties for the model specifications of ABC achieving reliable results, seem to be well based.

Regression analysis is an important statistical method of identifying explanatory power among independent and dependent variables. Chapter 5 completes the statistical examination by including use of regression models to determine linkages between hypothesised variables and cost systems.

CHAPTER 5

DATA ANALYSIS AND RESULTS

5.1 FOREWORD

This chapter contains the analysis of the data provided by respondents to the survey questionnaire. The study has identified a need for empirically based evidence to answer certain questions via a survey. Firstly, a comparison is made of the characteristics of the different cost system types. Cost systems are then classified by using the survey instrument's measure of cost system type into two broad groupings of VBC or ABC. The characteristics of these broad measures are then compared to reveal differences between cost systems tending towards being ABC or VBC.

The regression models are presented and the results of testing discussed. The regression models are the highest level statistical tests, which may allow inferences to be drawn of the hypotheses identified in Chapter 3. The first regression models seek evidence that the contextual factors do influence the use of cost systems. Subsequently, the analysis proceeds to examine the effects on use of the particular cost system type with each contextual factor.

The hypotheses are tested by using regression models that examine the actual use of cost systems. They also examine the perceived potential use according to cost system type, when moderated by the contextual factors. This leads to a comparison between use and perceived potential use between ABC and VBC systems. This procedure attempts to gain support for the prediction by ABC theory, that when the contextual factors are high such systems are used more than VBC systems.

Finally, a regression model is examined which tests, irrespective of contextual factors, whether there are differences between the use and perceived potential use of ABC and VBC systems. This model calculates an information gap where the size is used to make cost system type comparisons.

5.2 COST SYSTEM TYPE AND PLANT CHARACTERISTICS

This first section will analyse data in a broad manner so that an understanding may be gained of the general operating characteristics of cost systems which tend towards being either volume or activity-based. Regression model analysis of the specific hypotheses will be performed in a subsequent section. This analysis has a high degree of mathematical rigour, but to begin with does not provide an encompassing view.

The aim of this section is to find out whether ABC and VBC systems are found operating in similar or dissimilar operating environments. If virtually no difference is evident, the possibilities raised in Chapters 1 and 2, that the use of ABC may be conditional less on the operating environment and more on other factors of management, may receive some limited support. While the comparisons made are not mathematically refined, they may indicate preliminary findings, and lead to an examination of areas which support or contradict theoretical expectations.

The theory of ABC leads to expectations that cost systems that tend towards being ABC, are likely to be found in more complex and difficult environments. They are also more likely associated with production methods that have less certainty and consistency.

Table 5-1 summates the rankings used to classify the cost system for each plant. The total is 79, being the number of analysed survey responses. Respondents classified their plant's system on the basis of the overhead allocation method used, by indicating a ranking on a 7 point scale. Systems tending towards using VBC methods indicated lower rankings and ABC indicated higher ones. The results show that VBC systems are more dominant in the sample than ABC systems. The first two cost system rankings (VBC) of the survey sample population account for nearly 60% of responses. Only slightly over 16% of plant cost systems were ranked at the last two points 6 and 7 (ABC orientated systems). The number of cases between these two group rankings is small: around 25% of the sample. This finding is consistent with expectations from Chapter 2 concerning the prevalence of manufacturers using ABC and VBC allocation methods.

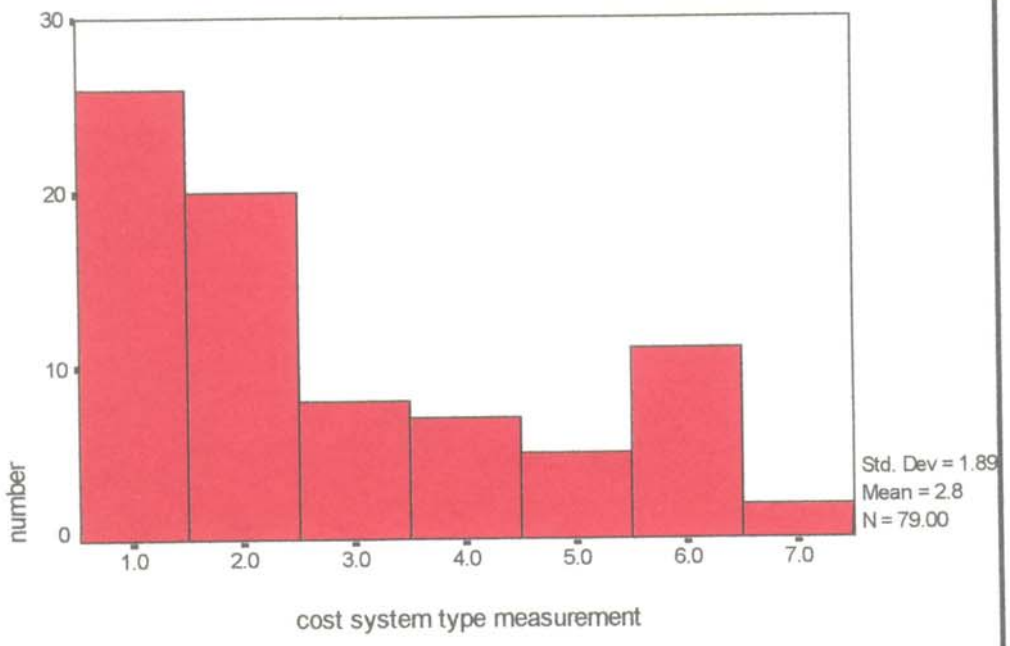
COST SYSTEM CLASSIFICATION

TABLE 5-1

Ranking	Frequency	Percent
1	26	32.9
2	20	25.3
3	8	10.1
4	7	8.9
5	5	6.3
6	11	13.9
7	2	2.5
Total	79	100

COST SYSTEM TYPE CLASSIFICATION

FIGURE 5.1



The lack of any obvious central tendency in the responses is visually demonstrated by the graph Figure 5-1. It is consistent with other survey findings from Chapters 2 and 3, and it indicates prima facie support that the question item was successful in discriminating between cost system types.

As a preliminary analysis for this section only, a dichotomous classification, from the 7 point ranking used for determining cost system type, will be made. Rankings at the

lower end of the continuum indicate volume-based allocation systems, while the higher end represent activity-based practices. For a simple dichotomous grouping, rankings 1-3 and 5-7 lie either side of the middle (4). There were few middle responses (7/79) and to avoid a larger impact on the substantially less numerous rankings 5-7, the 4th ranking will be classified with VBC systems.

Using the dichotomous classification, Table 5-2 displays means and standard deviations for the cost systems. ABC systems are indicated to be more likely to use production methods which use more small customised and batch production operations (mean = 3.2), when compared to VBC (mean = 4.1). This is on the 7 point ranking continuum, anchored at the poles between: (1) small customised operations, and (7) continuous process production. This difference is consistent with the expectations of ABC theory.

The data in Table 5-2 indicates whether or not cost accounting practices were essentially identical for all units of production. The 7 point ranking is anchored at the poles between: (1) identical, and (7) significantly different cost accounting practices. The difference between VBC systems (mean = 3.3) and ABC (mean = 4.1) is consistent with expectations from the literature in Chapter 2.

COST SYSTEM TYPE AND PLANT VARIABLES

TABLE 5-2

Variable	Vol-Based		Activity-Based	
	Mean	Std Dev	Mean	Std Dev
Production method	4.1	1.58	3.2	1.17
Cost accounting practices	3.3	2.04	4.1	1.49
Dissatisfaction-cost system allocations	3.9	1.74	3.7	1.44

Cost system dissatisfaction with overhead allocations to products (Table 5-2) is anchored at the poles between: (1) satisfied, with no improvements needed, to (7)

dissatisfied, with major improvements needed to the way product overhead costs are allocated. The mean dissatisfaction difference between VBC and ABC systems was very small.

Table 5-3 reveals data on the computed three contextual factors using the dichotomous classification: intensity of competition, production complexity, and product diversity. This is calculated from Part D of the survey instrument.

COST SYSTEM TYPE AND CONTEXTUAL FACTORS

TABLE 5-3

Variable	Vol-Based		Activity-Based	
	Mean	Std Dev	Mean	Std Dev
Intensity of Competition	4.8	1.02	5.2	.64
Production Complexity	3.5	1.16	3.4	1.03
Product Diversity	4.1	1.00	4.6	.98

There are very few apparent differences in this table. Product diversity shows the greatest difference; VBC (mean = 4.1) and ABC (mean = 4.6). This indicates that plants using activity measures for overhead allocation seem to conform to theoretical expectations of being associated with many different products.

Table 5-4 provides data for a comparison of the mean total use of cost systems by dichotomous type. It also reveals the perceived mean potential usage of both system types. There is virtually no difference between ABC (mean = 4.5) and VBC (mean = 4.6) for cost system use. This finding, although preliminary, is surprising considering that activity-based overhead allocation systems are argued to be more relevant and reliable. ABC systems should be used more, relative to volume-based systems. The mean of potential cost system use does not reveal any significant differences between the two systems either.

COST SYSTEM TYPE AND COST SYSTEM ACTUAL USE AND POTENTIAL USE

TABLE 5-4

Variable	Vol-Based		Activity-Based	
	Mean	Std Dev	Mean	Std Dev
Mean total use	4.6	.83	4.5	.74
Mean total potential use	5.0	.71	5.1	.70

5.3 ACTUAL USE, POTENTIAL USE AND CONTEXTUAL FACTORS

As a result of the foregoing, regression analysis is now used to further preliminary analysis and ascertain whether any relationship exists between the three contextual factors, and actual and potential use of cost system information. This excludes any reference to cost system type, in order to examine the impact of contextual factors. Later analysis will examine any differences within these changes, which are attributable to a particular cost system.

The six regression models are based on the following general equation:

Cost System Use = $B_o + B_1CF$

where:

B_o = regression coefficient unrelated to independent variables

B_1 = value which represents the variable effect of an increase of one unit in the independent variable (x) on the dependent variable (y).

CF = each of the separate contextual factors

Table 5-5 presents the relevant results. Five of the six regression models are acceptable at the benchmark significance $p \leq 0.05$. The models show that the factor intensity of competition has the most impact upon cost system use, with explanatory variance of around of 15% (actual use) and over 12% (potential use). B_1 is positively signed which

indicates that as competition increases, greater use is made of cost systems. What is interesting about this result, and considering there are relatively few cost systems in the sample which are largely activity-based, is the indication that the type of cost system is perhaps not important. Further analysis will be performed in order to determine whether any difference in use is related to cost system type, and changes in contextual variables.

COST SYSTEM ACTUAL AND POTENTIAL USE INTERRELATION WITH CONTEXTUAL FACTORS
REGRESSION MODELS
TABLE 5-5

Factor	R^2	B	t-statistic	t-sig	R^2	B	t-statistic	t-sig
	Regression Actual Use				*Regression Potential Use*			
Intensity of Competition	.153	.334	3.72	.0004	.122	.262	3.269	.002
Production Complexity	.140	-.080	3.52	.0007	.003	.011	.516	.607
Product Diversity	.055	.186	2.122	.037	.071	.185	2.424	.018

Production complexity while significant, has a negative beta B_1, which appears an unlikely reality. The Cronbach alpha for this factor was low, and it is not reliable (Chapter 4).

5.4 COST SYSTEMS, USE AND CONTEXTUAL FACTORS

The hypotheses H1 to H3 and H1a to H3a developed in Chapter 3, explain use of cost system type when contextual factors (moderating variables) intervene. In order to test for an explanatory variance, ordinary least squares regression is used.

To test the hypotheses a regression equation is used:

Regression A: $Y' = B_0 + B_1CST + B_2CF + B_3(CST*CF)$

Where: CST = cost system type

(CST*CF) = the product of CST and CF (independent variables)

The regression model for testing the hypotheses uses a statistical method that enhances the test for interaction of the variables. The inclusion of a product term (CST*CF) creates an additional variable which aids the multiple regression testing mathematically. Transforming variables is common for analysis and is often incorporated in statistical software packages (Levin and Rubin, 1991, ch.11).

To determine whether cost system type and/or each contextual factor has a direct impact upon cost system use, the product term is removed and another regression model is used.

Regression B: $Y' = B_0 + B_1CST + B_2CF$

The results from this regression model can indicate whether one or both of the variables being examined are separately significant in determining cost system use.

5.4.1 Cost Systems, Use and Intensity of Competition

Hypothesis H1 predicts a relationship exists between the use of cost systems and cost system type, moderated by intensity of competition. It can be expected that as intensity of competition increases, ABC systems should be used more. Correspondingly, in increasingly competitive environments, VBC systems should be used less than ABC systems.

Table 5-6 presents the results of testing hypothesis H1 with regression model 1A (with interaction term). It also presents the results of model 1B which tests for the direct effects of the independent variables, intensity of competition and cost system type, upon cost system use. Regression model 1A is significant (f-sig = 0.003) and has an explanatory effect on the dependent variable cost system use of 17.1% (medium effect). The Durban-Watson statistic has a value of 2.03 which indicates excellent independence for the residuals from the regression estimate.

COST SYSTEM TYPE, USE AND INTENSITY OF COMPETITION INTERRELATION

REGRESSION MODELS 1A AND 1B

TABLE 5-6

Variable	B	t-statistic	t-sig	B	t-statistic	t-sig
	Regression 1A			*Regression 1B*		
Cost system type	.250	.758	.451	-.043	-.946	.347
Intensity of Competition	.471	2.970	.004	.355	3.839	.0003
Intensity of Competition *CST[1]	-.055	-.897	.372	NA	NA	NA
Constant	2.359	2.904	.005	2.961	6.459	.000
	R^2 =	.171			.162	
	F =	5.17			7.37	
	F- sig =	.003			.001	
	Durban-Watson	2.03			2.08	

Model 1A: $Y' = Bo + B_1CST + B_2IC + B_3(CST*IC)$

Model 1B: $Y' = Bo + B_1CST + B_2IC$

The resulting product of the two independent variables, cost system type and intensity of competition, is not significant (t-sig = 0.372). Results do not support that cost system use is moderated by a relationship between cost system type and intensity of competition.

Regression model 1B calculates the direct relationship of cost system use between intensity of competition and cost system type. The results of regression model 1B using

[1] Intensity of Competition (IC) * CST, Production Complexity (PC) * CST, and Product Diversity (PD) * CST are the cost system type identified in the survey instrument (A3) multiplied by the respective contextual factors.

two independent variables, are significant (f-sig = 0.001). It has a medium positive explanatory variance of 16.2% (t-sig ≤ 0.05) of cost system use. Intensity of competition is significant (t-sig ≤ 0.05) and positively associated with cost system use, but cost system type is not significant (t-sig = 0.347).

The results of the above indicate that while intensity of competition affects cost system use the type of cost system used is not significant.

5.4.2 Cost Systems, Use and Production Complexity

Hypothesis H2 is tested to determine whether a relationship exists between the use of cost systems and cost system type, moderated by production complexity. It can be expected that ABC systems should be used more as production complexity increases. Correspondingly, as production complexity increases VBC systems should be used less than ABC systems.

Table 5-7 presents the results of testing hypothesis H2 with regression model 2A. It also produces the results of model 2B which calculates the direct effects of production complexity and cost system type upon cost system use. Regression model 2A demonstrates explanatory effect on the dependent variable, cost system use of 20.9% and significance (f-sig ≤ 0.05). The Durban-Watson statistic has a value of 2.16 that indicates good independence of residuals from the regression estimate.

The result of the product of the two independent variables, cost system type and production complexity is significant (t-sig = 0.021). B_3 is positively signed as expected. Hypothesis H2 can be supported because of regression model 2A. This indicates that the model supports a relationship between the interaction of cost system type and production complexity, similar to the theoretical argument of ABC. Production complexities of modern manufacturing are believed to impose severe strains on volume-based cost systems because of their lack of relevance for decision making.

The model with the interaction term supports the contention that ABC systems are used more as production complexity increases, and correspondingly provides some justification for the proposed benefit of plants adopting ABC methods.

COST SYSTEM TYPE, USE AND PRODUCTION COMPLEXITY INTERRELATION

REGRESSION MODELS 2A AND 2B

TABLE 5-7

Variable	B	t-statistic	t-sig	B	t-statistic	t-sig
	Regression 2A			*Regression 2B*		
Cost system type	-.165	-1.679	.097	.041	.874	.385
Production Complexity	-.076	-3.284	.002	-.085	-3.621	.0005
Production Complexity * CST	.057	2.363	.021	NA	NA	NA
Constant	4.876	9.301	.000	4.903	28.2	.000
	R^2 =	.209			.149	
	F =	6.49			6.56	
	F- sig =	.0006			.002	
	Durban-Watson	2.11			1.98	

Model 2A: $Y' = Bo + B_1CST + B_2PC + B_3(CST*PC)$

Model 2B: $Y' = Bo + B_1CST + B_2PC$

Regression model 2B tests the direct relationship of cost system use between cost system type and production complexity. The results of regression model 2B with the two independent variables, reveal 14.9% explanatory variance of cost system use at a significant level (f-sig = 0.002). Production complexity (t-sig = 0.045) has a negative beta sign which is inconsistent and difficult to reconcile with expectations. The reliability of the factor is very low (Cronbach alpha = 0.45), which cautions reliance upon the results. When production complexity is controlled for, cost system type is

positively but not significantly associated (t-sig = 0.385), with the use of cost information.

5.4.3 Cost Systems, Use and Product Diversity

Hypothesis H3 tests whether a relationship exists between cost system use and cost system type, moderated by product diversity. ABC theory predicts a positive relationship for the coefficient of the interaction term (B_3) in model 3. When diversity of products increases, ABC cost system use should be relatively higher than VBC systems.

Table 5-8 presents the calculations of regression models 3A and 3B for the explanatory effect of cost system use and cost system type, when moderated by product diversity. The Durban-Watson statistic has a value of 2.02 which indicates excellent independence for the residuals from the regression estimate.

Regression model 3A demonstrates explanatory effect of 6.3%, which is relatively small but not insignificant. The model and the interaction between cost system and product diversity is not significant ($p > 0.05$). There is a lack of support for hypothesis H3: that ABC systems are of more use when product diversity is high.

Regression model 3B calculates the direct effects on cost system use of cost system type and product diversity. The explanatory significance of regression model 3B is 5.9% of cost system use, but it is not significant (f-sig = 0.098), although 0.1 can be used with lower certainty (Huck, Cormier, Bounds, 1974, ch.1; Krishef, 1987, ch.9). The product diversity coefficient (B_2) is positively signed, as expected, and significant (t-sig = 0.032), but there is a lack of statistical significance for cost system type (t-sig = 0.571). The result indicates some relationship to cost system use with product diversity but does not support the expectations that the type of cost system is important.

COST SYSTEM TYPE, USE AND PRODUCT DIVERSITY INTERRELATION REGRESSION MODELS 3A AND 3B

TABLE 5-8

Variable	B	t-statistic	t-sig	B	t-statistic	t-sig
	Regression 3A			*Regression 3B*		
Cost system type	.068	.351	.726	-.028	-.569	.571
Product Diversity	.256	1.775	.080	.199	2.187	.032
Product Diversity *CST	-.022	-.510	.612	NA	NA	NA
Constant	3.62	5.910	.000	3.867	10.145	.000
	R^2 =	.063			.059	
	F =	1.66			2.39	
	F- sig =	.181			.098	
	Durban-Watson	2.02			2.04	

Model 3A: $Y' = Bo + B_1CST + B_2PD + B_3(CST*PD)$

Model 3B: $Y' = Bo + B_1CST + B_2PD$

5.5 COST SYSTEMS, POTENTIAL USE AND CONTEXTUAL FACTORS

The hypotheses H1a to H3a, developed in Chapter 3, require testing for explanation of the perceived potential use of cost systems and cost system type, when moderated by contextual factors. The regression equations C and D are the same as for regression equations A and B in section 5.4; i.e.:

Regression C: $Yp' = B_0 + B_1CST + B_2CF + B_3(CST*CF)$

Regression D: $Yp' = B_0 + B_1CST + B_2CF$,

except that for each of the regression models C and D, Yp' is the perceived potential use of the cost system rather than the actual use. Similarly, regression models C are used to determine whether support for the hypothesis exists, that potential cost

system use is interrelated with type of cost system employed as the contextual factors increase. Models D examine the direct effect of both variables together on potential cost system use.

5.5.1 Cost Systems, Potential Use and Intensity of Competition

Hypothesis H1a is the corollary of its counterpart H1 and requires testing to determine whether a relationship exists at the plant level between the potential use of cost systems and cost system type, moderated by the intensity of competition.

Regression analysis may reveal if intensity of competition impacts upon the perception of the potential use of a cost system according to cost system type.[2] Regression model 1C is used to indicate any relationship of use and cost system type, when moderated by intensity of competition.

Table 5-9 presents the results for regression models 1C (with interaction term) and 1D (direct effect of variables). Regression model 1C has a 13.8% explanatory effect for potential cost system use. The Durban-Watson statistic has a value of 1.96, which indicates that the residuals are satisfactorily independent of each other. Model 3C is significant (f-sig = 0.011) but B_3 is not positively signed as expected. The significance for the product of the two independent variables, cost system type and intensity of competition, is below the benchmark (t-sig = 0.245). This indicates a lack of support for accepting hypothesis H1a that cost system type and intensity of competition interact to determine potential cost system use

Regression model 1D calculates the relationship directly between cost system potential use and cost system type, when moderated by intensity of competition. The results of regression model 1D are significant (f-sig = 0.007) and explain 12.2% of the variance in the potential use of cost systems. The coefficient B_2, indicates the relationship between potential cost system use and intensity of competition, is positive. This explains increasing potential use as competition intensity increases (t-sig = 0.002). However,

[2] The first step is the calculation of the resulting mean from the survey instrument. Part B:(Bx) is multiplied by plant perceived potential of cost system, Part C:(Cxb): i.e. [Bx*Cxb].

cost system type is not significant (t-sig = 0.934) and not associated with increased potential use of cost systems, as intens ty of cc mpetition increases.

The results of the foregoing do indic ate a relationship between changing intensity of competition and potential cost system use. They do not support the expectation that as competition increases, ABC systems will be used more than VBC systems.

COST SYSTEM TYPE, POTENTIAL USE AND INTENSITY OF CC MPETITION
REGRESSIO N MODELS 1C AND 1D
TABLE 5-9

Variable	B	t-statistic	t-sig	B	t-statistic	t-sig
	Regression 1C			*Regression 1D*		
Cost system type	.339	1.148	.255	-.003	-.083	.934
Intensity of Competition	.399	2.811	.006	.251	3.174	.002
Intensity of Competition *CST	-.065	-1.171	.245	NA	NA	NA
Constant	3.048	4.192	.0001	3.763	9.107	.000
	R^2 =	.138			.122	
	F =	3.99			5.28	
	F- sig =	.011			.007	
	Durban-Watson	1.95			2.02	

Model 1C: $Yp' = Bo + B_1CST + B_2IC + B_3(CST*IC)$

Model 1D: $Yp' = Bo + B_1CST + B_2IC$

5.5.2 Cost Systems, Potential Use an l Production Complexity

The corollary hypothesis of H2 is H2a and aims to calculate whether a relationship exists between potential cost system use and cost system type, when moderated by production complexity.

Table 5-10 presents regression models 2C and 2D which calculate explanatory effects for potential cost system use and he variables cost system type and production complexity. The expectation is that at low levels of production complexity, volume-based systems may be equally used. As complexity increases a positive B_3 coefficient is expected, evidencing that ABC systems could be used comparatively more.

COST SYSTEM TYPE, POTENTIAL USE AND PRODUCTION COMPLEXITY REGRESSION MODELS 2C AND 2D

TABLE 5-10

Variable	B	t-statistic	t-sig	B	t-statistic	t-sig
	Regression 2C			*Regression 2D*		
Cost system type	-.169	-1.812	.074	.024	.545	.587
Production Complexity	-.017	-.760	.449	.008	.366	.716
Production Complexity *CST	.053	2.336	.022	NA	NA	NA
Constant	4.93	30.75	.000	4.95	30.09	.000
	R^2 =	.076			.007	
	F =	2.02			.280	
	F- sig =	.119			.756	
	Durban-Watson	2.07			1.95	

Model 2C: $Yp' = Bo + B_1CST + B_2PC + B_3(CST*PC)$

Model 2D: $Yp' = Bo + B_1CST + B_2PC$

Regression model 2C tests hypothesis H2a. The interaction terms, cost system type multiplied by production complexity, is within the benchmark significance level (t-sig = 0.022) and B_3 is positively signed as expected. It explains 7.6% of the variation in potential cost system use. The Durbar-Watson statistic equals 2.07, which indicates the regression fit of residual independence is reliable. However, hypothesis H2a can not be supported due to the model's significance being outside the set benchmark ($p \leq 0.05$).

The results of the foregoing demonstrate that the regression model indicates some of the variation of cost system potential use is related to cost system and changes in production complexity. However, the model is not so statistically significant to provide acceptable support for hypothesis H2a.

Regression model 2D calculates the relationship directly between potential cost system use and cost system type, as well as potential cost system use and production complexity. The regression model has virtually no explanatory effect (0.7%) and is not significant (f-sig = 0.756). Neither cost system type, or production complexity, has direct effect significance with potential cost system use.

5.5.3 Cost Systems, Potential Use and Product Diversity

Hypothesis H3a calculates whether a relationship exists when moderated by product diversity, between cost system use and cost system type.

Table 5-11 presents the results of regression models 3C and 3D which calculate the variation in potential cost system use with respect to cost system type and product diversity. Regression model 3C tests hypothesis H3a. The Durban-Watson statistic is 2.02, which indicates the regression estimate does not suffer from autocorrelation. The model explains 7.7% of the variance in potential cost system use but is not statistically significant (f-sig = 0.108).

The interaction term of cost system type and product diversity is not significant (f-sig = 0.472). A statistically significant positive coefficient of the interaction term is expected.

Such a result would accord with expectations that with high product diversity, ABC systems have greater potential use than VBC systems. The interaction product term between cost system type and product diversity does not support hypothesis H3a.

COST SYSTEM TYPE, POTENTIAL USE AND PRODUCT DIVERSITY REGRESSION MODELS 3C AND 3D

TABLE 5-11

Variable	B	t-statistic	t-sig	B	t-statistic	t-sig
	Regression 3C			*Regression 3D*		
Cost system type	.122	.720	.473	-.004	.083	.934
Product Diversity	.254	2.022	.047	.183	2.314	.023
Product Diversity *CST	-.027	-.723	.472	NA	NA	NA
Constant	3.98	7.47	.000	4.29	12.902	.000
	R^2 =	.077			.071	
	F =	2.10			2.903	
	F- sig =	.108			.061	
	Durban-Watson	2.02			2.03	

Model 3C: $Yp' = Bo + B_1CST + B_2Diverse + B_3(CST * Diverse)$

Model 3D: $Yp' = Bo + B_1CST + B_2 Diverse$

Regression model 3D calculates the effect of the two variables, cost system type and product diversity, on potential cost system use. The results of the regression model explain a variance of 7.1% for the dependent variable potential use, which is a small but not insignificant effect. The regression is outside the benchmark significance (f-sig = 0.061) which means the result can not be relied upon. Product diversity (t-sig = 0.023) is significant, but the cost system type is not. This supports the view that while product diversity affects cost system use, the type of system is irrelevant.

While most regression models suffer in confidence levels, and must be treated with caution, some interesting observations can be made. These can be used for further searches of the data in an attempt to gain reliable and meaningful information.

This study extended the search for evidence to support the adoption and practice of ABC by including an examination of the potential use which could be made of cost systems. In part this was undertaken because prior similar broadly based surveys to determine the use or usefulness of cost systems, rarely matched the theoretical expectations with satisfactory evidence. It has been suggested, in this paper, that part of the reason for the lack of substantiating prior evidence may be that the use of ABC systems have been associated with some form of implementation or similar difficulty.

The regression models indicate that when controlling for each of the contextual factors, there were no significant differences in favour of potential cost system use in comparison with actual use (measured by R^2). Consequently, there appears to be little prima facie evidence in these circumstances that there is a large difference in expectations of potential use between cost system types. This indication is unexpected if one assumed that the lack of clear evidence supporting ABC is related to causes like relative newness and user inexperience.

In order to examine the data for any evidence of systematic differences between cost system use and potential use, according to the type of cost system employed, another specific test will be made.

5.6 INFORMATION GAP

The foregoing indicates that there is little relative difference between actual and potential use of cost systems, according to the moderating influence of each of the contextual factors. Production complexity was the only factor found to be significantly and positively associated with actual cost system use and ABC systems.

The regression models which tested actual and potential use of cost system type according to contextual factors invite further analysis of any differences between ABC

and VBC systems. There was not significant support for the view that ABC systems have, when the level of each contextual factor is high, an unrealised potential advantage which should emerge clearly as managers become more experienced users.

It is possible that there are other unidentified factors, which are significant upon the type of cost system and cause differences between actual and potential use. These unidentified factors suggest further research could be beneficial into the differences between activity-based and volume-based cost systems. Davies and Sweeting (1991, p.44) believe that new cost techniques are confusing and the data not useable by many managers. It may be that issues similar to this need further examination in order to achieve greater beneficial use of cost systems.

Hypothesis H4 was developed in Chapter 3.4 to test for any systematic difference between actual use and potential use, of the cost systems being examined. It was specifically developed to test whether ABC systems were operating to expectations in providing information used for decision making. The aim is to establish whether there is an identifiable difference between actual and potential use of ABC and VBC systems, irrespective of any relationship to the contextual factors expected to influence them. Any difference which emerges will be called an information gap and, if the coefficient (B_1) is positively signed, it will indicate that managers expect ABC systems to be of comparatively more use. It is an exploratory attempt to seek whether evidence exists of an information gap but does not attempt to statistically associate certain predefined causes.

A search of literature has not revealed any other similar attempt to identify an information gap possibility by cost system type. A finding that ABC had a difference that was systematically larger in magnitude than VBC systems, would provide incentive to further investigate its specific cause. Chapters 2 and 3 revealed that there are concerns that studies into ABC, have misspecified models, and are incapable of accurately revealing actual associations (Davies and Sweeting, 1991, pp.44-45; Kaplan, 1993, p.3; Innes and Mitchell, 1995, p.137). Evidence of an information gap may assist in refining measures to reduce those concerns.

The method of measuring the information gap was outlined in Chapter 4.3. It captures the importance of the activity and is a measure of the actual use of cost systems compared to the assessed potential use If the information gap is larger for plants having cost systems which tend toward being activity-based, then a problem in expectations and actual usability is identified for the activities regarded as most important. This test for an information gap could partly explain why studies measuring cost system use and usefulness may fail to substantially support the claims of ABC.

Hypothesis H4 proposes a null association between information gap and cost system type. To test hypothesis H4 a simple regression model will be used between the mean total perceived information gap of each plant and cost system type, as ranked on the 7 point item for determining each plant's type of cost system.[3] The regression uses the data from Table 5-12 indicating that there may be a difference worth investigating interrelated with cost system type.

MEAN INFORMATION GAP

TABLE 5-12

Variable 'Mean Total Information Gap'

by

Variable 'Cost System Type'

Cost System Type Ranking	Count	Mean	Standard Deviation
1	26	3.0	2.4
2	19	5.9	4.8
3	8	3.8	2.5
4	7	2.8	2.5
5	5	7.3	2.1
6	11	6.0	3.1
7	2	5.8	5.4
	78[4]	4.5	3.6

[3] predicted information gap = B_1 cost system type + B_2 mean total information gap.

[4] 1 case was deleted because of incomplete information gap data

Table 5-13 presents the regression for hypothesis H4, testing the relationship between the information gap and cost system type. The regression explains a 6% variation in the difference between actual and potential cost system use attributable to cost system type. This result is a small, but not insignificant, amount of explanation. The regression model and cost system type are statistically significant ($p \leq 0.05$) and provide support for concluding that an information gap may exist with a magnitude more positively related to ABC than VBC systems.

COST SYSTEM TYPE AND INFORMATION GAP

REGRESSION MODEL 4

TABLE 5-13

Variable	B	t-statistic	t-sig
	Regression 4		
Cost system type	.46	2.20	.031
Constant	3.23	4.57	.000
	R^2 =	.06	
	F =	4.84	
	F-sig =	.03	
	Durban-Watson	1.84	

$$MTIG = Bo + B_1CST$$

where: MTIG = mean total information gap

To some extent, ABC systems appear not to be delivering the perceived potential use to their users at the plant level. It may be possible to further refine measures for the information gap which may lead to reassessing its size.

The result of finding that ABC has a wider divergence between the use of the system and the expected capability of use when compared to VBC systems, tends to support the view of those who urge caution about adopting ABC. The information gap evident from this study needs cautious interpretation as the magnitude is not large. Further research

and refinement of measures may produce a result of greater magnitude. What the finding does not achieve, is provision of a reason for this difference between information gaps. This reason may need to be the subject of further investigation.

Evidence of an information gap may assist in understanding why ABC has a lower rate of comparative use and adoption than proponents expect. This has the potential to be significant when one considers that the studies reviewed in Chapter 2 have largely shown that volume-based cost drivers are correlated to overheads more strongly than expected by ABC theory.

This study also did not find identifiable significant support ($p \leq 0.05$) that plants using cost systems with more activities to allocate overheads were being used more than plants which used volume-based methods, when moderated by intensity of competition and product diversity. A regression model employed to further investigate the preliminary analysis made in section 5.2, without examining contextual factor influence, indicated that there was less than a 1% change in total cost system use attributable to cost system type. However, it was not statistically significant ($p > 0.05$) and can not be relied upon.[5] The model tested the total use made of cost systems according to the item containing the 7 point rankings of cost system type.

The significance of the information gap may lie in its ability to allow comparison between cost system types rather than any actual calculated score. If the type of cost system is found not to be important for determining the frequency of use, it may appear that cost system type is irrelevant. However, a comparison of the size of the comparative information gaps may suggest that ABC is thought to be capable of being used more in management decisions. Accordingly, this demonstrates a potential benefit of using ABC which is currently not attained in practice. Such evidence suggests that there should be a search for factors which are preventing the potential of ABC being achieved. There may well be additional guidance for this search contained in the literature.

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[5] The regression equation to test for a relationship: $Y' = Bo + B_1CST + B_2$ Total Use of Cost System where: Y' = Predicted Cost System Use.

5.7 CONCLUSION

An analysis is performed in this chapter of the statistical data gained from the survey instrument. The type of cost system employed is compared to data that can reveal any association with production process method, overhead allocation practices, and satisfaction with existing cost attribution product methods.

A significant majority of manufacturers were found to use volume-based measures for the allocation of overheads. Plants using ABC measures for allocating overheads seem on average, to operate in environments which are a little more competitive and where product diversity is slightly higher. These systems also tend to operate where the production methods favour shorter runs of small customised orders and batch processes.

The three contextual factors were examined for any discernible effect on cost system actual and potential use, irrespective of the actual cost system type. The intensity of competition and product diversity regression models employed were statistically significant and had expected coefficients B_1 that were positively signed. This indicated that as the operating environment became more uncertain, cost system use increased. This result led to the next stage of analysis to investigate whether this increased usage is significantly related to ABC systems.

The three contextual factors: intensity of competition, production complexity, and product diversity, were next examined for possible explanatory effect on cost system use corresponding with cost system type. Multiple linear regression was used to test hypotheses and relationships between the variables. A medium significant explanatory variance of 20% of cost system use is found in the regression model with an interrelationship term of cost system type and production complexity. Hypothesis H2 is found to have support from this study indicating that as production complexity increases ABC systems are used more than VBC systems. While some explanatory variation was also found for hypotheses H1 and H3, they could not be supported because the levels of significance did not achieve the study's requirement ($p \leq 0.05$).

Analysis of the regression models of the direct effect of each contextual factor and the type of cost system on cost system use showed that intensity of competition (model 1B) had a significant positive effect on cost system use. The type of cost system was not significant in determining cost system use in any of the direct effect models (1B to 3B). The testing of hypothesis H2 supported the arguments for the adoption of ABC. The other factors tested in this study did not support the theoretical expectations.

Regression models were also used to test perceived potential usage of cost systems to discover whether systems using activity measures, were potentially capable of more use than volume-based systems. Such a finding could encourage measures to search for and reduce factors limiting the achievement of potential use. The production complexity interaction term with cost system type in regression model 2C, explained a medium effect variation in potential use according to cost system type. However, hypothesis H2a could not be supported because the model did not achieve required statistical significance.

The other models did not conform either to the theoretical expectation of a positively signed B_3, or obtain significance at the benchmark ($p \leq 0.05$) for the interaction term to support hypotheses H1a and H3a. The search for an explanation of the lack of clear statistical support from empirical studies investigating cost systems, as a failure to achieve ABC system potential, has not been supported. The reasons for weak statistical associations with factors the literature regards as important, appear to lie elsewhere.

Regression models were used to test for direct effects on cost system potential use (models 1D to 3D). Intensity of competition conforms to theoretical expectations and is statistically significant ($p \leq 0.05$). Product diversity was also significant, but the model was not close enough to the benchmark (f-sig = 0.061). Testing of potential use of cost system type for all models, did not prove to be significant. These findings indicate that the type of cost system can not be claimed to affect perceived potential use of a cost system. However, changes in some contextual factors may interact positively with potential usage.

An information gap was calculated in order to find if any systematic evidence exists between the type of cost system and differences between cost system actual and potential use, irrespective of any relationship to the contextual factors under study. An information gap of 6% was found by using a regression model that displayed a statistically significant variation between cost system type and the difference between actual and potential use. This is an indicator that ABC systems may not be delivering, at the expected attainable level, the decision making use for management activities. The gap is prima facie evidence, of some difficulty or unknown factor, limiting ABC systems.

Further research may be beneficial in improving measures and identification of this problem. An information gap is a possible reason why the evidence for ABC in practice has not been as significant as expected. Further data which could be useful may include examining how ABC has been introduced into firms. This could include the training and support services available to those who have adopted ABC, or are considering doing so. A lack of support and training may overcome some of the limitations occurring in practice and allay concerns of critics who believe that there are serious issues of operating complexity to be overcome (Davies and Sweeting. 1991; Fox, 1991). Managers may then extract the potential use from advantages that ABC could offer the decision making process.

CHAPTER 6

CONCLUSION

6.1 FOREWORD

The final chapter draws conclusions based on the findings concerning cost system use, potential use and cost system type, from within the framework outlined in earlier chapters. The purpose of the study was to find broadly based empirical evidence that could contribute to the investigation of the cost system debate between activity-based cost systems and volume-based cost systems. The evidence that supports hypotheses H1 to H4, and H1a to H3a, is discussed for explanatory significance and reliability. This highlights what has been learnt from the study.

The reliability of undertaking studies of this type is commented upon, limitations reviewed, and the difficulties of undertaking cross sectional empirical survey research is contrasted with alternatives. Finally, the directions of possible future research are raised, while including doubts about the suitability of ABC for substantiation mathematically.

The study did not find compelling evidence for using activity-based cost systems. Some reasons for this may be:

a) the difficulty of correctly and precisely specifying an ABC model, and associated measurement factors, cause results which do not clearly indicate the use made of ABC systems; or

b) the advocates of ABC have not clearly established the case for widespread adoption in manufacturing plants. There may be complexities and intervening variables still to be determined. These findings infer further research is needed to investigate what these influences and specifications are. Until further answers are determined, it may be premature to argue for widespread adoption of ABC.

The study did not produce reliable evidence of an association between cost system type

and two of the three contextual factors used in this study. Prima facie evidence indicates that an information gap exists with ABC systems. This indicates that ABC systems may be capable of greater potential use for important management decision activities. Further investigation may confirm the information gap and its magnitude: perhaps as a study aimed at determining the size and influences upon the information gap.

These findings may indicate that ABC is being proposed too widely for too many purposes and situations. A search for a more narrow focus and level of benefit, may assist in identifying specific circumstances where ABC is significantly worthwhile.

6.2 SUMMARY OF FINDINGS

The seventy-nine industrial plants that returned useable replies to the survey provided the data for analysis.

The model developed in Chapter 3-5 provided the framework to predict that when contextual factors:

a) intensity of competition,
b) production complexity,
c) product diversity,

are high, the use of a cost system will be greater if it tends towards being activity-based rather than volume-based.

a) When the moderating factor intensity of competition is high, manufacturing plants will use their cost system more if it tends towards being activity-based rather than volume-based.

b) When the moderating factor production complexity is high, manufacturing plants will use their cost system more if it tends towards being activity-based rather than volume-based.

c) When the moderating factor product diversity is high, manufacturing plants will use their cost system more if it tends towards being activity-based rather than

volume-based.

As a corollary, each contextual factor is associated with perceived potential cost system use. This is to gain evidence of any obstacle or lack of attainment associated with a particular cost system type. A measure based on Foster and Gupta (1994) was used to calculate the 'information gap' which is a measure of difference between actual use and potential use of cost systems for decision activities. Evidence of such a gap is sought because it may partly explain why many surveys have not found reliable support for the theoretical arguments of ABC. Such evidence could indicate that there is a problem with ABC systems reaching their potential. Such knowledge would be beneficial for future research in promoting investigation into the cause of the problem.

Lastly, a test was performed on an hypothesis predicting there would be no systematic difference between actual use and potential use for ABC and VBC systems. This excluded the influence of contextual factors in order to determine the existence of any information gap differences which may be related to untested factors.

The literature search in Chapter 2 found widespread, but not universal, support for the benefits of ABC when compared to VBC systems. The contextual factors chosen for this study were selected from the sources identified in Chapters 2 and 3. These factors are thought, and evidenced, to impact upon organisations and cost systems to varying degrees.

Preliminary analysis of the survey instrument revealed cost systems that tended towards being activity based were:

a) more likely to use smaller batch and customised production methods;
b) more likely to have differing cost accounting practices for their products; and
c) regarded with marginally less dissatisfaction when compared to cost systems using more volume measures.

It is consistent with the theory as reviewed in Chapter 2, that ABC systems should be more prevalent where the contextual factors were argued to suit its methods. From the survey instrument, it was found that ABC operated in conditions where intensity of competition and product diversity were a little higher, than for VBC systems. This

provides some confirmation that ABC systems are more likely to be adopted where intensity of competition and product range conforms to theoretical expectations. The survey revealed very little difference in the total use of ABC and VBC systems. This finding is surprising, as it is inconsistent with theoretical expectations.

In Chapter 5.3 regression analysis was conducted of cost system use, irrespective of type, and each separate contextual factor. The aim of the regression models was to discover if any of the three factors influenced the amount of actual and potential use, respondents perceived from their systems. Intensity of competition was significant and showed that as the operating environment became more competitive cost system use increased by 15.3% (potential = 12.2%).

Product diversity was also significant but explained a much lower percentage variation in cost system use (actual = 5.5%; potential = 7.1%). These findings are interesting, as they are independent of the type of cost system used. It appears irrespective of the type of cost system, that use also increases in response to high product diversity.

In Chapter 5.4 and 5.5, two regression models were used to provide statistically rigorous calculations for relationships between use, cost system type, and a moderating contextual factor. Each hypothesis was tested using an interaction term between a contextual factor and cost system type. The first regression model, using the interactive term, tested the hypothesis. The second model tested both independent variables directly against cost system use, but not an interaction between them. The second regression model revealed whether cost system type, and each contextual factor, were separately significant in determining use (actual and potential).

The interaction term of intensity of competition and cost system type had weak statistical significance. This does not support hypothesis H1, that the type of cost system is important for use as competitive factors increased. The potential use hypothesis H1a did not reach the significance level ($p \leq 0.05$) either.

The models testing direct effects on cost system use (actual and potential) found cost system type insignificant but supported that intensity of competition did significantly affect cost system use ($p \leq 0.05$).

The earlier finding from Chapter 5.3 concerning cost system use (irrespective of type) and intensity of competition, accounted for 15.3% of variation in use. If the type of cost system is insignificant, then there is a need to explain why predictions for ABC are not supported. Wagenhofer (1996, p.367) questions ABC and the focus upon negative consequences of inaccurate cost information. He claims that the cost accounting system does not serve to become informed about costs but to motivate decisions in line with management desires (p.380). Wagenhofer (1996, p.368) believes enhancing accuracy may serve one purpose at the cost of another. He identifies this as, (i) decision facilitating, and (ii) performance evaluation.

Hypothesis H2 examined production complexity. The interaction between cost system type and the contextual factor was significant ($p \leq 0.05$). The 20.9% explanation of actual use variation supports hypothesis H2. The hypothesis supports claims, that ABC systems are used comparatively more as the complexity of the production process increases. This is the only hypothesis of the six with contextual factors, to be supported. The finding suggests that an interaction exists between the type of cost system and changes in production complexity. The finding specifically supports the theoretical expectations of ABC that such systems are used more than VBC systems as production complexity increases.

While the finding for hypothesis H2 supports ABC theory, there are qualifications to this finding. While statistically significant, the direct effect test of product diversity has a negatively signed B_2 that is unexpected. The negative coefficient suggests an inverse relationship that is at odds with the theory and difficult to reconcile. The major qualification of hypothesis H2 is that the Cronbach alpha, of 0.45 for production complexity is too low for reliance on the accuracy of what it is supposed to measure. Before the hypothesis can be confidently supported and generalised to a wider population, further study of the factor is warranted.

High levels of product diversity are expected to increase reliance on an ABC system, relative to a VBC one. Regression models 3 tested the relationship between cost system use and type, with product diversity. The interaction term of cost system type and product diversity was not significant. The testing of direct effects upon cost system use

indicated that cost system type was insignificant, but that product diversity did affect actual and potential use to a small degree. However, the model did not reach the acceptable benchmark ($p \leq 0.05$).

The testing of hypotheses H3 and H3a could not support ABC expectations. It is possible that development of computerised production systems have reduced the difficulty of the number of setups, variation in production volumes and the number of product inputs. The advances in computer aided manufacturing, materials requirement planning (MRP), JIT and other changes which lessen product diversity complications, may have reduced the impact of high diversity.

There have been changes in recent years in manufacturing strategies that have been specifically designed for non-standard production and customisation of products. Many manufacturing organisations now see themselves as a professional service industry, customising products to the preferences of special market segments (Jaikumar, 1986, p.86), including meeting standards of energy efficiency and recyclabililty (Green, 1995, p.5). These developments may partly explain why the findings for product diversity did not support theoretical expectations of ABC.

The literature in Chapter 2 (Kaplan and Johnson, 1987; Cooper, 1988; 1989b, 1990a and Turney, 1990; Foster and Gupta, 1994; Smith, 1994; Miller, 1996) suggests that contextual variables will impact on cost system use and benefit. Five of the six hypotheses predicting contextual interaction with cost system type do not clearly support that differences in actual usage or potential usage are dependent upon the cost system type.

The hypotheses for potential use were specifically developed to discover whether any implementation difficulties were preventing the attainment of the desired use of ABC systems. The study did not find that there is a significant effect with any of the potential use hypotheses, related to contextual factors. This result is surprising, given the role expected of these factors in the literature. This is especially so, because studies of other than volume-based cost drivers and allocation methods of use and cost system usefulness, have generally not found significant support for adopting ABC.

A final regression model was undertaken after the foregoing, to exclude the influence of moderating external factors upon cost systems. This test aimed to find any evidence for important decision activities, of differences between cost system use and potential use (information gap), according to the type of cost system.

Hypothesis H4 sought to allow a test to determine whether the size of an information gap is related to cost system type, while excluding contextual factor influence. The simple regression formulated to test the resulting hypothesis H4, found a small, but not insignificant, explanation of 6% which was reliable (t-sig = 0.031).

Hypothesis H4 demonstrates evidence that an information gap exists and varies according to cost system type. It is not surprising that a difference exists between actual use and perceived potential use, of a cost system. The finding that there is some explanatory significance related to ABC indicates that ABC systems are not achieving the potential use they are believed capable of, relative to VBC systems, for decision making activities. The finding provides some interest when compared to the findings of actual use, and to other surveys of cost system drivers, use or usefulness (Foster and Gupta, 1989; 1994; Gul, 1991; Banker and Johnson, 1993).

It is possible that the complexity of an ABC system hinders people using it to the perceived potential. Innes and Mitchell (1990, p.29) found support for ABC achieving cost savings but contrasted simple British ABC systems with more complicated North American ones. If Australian ABC systems copy North American (particularly computer software) designs, then a partial explanation may have been found.

The finding concerning hypothesis H4, may reflect the problem raised by Davies and Sweeting (1991, p.44. They believe new costing techniques create some confusion amongst management, and the data is often not useable by managers. Dikolli and Smith (1996, p.45) state that while ABC systems have been an important innovation, we know little about the practical difficulties associated with design and implementation. Fox (1991, p.32) believes that ABC is a classic example of the gap between theory and practice. He has great difficulty with traditional based accounting and economic theory being used to justify ABC. If this claim is correct, then it may contribute to understanding the information gap finding.

6.3 VALIDITY OF THEORETICAL STUDY

There can be many reasons why study results do not often indicate particularly strong support for ABC systems. The theoretical model may be incorrect with respect to capturing the cost system use and the impact of the contextual factors. Although some explanatory variance for cost system use and contextual factors is indicated, it is not at significant levels for the type of cost system employed, apart from hypothesis H2 (production complexity). It is also possible that the predictions are weaker than expected. Fox (1991, p.32) wondered whether the theoretical model of ABC could be expanded to explain why ABC may sometimes be useful.

Many surveys of differing management accounting issues have found the contribution of contingency theory to be substantial (Khandwalla, 1972; Gordon and Narayanan, 1984; Chenhall and Morris, 1986; Gul, 1991; Foster and Gupta, 1994). The problems associated with using a contingency theoretical approach, is that the variables or factors are not well defined, and relationships are complex. Several studies have obtained negative or conflicting results. Hopwood (1978) and Otley (1980) obtained contrary results from their studies. Foster and Gupta (1989) had results that contrasted with the cost driver study of Banker and Johnson (1993). The positive finding from this study of the interaction of cost system type and production complexity influencing cost system use, must be viewed with caution due to the low statistical reliability of the factor. This could result in a contradiction with another study, as extrapolation of this finding to the general population is unreliable.

Many studies that have been undertaken over the last 20 years experienced difficulties of comparability with the variables which were measured (Khandwalla, 1972; Merchant, 1981; Gordon and Narayanan, 1984; Moores and Stuart, 1985; Karmarkar et al, 1989; Foster and Gupta, 1994).

Moores and Stuart recognised limitations of relying on cross sectional data in their study and saw value in extending it by using a longitudinal case study. Tinker et al (1982) extends this limitation by concluding that reliance upon utility based marginal economics is deficient.

Kaplan (1993) discusses survey research methods and concludes that they inevitably have specification problems that will not be resolved. He cites Banker and Johnson's study of the US airline industry, where the impact of the variety and complexity factors can shine through, even if more weakly than the real effect. Kaplan concludes by expressing his view that the theoretical validity of ABC is not likely to be meaningfully tested using regression and correlation analysis. He believes that applying statistical research methods to contemporary management accounting issues is not a promising direction (1993, pp.2-3). This study has found those problems that Kaplan discusses.

Kaplan's view of the difficulties of using statistical procedures to justify ABC is interpretable within the framework raised in Chapter 1. It raises the possibility that ABC does not receive the support expected, because it rests on some constructs reflecting certain management styles and methods. If correct, then ABC may be conducive to work practices that rely more on quantitative (hard) data for decision making justification rather than negotiated internal processes. Further specific consideration of ABC could involve issues as production systems and management styles and extending the previous work of Kochan, Katz and McKersie (1986), Piore and Sabel (1984), and Mathews (1990).

It is entirely possible that while the proceeding views have significant opposition, they may partly explain why widespread support for the advantages of ABC is not as significant as some expect. It is also possible that the models are not mis-specified and that the findings reveal that the proclaimed benefits of using ABC are not supported as strongly as postulated.

6.4 SURVEY INSTRUMENT AND LIMITATIONS

The survey instrument used was a postal survey with the inherent strengths and weaknesses of the method. Chapter 4 discusses the selection method and related issues, by drawing upon advice from the literature on method and technique by de Vaus (1995); Emory and Cooper (1991); Foddy (1993); Krishef (1987); and Rea and Parker (1992). There was no opportunity to conduct longitudinal studies which are recommended (Kaplan, 1993). This mail survey technique makes clarification more difficult for

respondents. Contact numbers were provided in the survey letter and a few respondents made contact. The survey by Swenson and Flesher (1996) found considerable support for ABC by users. Their survey method differed by using interviews rather than mail questionnaires. It is possible that their method is more appropriate with a complex subject like ABC.

The scope of the investigation is limited. While the contextual variables were derived from the literature, there are still unresolved issues concerning variables and their specification. Surveys to indicate managerial accounting use or usefulness have validity of measurement concerns. These concerns cover all fields of research and the method used in this study has wide acceptance, as evidenced by Chapters 2 and 3.

There has been much research in management accounting with factors, which were not incorporated here. Some of these factors include the way management accounting information is used, as well as the personal styles and decision-making methods of users. In this study there was no separation of results by organisational style or profitability. This resulted in examining a set of variables which is limited and requires acknowledgement that results may be influenced by unmeasured factors. To reduce this risk, the variables being studied were drawn from studies, which included substantial theoretical support.

The instruments used in these prior studies and used here are capable of further refinement. This could reduce consequential weaknesses of the results by examining other characteristics of the variables (Karmarkar et al, 1989; Kaplan, 1993). The Karmarkar et al (1990, pp.375-376) study, specifically discussed difficulties with reliability of their items. They called this problem a noisy survey instrument. They believed reliability was a likely factor for not finding the hypothesised relationships with manufacturing complexity and other examined variables. This study of three contextual factors found only intensity of competition around accepted reliability levels, as determined by Cronbach alpha measures.

The survey questionnaire was sent to the financial manager of manufacturing plants. While this function was identified as being the most likely to have the requisite factual and skill based knowledge to answer the questionnaire, it does involve an amount of

averaging. It is possible that different persons primarily responsible for areas covered in each section of the survey may have been a more reliable source. This approach was viewed as being too difficult to implement and obtain a reasonable response rate.

The study is restricted to manufacturing plants in New South Wales and the Australian Capital Territory, which were larger than small sized. Extrapolation of results outside the population group from which it was drawn, should be treated with caution. At best the results may be general, but they do not seek to explain specific behaviour at plant level when other than examined factors intervene.

The response rate from the survey was an effective 25%, which leaves open the question of non-response bias. A test for this bias was performed on a first response group and a last response group in accordance with statistical recommendations (Krishef, 1987, p.183; Cohen, 1988, ch.3). This test indicated that the study did not suffer bias.

Postal surveys do, by their nature, lack certainty as to who actually completed the returns. This problem was not viewed as being particular to this study and comparisons could still validly be made to established benchmarks.

6.5 FUTURE RESEARCH

ABC cost systems have mostly been examined from a case study and a manufacturing basis. This study was confined to manufacturing plants and was limited in scope due to the constraints of the study. There is potential to engage in future research from a non-manufacturing viewpoint in order to comment on the appropriateness of ABC techniques in other workplace environments.

Further research indications are present in this work. The argument of the cost or benefit of changing a volume-based cost system to an activity-based one is still unresolved. Broadly based empirical research is not yet conclusive.

Specifically, future research may be useful in three areas:

a) the specifications of ABC interrelationships with contextual factors and the use of

ABC systems;

b) problems in ABC systems reaching their potential use; and

c) consideration of ABC and management philosophies and styles.

The first area (a) could lead to further refinements of the measuring instruments of the model. The specific concerns of critics like Young and Selto (1991); Kaplan (1993); and Wells (1993), could be addressed. In particular, the hypothesis that received support from the regression model requires further examination, and improvement is needed of the reliability of the production complexity measure.

There is prima facie evidence of an information gap (b) indicating that ABC systems are not quite achieving their comparative potential. Replication and investigation of the information gap may be capable of yielding more particular answers for causes and influences.

The present study did not obtain statistically reliable and significant data concerning the contextual factors and potential cost system use. Further research into potential use and the information gap may be capable of contributing some information to explain why ABC systems are not used as the supportive literature expects. There are many variables that could cause the information gap, and the investigation requires further refinement.

The third area (c) concerns political research dimensions involving investigation into particular management styles that suit the provision of statistical data for decision making. If the type of management philosophy of the manufacturing plant is a determining factor, then empirical testing that ignores this is likely to continue to obtain inconclusive statistical results.

This study produced reliable evidence that as the contextual factors increased, decision-makers made more use of cost systems, irrespective of the type. Specific attention is warranted into possible reasons from within the framework of ABC. It would appear that a major assumption made by advocates of ABC, concerning volume-based systems, might need investigation. Some of the suggestions above may assist in resolution of the debate.