THE IDENTIFICATION AND EVALUATION OF FACTORS INFLUENCING THE USE OF QUANTITATIVE METHODS IN SOUTH AFRICAN BUSINESS

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Except as noted above this work is entirely my own and all references are adequately cited.

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NOTE

There are some words in the English language which have alternative spellings, and it is a matter of personal, or institutional preference as to the spelling used. Some of these differences arise because of English and American preferences. In South Africa convention dictates that the English version is used in certain circumstances (colour rather than color) while in other circumstances there is no convention.

In this thesis there are numerous words for which there are optional spellings such as the choice between s or z, or using a single or double l in adding a suffix. The choice has been to use the s as in centralise and the double l as in modelling, and this has been consistently applied throughout this work. However where direct quotes have been used or in titles of papers these have been reproduced using the spelling in the source document.

ABSTRACT

The objectives of this study are:

- to identify the factors which influence the use of quantitative methods
- to test the presence of those factors in South Africa's listed companies, and to survey the opinions regarding those factors among various categories of people.

The factors may thus be evaluated as to the influence they have on the use of quantitative methods. This insight should be of use to people and organisations wishing to use quantitative methods.

The identification of the factors was undertaken in the first part of the study and were found to fall within four broad categories, organisation structure, education, nature of application, and personal attributes.

In the second part these factors were subjected to two questionnaire surveys. The first was directed at the

managing directors of South Africa's listed companies who were asked to provide two answers to each question. Firstly what the position regarding the particular factor is in their companies, and secondly what they would like the position to be. The results showed that by and large the factors identified in the literature are present in the companies surveyed. Furthermore where there are differences the desired position showed a tendency towards that suggested in the literature. One of the more important features identified by this survey was the difference shown in the desires among the international companies as oppposed to the local and national companies. This showed that the influence from overseas had some bearing on the use of quantitative methods.

The second questionnaire tested the opinions of people working in quantitative methods and of their managers. The opinions are mostly consistent between the two groups. The major differences were found regarding the use of interactive models and the position of the quantitative methods person in the organisation.

Managers wanted more use of interactive models and considered them to be more important than did the quantitative methods people. This difference may be due

to a lack of understanding of technical skills involved or simply a communication gap between the parties.

The quantitative methods person is seen to be lower in the organisation structure and to have less potential for achieving top managerial positions by the managers than by the quantitative methods people themselves.

The findings of this survey were generally compatible with those of the first survey. An important aspect to emerge from both surveys was the need for a masters level of education, and for a broader education.

To place the factors in their organisational context three post survey interviews were reported on in the third part of this thesis. Three companies were chosen which were different in size, industry, stage of development etc. The most important aspect to emerge from the interviews was the impact the use of computers had had on the permeation of quantitative methods within these companies.

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CHAPTER 1

INTRODUCTION

PREAMBLE

One of management's major functions is that of decision making. A decision may be taken intuitively or with supporting information or with some combination of intuition (flair, entrepreneurship) and information.

Time and circumstances dictate the degree and balance of intuition and information that is appropriate for the particular decision at hand. It is submitted that the quality of the decision is likely to be enhanced if it is supported by good information.

Management has at its disposal a selection of decision-aiding techniques, amongst which are a variety of quantitative methods.

DEFINITION

Quantitative methods are defined as any statistical, operations research or management science technique (such as regression, correlation, forecasting techniques, linear programming, economic order quantities etc.) as well as discounted cash flows and computer modelling.

This definition is compatible with that given by Money[1] who includes in his definition of quantitative methods not only operations research, statistics, and some basic computer science, but also the more quantitative aspects of other disciplines such as Economics and Psychology, as well as some aspects of the functional areas of management such as production, marketing, accounting and finance.

OBJECTIVES

Quantitative methods are used in business to a varying degree with differing success rates.

The objectives of this thesis are:

1. To establish which factors are identified by the literature to be influential in the use of quantitative methods.
2. To test if those factors are present in South Africa's listed companies and whether the senior managers desire some other state of affairs.
3. To test whether there are differences in the opinions regarding those factors between people working in quantitative methods and senior management. (Management consultants were also tested to get a viewpoint as a potential control feature.)

ORGANISATION OF THESIS

This thesis is arranged in three parts. The first part deals with a literature search in an attempt to establish which factors are important to the use of quantitative methods.

The second part tests the factors generated in the first part by means of questionnaire surveys.

Some South African applications are investigated and reported to form the third part.

METHODOLOGY

The attempt to establish which are the primary factors influencing the use of quantitative methods was carried out by an extensive literature search.

Papers[2] which were singled out for closer scrutiny were mainly those which

- were editorial in nature, in that they expressed the opinions of reputed individuals on matters of interest to this thesis
- reported the findings of research on issues similar or related to this thesis
- described applications, both successful and failed, which contained comment or gave insight to factors influencing that application

Many factors which had an impact on the use of quantitative methods were identified during the literature search. These were categorised as follows:

Organisation structure

Nature of application

Education

Personal attributes

Each of these is discussed in turn in chapters 2, 3, 4 and 5, which comprise Part 1 of this thesis.

No doubt other categorisations are possible, but the data generated suggested the above to be appropriate.

The second objective, viz. to test whether the factors identified in the literature search are present in South Africa's listed companies and the senior managers' satisfaction with them, is achieved by means of a questionnaire survey. The questionnaire was sent to the managing director of every company listed on the Johannesburg Stock Exchange.

A second questionnaire probed the factors in greater depth and was designed to test similarities and differences in perceptions between people working in quantitative methods and their senior managers.

In this part of the study the perceptions of people who are with companies that are using quantitative methods are being surveyed. The starting point then is one of congruence i.e. they are using quantitative methods with some degree of success.

The questions to be addressed then are along the lines of

- did similarities in certain perceptions assist in the success achieved?
- were the similarities there from the start or did they develop?
- are the differences serious and what potential impact do they have

The analysis of the questionnaire surveys forms Part 2 of this study. Part 3 is the investigation of some local situations. These will be reported in interview form. Suggested answers to some of the questions should become evident during the course of the interviews.

The number of interviews will be very small and while it will not be possible to draw conclusive inference from them they should provide "food for thought" and "round off" the thesis.

The details of the approach to the questionnaire surveys are reported in a later chapter.

PRIOR RESEARCH

Research in this area in South Africa has not been extensive. A doctoral thesis by Wright[3] submitted in 1976 investigated the use of management science in ten selected companies in South Africa. It therefore does not provide a broad South African overview, furthermore the developments in the data processing field in the last decade will have influenced the current validity of Wright's findings.

Wegner[4] carried out a survey among South Africa's listed companies which has some similarities with the first survey in this thesis. However there are important differences, inter alia, Wegner's subject was operations research whereas this study has a far broader definition of quantitative methods; Wegner asked questions about specific techniques, this study asks questions about factors influencing use.

LIMITATIONS

This study is limited in the following respects:

- it is biased towards users (whilst a limitation this is intentional).

- questionnaires were mailed and a follow-up procedure carried out, no further attempt was made to canvas non-respondents. In the case of the first questionnaire it is probable that the proportion of non-users would be higher among the non-respondents than among the respondents. In the light of the bias towards users this is not considered to be a serious problem, however the supposition above has not been validated.

- the interviews were carried out on three companies selected for their differences (including size, control and listing on the J.S.E.). They are thus not random, nor can inference be drawn from a sample of three.

Details of the surveys are described later, other limitations may be dealt with in context.

FOOTNOTES AND REFERENCES

1. Money, AH. The role of quantitative methods in business education. Inaugural address, University of Cape Town. 25 April 1984, p.1.

2. It is noticeable that the majority of the papers are from the journal "Interfaces". This is not altogether surprising, since according to its editorial policy, Interfaces is devoted to the use and application of quantitative methods. Its purpose is to increase communication about the practice of quantitative methods, consequently it attracts articles which are managerial rather than mathematical in nature.

3. Wright, DS. A model of the diffusion of management science in South African Business. Phd. thesis University of Cape Town. 1976.

4. Wegner, T. A survey of quantitative methods in South African management. South African Journal of Business Management, Vol. 14 No. 3, September 1983, pp. 120 - 124.

PART 1

THE LITERATURE SEARCH

The first part of this thesis reports the findings of the review of the literature regarding factors influencing the use of quantitative methods. As mentioned in the introduction, these factors have been categorised into the following broad areas:

- the personal attributes of the quantitative methods people
- the structure of the organisation
- the nature of the problem to which quantitative methods are applied. Closely related to this is the nature of the solution expected
- the education of the people involved in the use of quantitative methods

These factors are now discussed in the ensuing four chapters.

CHAPTER 2

THE IDENTIFICATION OF PERSONAL ATTRIBUTES WHICH INFLUENCE THE USE OF QUANTITATIVE METHODS

INTRODUCTION

The objective of this section is to identify those characteristics which were thought to be desirable for the person working in the quantitative methods section of an organisation to have.

It is not intended in this section to consider specifically those acts or approaches that the quantitative methods person should perform or adopt to improve successful implementation, nor to consider the educational needs for the generation of a competent quantitative methods person. It is however acknowledged that these areas are all closely interrelated. It follows therefore that at times the lines between

personal attributes, performance and education, may be somewhat hazy.

TECHNICIAN OR ADVISER

Samuel Eilon[1] questions whether an operations research person is a technician or an adviser. He suggests that while many will be content with the role of technician, any significant impact on the decision making process will come about through the role of adviser.

Since the literature[2] in recent years has indicated that the quantitative methods person should be assuming greater responsibility in the advisory capacity, it is primarily the attributes of the "adviser" with which this section will deal.

Eilon's passage is informative:

> "The advisor is a man who does not shrink from considering intangibles and who will use any method (numerical or otherwise) to face problems for which decisions have to be made. But the major difference between the technician and the advisor lies in their perception of the level of responsibility attached to their work. The former accepts only limited responsibility for the definition of problems and for their stated

> objectives, but total responsibility for the execution of his projects, once they are clearly defined; the latter identifies himself with the decision process and sees it as his duty to give recommendations on courses of action which incorporate his assessment of objective and value."[3]

It is noted that the quantitative methods person should possess the necessary character to face intangibles and be willing to to use non-numerical methods in dealing with problems, however the thrust of the passage and perhaps the most important attribute for a good quantitative methods person to possess is that of the appropriate self-perception. He must see himself as having a worthwhile contribution to make towards the decision making process and furthermore he must be willing to accept the responsibility that this entails.

In a slightly different vein Savas[4] views the management science/operations research function as a change agent. He suggests that this can be intimidating to an operations research analyst. The implication is similar to the distinction made by Eilon above, namely that the quantitative methods person is not expected to be and should not see himself as merely the provider of answers to problems but should be involved in the higher levels of decision making. This then requires

attributes beyond the technical competence he is presumed to possess.

PERSONAL ATTRIBUTES

Several writers have dealt, either explicitly or implicitly, with the attributes required of a quantitative methods person. Some of these writings are now considered.

Ayres[5] dealt with the nature of the quantitative methods person in a paper presented at the same meeting at which Savas made the observations above. He described management science as a tripod, suggesting that the management scientist should possess, broadly, three skills. Technical skill is only one leg of the tripod, the other legs are what Ayres describes as the ferret skill and the involvement skill.

The ferret skill is the skill of being able to find out what the problem really is, the ability to identify the real issues. This skill is of vital importance to the successful implementation of quantitative methods into an organisation. One of the problems may be that the answers generated are not the answers to the problems

identified by management, or that the problem identified by management is not the real problem.

The involvement skill is described as being the ability to keep the client or the senior manager involved with the problem as a solution is sought . This also is a vital attribute, as similarly to the correct identification of the problem, so the inability to keep management involved is seen as a problem area in quantitative method implementation. What Ayres is suggesting is that the onus of ensuring management is involved rests on the quantitative methods person. It is the duty of the quantitative methods person to communicate in the language of management and not for management to master the quantitative methods language.

Vazsonyi[6] suggests the following as the ideal characteristics of the person to fill an operations research/management science function in an organisation:

1. Understands the management process
    - knowledgeable in the functional areas of business
    - systems oriented
    - can differentiate between the practical and the theoretical

2. Considers computers a resource
   - understands the basis of computer applications
   - knows computer hardware and software
3. Knows quantitative techniques
   - knows the limits of rationality
   - knows when to use and not to use mathematical models
4. Considers himself a change agent
   - recognises the role of emotionality
   - is aware of behavioural situations and patterns
   - balances benefits versus costs and risks
   - is sensitive to change and changing relationships

By way of contrast Vazsonyi details the profile of a typical computer professional, he suggests that his observations about the computer professional may apply just as easily to an operations research/management science person.

1. Ignorant and disinterested in management
   - considers management stupid and incapable of understanding the computer and the computer professional
   - advocates the dictatorship of the computer professional

- ready and willing to cure single-handed all the ills of the world

2. A fanatic technical enthusiast full of energy to recognise his missionary goal
   - obsessed with the computer as an end in itself
   - an arrogant prima donna, difficult to deal with and impossible to manage
   - a specialist hiding behind the technical jargon
3. Poor in interpersonal relationships
   - mechanistic in his approach and ignorant of people
   - neither hears nor listens, only coerces
   - emotionally charged under the cloak of rationality
   - insulted if it is implied that he might be at fault
4. Obsessed with change for the sake of change
   - disregards costs and benefits
   - innovates to the point of irresponsibility

While the writer's experience in the business community confirms many of these observations with regard to certain individuals, it must be noted that the comments were made in 1973 and to generalise that the computer professional is still typical of this profile is likely to be naive. What is of interest is the highlighting of these factors as important for the computer

professional, and by implication, the quantitative methods person.

Cain[7] discusses his experiences at implementing operations research/management science in his organisation. Within his discussion certain desirable personal attributes become apparent.

- Knowledge of management science principles. The person should have formal training as well as some practical experience.
- Common sense perspective of the organisation and the people in the organisation. This includes an awareness of corporate politics and people idiosyncracies.
- Possess a management science philosophy. By which is meant an understanding of how management science relates to the decision making process as part of the organisation.
- Good morale. Morale includes loyalty, unity, professional pride and ambition. Cain states that the management science manager is responsible for establishing and maintaining good morale.
- Communications creativity. This is identified as the most important intangible factor of successful implementation. It entails the ability to

communicate with other people in the organisation in terms they understand.

- Business image. The image is projected through professional behaviour and personal appearance. The implication is that if an individual wants to be taken seriously in a business environment he should project the image of being a businessman.

A study on the personal characteristics of operations research/management science leaders was carried out in Japan by Kawase and Nemoto[8]. In this study the authors identified fifteen factors which were considered to be important for an operations research/management science leader. These were divided into organisational factors and professional factors:

Organisational factors.

1. Persuasiveness with top management (Persuasion)
2. Diplomatic and negotiative ability (Diplomatic)
3. Concern for communication with line managers (Communication)
4. Orientation toward judgement from a company-wide viewpoint (Company-wide)
5. Directive ability to orient and guide operations research/management science organisation (Directive)

6. Ability to co-ordinate group and project members to achieve goals (Co-ordination)
7. Favourable attitude to reflect the opinions and views of subordinates (Subordinates)
8. Knowledge of informal and political information within the company (Political)

Professional factors.

9. Enthusiasm and interest in projects (Enthusiasm)
10. Ability to make choices in project selection (Selection)
11. Ability to estimate project program requirements and results (Estimation)
12. Technical skill (Technical)
13. Ability to identify problems and eradicate the difficulties (Problem)
14. Positive attitude toward new knowledge (Knowledge)
15. Creativity and imagination (Creativity)

The study attempted to identify the relative importance of these groups of factors over the different phases of evolution of operations research/management science activities within the organisation. The phases were missionary,transitional and maturity.

The study revealed that in general as the operations research/management science activities evolved from the

missionary through to the maturity phase so the organisational factors as a group took on more importance and conversely the professional factors assumed less importance.

In analysing how the individual factors behaved through the evolution, it was found that the only professional factors to increase in importance with increased maturity were the selection and the estimation factors. The organisational factors which declined with increased maturity were persuasion, diplomatic and political. Two possible explanations for this trend come to mind. Firstly that as the operations research/management science activities become established so these types of activities are no longer as important, as their main function is to secure recognition and credibility. By having achieved maturity, recognition and credibility must also have been largely achieved. A second possibility is that since this study was carried out in Japan, the cultural differences particularly with regard to business practice[9] may have a bearing on the results.

McArthur[10] maintains the important factors in solving problems are leadership, personality, ability to communicate, selling oneself, acceptance by management, and other behavioural attributes. It is clear that most

of these can be directly translated into the personal attributes required of the problem solver.

In another paper[11], he suggests that the operations research person should aspire to become management. To achieve this he should think, talk and have the same concerns as management. He should associate himself with management's objectives and desires. These are not only some of the details of being part of management but also contribute to the self realisation of being management.

In selecting suitable candidates for training as operations research practitioners at the National Coal Board, Tomlinson and Mitchell[12] looked for the following attributes:

1. Technical competence. However, less importance was placed on specialisation with intricate techniques and more on the absolute and thorough understanding of the limitations and robustness of the various techniques. The behavioural aspects were included in technical competence.
2. Human competence, including maturity and conviction.

3. Creativity, which was described as the ability to transfer concepts and structures from one field of application to another.
4. The ability to work with people from different disciplines, which they termed "discussion".

At the Babcock and Wilcox Company, Machamer and Smith[13] noted that recruitment criteria for operations research/ management science positions include a combination of operations research, business, and communications skills.

At the same company they found that successful project leaders possessed specific administrative skills (scheduling, budgeting, reporting, time management, and data collection/synthesis) and behavioural skills (initiating, facilitating, co-ordinating, and motivating).

The point is made that these qualities are synonymous with those desired in top-level executives. A similar observation is made by Davidson[14] who notes that seventeen of the top management posts in Air Canada are held by operations research people.

References to the qualities of the quantitative methods person are made by various writers in passing.

Ackoff[15] calls for creative people to be involved in problem solving. Stern[16] appeals to operations research workers not to be afraid of proposing solutions which ordinary people can understand.

The ability to get involved in politics is referred to by Cunningham and Swirles[17] and by Mcarthur[18].

In a study carried out by Cox, Ledbetter and Smith[19] it was found that a large proportion (38.15%) of the people working in operations research had received formal training in management or a functional area of business[20]. The comments of one director are illustrative. He indicated that his company felt it much more important to have the ability to communicate and understand the functioning and realities of the business world than the abstractions of mathematics.

The study also highlighted the fact that an operations research/management science worker needs a high level of formal education. 60% of the workers had masters degrees and a further 14% had doctorates.

Charan and Freeman[21] emphasise the need to take a broad view and to co-ordinate teamwork. Along similar lines Lee[22] argued that no one operations research worker can

be so comprehensively trained that he will be competent to deal with all aspects of a problem. Therefore the use of interdisciplinary teams was advocated. Implicit in this is the ability of the operations research worker to work in such a team.

SUMMARY AND CONCLUSION

On analysing the above comments and observations it is patently clear that the ability to communicate effectively is seen as one of the most important skills that the operations research/management science worker needs to possess. Almost all the writers mentioned refer to the communicative skill while Cain[23] identifies it as the most important intangible factor in implementation.

Understanding the management process and being aware of how the operations research/management science section relates to the decision making process is also referred to by most of the writers. Of particular interest is that Eilon[24] and Mcarthur[25] write of the need for the quantitative methods person to see himself as part of the management structure, that it is important to be part of management and to know that being part of management is possible and desirable.

A broad-minded approach is considered to be another desirable attribute, evidenced by the number of references to the need to deal with issues beyond the strictly quantitative and to be aware of and deal with behavioural aspects.

Closely related to both communication and the ability to function within the management structure are the attributes of projecting a business image, and a willingness to get involved in and be aware of corporate politics.

That a quantitative methods person be technically competent is inherently obvious. Some of the writers referred to it while others did not. Presumably they did not feel there was any need to do so. What is of interest however, is that Vazsonyi[26] and Tomlinson and Mitchell[27] suggest that it is more beneficial and important to be aware of the limitations of the techniques available rather than to have greater technical skills.

In conclusion a profile of the ideal quantitative methods person is suggested.

He is a highly educated person with technical competence and a broad-minded approach as a base. To this base he must add communicative skills and an understanding of the management process. The projection of a business image and the willingness to get involved in corporate politics would be of assistance.

FOOTNOTES AND REFERENCES

1. Eilon, S. Technician or Adviser? Editorial - Omega, Vol. 5 No. 1, 1977, pp. 1-6.

2. Many papers dealing with applications for managerial purposes support this view either explicitly or by implication.

3. Eilon, S. Op.cit., pp. 5-6.

4. Savas, ES. How to make operations research fail in Government without really trying. Paper presented at the American meeting of the Institute of Management Scientists, Detroit, October 1971. Interfaces, Vol. 2 No. 4, August 1972, Through a looking glass darkly, p. 3.

5. Ayres, HF. Skills for effective Management Science. Paper presented at the American meeting of the Institute of Management Scientists, Detroit, October 1971. Interfaces, Vol. 2 No. 4, August 1972, Through a looking glass darkly, pp. 7-10.

6. Vazsonyi, A. Why should the management scientist grapple with information systems. Interfaces, Vol. 3 No. 2, February 1973, p. 15.

7. Cain, H. The intangibles of implementation. Paper presented at the TIMS meeting, November 1978, Los Angeles, California. Interfaces, Vol. 9 No. 5, November 1979, pp. 144-147.

8. Kawase, T and Nemoto, T. An empirical study on ideal personal characteristics of Japanese OR/MS leaders. Interfaces, Vol. 9 NO. 2, February 1979, pp. 56-62.

9. Ibid., p. 57

10. McArthur, DS. Decision scientists, decision makers and the gap. Interfaces, Vol. 10 No. 1, February 1980, pp. 110-113.

11. McArthur, DS. Fantasies, fundamentals, and a framework in corporate OR. Interfaces, Vol. 10 No. 4, August 1980, p. 100.

12. Tomlinson, RC and Mitchell, GH. Training OR practitioners. Interfaces, Vol. 2 No. 1, November 1971, pp. 20-24.

13. MacHamer, A and Smith, RD. Career planning and managerial development: the unrecognized potential of centralized OR/MS. Interfaces, Vol. 10 No. 3, June 1980, p. 72.

14. Davidson, JD. Four vice-presidents, four directors, and a partridge in a pear tree. Interfaces, Vol. 11 No. 1, February 1981, pp. 59-61.

15. Ackoff, RL. The art and science of mess management. Interfaces, Vol. 11 No. 1, February 1981, pp. 20-26.

16. Stern, GJA. SOSIPING, or sophistical obfuscation of self-interest and prejudice. OR Quarterly, Vol. 27 No. 4(ii) 1976, p. 928.

17. Cunningham, AA and Swirles, J. Modelling the great Canadian Oil Sands Operation: the politics of implementation. Interfaces, Vol. 10 No. 5, October 1980, p. 62.

18. McArthur, DS. Decision scientists, decision makers and the gap. Interfaces, Vol. 10 No. 1, February 1980, p. 111.

19. Cox, JF. Ledbetter, WN and Smith, JM. An analysis of the operations research/management science industrial-academic interface. Interfaces, Vol. 9 No. 1, November 1978, p. 99.

20. The study was carried out by mailing questionnaires to the operations research /management science directors of the 500 largest US industrial corporations.

21. Charan, R and Freeman, RE. Planning for the business environment of the 1980s. The Journal of Business Strategy, Fall 1980, Vol. 1 No. 2, p. 18.

22. Lee, AM. New paths for operational research. OR Quarterly, 1976, Vol. 27 NO. 1(ii), p. 184.

23. Cain, H. Op.Cit., p. 146.

24. Eilon, S. Op.Cit., pp. 1-6.

25. McArthur, DS. Op.Cit., p. 100.

26. Vazsonyi, A. Op.Cit., p. 15.

27. Tomlinson, RC and Mitchell, GH. OP.Cit., pp. 20-24

CHAPTER 3

THE EFFECT OF A DECENTRALISED AS OPPOSED TO A CENTRAL FUNCTION FOR QUANTITATIVE METHODS

INTRODUCTION

In general the trend towards decentralised rather than centralised organisational structures has been fairly pronounced in recent years. This has occurred largely due to the increased performance levels achieved by decentralised organisations as a whole over their centrally organised counterparts. The increased level of performance is a result of the advantages of a decentralised system, amongst which increased motivation is perhaps the most compelling. There are of course other notable advantages.

Despite the advantages of decentralisation, certain organisations and certain functions within organisations are more suited to central control. For

example, even in some decentralised organisations the finance function remains centralised, one of the reasons being simply that the strength generated by a large finance section (mainly through a more powerful bargaining base) far outweighs the advantages of a decentralised finance function.

The objective of this chapter is to consider whether the quantitative methods section is better housed in a division or whether it should be a centralised corporate function.

CENTRAL LOCATION

It was noticed that operations research or management science groups started off in the earlier days as a centrally controlled function[1]. This is consistent with the perceived advantages of a centrally located section.

If centrally located the quantitative methods section would be involved with the problems of the whole organisation, thus being able more readily to take a view on problems as they affect the entire operations of the organisation[2].

A greater variety of specialist skills are available if centrally located. Since all the quantitative methods talent in the organisation will be concentrated in one area the individual will have the opportunity to develop whatever speciality is preferred[3].

Furthermore a centrally located function is likely to be less expensive for the whole organisation since there will be no need to duplicate the skills in various divisions.

DIVISIONAL LOCATION

As operations research/management science gained maturity the function tended to be shifted away from a central location and placed within the division[4]. This is consistent with the view that the quantitative methods function is part of the problem solving function of management and should be involved in the operational problems of the division.

McArthur advises

> "Work with the business rather than for it. Splitting our areas of responsibility by type of specialization .... doesn't work, we must

> sell ourselves as people not as specialists."[5]

The case for decentralisation is strengthened by the view that skills in applications are of greater importance than extra specialisation[6]. As a result decentralisation would contribute to the greater detailed knowledge of the division, and the greater involvement with the total problems of the division that would be required for successful application.

> ".... by spreading Management Science throughout the firm, practitioners would be better acquainted with the problems they had to solve and, therefore, would be more efficient."[7]

A further argument in favour of decentralisation is from the functional, management viewpoint. Many of the previously so called OR techniques have now become standard techniques in other disciplines. Particularly in such functional areas as accounting and finance, marketing, production and others.

The observation that operations research/management science groups were originally located centrally but that maturity has brought about greater decentralisation[8] is confirmed by a study carried out by Thomas and Da Costa[9]. In comparing their study with

previous studies they commented that one of the most important findings of the study was the difference in extent of decentralisation over the time period, with the later study showing greater decentralisation.

It is interesting to draw an analogy between the views expressed by Thomas and Da Costa and the study carried out by Kawase and Nemoto[10] mentioned in chapter 2.

Thomas and Da Costa:
There has been a trend from central to divisional location. This implies greater involvement in the functions of the division and less emphasis is placed on technical specialisations.

Kawase and Nemoto:
As the "quantitative methods" function passes from introduction to maturity so the skills that are important change from professional to organisational.

If the suggestion is made that the quantitative methods function in general has moved from the introduction to the maturity stage, then the trend noticed by Thomas and Da Costa is to be expected in the light of the Kawase and Nemoto study.

If this argument is valid then evolutionarily the quantitative methods function should be housed in the division rather than being centrally located.

This is consistent with the preference in management control systems theory for decentralisation[11]. Where decentralisation is appropriate, higher levels of performance are achieved sufficient to supercede the additional costs of decentralisation as a result of the autonomy and increased motivation of the individuals concerned.

FURTHER CONSIDERATIONS

However there do exist certain advantages, over and above those mentioned in the earlier part of this chapter, in maintaining a central quantitative methods section.

MacHamer and Smith[12] in their study at Babcock and Wilcox suggest that the reason this company could attract the top operations research/management science graduates was because they could offer them a dual career path and that this was possible due to centralisation.

> "The data collected at Babcock and Wilcox supports the value of centralized Operations Research in providing good solutions to operating problems and, perhaps even more important, in training potentially top-level decision makers.
>
> By offering a defined career path that has dual possibilities, the company can attract the highest qualified graduate. Individuals are motivated to perform because they know that successful projects enhance their opportunities for promotion to management. Seasoned OR/MS thinkers become disciples of analytic/systems thinking throughout the organization."[13]

Another advantage of centralisation is the stability of the quantitative methods team which, while intuitively desirable, is seen by Thomas and Coveleski to be crucial for large projects.

> ".... from 1967 to 1970 when this system was installed there were numerous changes in management personnel at all levels. .... the original division was reorganised from one division to five profit centres .... through all of this change, two things stayed the same; the problem and the project team. Anyone thinking of organising an OR function in his company should be certain it is placed in the part of the company which would provide adequate stability for continual

effort on large scale problems. In BMW, the OR department is a corporate function ...."[14]

The situation described by Thomas and Coveleski is not the normal state of affairs in business. Business is not in the habit of constantly reorganising and changing its divisions around. Nonetheless the point made is valid i.e. if a business is organisationally volatile, this fact and its implications, should be carefully considered in the decision regarding the structure.

Shycon, while supporting decentralisation in principle[15] does suggest as a compromise that each division maintain its own quantitative methods department as large as it can afford. This is bolstered by a corporate quantitative methods department which has a staff and not a line relationship with the divisional departments, and which can support the divisions with additional staff if necessary[16]. It must be noted that, besides being expensive, such an arrangement could give rise to the problems associated with an individual or group having staff and line relationships. These include the problem of having two bosses and the subsequent divided loyalties and potential lack of trust and acceptance by the division.

LINE OF AUTHORITY

The last aspect to be addressed in this chapter is the person to whom the quantitative methods division should report. Clearly this person should be a senior executive, if not, the quantitative methods department will not be seen to enjoy very much status within the organisation.

Shycon[17] observes that originally the departments tended to be under the direct control of the chief executive officer, however, this was not found to be successful as he did not have the time to get truly involved. Thus he suggests that reporting should be done to an executive high enough and broad enough to provide problems such that an important contribution may be made, and with the authority to do so. A small survey was carried out and Shycon found that most of the operations research/management science departments reported to a vice-president and that these were mostly in finance.

SUMMARY AND CONCLUSION

It appears that the quantitative methods division would be better located in a division where it can then get more involved in the problems of the division and more readily be part of the division rather than a more remote head office function.

There are notable advantages to being centrally located, particularly as a central function would be less expensive directly and can thus support a fuller quantitative methods function. Other perceived advantages of central location are stability and dual opportunity for career development.

In spite of these advantages the motivational and involvement aspects of decentralisation are likely to be more advantageous in the majority of cases. A very real problem of decentralisation is the cost involved, hence the compromise suggested by Shycon may well be appropriate i.e. each division maintain as large a quantitative methods function as it can afford and there also be a centrally located department.

Finally it is considered important that the person to whom the quantitative methods division reports should be a senior executive, probably a member of the board

of directors, as he would have the necessary breadth and authority to provide projects and problems.

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CHAPTER 4

THE IDENTIFICATION OF THE NATURE OF PROBLEMS TO WHICH QUANTITATIVE METHODS MAY BE APPLIED

INTRODUCTION

Before considering the nature of problems with which the quantitative methods department may become involved, Two aspects should be acknowledged. Firstly the computer is a resource, and secondly, that quantitative methods workers often function as part of teams. Both these factors have a bearing on the nature and solution of the problems.

With the advent of more sophisticated and/or more readily accessible computers, problems and formulations which had been developed in theory could now be processed. The computer can not only compute the solution to formulated problems but can also perform

sensitivity analyses and generate a range of solutions under differing assumptions and differing variables.

Related to this is the use of teams. The view that quantitative methods must necessarily provide a "right" answer is no longer widely held. Rather the problem should be properly analysed, and the suggestion is that this is best carried out by people with varying skills and backgrounds so as to get as wide and thorough a perspective as possible on the situation.

While the points made above are widely supported in the literature, Lee makes reference to both items:

> "In 1951 many, perhaps most, of the standard techniques which people associate with OR already existed - at least in the embryo .... what was not readily available was computer power. There were few computers, neither powerful nor reliable, and relatively inaccessible"[1]

and with regard to the use of teams:

> "It may be argued rightly that no one OR worker can be so comprehensively trained that he will be competent in all aspects of such systems design problems, but there is a modus operandi which could overcome individual limitations. One might coin a phrase and call it the use of interdisciplinary teams."[2]

The nature of problems with which the quantitative methods people may be involved are now examined.

THE CALCULATION OF THE RIGHT ANSWER

There is the attitude that because a solution has been calculated numerically it must be correct. While the occasional problem may well lend itself to the generation of a "right" answer, support for the expectation that this should be a major output of quantitative methods could not be found in the literature.

Lee comments:

> "A fairly common degenerate case occurs when only one future state is forecast and the decisions are taken in the naive expectation that it will come about."[3]

Vazsonyi expresses his views more forcefully:

> "People who still talk about optimal solutions in the real life business environment ought to be shot."[4]

THE DEVELOPMENT OF THE PROBLEM

The nature of the solution expected may turn the problem into one of a different type. The same basic situation may exist but the expectation that the solution calculated is not the sum total of the matter will result in different benefits from the analysis of the problem.

The implication of this is that even though the model or technique is capable of producing a point solution this is not the object of the exercise. The use of quantitative techniques may have several benefits.

The answer generated by the model, the optimal solution, may be used as a starting point to which management judgement should be applied.[5] In this way, at the very least, management has a base from which to work. This base can be fruitfully utilised in the manner described in the following paragraphs.

A further use of quantitative methods is the ease with which a range of alternatives can be generated, by means of testing for the impact of a change in one of the inputs. Any variable can be changed and assumptions can be negated or new ones introduced.

The use of sensitivity analysis together with the ability to deal with the "what if" type of analysis greatly enhances the ability of management to deal with the complex problems that are encountered daily in the course of their duties.[6]

Systematically structuring and analysing the problem results in a thorough understanding of the situation and the variables that affect the decision. It is suggested that this is one of the more important benefits to be derived from the use of quantitative methods, in that if properly applied, they force the management to examine the inputs and to analyse the situation carefully, so much so that this becomes of greater benefit than the solution itself.[7]

Pareto's rule (or the 80:20 syndrome) is said to be also applicable to the use of quantitative techniques, whereby it is suggested that business gets the bulk of the benefit from the use of a quantitative methodology in the first "80%" of the solution and tends to derive very little benefit in pursuing with the problem through to a final solution.[8]

The implication is that the benefit is derived in identifying, analysing, examining and evaluating the problem, constraints, inputs and alternatives, but that

very little additional benefit is gained by arriving at the optimal solution.

> ".... our objective should be getting the best answer, not optimization per se. We do the OR/MS community a disservice when we preach optimization for the sake of optimization. Management did not buy it the first time around, in the late 1950's and early 1960's, and they wont buy it now."[9]

The pertinent point about the last "20%" of the solution in a business environment is that the marginal benefit derived is often not worth the additional cost.

Halbrecht, a consultant, gets to the crux:

> "One of our clients as a matter of fact refuses to hire PhDs in operations research because they insist on working with the last 15-20% since it injures their professional analytical pride to do otherwise. Unfortunately this same professional pride is not as important to business executives as the bottom line on the balance sheet...."[10]

It is evident that in dealing with problems in this manner, the quantitative methods department is providing management with a different service than it is in calculating optimal solutions. It is further evident that this is of greater benefit to management

in assisting with the decision making process in a complex environment, which is where many problems occur.[11]

One of the functions of management is the efficient utilisation of scarce resources. Since the application of quantitative methods makes demands on the resources of an organisation, the following comment perhaps sums up much of what has been written in this section.

> "Management Scientists would do well to consider carefully what the expectations and goals of management are in supporting research and not blithely assume all efforts should be evaluated in terms of attaining a blissful state of optimisation."[12]

While the tone of the above statement is somewhat critical of management scientists, a slightly freer , yet valid (it is submitted) interpretation is that quantitative methods can support management's decision making function i.e. satisfy expectations and be consistent with goals, however this must not be carried out beyond the point where marginal cost exceeds marginal utility.

STRATEGIC PLANNING

Modern business needs to be involved in the strategic planning issues so that it may react to the changing environment in which it operates.[13] This area of business has two features which are worth noting at this point.

Strategic planning is the responsibility of top management, and should not be delegated to any large degree to lower management levels. Anthony's[14] framework shows the various functions for managerial planning and control and is depicted in Figure 4.1. The levels of management can be superimposed over this framework to show the area of planning and control to which each level of management should direct his efforts. (Figure 4.2) It can be seen that the bulk of the strategic planning function is carried out by top management.[15]

As a result of the fact that strategic planning is the domain of top management it follows that if quantitative methods are to have a significant impact on this area of management it must be at the instigation of top management.

FIGURE 4.1 FRAMEWORK FOR PLANNING AND CONTROL

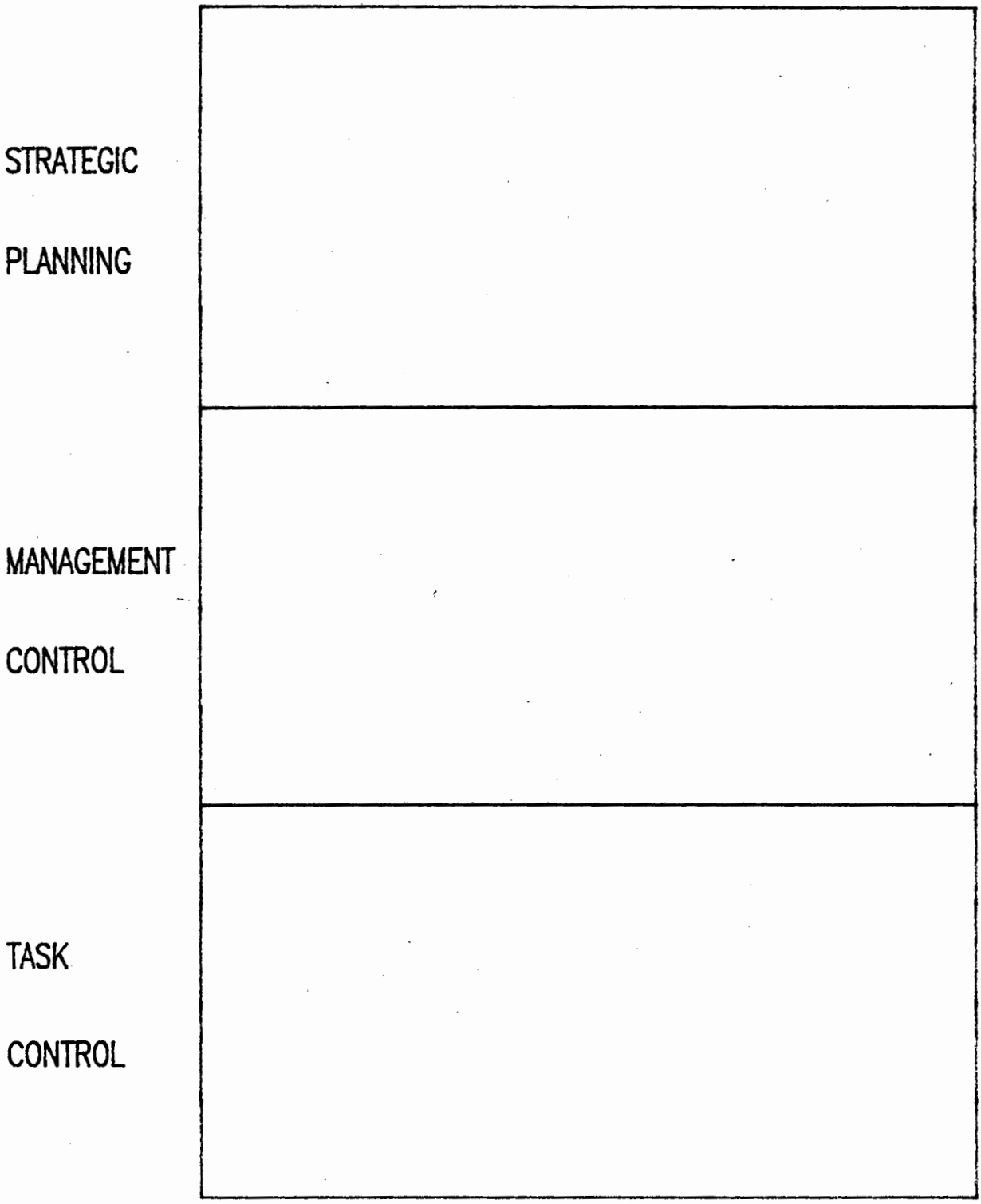
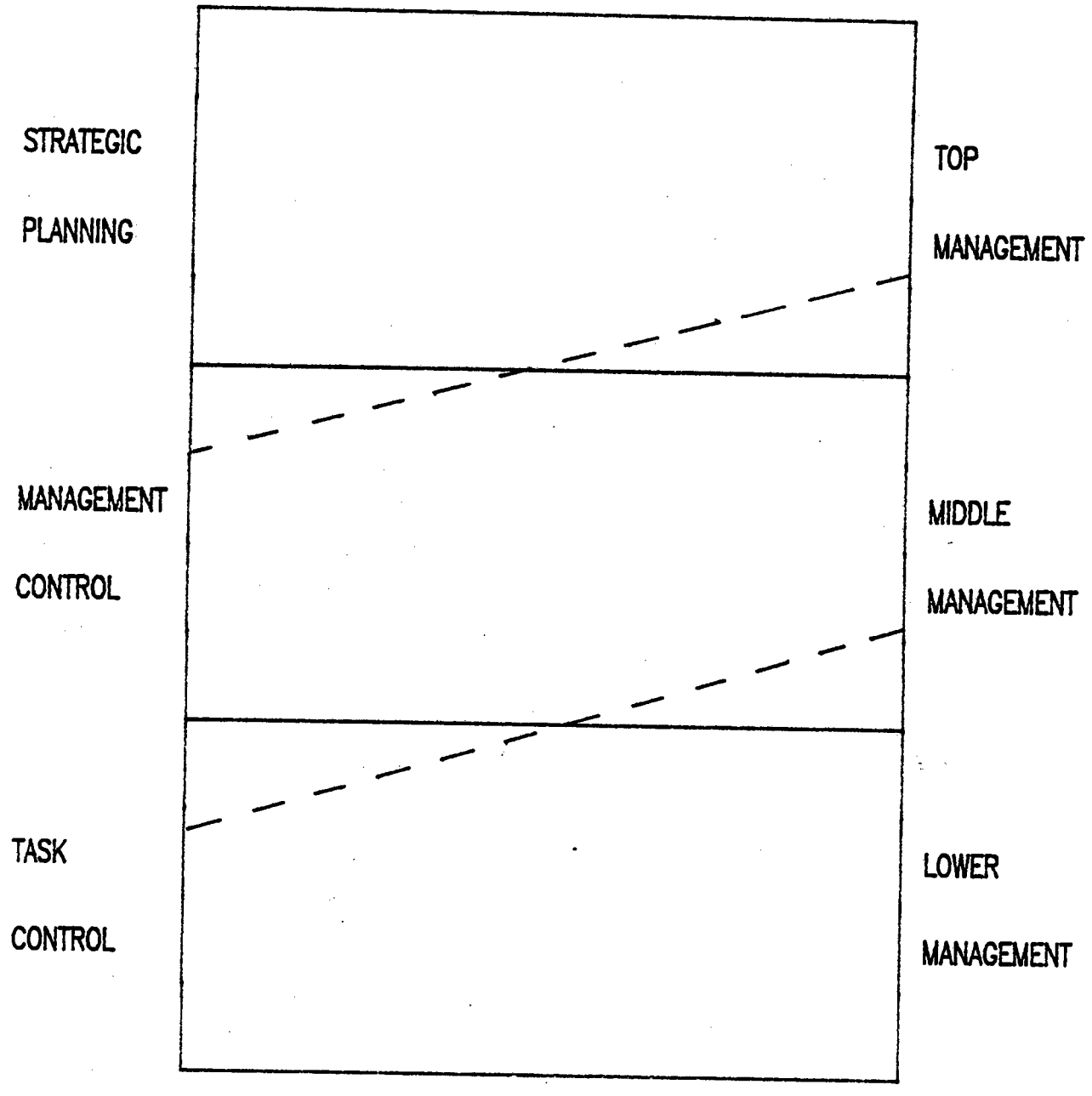


FIGURE 4.2 LEVEL OF MANAGEMENT AND DECISION MAKING



The second important issue in the area of strategic planning is that not only are the answers unclear but the issues themselves have been described as "fuzzy".[16]

The matters to be addressed then are, firstly, whether the disciplines of quantitative methods can meaningfully contribute towards dealing with these "fuzzy" issues. If so, given that these issues are the responsibility of top management, will the quantitative techniques be given the opportunity to contribute to the decision making process.

The question of the attributes of the person serving in the quantitative methods section of a company and the placing of such a section within the company have been considered elsewhere in this thesis.

In the earlier section of this chapter it was noted that the trend had been away from quantitative methods supplying point answers to problems and towards providing a basis to which management may apply judgement. This "open" approach is even more pronounced with respect to strategic planning.

> "Planners suddenly realize that their responsibility is not so much to chart the future as it is to lay out for management key

> issues that face the company. .... strategic plans are made to formulate questions, and that it is often more important to raise key issues than it is to forecast future trends to second decimal point accuracy."[17]

Over the past decade views have varied as to the role of quantitative methods in strategic planning. In 1971 Radnor[18] observed that management science people appeared to be contributing to a management planning type of role.

By way of contrast two years later Magee[19] laments the reluctance of management scientists to participate in the exploration of strategic issues. Furthermore he notes

> "....a strong tendency to convert such (strategic) issues, however unrealistically, into problems that can be solved, rather than discussed, questions that can be answered rather than be explored."[20]

In the middle 1970's the quantitative methods literature abounded with encouragement to become involved in strategic issues.[21]

A potential problem arises in that the traditional quantitative methods approach of seeking optimisation

would not be appropriate.[22] The strategic issues are generally unstructured, unbounded and clouded in uncertainty,[23] they are typically concerned with continuously changing variables from the environment.[24] Nevertheless it is believed that the quantitative methods can make an important contribution towards the solution of these problems, but the classical ideal of solving the whole problem is not always appropriate.[25] As mentioned earlier, the point of equilibrium between costs and benefits should not be exceeded. This is particularly important in a strategic planning context due to the "fuzziness" making too detailed or precise a solution, frequently meaningless.

Evidently for the quantitative methods people to participate in strategic planning, they will need to think a little more broadly than is traditionally the case.

Ansoff draws two distinctions between a management science approach and a strategic planning approach to solving problems. In the management sciences all the alternatives are identified and an effort is made to evaluate them. Whereas in strategic planning a strategy is selected and a "solution" is built up around this strategy, as the "solution" proceeds so the earlier decisions become re-examined and possibly even

rejected, in which case the process would start again.[26]

The second distinction drawn by Ansoff is that the strategic planning approach attempts to satisfy rather than optimise, and that there is no assurance whatsoever that the solution is the "best" alternative.[27]

Despite the fact that strategic decisions tend to be unstructured and the approach towards dealing with them may be different to that normally adopted by the management scientist, these decisions would benefit greatly through the availability of timely and relevant information.[28]

It has been suggested that interactive or simulation models are the tools necessary for strategic planning.

> "This type of model (simulation) is capable of handling complex systems, does not require a mathematical objective function, can incorporate management's desires and policies and is capable of being built, understood and used by the non-specialist manager."[29]

Interactive models are required which can perform the necessary calculations and take advantage of the human capacity for changing the variables with regard to

assisting different questions, formulating new hypotheses, or simply investigating the outcome of altering the inputs.[30] Not only do such models perform the functions detailed but the

> "process of interacting with such models is more helpful in guiding management towards sounder formulations than any attempt we may make to demonstrate perfect formulations in the shifting patterns of strategic decision making."[31]

These sentiments are confirmed by a study carried out in 1975 by Naylor and Gattis,[32] wherein they investigated, inter alia, the benefits derived from the use of the corporate simulation models. Their findings, reproduced in Table 4.1, are self explanatory.

Naylor and Gattis saw models which incorporate the external environment as a development for the near future.[33] The need to consider the impact of the global environment has become more pronounced in the 1980's.[34] Gibson[35] comments that strategic planning views the role of the whole business in the economy and the community. Zentner[36] perceives the need to understand and anticipate the environment using inputs varying from newspapers to consultants.

TABLE 4.1	SIMULATION MODEL BENEFITS
BENEFIT	PERCENTAGE
Able to explore more alternatives	78
Better quality decision making	72
More effective planning	65
Better understanding of the business	50
Faster decision making	48
More timely information	44
More accurate forecasts	38
Cost savings	28
No benefits	4

In the keynote address to the TIMS College in July 1980 he again spoke of the need to incorporate the environment in the decision making process.

> "In the past, most of our decision making inputs have come from within .... But as social pressures on the corporation increase, internal data are no longer sufficient. We are going to have to find a way to acquire social data from the corporate environment and to bring it into our management information systems and decision making process. How to do that is something we have to invent and invent soon .... Whether the American corporation can cope with the changes to come will depend in large on how perceptive, how flexible, and how dynamic the management sciences are in anticipating and accommodating those changes."[37]

SUMMARY

The use of quantitative methods can provide a variety of benefits depending on the type of problem to which they are applied and the attitude of the user.

1. An answer can be provided to a well structured, well defined problem. However in a business environment most problems are not sufficiently

well defined, structured and certain as to lend themselves to accurate answers.

2. The answer generated above may be used as a base to which management then applies its judgement.

3. Rather than produce a single answer a range of alternatives or a sensitivity analysis can be generated. In this way the user develops a better insight into the problem and the various inputs.

4. Simulation and interactive models have enabled the people involved with quantitative methods to contribute towards the strategic planning process in the organisation. This area is the domain of top management and typically the issues are largely unstructured, ill defined and have been described as "fuzzy". The management scientist would need to undergo some change in his approach if he is to contribute meaningfully in this area.

5. In all of the above one of the greater benefits to be derived from the use of quantitative methods is that it forces the user to examine the issues involved. This is said to be of greater benefit than the answer produced. Some writers have cited the 80:20 syndrome as being appropriate here

whereby very little benefit is derived in working on the last "20%" of a solution.

Two factors which have contributed to the above use of quantitative methods are:

- quantitative methods divisions work as teams, thus being able to draw from a variety of skills and backgrounds. This is particularly useful since most problems have a wide range of implications.
- the development of powerful and readily available computers.

Finally, a need and an opportunity is seen for the quantitative methods to contribute in the development of new techniques which enable the corporate environment to be incorporated in the decision making process.

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CHAPTER 5

EDUCATIONAL FACTORS THAT INFLUENCE THE USE OF QUANTITATIVE METHODS

INTRODUCTION

In Chapter 2 it was noted that the person who is to work in a quantitative methods department should be technically competent. In this section on education it will be assumed that the training of technical expertise is taking place and the point of concern is to establish what education or training beyond technical skills are seen to be desirous.

TECHNICAL SKILLS ARE NOT ENOUGH

In discussing the problems between teaching and implementing inventory management, Zanakis et al observe

> ".... several important issues are overlooked or taken for granted in many courses, such as appropriate model selection and calibration; aggregate inventory analysis; interaction with other business functions; and behavioural and organizational aspects affecting modelling and implementation."[1]

The implication here is that while a particular inventory model may be very useful it is important to use the correct model hence "appropriate model selection" is an important issue, but in spite of this the typical curriculum will teach the model but not when to use it. Furthermore having taught the use of the model, there is no instruction on the application of business acumen in evaluating the outcome as to its reasonability nor how the outcome interacts with and affects the business in its totality.

These sentiments are echoed by other writers; Ackoff[2] bemoans the fact that OR students have very little understanding of management, organisations, business or government. A possible counter is suggested by Ansio, Kivijarvi and Soismaa[3] in including in the objectives of teaching quantitative methods, the ability to deal with management, business or economic matters. Similarly, Hesse[4] maintains that students should know about business and that teaching should focus on

problem solving rather than the appreciation of mathematics.

Perhaps Heany[5] gets to the point in his comment that management education tends to be an afterthought. He urges that education should provide an understanding of the requirements of management.

Both Hoffman[6] and Ackoff[7] refer to the need for education of quantitative methods people to be broader based and to provide an understanding of the environment in which people will be operating.

In a survey carried out in 1977 Thomas and Da Costa[8] found a decline in the percentage of PhDs hired by companies for management science. They comment that as quantitative methods have matured and become more decentralised so the emphasis has shifted away from specialisation towards functional areas of application. Hence the need for the highly specialised PhDs has declined.

This trend is consistent with the observations and comments made previously in this chapter as well as with those from earlier chapters, viz. that for quantitative methods to be successfully applied the people applying it should be more like managers and a little less like mathematicians. Consequently the

training of quantitative methods personnel should bend a little towards issues beyond mathematics.

It must be emphasised that these comments assume the quantitative methods person to have a relatively high level of technical competence. The point is that, given the technical skills, is there more benefit to be derived from even greater technical specialisation or would a broadening into managerial issues be more desirous in a business environment.

An appropriate aside at this point may well be Ackoff's comment with regard to practically oriented research as opposed to pure research:

> "This avoids one's confusing mathematical masturbation with intercourse between research and reality."[9]

Earlier in this chapter reference was made to the need to view problems within the totality of the environment. This attitude is supported by Ackoff[10] in a paper in which he maintains that operations research has no future because while decision making forms part of a whole, operations research is concerned only with the part. In a later paper he relates this to the education issue in suggesting that since most managerial problems are complex, a broader, less precise approach towards solving these problems should

be adopted, education should be leading towards producing people who are capable of being creative.[11]

While Ackoff may well be extreme in his views as to the future of operations research (a large part of chapter 4 is devoted to the impact quantitative methods may have on the broader strategic issues of management), his call for education is supported by Gregory in a paper on operations research education.

> "Given that the basic techniques and allied disciplines have been covered at the undergraduate levels, what then should be the content of the postgraduate course? It should not, in my opinion, be composed of more techniques. This surely is the opportunity to design a course which develops creativity and imagination ...."[12]

If quantitative methods are to have a future, then it appears as if this future may be in the field of corporate planning. Education should respond to this by providing the curriculum that prepares the person for this type of function.

This chapter thus far is aptly summarised by Carruthers[13] who also notes a trend towards the corporate planning function and suggests that to cope

with this the future quantitative methods curriculum should have the following features :

1 - Less mathematics.

2 - More on the ability to convert data into useful information - especially in view of the development in computer technology.

3 - More on the handling of human resources.

Both Ackoff[14] and Hoffman[15] recommend practical experience as part of the requirement for a quantitative methods specialist. The deficiencies mentioned above may well be overcome with sufficient practical experience, this however takes time, more so if ingrained bias has to be superceded. In the following sections of this chapter ways of simulating practice or at least of imparting some of the benefits of practical experience within the student period are examined.

CASE STUDIES

Chen[16] maintains that the most useful techniques for business are not those given predominance in university teaching. He also maintains that teaching should be problem oriented. In similar vein Rivett[17] urges

academics to deal with unstructured problems and to teach more on "real life" type problems.

Case studies are suggested as a medium for teaching "management" skills[18] or at least for assisting in recognising situations which are suitable for the application of quantitative methods.[19]

It may be argued that a case study cannot simulate reality and as such the exercise is futile. This could be true if the objective of the case study was to bring reality into the classroom, however it is submitted that this should not be the reason for using case studies. Rather case studies should be used to provide a medium whereby the student's problem solving and analytical skills are developed so that he is better equipped to cope with real problems, not because he has simulated real problems but because he has acquired skills which are useful in dealing with them.

This is not to imply that simulated or real experience is not valuable.

PRACTICAL EXPERIENCE

In recent years several academics have attempted to provide their students with practical experience.

Gene Woolsey[20] achieves this by offering to a company which has approached him with a consulting job, the alternative of either having him at a very high fee or having him and a student for no fee.

In relation to the student's regular workload he requires that

> "Any thesis or dissertation done for me must absolutely meet two requirements:
> It must be a real world problem done for a company/agency that uses the results.There must be a provable reduction in costs or increase in profits, measured according to generally accepted accounting and/or auditing principles."[21]

While it is accepted that this type of research is valuable, the prohibition of any `non practical' research must be questioned although Woolsey's view is consistent with that of Ackoff[22] mentioned earlier on page 72. However when considering the vast amount of `non practical' research being undertaken throughout

the world, perhaps the `hard line' approach adopted by Woolsey and Ackoff is more understandable.

In Belgium Gelders[23] tried using field consulting as part of the training programme for his students. He met with an 80% success rate, but did warn that it is imperative to have good students, good projects and good companies.

The concept of requiring students to do practical consulting during their programme was also due to be tried at Universidad Anahauc near Mexico City by Gaiuque and R.E.D.Woolsey[24]. The results of this effort are not yet to hand, but the idea, when presented to Mexican businessmen, was well supported.

Gaiuque[25] has already introduced a field consulting programme in the U S A and reported large success. The programme has been well received by students, the sponsoring companies and by academic colleagues. As is the case with Gelders, Gaiuque also considers it imperative to choose good students and good projects for this type of exercise.

Schultz[26] also experimented with `live' projects in the USA and met with great success.

Simpson[27], although acknowledging the usefulness of projects, raises the problem of assessment. While it may be difficult to assess a project or consultancy, this is a problem to which the academic should apply his mind and come up with as best a method as possible, for it would be absurd to reject a valuable teaching medium simply because it is difficult to assess.

Tomlinson and Mitchell[28] are of the opinion that proper quantitative methods training can only take place within a work environment and that even the projects done in typical master's courses are not true practical experience.

These opinions were expressed in 1971, and whether the "projects done in typical master's courses" are similar to those described above (mostly 1981) is doubtful. Furthermore it is submitted that the use of "live" cases is not intended to be a substitute for practical experience but rather to expose the student to the type of problem, environment and interactions that may occur in the course of practical applications. In this way he should be better equipped to integrate into the practical situation; it is not claimed that he is totally trained.

Also in 1971 Reinitz[29] expressed the opinion that case studies were of limited value and suggested one of two courses of action:

- a complete interruption of academic training permitting experience to be gained in industry
- a parallel programme involved in actual business projects, giving the student a more realistic understanding of the course material and also provide him with an opportunity to comprehend the needs of the business organisation.

Ten years later the parallel programme appears to be the approach adopted by some course leaders, as described above.

Assuming the use of "live" cases proves to be successful in the longer term, certain questions will have to be answered, not the least of which being the availability of suitable projects. Are enough companies going to volunteer projects? If so will they continue to do so? Even if the answer to both these questions is affirmative , is there any scope outside the main industrial areas, in fact will a city like Cape Town be able to generate sufficient good quality projects, bearing in mind the type of business traditionally found in the area.

Another question to be addressed is the matter of fees for the projects. Both Woolsey[30] and Gaiuque[31] indicated that they only charged expenses. This must be questioned since one of the objects of the exercise is to provide practical experience and part of practice is to provide value for money. Thus by not paying a fee the sponsoring company may well be receiving value for money but were a fair rate to be charged the value may not meet the fee paid.

The danger is that the student and the course leader may be led into a situation of false satisfaction and reality would be simulated better if the project be required to pay for itself. In this case projects would be more difficult to find and the benefit of better simulation of reality must be weighed against the possible lack of a project at all.

Some thought should be given to combining students of quantitative methods with those from other disciplines in dealing with "live" cases. In this way the students would be able to draw from each others' disciplines and get experience in working with people from other disciplines. They would also improve their understanding of the other disciplines and their ability to communicate effectively their own discipline to others. This idea could be extended to

students for higher degrees submitting joint dissertations. This has several immediately obvious advantages, not the least of which being a likely improvement in the quality of the research, since the majority of research spans more than one discipline. There would of course also be disadvantages and the full implications would have to be examined.

EDUCATION OF MANAGEMENT

In a survey Watson and Marett[32] found that one of the more frequently cited problems in using quantitative techniques was that neither top nor middle management had the educational background to appreciate such methods. The comment attributed to Bradshaw is appropriate :

> "Most managers would rather live with a problem they can't solve than use a solution the don't understand."[33]

This comment drew an editorial note which emphasises the importance of the sentiments expressed:

> "Amen, hallelujah."[34]

Bonini's observations are illuminating:

> "... computer modelling has had relatively little impact on top-level management decisions. The reasons are related not so much to methodology as to lack of understanding about how to use models and how to deal with the modelling process. At least some of the fault lies with management education, which focuses primarily on the management science methodology rather than on managerial issues." [35]

The interesting point here is the assertion that management education focuses on the techniques rather than on the managerial issues. Presumably also the time spent is not sufficient to develop a thorough knowledge and understanding of the techniques. Thus management education leaves the student in a position where his quantitative methods education is of little benefit to him. He does not know enough about the techniques to do anything with them himself and he has had no training on the use of them.

Van Zante[36] conducted a survey among accountants to establish the importance of various topics in the management accounting curriculae. Respondents were

asked to rate each topic on a scale of 0 to 5 as to its importance. 0 represented no importance, while 5 represented extremely important, with 2,5 being of average importance. The responses were divided into industrial accountants and accounting educators. Table 5.1 is an extract of the relevant data as it pertains to quantitative methods.

The above indicates that while quantitative methods are not regarded to be as important as most other topics they are still considered to be of above average importance by both groups. The higher rating given by accounting educators may be due to different objectives e.g. rounding of the student, potential future importance, develops analytical skills.[37] What is not clear is whether the industrial accountant rates the level of importance in relation to the use of techniques or the way in which the techniques were taught, which would most likely be in the technique oriented undergraduate manner.

It is worth noting the rankings of two other topics in this survey. Computer systems ranked very highly but computer programming was ranked second last by both groups.[38] Perhaps if quantitative methods techniques were to be distinguished from quantitative methods application (such as the approach to and formulation of

TABLE 5.1	IMPORTANCE of TOPICS	
	Industrial Accountants	Accounting Educators
Rating for quantitative methods	2.92	3.63
Mean score for all topics	3.44	3.74
Rank for quantitative methods	23.	19
Total number of topics	28	28

a model for the problem at hand) a similar divergence of rankings would result. This would be consistent with Bonini's views discussed above.

Shycon[39] expressed similar sentiments to those of Bonini[40] in that quantitative methods for managers is taught largely from a technique point of view. His suggestion for improving the situation is the attendance at seminars and notes a large increase in the number of managers attending quantitative methods seminars, an increase in the level of management attending these seminars and that the number of seminars prepared especially for individual firms has also increased greatly.[41]

SUMMARY

While it is important for the quantitative methods graduate to be technically proficient, it is apparent that the teaching is too exclusively technique oriented and insufficient attention is devoted to application skills.

A need is perceived, partially in view of the role quantitative methods may play in the corporate planning function, for quantitative methods education to be

broader based and especially to include training in management.

Practical experience is essential to complete the education and while this cannot be fully supplied during the period of formal study, the use of case studies assists in developing some of the skills that will be useful in practice. In recent years a number of academics have tried to obtain real problems for their students to work on thus providing some practical experience alongside academic training. Initial results have been encouraging.

The education of management as far as quantitative methods is concerned has focused mainly on techniques rather than on managerial issues. Management can take steps to improve its own position by attending seminars and short courses. Nevertheless, although important per se, quantitative methods rank fairly low in relative importance against other topics in the education of management.

An appropriate concluding viewpoint is that of Graham[42] who is of the opinion that the manager has too many different disciplines under his control that he cannot be expected to understand all of them. The onus is therefore on the other discipline, in this case

quantitative methods, to learn to communicate with the manager.

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PART 2

THE SURVEYS

In part 1 certain factors were identified as important to the successful use of quantitative methods within an organisation. These factors focussed around four areas:

- personal attributes
- organisation structure
- nature of application
- education

Two questionnaire surveys were carried out to gather data about these factors in South Africa.

The first questionnaire was aimed at the managing directors of companies listed on the Johannesburg Stock Exchange. It asked a series of straightforward questions about the four categories identified. To each question the respondent was asked for two answers.

Firstly what the situation in his company is, and secondly what he would like it to be.

This served to identify

1. The situation among South African leading companies
2. Any gaps that were perceived by the top management between what the situation was and what they would have liked it to be.

The analysis of this survey is reported in chapter 6.

The second questionnaire probed the areas in greater depth. This survey was aimed at people who were familiar with the use of quantitative methods. hence the members of the Operations Research Society of South Africa were used as the sample. The only exclusions were those members who were clearly not using quantitative methods in a business environment, such as academics.

The senior management of the companies employing such people were also surveyed.

This questionnaire asked questions about their opinions and attitudes towards the factors identified. The aim was to highlight differences and similarities in the opinions and attitudes. It would then be possible to

consider these similarities and differences in the light of the impact they may have on the use of quantitative methods.

The analysis of this survey is reported in chapter 7.

While the two surveys were directed at different populations and had different objectives it was still possible to compare some of the results of the surveys. In so doing certain findings would be supported and hence strengthened, while others may be exposed as needing further investigation.

The comparison of the surveys is reported in chapter 8.

CHAPTER 6

SURVEY OF LISTED COMPANIES

INTRODUCTION

The questionnaire was designed to facilitate responses and to take up as little of the respondents' time as possible, thus it was organised in a columnar fashion with each question requiring two responses. The first column requested information about the situation in the company while the second column sought the managing director's wishes for that same situation.

While this design may have been successful overall it appears that it may have confused some respondents as will be seen later.

The questionnaire was pilot tested on people from various backgrounds including management, quantitative methods, consultants and academia. Adjustments to the questionnaire were made as a consequence of the testing.

The questionnaire was mailed to the managing directors of companies listed on the Johannesburg Stock Exchange (J.S.E.). A total of 481 questionnaires (Appendix 1) were sent together with a covering letter (Appendix 2) and a stamped return envelope. When no further replies were forthcoming a follow up letter (Appendix 3), questionnaire and envelope were sent.

174 responses were received, however 21 of these were letters explaining why they were not going to complete the questionnaire (usually a matter of company policy). Of the 153 valid responses many did not complete the whole questionnaire, this was probably due to two main reasons. Firstly many of those who do not use quantitative methods at all may have found difficulty in completing the first column. Secondly, the positioning of the second column, which was intended to facilitate completion may have confused some respondents. Nevertheless the questions in the first column tended to have between 125 and 130 responses

while those in the second column had between 110 and 115.

The questionnaires were analysed using the Prime computer at the Graduate School of Business at the University of Cape Town. The Statistical Package for the Social Sciences (SPSS) was used.

Frequency counts and cross tabulations were carried out. Results are presented in percentage form for greater ease of comparison. The confidence level was set at 95%[1].

Twelve questions were asked. Questions 1 to 5 established background information about the respondent companies, while questions 6 to 12 enquired into the use of quantitative methods in the companies.

Tables of responses are presented in appendices 4 through 10. Table 6.1 shows a broad overview of how the questionnaire was analysed and is cross-referenced to the tables of responses contained in the appendices.

To establish if the respondents were companies from across all sectors of the stock exchange the nature of business of the respondents was compared with the stock exchange sectors. While the categories of "nature of

TABLE 6.1	OVERVIEW OF QUESTIONNAIRE ANALYSIS						
Company details	Questions about quantitative methods						
	6	7	8	9	10	11	12
1. Nature of business	Not analysed						
2. Dispersion of company	App.4	App.5	App.6	App.7	App.8	App.9	App.10
3. Head office location	Not analysed						
4. Employees	Not analysed						
5. Turnover	App.4	App.5	App.6	App.7	App.8	App.9	App.10

business" in question 1 are not an exact replica of the J.S.E. sectors, they can be conveniently compared after the following minor adjustments:

- Manufacturing and retailing were merged as it is difficult to distinguish between these on the stock exchange listings
- "Other" were reallocated to one of the other categories.

The proportion of respondents for each category to the survey matched up very closely to the stock exchange categories as can be seen from Table 6.2. The only significant differences were:-

	Survey	J.S.E.
Mining	12%	24%
Manufacturing	57%	43%

The difference for mining was expected as many of the mines are controlled by the same house, as a result it was highly unlikely to receive a response from each of them. It is noted that the survey proportion for mining was less than the stock exchange proportion which is consistent with the expectation.

In the case of manufacturing and retailing, while the difference is statistically significant it is submitted

TABLE 6.2	SURVEY RESPONDENTS COMPARED TO JSE LISTINGS	
	[2]	
	J.S.E.	SURVEY
Category	No. %	No. %
Mining	114 24.2	18 11.8
Banks	25 5.3	6 3.9
Insurance	13 2.8	5 3.3
Investment	11 2.3	5 3.3
Property	28 6.0	6 3.9
Manufacturing and Retailing	200 42.6	88 57.5
Building	18 3.8	6 3.9
Industrial Holding	61 13.0	19 12.4
Total	470 100.0	153 100.0

that it is not serious. The significance has been influenced by the imbalance in mining (on removing mining from the calculation the "Z" was reduced from 5 to 3) and by the large number of observations for this category. It therefore appears reasonable to suggest that the survey respondents represent an acceptable cross-section of the types of companies listed on the J.S.E.

"Turnover" was selected as the measure of size for purposes of presentation. Since there is a high correlation with "number of employees" it would be pointless to present both. Where there are differences worth noting these are highlighted in the text.

The results for "turnover less than R10 million" have been included in the tables presented in the appendices. However they have been referred to in the text only in passing as there were, at most, 9 respondents to any particular question. (The position was similar for "employees less than 250").

The responses to each of questions 6 to 12 are presented in a separate table being appendices 4 to 10. The responses have been tabulated as percentages for ease of comparison.

Table 6.3 shows the format that has been used to present the responses in the appendices. Across the top are the response categories, these are columns displaying the responses to the question represented by that table. The table is divided into two broad categories, the current position and that desired by the respondents. Each of these is further categorised according to company attribute as is evidenced by the rows down the left margin of Table 6.3:-

Full sample - the results of all respondents are presented.

Dispersion - the responses are sub-categorised according to the degree of dispersion of the company i.e. whether it operates locally, nationally or internationally.

Size - the responses are sub-categorised according to the size of the company as indicated by the turnover.

The survey has yielded a large quantity of data, hence a fairly systematic approach has been adopted to analyse and assimilate this data.

TABLE 6.3	FORMAT FOR PRESENTATION OF SURVEY RESPONSES
	Response details

CURRENT

Full Sample
Dispersion Local National International
Size Turnover <R10m R10m – R100m R100m – R500m >R500m

DESIRED

Full Sample
Dispersion Local National International
Size Turnover <R10m R10m – R100m R100m – R500m >R500m

For each question two areas of distinction are sought:-

1. Does the company attribute distinguish one set of respondents from another.
2. Is there a distinction between the current situation and that desired.

Each of questions 6 to 12 will be dealt with in order. Within the analysis of each question the most striking points will be dealt with first followed by other notable points. Those items within each question which are not considered worthy of comment are dealt with in a general statement.

At this point it must be emphasised that the above comments do not apply to the category "Turnover < R10m". Due to the small number of respondents (less than nine) in this category, it would frequently appear to be distinguished in percentage terms. Reference to this category is made only where it is felt to be necessary.

At the start of each of the ensuing sections of text in this chapter are three items :-

- Question number. This refers to the corresponding

question number in the questionnaire.

- Restatement or paraphrase of the stem of the question.
- Appendix number. This refers to the appendix containing the responses to that question.

ORGANISATION STRUCTURE

Question 6. Location of quantitative methods section within the organisation. Appendix 4.

The most striking aspect to arise from this question is that whereas currently 28,1% of respondents do not have a quantitative methods section only 9,1% find this to be a desirable state of affairs. Clearly the need is seen to have persons skilled in quantitative methods to a greater extent than is currently the case. (Z = 7,9)

An analysis of respondents who do and do not currently have a quantitative methods section showed that of those who do have a section 100% felt this to be a desirable state of affairs while 65% of those who do not have such a division indicated they wanted one.

The implication is that "users" feel they are deriving benefit from their quantitative methods section and

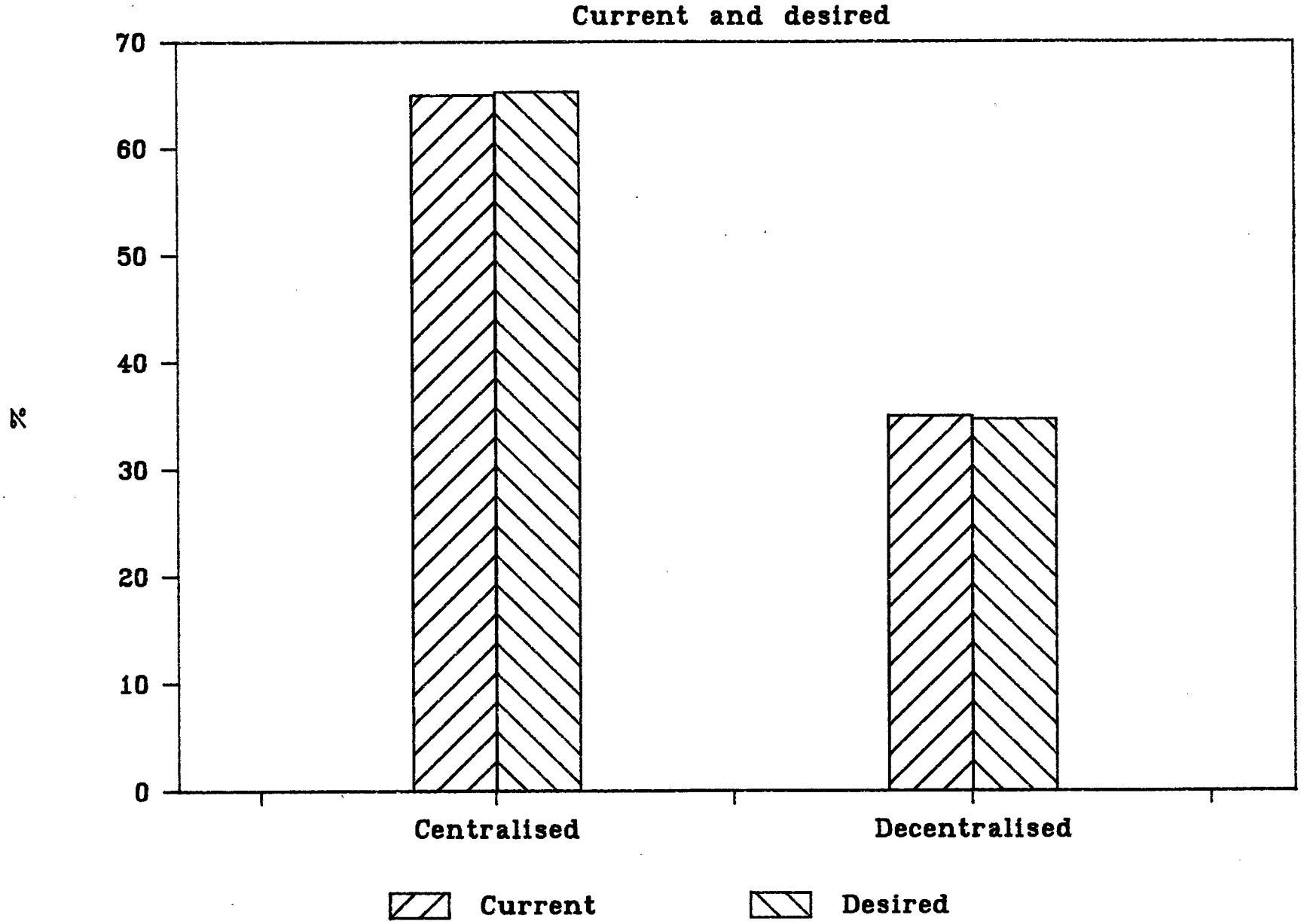
that even those who currently do not have a section perceive a benefit.

The first two columns of Appendix 4 have been restated in Appendix 4a to represent the relationship between centralised and decentralised companies. Figure 6.1 shows the relationship. The ratio of centralised to decentralised was approximately 2:1 for the current situation. The only category to differ was size. Interestingly no pattern was immediately evident with the ratio being approximately 3:1 for the R10m to R100m group, 1:1 for the R100m to R500m group and 3:1 for the greater than R500m group.

A trend of decreasing centralisation with increasing size might have been expected, yet the largest companies reverse this. A possible explanation is that the very large companies may have highly centralised organisation structures, tending towards bureaucracies. Hence centralised quantitative methods divisions would be consistent with the organisation structure.

The desired position is almost identical to the current for the full sample of respondents. However there are differences within the categories of respondents.

FIGURE 6.1 ORGANISATION STRUCTURE



NATURE OF APPLICATION

Question 7. Nature of application for quantitative methods. Appendix 5. Tables and figures represent percentage using (or desiring).

The applications are represented by the numbers 1 to 5 as follows:-

1 - Provide a "final unqualified" answer to a problem.

2 - Provide an answer which will then be used as a base to which management applies judgement.

3 - Provide a range of possible answers.

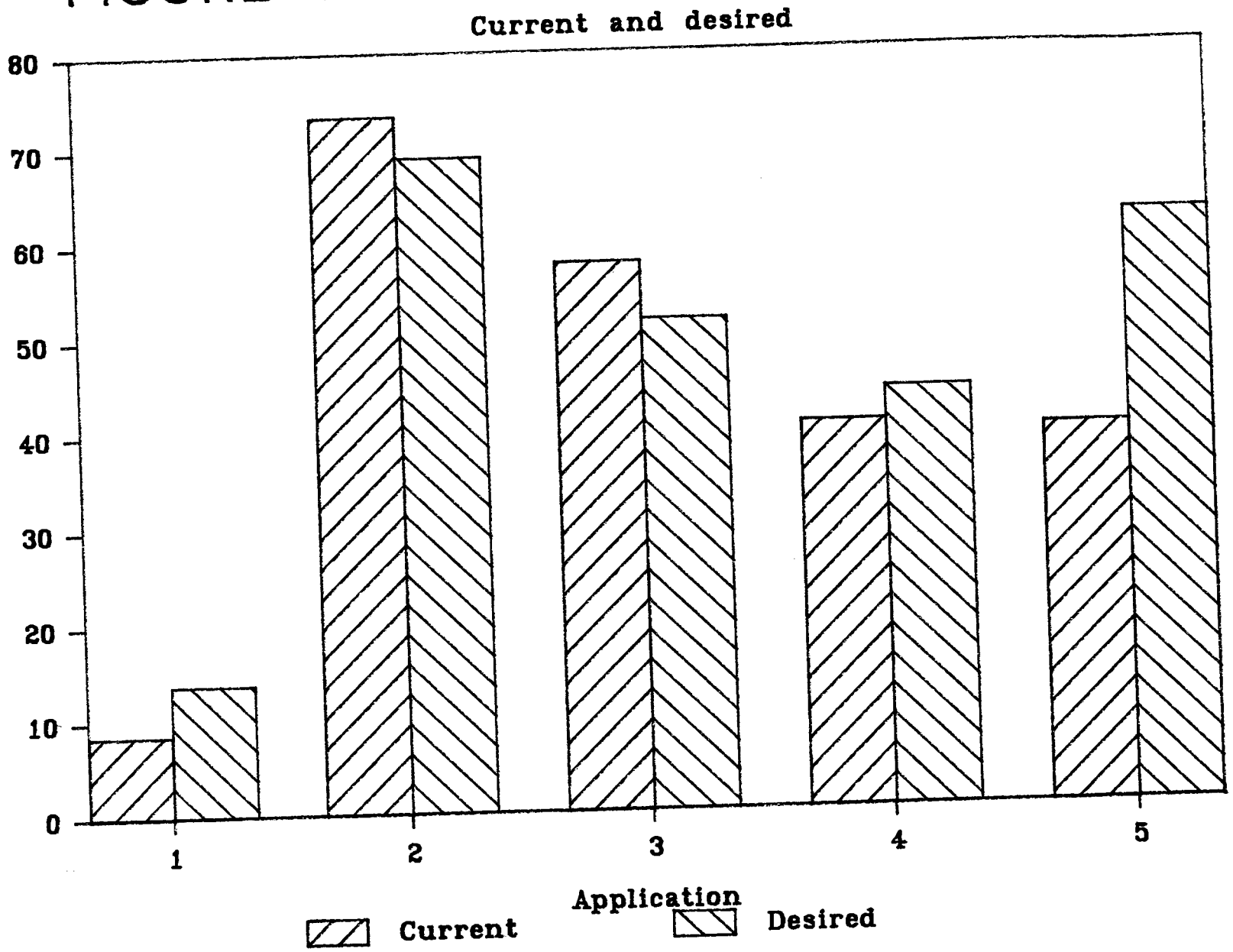
4 - Structuring the problem to carry out sensitivity analysis

5 - Long range planning through the use of interactive models.

The applications are also listed in order of sophistication; by portraying the responses in a histogram (Figure 6.2) any patterns will become evident.

Figure 6.2 shows that except for the first application i.e. providing an "answer" (which intuitively and borne out by this study is only useful in certain specific

FIGURE 6.2 NATURE OF APPLICATION



circumstances) there does appear to be a trend of decreasing use relative to increased sophistication.

In the desired situation the trend is similar except that the use of interactive models leaps to a position desired by most of the managers surveyed.

A glance at Appendix 5 will confirm that these general trends (i.e. decreasing usage with increased sophistication of application and a similar decreasing desired application with a jump to a high desire for the application of interactive models) are largely consistent throughout the cross-section of respondents. This desire for using interactive models is supported very strongly in the interviews (reported later), with the most important hindrance being the availability of suitable data bases and software.

A strong market need is in evidence here which represents an opportunity and a responsibility for people involved in quantitative methods to develop and promote the necessary tools to satisfy this need and even to extend it. Such a development would also serve as a retort to criticisms levelled at the quantitative methods by some writers, as reported in the first part of this thesis.

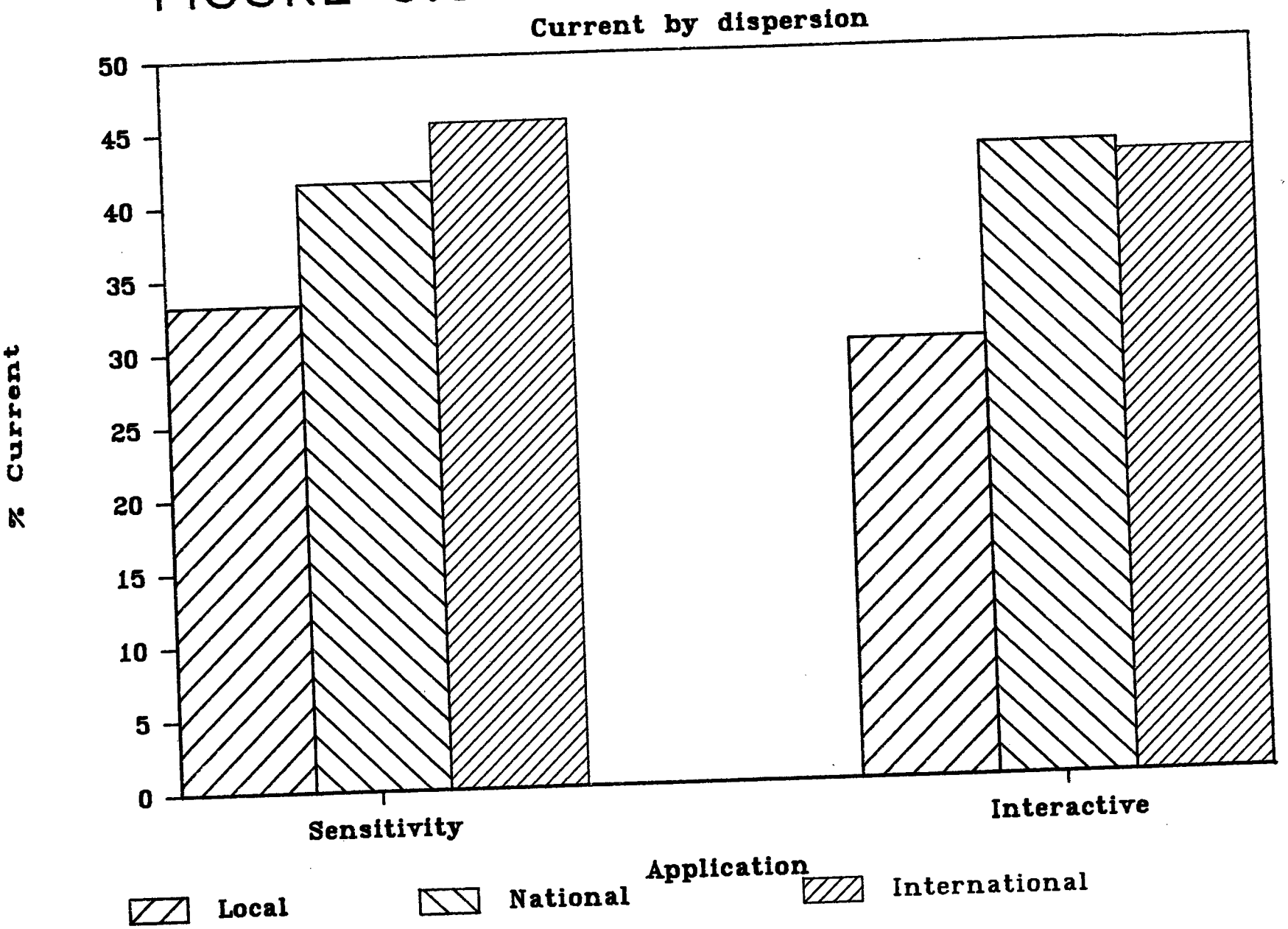
The pattern displayed by Figure 6.2 is both striking and consistent through the various categories of respondents.

The pattern displayed by Figure 6.2 is both striking and consistent through the various categories of respondents. There are nevertheless other observations and slight differences among respondents worth mentioning.

Firstly some observations. It is clear that management is not looking to quantitative methods to provide answers to problems (application 1), nor do they find this desirable. They do however use that numerical answer and then apply their own judgement thereto (application 2). This is the most popular application and there is little change in the desired position. This is not surprising since the vast majority of problems in business do not warrant the time and money of the more sophisticated applications. So it is to be expected that for the day to day problems application 2 would suffice.

Possibly a greater usage of sensitivity analysis and certainly a higher desire for this application could have been expected. Figure 6.3 shows how those companies which are more widely dispersed i.e. national and international have greater use in the area of sensitivity analysis and interactive models than purely local companies. There is a similar pattern for size of

FIGURE 6.3 NATURE OF APPLICATION



company. Possibly these companies have had greater exposure to these techniques.

Figure 6.4 shows the cross-tabulation of the desired applications by the dispersion of the companies. Noticeable is the high band of desirable applications for the international companies. Less high, but displaying a similar pattern are the national companies, whereas the local companies show a pronounced decline in desirability as sophistication of the application increases (with the exception of interactive modelling - application 5).

It appears that the managing directors of the local companies see less potential for the more sophisticated application than their more widely spread counterparts. This is particularly so in the case of carrying out sensitivity analysis (application 4), where more than double the respondents (in percentage terms) see potential use in the case of both national and international companies as opposed to local companies.

There is a different pattern for size of company (Figure 6.5). The desire for sensitivity analysis does not appear to be affected by size but the need for interactive models is far more pronounced among the

FIGURE 6.4 NATURE OF APPLICATION

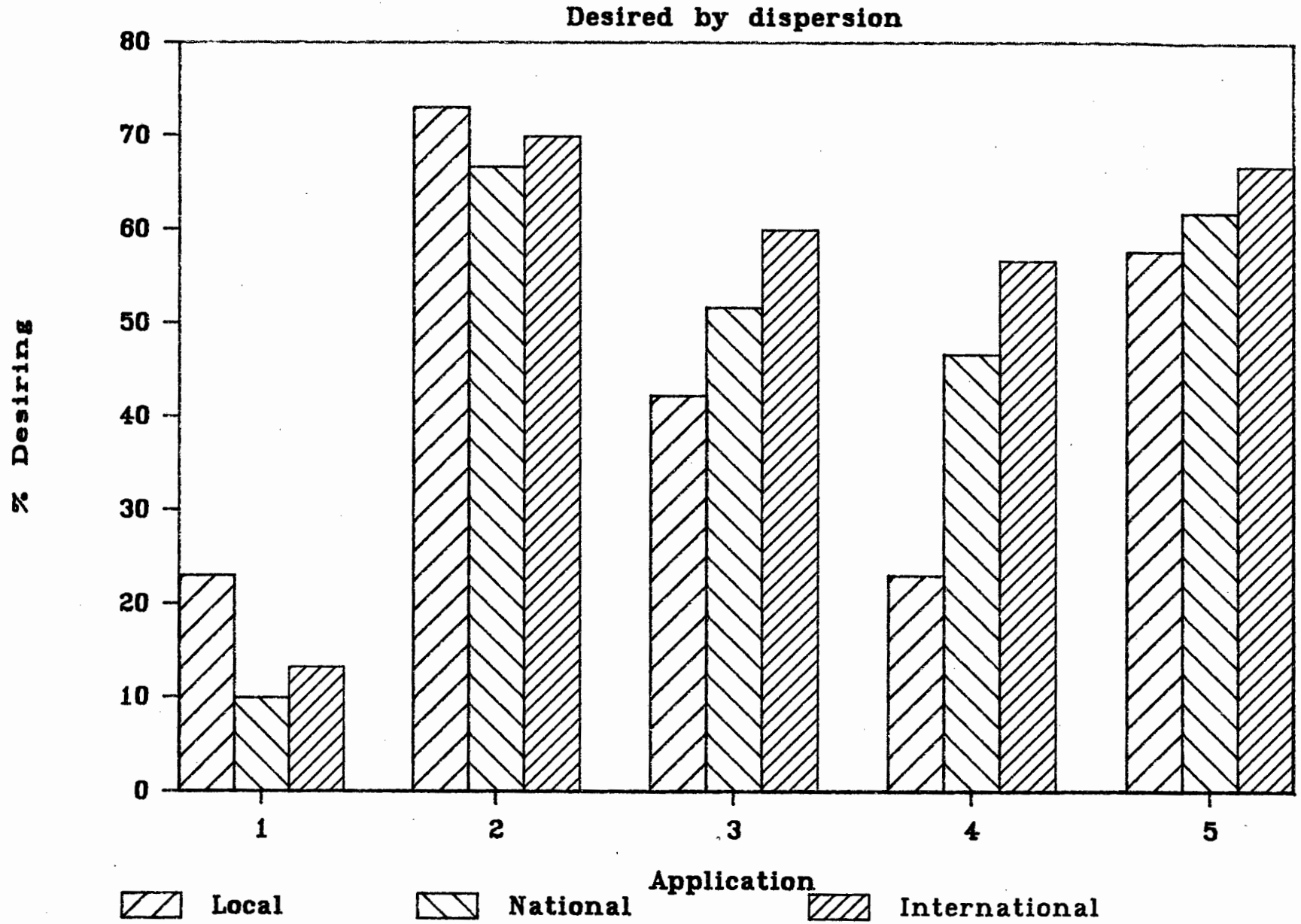
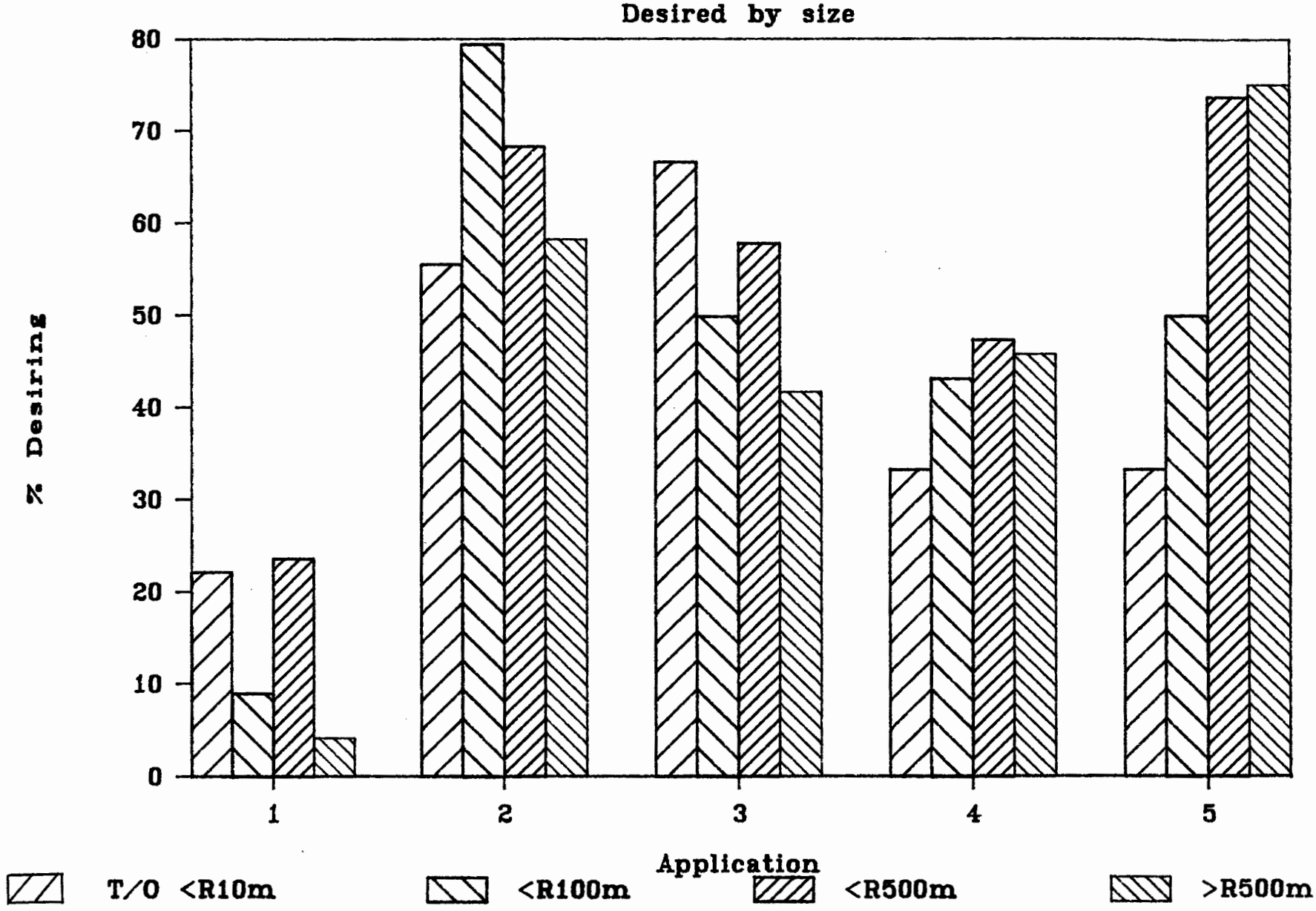


FIGURE 6.5 NATURE OF APPLICATION



larger companies. These companies would tend to have a greater need for interactive modelling.

The distinction shown by the dispersion of companies in the desire for the application of sensitivity analysis, with increasing desire shown by the more dispersed companies, is not easy to explain. All manner of companies could gainfully use this technique (indeed size of company showed no large differences). Yet the purely local companies showed a very low desire (lower in fact than current usage). A possible explanation may be that this category of respondents did not fully understand the technique and may have a desire for it to grow into interactive modelling. A further contributing factor may be that the exposure to the technique, and hence its benefits, is influencing the desire. It appears that overseas influence again plays an important part in the usage of quantitative methods in South Africa. It is significant that while there was little difference in the desire among companies of different sizes, this was not the case for the dispersion of companies where the difference was noticable.

In summary, the high desire for interactive models is the most significant item to be revealed by this question.

EDUCATION OF QUANTITATIVE METHODS PEOPLE

Question 8. Level of education for people working in quantitative methods. Appendix 6. Tables and figures represent percentage having (or desiring).

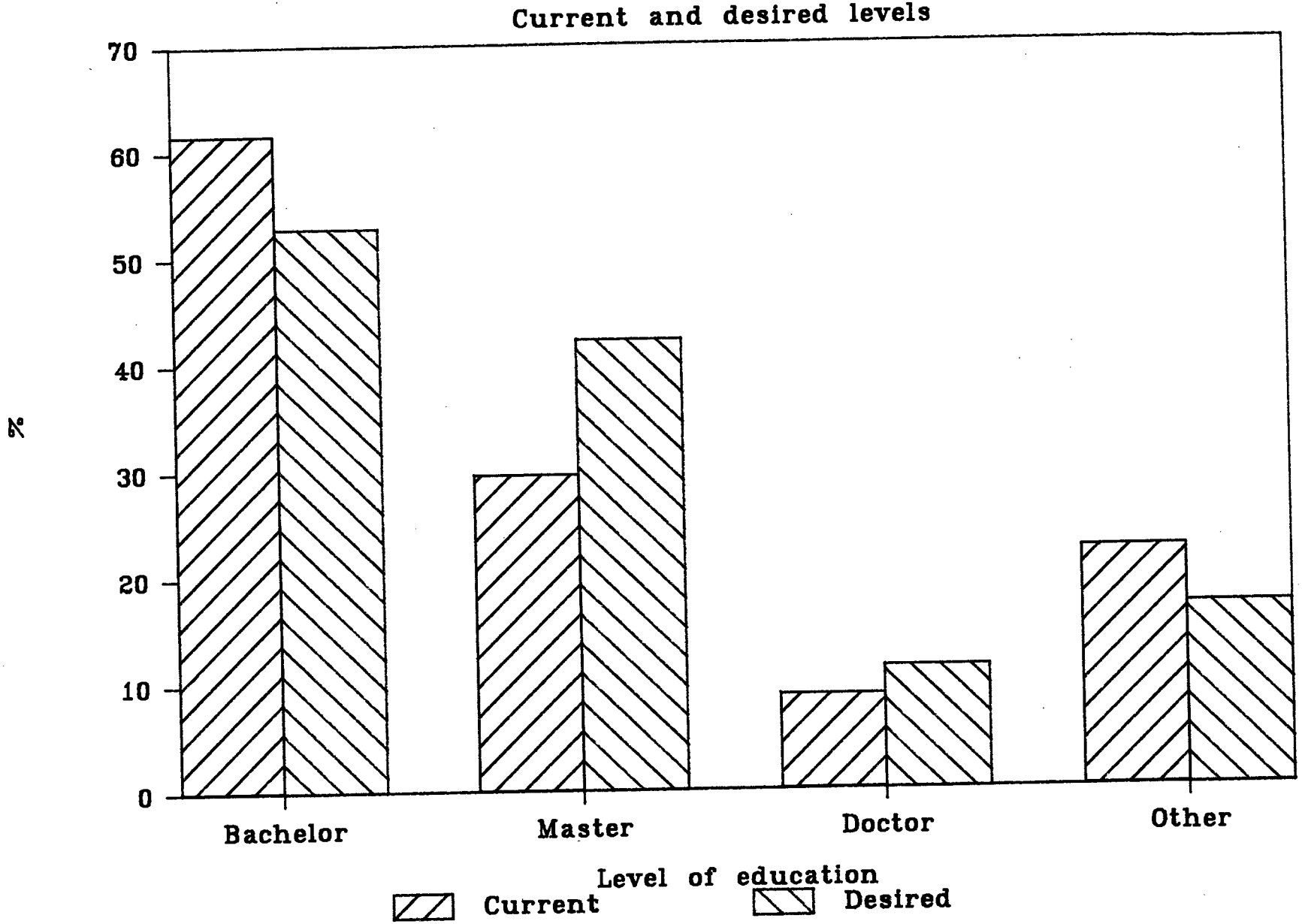
EDUCATION OF QUANTITATIVE METHODS PEOPLE

Question 8. Level of education for people working in quantitative methods. Appendix 6. Tables and figures represent percentage having (or desiring).

Currently the majority of people working in quantitative methods in a business environment have a bachelors degree (61,6%) while 29,6% have a masters degree and 8,8% a doctorate. Figure 6.6 shows the comparison of the current and the desired situations. While management still desire a majority of people with bachelors level qualifications there is a strong need seen for many more with qualifications of a masters level (42,3%). The desired level of masters graduates is significantly higher than the current position (Z = 4,0).

The totals of the categories exceed 100% as many respondents indicated more than one level of education. This was particularly so with regard to "other" where this qualification (usually specified as a professional qualification) was in addition to the university degree. In addition certain respondents indicated a selection of degrees, possibly suggesting that they saw a diversity of people in their quantitative methods division. This is consistent with the preference

FIGURE 6.6 EDUCATION FOR Q.M.PEOPLE



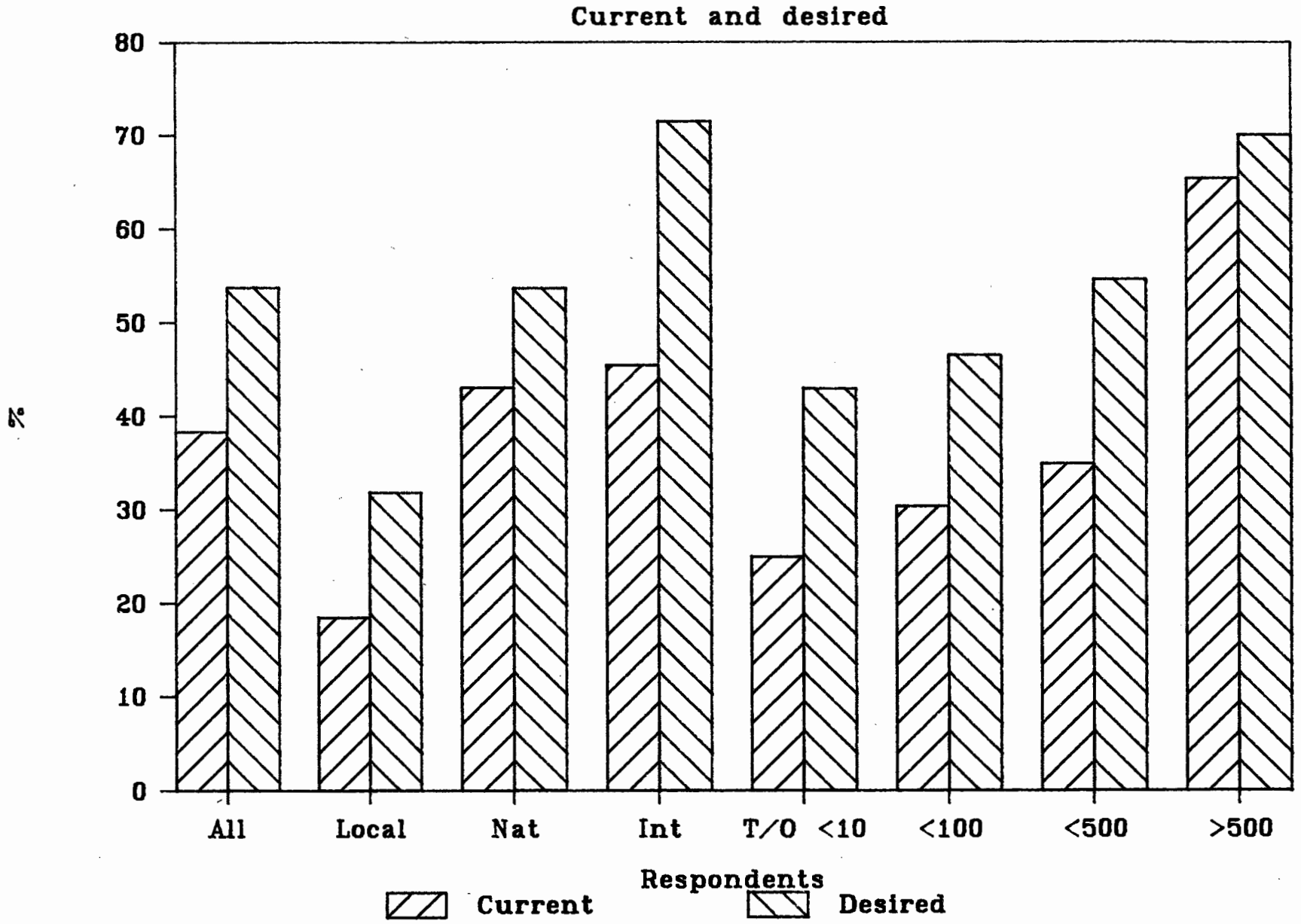
indicated for team work in a later question and with the findings in the interviews.

Since the number of respondents selecting the doctor category was fairly low, the doctor and master categories were combined so that the situation regarding higher degrees could be considered. This is represented in Figure 6.7.

It is clear from Figure 6.7 that all categories see a need for more highly qualified individuals, this is particularly evident among the more widely dispersed companies. Compare the desire for higher degrees among international companies (71,5)% against local companies (31,8%). The large companies (turnover > R500m) seem to already have the desired level of skills. This is probably because they are already well developed in the use of quantitative techniques.

In summary this profession has a very high incidence of people with post graduate degrees. Even more people so qualified are desired, with a masters level of education seen as the area most lacking currently. These observations apply to all the categories of respondents, although not in the same proportions.

FIGURE 6.7 HIGHER DEGREES



THE USE OF TEAMS FOR PROBLEM SOLVING

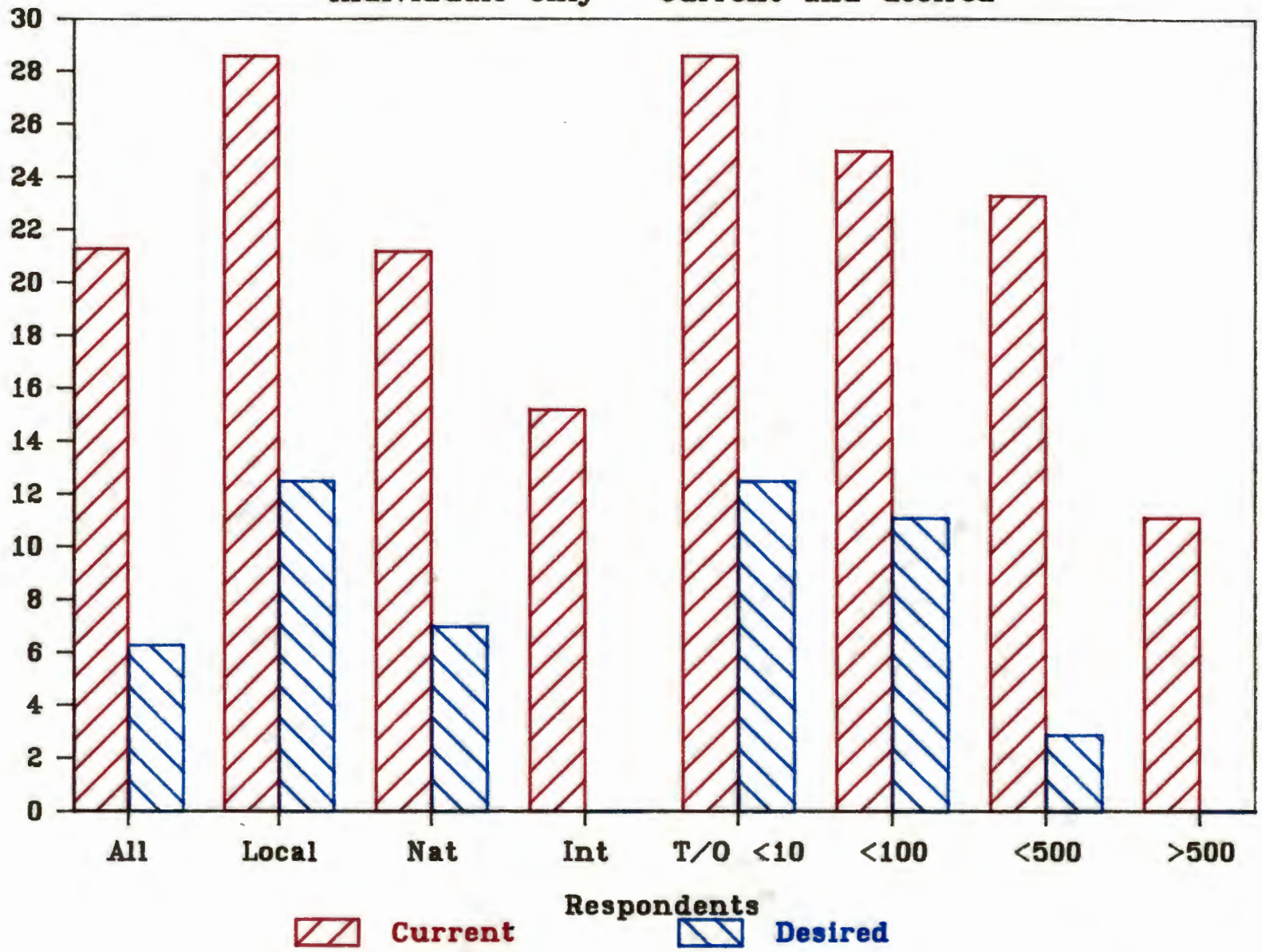
Question 9. The use of teams or individuals for working on problems in quantitative methods. Appendix 7.

Currently a high proportion of the respondents are using the team approach to problem solving with only 21,3% using individuals exclusively. However the desired situation is even more team oriented with only 6,3% of respondents wanting people to work on their own. (Z = 6,6).

Figure 6.8 clearly shows how across the board the desire for problems to be tackled on an individual basis is substantially below the current situation. This is despite the fact that the current situation is already low.

The international companies and the large companies (turnover > R500m) use individuals less than the other categories of respondents. This may be a function of the infrastructure available to the companies. It may also be a function of the nature of the application. This is borne out to some extent by the findings from question 7. It was shown that the larger and the international companies had a greater incidence of the more sophisticated applications. It is submitted that

FIGURE 6.8 TEAMWORK



such applications are more conducive to a team approach.

The analysis of the desired situation demonstrates that the larger and the more widely dispersed companies do not favour the individual approach to problem solving. This favouring for teamwork has implications for people working in quantitative methods. It appears that in addition to technical skills, interpersonal skills will be a necessary prerequisite for the efficient conduct of their duties.

In summary the evidence supporting teamwork is strong and is consistent with the suggestions made in the literature and with the findings of the other questions of this survey.

EDUCATION OF MANAGEMENT

Question 10. Level of education in quantitative methods for the managing director. Appendix 8.

Seven levels of education were identified in increasing order of mathematical competence as follows:-

1 - None

2 - An awareness of the discipline

3 - An awareness of some techniques

4 - An ability to use some techniques

5 - A full understanding of the techniques used

6 - A formal education in statistics and O.R.

7 - A formal education in mathematics

The current and the desired level of education for the full sample is displayed in Figure 6.9. It can be clearly seen that level 5, a full understanding of the techniques used, is the level which shows the greatest change between the current and the desired situations. The other changes are at the lower levels of education,where such levels are less desired. These differences show that management are keen to know more about quantitative methods than is currently the case.

The various categories of respondents showed similar patterns. The only exception being the local companies which showed an already relatively high percentage at level 5. This could be because they are not using very complex techniques. It is also possibly due to a misinterpretation of the question.

Table 6.4 shows the level of education desired by the respondents for each of the levels which they currently have.

FIG.6.9 Q.M.EDUCATION FOR MANAGEMENT

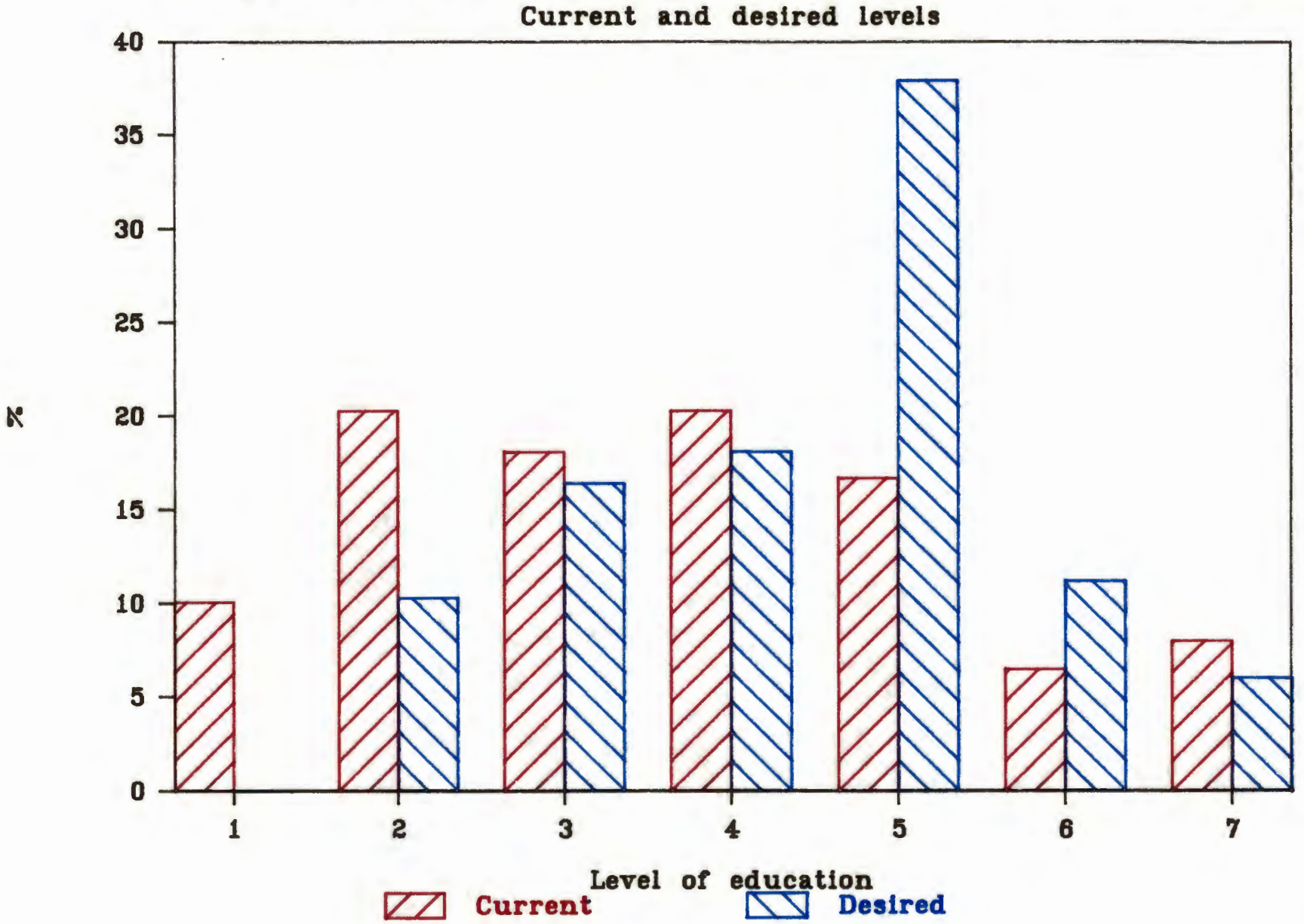


TABLE 6.4	QUANTITATIVE METHODS EDUCATION FOR MANAGEMENT

CROSS TABULATION–CURRENT LEVEL BY DESIRED LEVEL

CURRENT LEVEL	DESIRED LEVEL							
	1	2	3	4	5	6	7	TOTAL
1	0	33	17	25	25	0	0	100
2	0	35	22	17	26	0	0	100
3	0	0	48	28	24	0	0	100
4	0	0	5	25	50	15	5	100
5	0	0	0	0	74	21	5	100
6	0	0	0	0	33	67	0	100
7	0	0	0	12	25	0	63	100

Of those who are currently at level -

1 - 100% desire a higher level

2 - 65% desire a higher level

3 - 52% desire a higher level

4 - 70% desire a higher level

These figures strengthen the suggestion made earlier that management is looking for a slightly higher level of skills in quantitative methods.

Of those managing directors who are currently at level 5, 74% indicated a desire to be at this level. This indicates a high degree of satisfaction with this level. Furthermore of those who currently have levels 6 or 7, 33% and 25% respectively would find level 5 acceptable.

A full understanding of the techniques used (level 5) thus appears to be the focal point to which management aspire in their quantitative methods knowledge. Many suggestions may be made as to the attainment of this level. One method, which became evident during the course of the interviews , is simply through usage. This has somewhat wider implications than the term "usage" simply means. This point will be raised again in the report on the post survey interviews but it is appropriate at this stage to suggest that management may acquire the level of education desired through usage and exposure to the techniques.

may acquire the level of education desired through usage and exposure to the techniques.

PERSONAL ATTRIBUTES

Question 11. Attributes of people working in quantitative methods. Appendix 9.

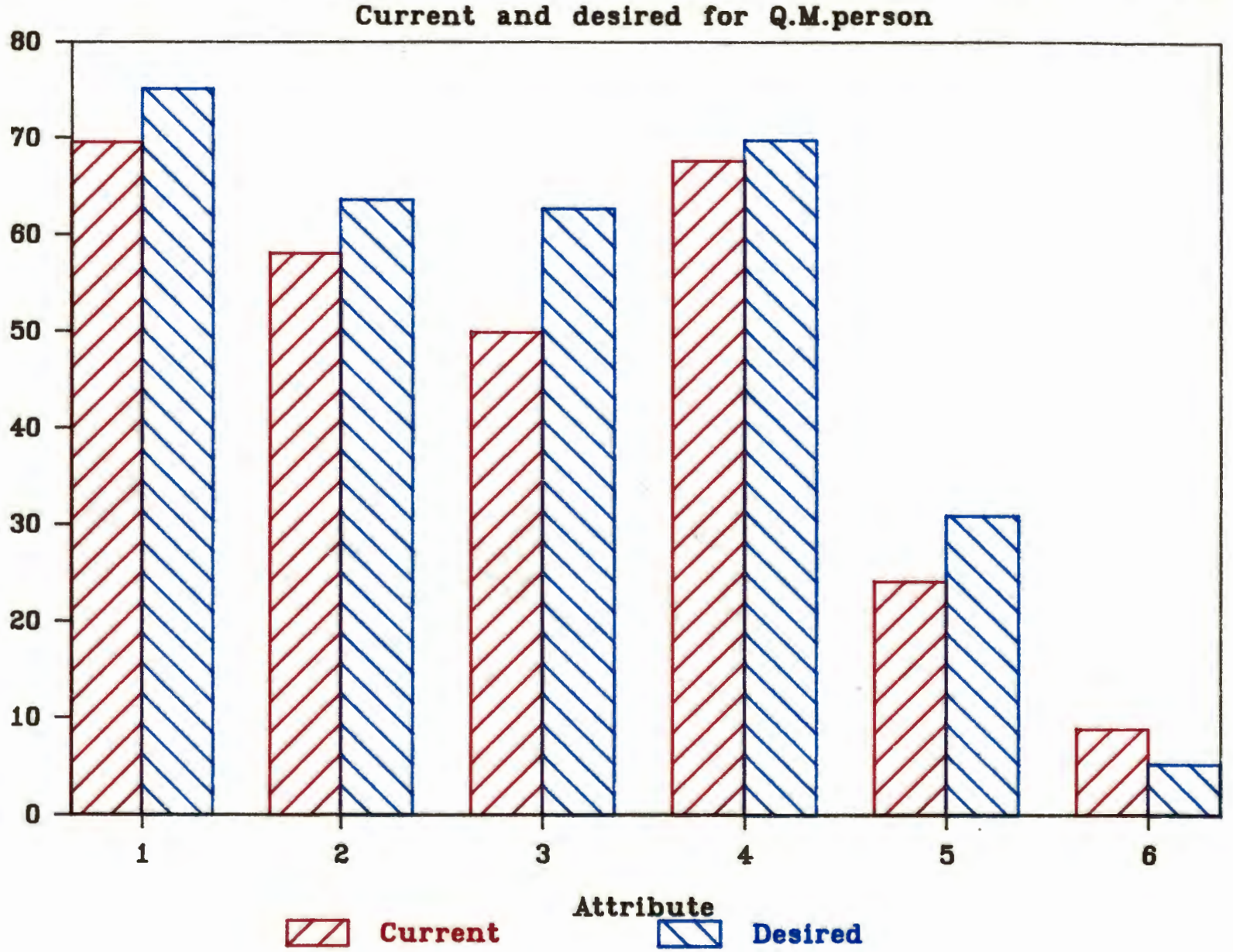
The current and the desired situations for the full sample of respondents are shown in Figure 6.10
The attributes are numbered from 1 to 6 as follows:

1 - Technically competent
2 - Broadminded approach to problems
3 - Possess communication skills
4 - Understand the management process
5 - Project a business image
6 - Willing to play company politics

The profile of the quantitative methods worker is that he is technically competent, has a broadminded approach to problems, possesses communication skills and understands the management process.

That he projects a business image while desirable is not as prevalent an attribute as those mentioned

FIGURE 6.10 PERSONAL ATTRIBUTES



immediately above. The involvement in company politics is not common and is seen as even less desirable.

Figure 6.10 shows the profile of the person currently working in quantitative methods to be very similar to that desired by top management. However each of attributes 1 to 5 is lower than desired which suggests that in general people possessing these attributes are required.

The most significant gap (Z = 4) is that for "communication skills" (attribute 3). Currently 50,0% of the quantitative methods people have this attribute in the opinion of their managing directors, whereas it is considered to be a desirable attribute by 62,8% of respondents. This greater desire for communication skills is consistent with the leaning towards teamwork described earlier.

Significant differences were also noted for attributes 5 (business image) and 6 (politics) with Z = 2,3 and 2,1 respectively. This desire for less involvement in company politics may also be seen as consistent with the move towards teamwork.

The pattern displayed in Figure 6.10 is generally consistent across the cross-sections of respondents,

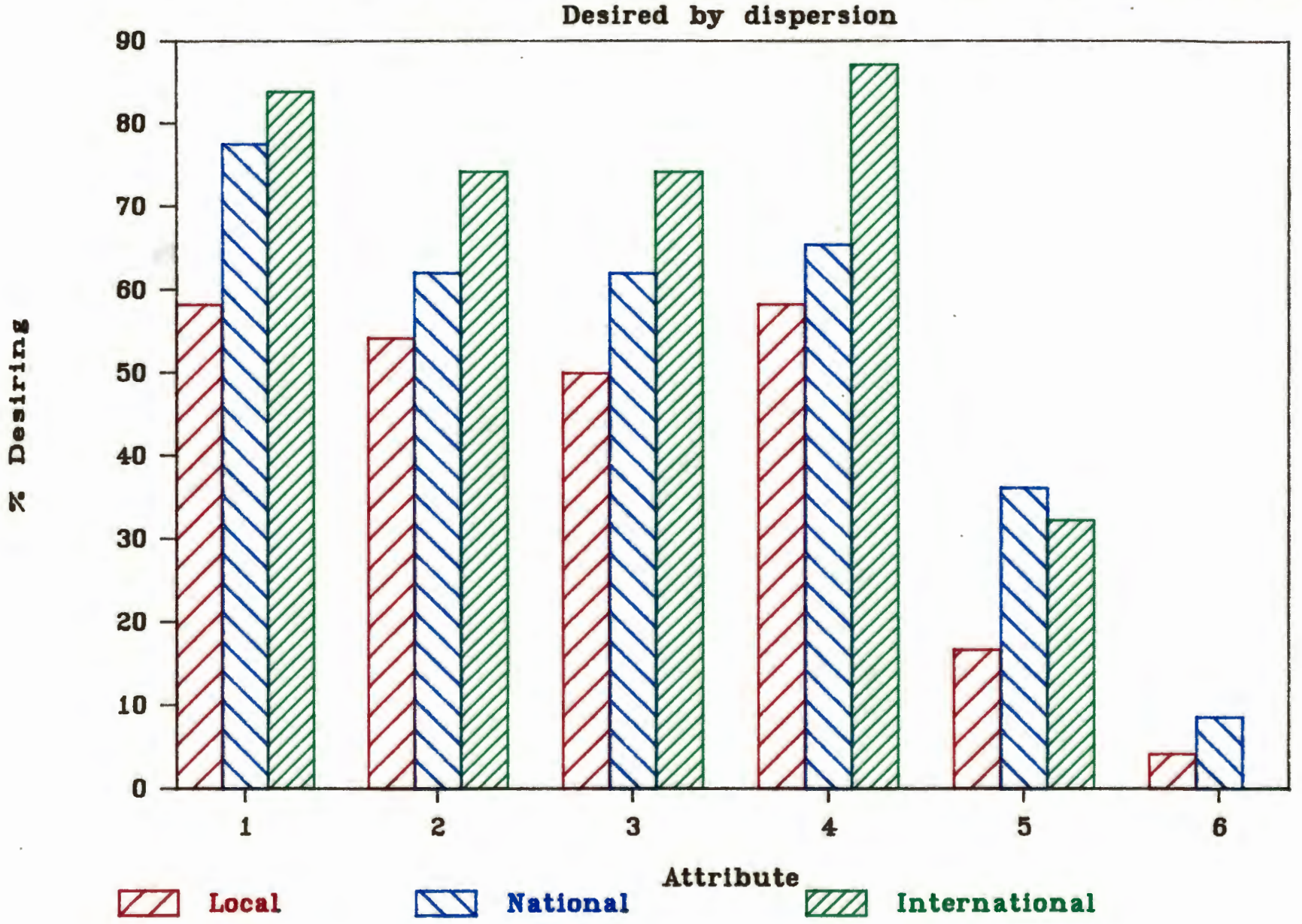
however certain differences are evident. The possession of communication skills and the projection of a business image were less prevalent among local companies, While communication skills and the understanding of the management process were lacking in the larger companies. This may be due to those companies employing technical specialists, or simply that the measure of adequate skill may be higher than among smaller companies. Eg. an understanding of the management process is likely to be more difficult in a large company.

Differing preferences were noted among local, national and international companies. The desire for attributes 1 to 5 is clearly higher among the more widely dispersed companies than among the local companies. (Figure 6.11)

The high desirability for technical competence is consistent with the desire for higher degrees shown earlier among the national and particularly the international companies.

An understanding of the management process scores very highly among the international companies, being the single most desirable attribute with over 87% of respondents desiring this.

FIGURE 6.11 PERSONAL ATTRIBUTES



An earlier question dealt with teamwork, and a very strong tendency towards teamwork was shown. The pattern of responses to this question is consistent with this as these attributes are likely to enhance teamwork.

The clear pattern shown by local, national and international companies in their desire for attributes 1 to 5 is not evident among the categories for size of company. This leads to speculation that the dispersion of the company has some impact. It is possible that the more widely dispersed the company the greater the need for these attributes, particularly the "managerial" skills. There may also be an overseas influence insofar as the demand for such skills is concerned.

In summary, the more important attributes are technical competence, broadminded approach to problems, communication skills and an understanding of the management process. While more of each of these attributes is desirable, the largest gap is for communication skills. It is also apparent that the more widely dispersed a company, the greater the need for these attributes.

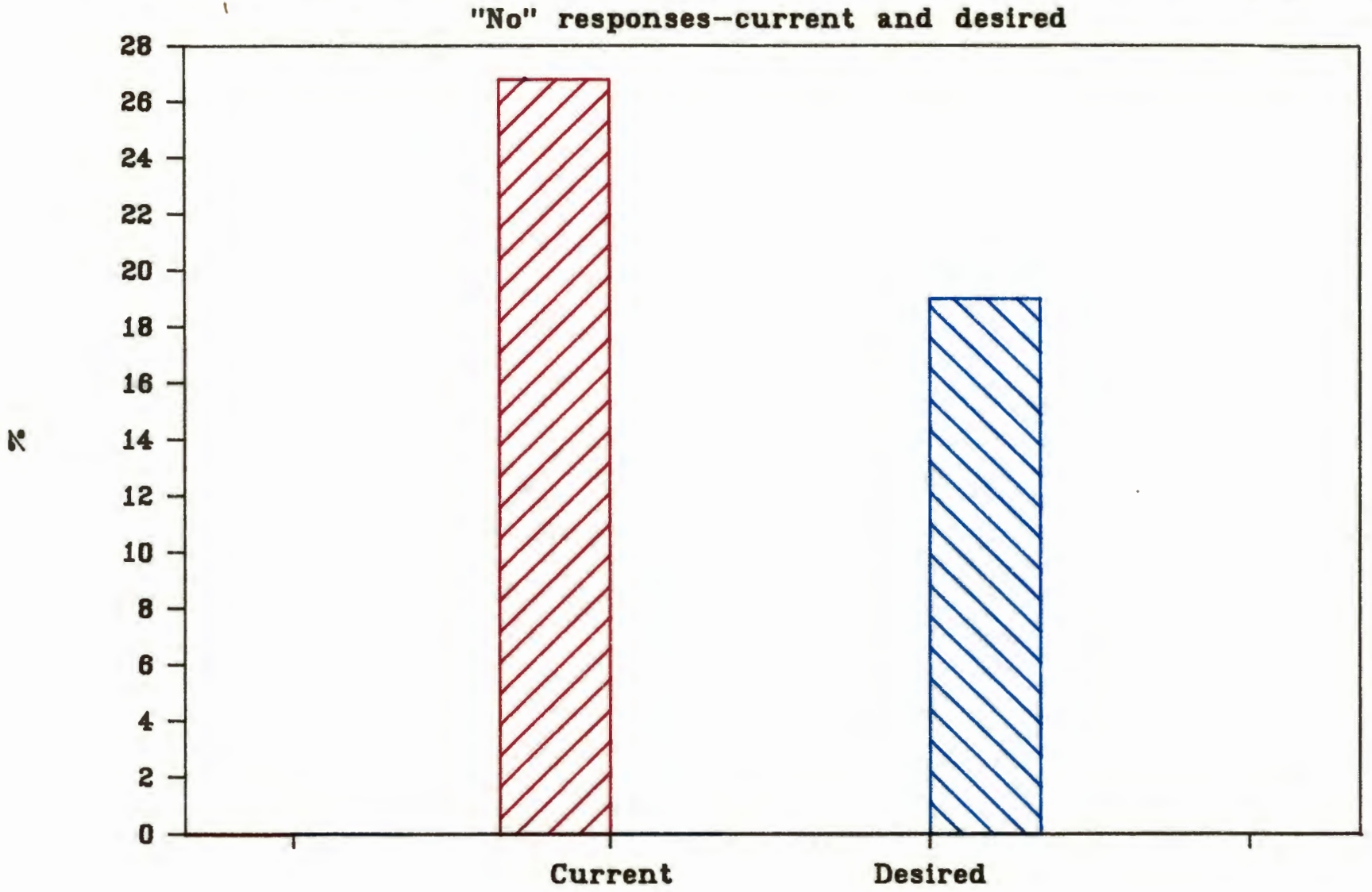
TOP MANAGEMENT POTENTIAL

Question 12. The suitability of the quantitative methods person for a position in top management. Appendix 10.

Some respondents made comments such as "It depends on the individual" or "Anybody is a potential top manager" etc. These were put into the "could be" category. For purposes of analysis the "no" responses are used and are depicted in Figure 6.12.

Few respondents, irrespective of category, believe the quantitative methods person not to be a potential top manager. However fewer still desire this to be the case. The implication being that in certain cases the managing directors do not consider their current quantitative people to be potential top managers. This is represented by the gap between the current and the desired situations as depicted in Figure 6.12. Currently 26,8% of respondents do not consider their quantitative methods people as suitable candidates for top managerial positions whereas only 19,0% believe this should be the case (Z = 3). This may be a consequence of the education received by quantitative methods people and is compatible with the view that a

FIGURE 6.12 TOP MANAGEMENT POTENTIAL



broader education is desirable. (This view is supported in the second questionnaire of this thesis.)

A comparison is made between the top management potential for quantitative methods people and for accountants, both in the second questionnaire and during the interviews, it will be evident that the quantitative methods person is less favourably viewed as a potential top manager.

While the pattern of the responses for the full sample is representative of the various categories there are some differences in the percentage responses.

There is a stronger negation of the top management potential among the local companies than among those more widely dispersed. One possible explanation is that there appears to be a bias among South African companies that their senior management come from certain disciplines, notably financial. This bias does not seem to be as strong among other Western countries.

Somewhat surprisingly the smaller companies (turnover < R100m) show less negation to the quantitative methods people having top management potential. This may be due to the fact that in the smaller companies people are more visible which could lead to a less discipline bound attitude.

more visible which could lead to a less discipline bound attitude.

In summary while the negation of the quantitative methods people as potential top managers is not very strong there is evidence that it could be less so.

SUMMARY

This questionnaire sought to establish two aspects:-

- what is the situation in South Africa
- Which are the areas where the senior management would prefer some other position

POSITION IN SOUTH AFRICA

ORGANISATION STRUCTURE

The quantitative methods divisions are centrally located as opposed to decentralised in the ratio of approximately 2:1

NATURE OF APPLICATION

There is a very low use of providing a final answer to a problem. The other four applications identified are all widely used with a decreasing incidence as sophistication increases.

EDUCATION OF QUANTITATIVE METHODS PEOPLE

The vast majority of people working in quantitative methods are graduates, with approximately one-third having a master or doctoral degree. In addition a little over 20% of the people working in quantitative methods are either professionally qualified or have a number of first degrees.

TEAMWORK

The use of teams for problem solving is extensive with only about one fifth of respondents using individuals exclusively.

EDUCATION OF MANAGEMENT

There is a low to medium level of skill in quantitative methods among South Africa's senior managers.

PERSONAL ATTRIBUTES

Most of the people working in quantitative methods have the following attributes,

- technical competence
- broadminded approach to problems
- communication skills
- understand the management process

About a quarter project a business image and very few get involved in company politics.

TOP MANAGEMENT POTENTIAL

Senior management believes about three quarters of the quantitative methods people have potential to become senior management themselves.

THE POSITION DESIRED BY SOUTH AFRICA'S MANAGERS

ORGANISATION STRUCTURE

The ratio of centralised to decentralised currently at 2:1 was satisfactory. However what did become evident was that there is a greater desire for quantitative methods sections within the organisations surveyed, with less than 10% indicating a preference for no such section.

NATURE OF APPLICATION

The current level of applications is largely as desired except for the use of interactive models for planning for which the desired level of application is approximately 60% as opposed to the current 40%.

EDUCATION OF QUANTITATIVE METHODS PEOPLE

Preference is shown for more people with higher degrees and somewhat less with bachelors degrees. The largest difference being at the masters level.

TEAM WORK

While the current level of team work is already high the desired position is far more so with only 6% of respondents indicating preference for using individuals only on their projects.

EDUCATION FOR MANAGEMENT

Management would like to be more highly skilled in quantitative methods than they currently are, with a full understanding of the techniques used being the focal point.

PERSONAL ATTRIBUTES

All the attributes identified (with the exception of "company politics") are desired at a higher

level with the possession of communication skills currently showing the most significant deficiency.

TOP MANAGEMENT POTENTIAL

The desire for quantitative methods people to be suitable for top management positions is greater than is currently the case (despite the fact that it is already high).

COMPARISON

Table 6.5 compares in general terms the situation suggested in the literature, the current position among South Africa's listed companies and the desired position by the senior management of those companies.

CONCLUSION

The suggestions generated by the literature search are largely consistent with the situation in South African listed companies.

The literature suggested decentralisation as preferable to centralisation. While this is usually regarded as a preferred organisation structure it is dependent on many factors including the nature of the function, the

TABLE 6.5	COMPARATIVE SUMMARY		
FACTOR	LITERATURE	SOUTH AFRICA	DESIRED
Organisation structure	Decentralised with support for centralised	Predominantly centralised	Predominantly centralised
Nature of application	Limited use of "final answer" Growth of interactive models	Low use of "final answer" Other applications widely used	More interactive models
Education of quantitative methods person	3 N/A	Mostly bachelors, some higher degrees	More masters
Teamwork	Supportive	Extensive	More
Education of management	Knowledge and understanding of techniques and how to use them	Awareness of some techniques or less	Understanding of techniques used
Personal attributes	Essential: technically competent broadminded communication skills understands the management process Useful: Business image willing to be involved in politics	As per literature except very low support for "politics"	As per South Africa but more accentuated particularly communication skills
Top management potential	Not addressed	yes	more so

stage of development of the company and of the function.

Table 6.6 presents the significant differences between the current and the desired situations in South Africa. Each of these and its implications has been discussed earlier. The point of interest here is that these differences are all towards the position evidenced by the literature.

The position among respondents is that the factors suggested in the literature as important to the successful use of quantitative methods are largely present, and that where there are differences it is the desire of the managing directors that the "literature position" be attained. Furthermore in almost every question the responses for the international companies were different to those for both national and local companies. Clearly these companies are receiving some overseas influence which causes them to be different. It is of note that the international companies reflect the position suggested by the literature more closely than the other respondents. Interestingly the responses from companies of different sizes are not always consistent with those for the dispersion, thus alleviating any suggestion that it is the size rather than the international influence which causes the differences.

While the position suggested by the literature is largely desired by the respondents, it is of note that the current situation among the international companies is little different to the others (despite the fact that their desired

position is even closer to the literature). It seems therefore that there are certain factors which are holding back the free integration of quantitative methods into the South African business community. Factors which even the international companies have not been able to overcome despite their ability to draw on the experience of their associates.

A reason for this inability to achieve the literature position may well relate to the individuals involved. There was a greater desire for all the important personal attributes as well as for a higher level of education. Affected parties (managers, educators, quantitative methods people, personnel officers etc.) should therefore take steps to facilitate the closing of the gaps.

TABLE 6.6	SIGNIFICANT DIFFERENCES BETWEEN CURRENT AND DESIRED POSITION		
Factor	Current	Desired	Z
No section	28.1	9.1	7.9
Understanding of techniques	16.7	37.9	7.7
Use of interactive models	39.8	62.1	7.0
Individuals	21.3	6.3	6.6
Masters degree	29.6	42.3	4.0
Communication skills	50.0	62.6	4.0
Not top management potential	26.8	19.0	3.0

FOOTNOTES AND REFERENCES

1. Z was calculated using the following formula

$$Z = \frac{P_1 - P_2}{\sqrt{P(1-P)(1/n_1+1/n_2)}}$$

where $$P = \frac{n_1P_1+n_2P_2}{n_1+n_2}$$

and

n = number of observations

P = proportion

2. The listing in the Cape Times on 12 December 1984 was used. Different classes of securities for the same company were ignored.

3. Not addressed in the literature search in terms of the level of degree. The subject of the literature search was not suitable for the type of question addressed here, and has been dealt with in the second questionnaire.

CHAPTER 7

COMPARATIVE SURVEY OF OPINIONS

INTRODUCTION

This section was the subject of a second questionnaire survey. The areas addressed were similar to those in the earlier chapters. In this case the questionnaire was aimed at people using quantitative methods for the purpose of gaining insight into their attitudes towards these areas.

The questionnaire (Appendix 11) was sent, together with an accompanying letter (Appendices 12 and 13) and return, stamped addressed envelope to members of the Operations Research Society of South Africa, their managers and to management consultants. A follow up letter (Appendix 14) was sent a month later.

OBJECTIVE

The aim of this questionnaire was to test the attitudes, of people working in quantitative methods and those of their senior management, to the factors identified in the literature search and confirmed or identified by the first questionnaire.

The objective was to establish areas of similar perception and areas of dissimilar perception.

THE SURVEY

Consequent to the aim above the survey was directed at people using quantitative methods. Members of the Operations Research Society of South Africa were used as the sample for people working in quantitative methods. People who were clearly not employed in a business environment (e.g. academics) were not included . 182 members were surveyed of whom 60 responded yielding 56 usable responses.

The places of employment of the quantitative methods people surveyed above were identified and their senior management surveyed. This was done to achieve a comparison of attitudes between management and

quantitative methods people who are applying quantitative techniques commercially. Since, on occasion, several quantitative methods people worked at the same place, fewer senior managers were surveyed. 157 senior managers were surveyed of whom 39 responded yielding 36 usable responses.

Management consultants were also surveyed in case their attitudes may lend some insight to the analysis. 104 consultants[1] were surveyed of whom 46 responded yielding 32 usable responses. Most of the unusable responses were explanations for not completing the questionnaire (usually very small practice having no experience thereof) .

Thus of a total of 443 questionnaires sent out, 124 usable responses were received.

The responses were analysed using the Statistical Package for the Social Sciences (SPSS) on the Prime Computer at the Graduate School of Business at the University of Cape Town.

The questionnaire was in five parts, the first part sought details about the organisation , while the subsequent four parts examined the subject matter of chapters 2 to 5 of this thesis. The organisation

details were analysed to show that the responses from quantitative methods people and from their managers were from similar companies. The questions in each of the following sections are dealt with sequentially, and where appropriate the results are summarised in tables. Each section is summarised and a comparison is made of similar and dissimilar perceptions by the quantitative methods people and managers. Note that the responses for consultants are presented for interest only. Their results are drawn on only where they enhance or give insight to the analysis

For ease of comparison frequencies are presented in percentage terms.

THE RESPONDENTS

Table 7.1 shows the breakdown of responses received from quantitative methods people and from managers per sector. As can be seen the responses were received from the various sectors in similar proportions for the two categories of respondents. The aim of eliciting responses from the quantitative methods people and from their managers seems to have been achieved.

TABLE 7.1	SECTOR PROFILE	
	Percentage responses	
SECTOR	QUANTITATIVE METHODS	MANAGERS
Mining	19.6	19.4
Banks and financial services	7.1	5.6
Insurance	7.1	5.6
Manufacturing	32.1	30.6
Retailing	9.0	11.1
Consulting	9.0	11.1
Transport	5.4	8.3
Utilities	10.7	8.3
Total	100.0	100.0

Similar proportions were also noted for the other categories such as, locality, size etc. It would thus seem fair to suggest that there should be no bias in terms of industry,size or locality in the responses.

ORGANISATION STRUCTURE

CENTRALISATION

In indicating their preference for the location of the quantitative methods section within the organisation both the people working in those sections and their senior management showed similar preference, with approximately half desiring central location, approximately 30% decentralisation and approximately 10% each for both and for no section.

The question regarding the feasibility of having a decentralised as well as a centralised section with regard to both cost and to organisational problems drew an interesting response. The percentage responses are summarised in Table 7.2 . "Yes" answers only are presented.

TABLE 7.2	FEASIBILITY OF MULTIPLE SECTIONS	
	Percentage responses Feasible with regard to:	
Opinion of	Cost	Organisation problems
Quantitative methods people	65.5	58.2
Managers	47.2	58.3
Consultants	48.3	55.2

As can be seen from the table, the groups had similar opinions regarding potential organisation problems, however, there is a sharp divergence of opinion between the quantitative methods people and management regarding the cost of carrying two sections. (Z=3.5). Clearly this indicates that quantitative methods people have a more optimistic opinion of the cost effectiveness of two sections than management. This difference in opinion between these two groups may stem from perceptual differences on costs or benefits.

TEAMWORK

Opinions regarding teamwork are presented in Table 7.3. Preference for using individuals only are presented.

Managers have a lower preference for the use of teams. This preference is significantly different to that of quantitative methods people (Z=2.67). It is possible that some managers have an erroneous perception of the type of problems to which the quantitative methods can be applied.

TABLE 7.3	USE OF INDIVIDUALS ONLY
Opinion of	Percentage responses
Quantitative methods people	12.5
Managers	22.9
Consultants	28.1

MANAGERIAL LEVEL

The level at which the head of the quantitative method section should be was differently perceived by each category of respondent. (Table 7.4). ($Z=3.7$ for difference between quantitative methods people and managers).

The results are interesting in that quantitative methods people have a much more ambitious perception of where they should be than where management perceive them. It would appear that the expectations of the quantitative methods people are unrealistic especially when one considers the responses of the consultants who are even further removed than the managers. These differences in perception are consistent with those found later in this chapter regarding the top management potential of the quantitative methods people.

FUNCTIONAL AREA

The respondents were largely consistent in their opinions regarding the functional area within which the quantitative methods section should be housed. There was strong support for both corporate planning and for

TABLE 7.4	MANAGERIAL LEVEL		
	Percentage responses In the opinion of		
Managerial level	Q.M.People	Managers	Consultants
Top	58.2	38.9	25.8
Middle	41.8	61.1	74.2
Lower	0.0	0.0	0.0
Total	100.0	100.0	100.0

statistics and operations research from all categories of respondents. These results may well have been expected. It is however interesting to note that there was some support for housing the quantitative methods section within management accounting and finance, from both managers and consultants but not from the quantitative methods people. The relative rejection of this function by the quantitative methods people was not expected since so many of the applications are in the area of finance. There may be an element of professional bias here. This suggestion is supported by the responses to the managerial level of the head of the quantitative methods section and to the top management potential for both quantitative methods people and accountants.

INVOLVEMENT IN DECISION MAKING

Both quantitative methods people and managers showed very strong preference for involving the person who carried out a project in the decision making process. This is consistent with management control theory and is possibly a contributing factor to the success these respondents have achieved in implementation. The analogy may be drawn with the budgeting process in that participation and involvement in the budget setting is

considered to be a motivating factor. The responses are presented in Table 7.5

TABLE 7.5	INVOLVEMENT IN DECISION MAKING		
	Percentage responses In the opinion of		
Degree of involvement	Q.M.People	Managers	Consultants
Involved	83.9	83.3	68.7
Informed	16.1	16.7	31.3
None	0.0	0.0	0.0
Total	100.0	100.0	100.0

SUMMARY

The responses to the questions on organisation structure showed the following points of congruence between management and quantitative methods people.

1. A slight preference for central control over decentralisation.

2. Organisationally it would be feasible to have a decentralised section with central support.

3. The section should be housed with corporate planning or in the statistics and operations research

4. The people carrying out projects should be involved in the decision making process.

Points of difference arose

1. Quantitative methods people considered the cost of a decentralised section, supported by a centralised section , to be feasible - this was contrary to the view of managers. Consultants' views were consistent with those of managers. It is submitted that this is not a serious difference and probably due simply to a lack of information, by one or both groups, regarding the costs involved or the benefits received or both.

2. There was a difference in the perception of level of individual problem solving, with managers seeing more individual involvement than

the quantitative methods people. Despite this both groups showed strong preference for team work.

3. The level at which the head of the quantitative methods section should be was differently seen with managers indicating a lower position.

The thrust of this section shows congruence. The most serious point of incongruence being that of the level at which the head of quantitative methods should be. This difference may have implications for job satisfaction or for attracting suitable people into the business community.

NATURE OF APPLICATION

IMPORTANCE

Table 7.6 summarises the mean ratings in terms of importance for each of the types of applications broken down by each group of respondents. Clearly all the applications are considered to be relatively important, except for providing a "final unqualified" answer to the problem.

A discriminant analysis was carried out on the data. The applications which discriminated were :

- Provide an answer to which management can apply judgement.
- Structure the problem to carry out sensitivity analysis.
- Long-range planning through the use of simulation and interactive models

Managers rated the first and third of these as more important than did the quantitative methods people, while the latter rated sensitivity analysis more highly.

However the mean scores are very close and in two of the three cases consultants score very differently. The discrimination shown is therefore likely to have resulted from consultants having different opinions from the other respondents rather than from differences between managers and quantitative methods people.

Consultants rated closer to the quantitative methods people than to managers.

The greater importance attributed by managers rather than quantitative methods people to certain applications emphasise managements' skills rather than

TABLE 7.6	NATURE OF APPLICATION – IMPORTANCE		
	Mean ratings (Scale 1=low 5=high) In the opinion of		
Nature of application	Q.M.People	Managers	Consultants
Provide a final answer	1.9	2.1	1.9
Provide an answer to which management can apply judgement	4.1	4.3	3.8
Provide a range of possible answers	4.0	4.1	3.9
Structure the problem to carry out sensitivity analysis	3.8	3.6	3.7
Long range planning through simulation and interactive models	3.4	3.6	3.1

the technicalities of the application. However, the lesser rating attributed to sensitivity analysis is in conflict. Since the application of sensitivity analysis requires quantitative skills. An explanation may be that the thought process involved in sensitivity analysis requires a good understanding of the concepts in quantitative methods. This supports the relatively low desire for the application of sensitivity analysis found in the first survey.

While the points above make it difficult for management to apply sensitivity analysis such applications require a thorough understanding of the organisation and its flows and processes, both physical and behavioural. This hinders the quantitative methods person. It is clear that this point needs to be addressed in the education of quantitative methods people.

FREQUENCY

Table 7.7 presents the mean ratings for the frequency for each type of application. The general impression to be derived is that the frequency of application is rated less highly than the importance, this is particularly noticeable in the case of applications for long-range planning.

TABLE 7.7	NATURE OF APPLICATION – FREQUENCY		
	Mean ratings (Scale 1=low 5=high) In the opinion of		
Nature of application	Q.M.People	Managers	Consultants
Provide a final answer	1.7	1.7	1.8
Provide an answer to which management can apply judgement	4.1	4.1	3.8
Provide a range of possible answers	4.0	3.9	3.9
Structure the problem to carry out sensitivity analysis	3.6	3.5	3.6
Long range planning through simulation and interactive models	2.9	2.9	2.6

The various respondents perceived the frequency of use for each application in a similar manner except for those involving long-range planning. However, in this instance the consultants' views differed, while the other categories of respondents showed similar results.

It is interesting to note that while people working in quantitative methods and managers do not discriminate in terms of frequency of application, discrimination was evident in relation to the importance of each type of application, with three types of application yielding discrimination as evidenced earlier.

FUTURE POTENTIAL

Table 7.8 presents the mean ratings for the potential for future application in the functional areas identified.

The potential for future application is seen to be highest in the fields of production and in corporate planning, with finance, marketing and research and development also being relatively highly rated. The

TABLE 7.8	POTENTIAL FOR FUTURE APPLICATION		
	Mean ratings (Scale 1=low 5=high) In the opinion of		
Functional area	Q.M.People	Managers	Consultants
Finance	3.7	4.0	4.1
Marketing	3.7	3.9	3.7
Corporate planning	4.0	4.2	4.0
Personnel	2.4	2.7	2.6
Production	4.2	4.2	4.1
Research and development	3.6	4.1	3.2
Purchasing	3.0	3.3	2.9

potential for application in purchasing was seen to be little more than average, while less than average potential was attributed to personnel. There is therefore a general awareness of the future usefulness of quantitative methods except in personnel and to a lesser extent in purchasing

It is interesting to note that the mean scores for managers were higher than those for the quantitative methods people in general, and particularly in the fields of finance and in research and development. This may imply unrealistic expectations by the managers. On the other hand it is true that financial modelling has become an increasingly important management tool over the last few years. The results of the first questionnaire, reported in chapter 6 of this thesis, showed that the managing directors of listed companies saw a need for interactive modelling far beyond the current level of usage. Much of the interactive modelling is in the area of finance and this emphasis is confirmed in the interviews reported in chapter 8.

The discriminant analysis confirmed the discrimination at finance and at research and development. As mentioned above, the managers rating more highly than the quantitative methods people. This may have been expected in respect of the finance, in addition to the

arguments raised above quantitative methods people in general do not receive a financial education and may not be aware of the potential their discipline has in this area. Perhaps the reverse may have been expected for research and development, simply because quantitative methods people receive training in scientific method and as such are closer to research and development than to finance. Despite this managers rated research and development relatively highly. Management today is becoming increasingly aware of the need for future planning, hence the need to be prepared for a constantly changing environment and the approach of thinking towards the future may be reasons for the high rating.

CARRYING OUT THE EXERCISE

A large difference was noted (Z= 5.7) between the quantitative methods people and managers in the perception of the value of carrying out the exercise as opposed to actually arriving at the answer. The large majority (83.6%) of quantitative methods people considered the exercise itself to be more important than the solution, while only 57.1% of managers held this view. Consultants seemed to identify more closely with the quantitative methods people. The views

expressed by managers here are strange when considered in conjunction with the results from earlier questions in this section.

The responses to the question regarding halting projects before completion were consistent across the groups with approximately 85% admitting to this. This clearly supports the contention that the answer itself is not always the prime objective of an analysis.

GROWTH IN ACCEPTABILITY

The respondents showed similar opinions as to when a growth in the acceptability of quantitative methods was likely to occur. Furthermore no particular time span emerged as preferent, similar ratings were awarded to all time spans suggested except for "never" which was very lowly rated.

Table 7.9 shows that highest growth is expected in applications which require an answer to which management may then apply judgement and in applications which provide a range of possible answers. A relatively high likelihood of growth is also anticipated in applications involving sensitivity

TABLE 7.9	NATURE OF APPLICATION – LIKELIHOOD OF GROWTH		
	Mean ratings (Scale 1=low 5=high) In the opinion of		
Nature of application	Q.M.People	Managers	Consultants
Provide a final answer	1.6	2.2	1.8
Provide an answer to which management can apply judgement	3.9	4.2	4.0
Provide a range of possible answers	4.1	4.2	4.0
Structure the problem to carry out sensitivity analysis	3.7	3.6	3.7
Long range planning through simulation and interactive models	3.4	3.6	3.3

analysis and long-range planning. These observations are consistent across all the groups of respondents.

A very low likelihood of growth is anticipated for the provision of a final unqualified answer. While the provision of a final answer is rated lowly by all groups it is also the only application which shows discrimination among the groups. Managers having a higher expectation for growth in this area than the other respondents.

SUMMARY

A comparison of the responses between quantitative methods people and managers to the questions regarding the nature of applications are summarised in Table 7.10.

The opinion of the quantitative methods people and those of managers are largely similar regarding the importance, frequency and also for growth in acceptability for the various types of application. In the latter case "provision of a final answer" is differentiated between the groups, nevertheless both groups rate this application lowly.

TABLE 7.10	COMPARISON BETWEEN Q.M.PEOPLE AND MANAGERS		
	Opinions with regard to:		
Nature of application	Importance	Frequency	Growth
Provide a final answer	Sim	Sim	Dis
Provide an answer to which management can apply judgement	Sim	Sim	Sim
Provide a range of possible answers	Sim	Sim	Sim
Structure the problem to carry out sensitivity analysis	Dis	Sim	Sim
Long range planning through simulation and interactive models	Sim	Sim	Sim

Sim = similar opinions

Dis = dissimilar opinions

Structuring the problem for sensitivity analysis was shown to be a discriminating application. Somewhat surprisingly mangers rating this application as less important than the rating given by quantitative methods people.

Potential application was considered to be highest by both groups in the areas of corporate planning and in production. High ratings were also given to finance and marketing

The ratings for finance were seen to be distinguishing with managers rating higher than quantitative methods people. A large difference in the ratings for research and development was evident with managers giving this a high rating, whereas the quantitative methods people rated a little above average.

A large difference was evident in the perception of the benefit to be gained from carrying out the analysis as opposed to actually arriving at an answer. Managers being less satisfied at not actually receiving an answer.

All groups had similar opinions regarding the timing of the growth in acceptability. The only point of note

being that all the groups considered the likelihood of no growth in acceptability to be very remote.

To generalise, similar perceptions were evident regarding

- the importance of types of application
- frequency of types of application
- growth of acceptability of types of application
- functional area of potential application (with two exceptions)
- timing of growth of acceptability

Differences were evident regarding

- potential application in the areas of research and development and finance
- The benefits to be derived from carrying out the exercise as opposed to the answer itself.

EDUCATION

QUANTITATIVE METHODS EDUCATION

The opinions as to what education the university should provide in the quantitative methods courses are presented in Table 7.11.

There is clearly a strong preference shown for somewhat less emphasis on mathematics and techniques and more on the application of techniques and the provision of a broader education generally and a managerial focus specifically.

These observations are consistent across the groups, most differences being small. There is a significant difference ($Z = 3.6$) in the attitude to a broader education shown by managers. Over 91% considered a broader education to be desirable as opposed to 77% in the case of quantitative methods people. This emphasises the need for people in business to have a broad base and is consistent with the preference shown for the team approach to problem solving

TABLE 7.11	UNIVERSITY EDUCATION IN QUANTITATIVE METHODS		
	Percentage responses In the opinion of		
The University should teach	Q.M.People	Managers	Consultants
More techniques	44.4	50.0	62.5
More mathematics	22.2	19.4	25.0
More applications	90.7	86.1	96.9
Broader education	76.9	91.4	71.9
Management education	90.7	88.9	93.8

Despite this difference, the preference for increased education in the last three identified areas is striking.

This preference is consistent with the literature search and with other findings of this study. It is worth noting at this point that the technical expertise of the quantitative methods person is respected and desirable[2] and that the preference shown above should not be taken to imply a significant lowering of these skills, if any at all.

Many of the questions that followed in the questionnaire asked for rankings, the responses have therefore been analysed using medians and modes rather than means.

Table 7.12 shows the medians and modes to the rankings provided by respondents as to where additional teaching time should be spent. The results are consistent with those shown by the previous question. Techniques and mathematical theory are shown to be least preferred with high preference shown for applications, management education and broader education. The responses provided by managers in ranking "broader education" third is inconsistent with the comparable response to the previous question. However, in viewing the questions

TABLE 7.12	ADDITIONAL TEACHING TIME		
	Rankings – median(mode) scale 1=most preferred 5=least preferred In the opinion of		
Additional time devoted to	Q.M.People	Managers	Consultants
More techniques	4(4)	4(4)	3(3&4)
More mathematics	5(5)	5(5)	4(4)
More applications	2(1)	1(1)	2(1)
Broader education	3(2)	3(3)	3(3&5)
Management education	2(2)	2(2)	2(1)

together a possible interpretation is that managers believe that universities should provide a broad education but not at the expense of applications or management education.

LEVEL OF EDUCATION

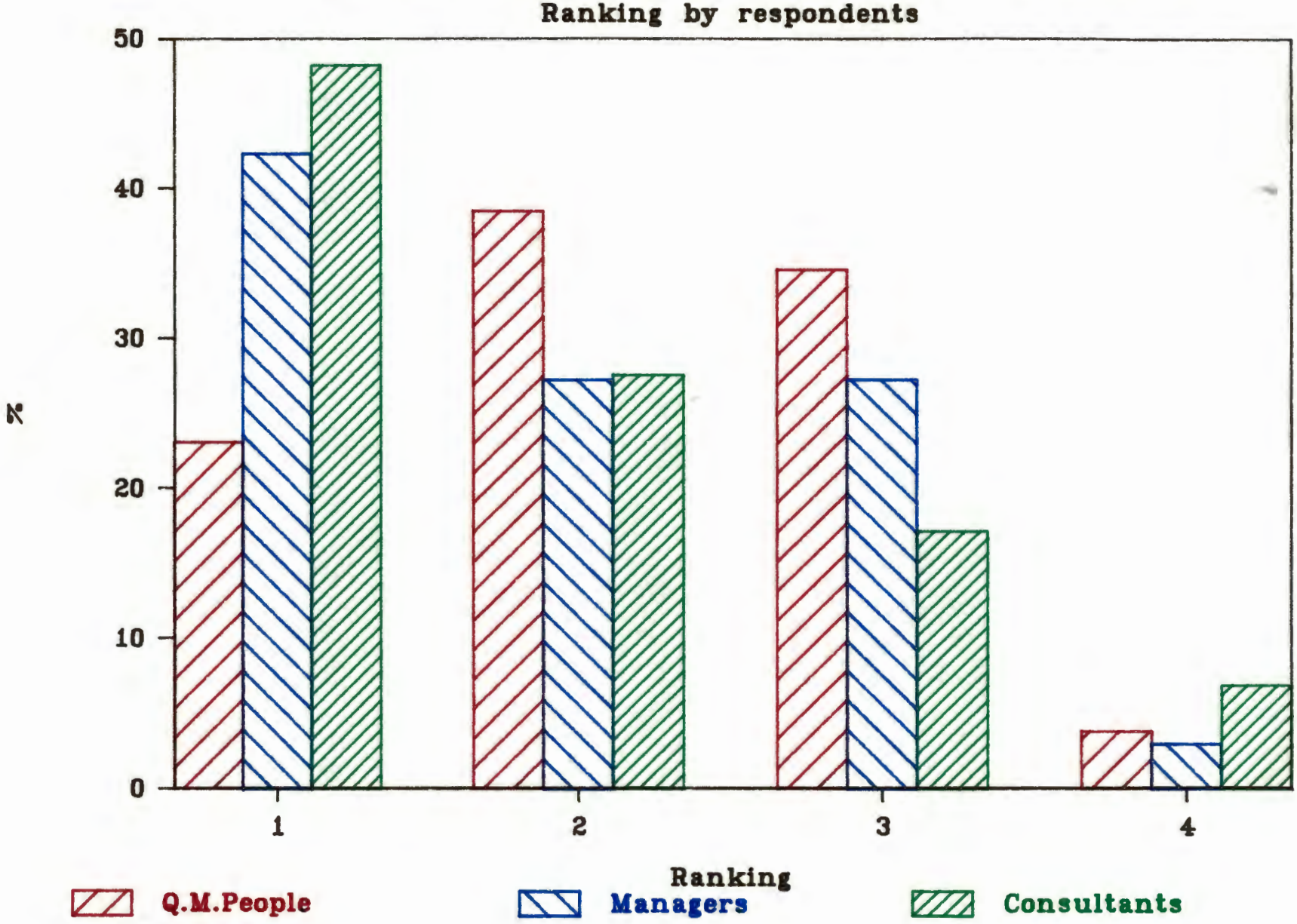
Across all groups strong support is shown for a master's level of education (Table 7.13). There is a difference in the preference shown for holders of Bachelor degrees. The support for Bachelors is low among quantitative methods people while it is fairly strong among the other groups. This is depicted in Figure 7.1. where the rankings are shown.

Since there were very few responses for "other" these have not been presented. However of those who did respond the holding of degrees in different disciplines was most frequently cited. This is consistent with the preference for a broader education.

It is clear that a high level of education is the preference of all respondents, but that PhDs are considered to be too high. These observations complement the findings of the first survey.

TABLE 7.13	LEVEL OF EDUCATION		
	Rankings – median(mode) scale 1=most preferred 3=least preferred In the opinion of		
Education level	Q.M.People	Managers	Consultants
Bachelor	2(2)	2(1)	2(1)
Master	2(1)	1(1)	2(2)
Doctor	3(3)	3(3)	3(3)

FIGURE 7.1 BACHELOR DEGREE



PRACTICAL TRAINING

Opinions regarding practical training for quantitative methods are presented in Tables 7.14 and 7.15.

Table 7.14 shows the responses to the question regarding when the practical training, if any, should occur.

The responses are somewhat dispersed, however certain patterns are evident. Firstly, there is virtually no support for no practical training. As to the timing of such training, the respondents do not appear to have a firm preference. However it appears that strongest preference is shown for "after university education" and for "between under and postgraduate degrees". There is some support for during postgraduate with considerably less for during undergraduate studies. These observations are consistent across the groups of respondents. These general trends are not surprising since practical training is likely to be more appreciated and more beneficial after the individual has gained some practical experience. There may perhaps be a need for some period of apprenticeship or articles similar to that required of accountants and attorneys?

TABLE 7.14	TIMING OF PRACTICAL TRAINING		
	Rankings – median(mode) scale 1=most preferred 5=least preferred In the opinion of		
Timing	Q.M.People	Managers	Consultants
After university education	3(1)	2(1)	2(1)
Between under and postgraduate degree	2(1)	2(1)	2(1)
During post–graduate degree	3(3)	3(3)	2(2)
During under–graduate degree	3(4)	3(4)	4(4)
No such training necessary	5(5)	5(5)	5(5)

Assuming that the university did attempt to provide some practical training, Table 7.15 shows the opinions as to the method that should be used.

The general trend was support for all three methods of practical training with very little support for no training. However some diverging opinions were shown. The managers showed strong preference for the use of projects while quantitative methods people were more enthusiastic about using students on supervised consultancies than their managerial counterparts. This is not altogether surprising as managers would be expected to baulk at the thought of students investigating their business, the likelihood is that they would expect this to be disruptive not to mention any considerations regarding confidential and sensitive information. However some of this reaction may be due to fear, and once having experienced a student consultancy they may be less reluctant. The cases reported in the first part of this thesis certainly showed positive reaction.

TABLE 7.15	METHOD OF PRACTICAL TRAINING		
	Rankings – median(mode) scale 1=most preferred 4=least preferred In the opinion of		
Method	Q.M.People	Managers	Consultants
Case studies	2(3)	3(3)	2(2&3)
Projects	2(2)	1(1)	1(1)
No training	4(4)	4(4)	4(4)
Supervised consultancies	2(1)	2(3)	3(3)

QUANTITATIVE METHODS EDUCATION FOR MANAGEMENT

Having examined the education of quantitative methods people the survey turned to the question of quantitative methods education for management.

INTEGRATION INTO MANAGEMENT STUDIES

The respondents were almost unanimous (Table 7.16) in their opinion that quantitative methods education for management students had either already started or should start immediately. This shows the importance attached to such education by all groups of respondents. Supporting this is the fact that not a single respondent felt such education to be unnecessary.

Note: although there were differences between quantitative methods people and managers in their responses to the first two categories, these were not considered to be serious nor were they significant (Z=1.5).

TABLE 7.16	MANAGEMENT EDUCATION IN QUANTITATIVE METHODS		
Education should start	Percentage responses In the opinion of		
	Q.M.People	Managers	Consultants
Already started	60.7	52.8	46.7
Now	37.5	44.4	40.0
Within 5 years	1.8	0.0	10.0
Within 10 years	0.0	2.8	3.3
Never	0.0	0.0	0.0
Total	100.0	100.0	100.0

EXTENT OF EDUCATION

The extent of quantitative methods education necessary for management is very similarly perceived by both managers and by quantitative methods people. As can be seen from Table 7.17 the ability to use some techniques is most highly ranked by both groups. However the rankings by consultants showed differences in that this group ranked a full understanding of the techniques most highly as opposed to a "middle" ranking by the other two groups. The ranking by the consultants in this case is similar to that by the managing directors of listed companies surveyed in the first questionnaire.

Opinions were also sought concerning the level of quantitative methods education necessary for an accountant. These are presented in Table 7.18. An accountant was chosen because he is a person with whom the quantitative methods people will often have to interface. In addition he is a user himself, particularly with regard to financial modelling and applications such as sales forecasting.

The extent of quantitative methods education desirable for an accountant showed very similar results to those for managers. A notable exception was "a full

TABLE 7.17	QUANTITATIVE METHODS EDUCATION FOR A MANAGING DIRECTOR		
	Rankings – median(mode) scale 1=most preferred 7=least preferred In the opinion of		
Level of education	Q.M.People	Managers	Consultants
None	7(7)	7(7)	7(7)
Awareness of discipline	3(3)	3(1)	4(4)
Awareness of techniques	2(2)	2(2)	3(3)
Ability to use techniques	2(1)	2(1)	2(2)
Understanding of techniques	4(4)	3(4)	2(1)
Education in statistics and operations research	5(5)	5(5)	5(5)
Education in mathematics	6(6)	6(6)	6(6)

TABLE 7.18	QUANTITATIVE METHODS EDUCATION FOR AN ACCOUNTANT		
	Rankings – median(mode) scale 1=most preferred 7=least preferred In the opinion of		
Level of education	Q.M.People	Managers	Consultants
None	7(7)	7(7)	7(7)
Awareness of discipline	3(3)	4(3)	4(6)
Awareness of techniques	2(2)	2(2)	3(2)
Ability to use techniques	2(1)	2(1)	2(1)
Understanding of techniques	3(4)	2(2&4)	2(1)
Education in statistics and operations research	5(5)	5(5)	5(5)
Education in mathematics	6(6)	6(6)	6(6)

understanding of the techniques used" which was ranked more highly in general across all the respondents. More specifically managers ranked this level of skill more highly than did the quantitative methods people.

This discrepancy may be because the quantitative methods people are not aware of the extent to which accountants use such techniques (note the rankings for consultants, a large number of the consultants are accountants). Or there may be different perceptions regarding the role of the accountant as interface with quantitative methods.

SEMINARS

The perceived benefits to be derived from the attendance at seminars are presented in Table 7.19.

A significant difference (Z=2.5) in perception between quantitative methods people and managers is noted in the responses to this question. While 73% of quantitative methods people consider seminar attendance to partly educate management in quantitative methods only 61% of managers believe this to be the case. The consultants were even less favourably disposed (45%) towards seminars as a satisfactory means of education.

TABLE 7.19	SEMINAR EDUCATION FOR MANAGEMENT		
	Percentage responses In the opinion of		
Adequacy	Q.M.People	Managers	Consultants
Sufficiently	8.9	11.1	16.1
Partly	73.2	61.1	45.2
Little or no benefit	17.9	27.8	38.7
Total	100.0	100.0	100.0

The groups show a similar pattern in considering seminars to be of little or no benefit.

The differences in these responses by the groups may be due to their having different expectations from attendance at seminars. For example the quantitative methods person may feel that if his manager attended a seminar and got some idea of what a technique was about, the exercise would have been worthwhile. On the other hand, the same manager at the same seminar may not be satisfied unless he could at least apply the technique in a relatively simple situation.

IN-HOUSE SEMINARS

All groups considered in-house seminars to be preferable to public seminars. This is no doubt because the seminar can then be specifically directed at the attending group. This matter is addressed in the interviews for the case studies (chapter 8), and the opinion was expressed that the interaction with people from other organisations and the exposure to new ideas gained at public seminars was invaluable.

Table 7.20 presents the opinions as to who should present the in-house seminars. The responses total more

TABLE 7.20	IN-HOUSE SEMINARS		
	Percentage responses In the opinion of		
Presenter	Q.M.People	Managers	Consultants
Training manager	6.8	6.1	17.9
Quantitative methods manager	54.5	48.5	46.4
Functional head	6.8	27.3	10.7
Outside party	56.8	42.4	50.0

than 100% as respondents could indicate more than one preference.

Strongest support is shown for the quantitative methods manager and for an outside party, which was to have been expected. Of interest is the fact that managers showed considerably more support than the other groups for the functional head. This may be due to the expectation that they would then be more likely to be addressed in terms that they could understand and relate to more readily.

COMMUNICATION

Table 7.21 shows that most respondents consider both parties have an equal responsibility for effective communication. However, consistent with the views of Graham[3] cited earlier in this thesis, there is some support for the quantitative methods person bearing more than his share of the responsibility.

SUMMARY

The questions on education may be classified into two parts, firstly those concerning the education of the

TABLE 7.21	RESPONSIBILITY FOR COMMUNICATION		
	Percentage responses In the opinion of		
Responsible party	Q.M.People	Managers	Consultants
Manager entirely	1.8	5.6	9.7
Manager mainly	8.9	8.3	22.6
Quantitative methods person entirely	5.4	0.0	0.0
Quantitative methods person mainly	16.1	22.2	16.1
Both equally	67.8	63.9	51.6
Total	100.0	100.0	100.0

quantitative methods people and secondly those concerning the quantitative methods education of management.

Quantitative Methods People

The views on the education of people in quantitative methods were similar in the following aspects:

- Less emphasis on techniques and theory and more on applications and a broader and managerial type education.
- A master's level of education is preferred.
- Practical training is required, preferably after the undergraduate degree, either before or after the postgraduate degree.
- The university should attempt to provide practical training of some sort.

There were few points of divergence the only ones of note being:

- Quantitative methods people show less support for a bachelor's degree only and they show some support for multiple degrees.
- As regards the universities' provision of practical training, quantitative methods people showed preference for using students on supervised

consultancies while their managerial counterparts were less enthusiastic and preferred projects.

Management

With regard to the quantitative methods education for management the following were the areas of congruence:

- Almost all the respondents thought the integration of quantitative methods into the education of management had either started or should start now.
- The ability to use some techniques was seen to be the most desirable level of quantitative methods for management by both quantitative methods people and by management. Similar responses were received for the education of an accountant.
- In-house seminars are preferable to public seminars for educating management in quantitative methods and such seminars should be conducted by either the quantitative methods manager or by an outside party.

Only minor differences were noted:

- Managers ranked a full understanding of the techniques used slightly higher for

accountants than did the quantitative methods people.

- The usefulness of seminars for the education of management was seen to be greater by the quantitative methods people than by the managers. However, the quantitative methods people were slightly less supportive of in-house seminars than managers.
- Managers showed some preference for functional heads to conduct in-house seminars.

Finally, the responsibility for effective communication was largely seen to be a joint responsibility with some evidence that the quantitative methods person should be mainly responsible

PERSONAL ATTRIBUTES

IMPORTANCE

The respondents were asked to rate the various personal attributes in terms of importance for a top manager, an accountant and a quantitative methods person.

Accountants were selected as the third group because they are similar to quantitative methods people insofar as they belong to a numerate profession assisting with the decision making function within the organisation. On the other hand, a glance at the annual reports of South African listed companies will show that, unlike quantitative methods people, accountants fill many senior positions. It was hoped to gain some insight into this by comparing the responses.

The personal attributes desirable for a top manager are presented in Table 7.22. The mean ratings for each variable in the opinion of each group of respondents are shown. Technical competence, broad-minded approach to problems, possessing communication skills, and an understanding of the management process are all highly rated. While quantitative methods people place more weight on the projection of a business image and the involvement in company politics than do their managerial counterparts.

The perception of the personal attributes for quantitative methods people are presented in Table 7.23. The views are consistent between quantitative methods people and managers. In brief, the quantitative methods person should be technically competent, have a

TABLE 7.22	PERSONAL ATTRIBUTES – TOP MANAGEMENT		
	Mean ratings (Scale 1=low 5=high) In the opinion of		
Attribute	Q.M.People	Managers	Consultants
Highly educated	2.9	3.3	2.8
Technically competent	4.2	4.2	4.2
Broadminded approach to problems	4.3	4.4	4.3
Possess communication skills	4.4	4.5	4.2
Understand the management process	3.9	4.1	4.1
Project a business image	3.0	2.7	2.7
Willing to play company politics	2.3	2.0	1.8

TABLE 7.23	PERSONAL ATTRIBUTES – QUANTITATIVE METHODS PERSON		
	Mean ratings (Scale 1=low 5=high) In the opinion of		
Attribute	Q.M.People	Managers	Consultants
Highly educated	3.4	3.7	3.5
Technically competent	4.6	4.6	4.5
Broadminded approach to problems	4.7	4.6	4.3
Possess communication skills	4.6	4.4	3.9
Understand the management process	3.9	3.8	3.8
Project a business image	2.7	2.4	2.4
Willing to play company politics	2.1	1.8	1.4

broadminded approach to problem solving and possess communication skills.

Of less importance but still desirable he should be highly educated and understand the management process.

It is relatively unimportant that he project a business image and undesirable that he get involved in company politics.

These opinions are consistent with the findings in the first survey where managing directors of listed companies were asked to identify the attributes they desired in their quantitative methods people.

It is interesting to compare the personal attributes for managing directors, accountants, and quantitative methods people in the opinion of the three categories of respondents. This is presented in Table 7.24. A discriminant analysis was carried out on the responses to identify which attributes discriminate among top management, quantitative methods people and accountants.

Each of the attributes was shown to be a discriminating factor.

TABLE 7.24	PERSONAL ATTRIBUTES – COMPARISON								
	Mean ratings (Scale 1=low 5=high) In the opinion of								
	Q.M.People			Managers			Consultants		
Attribute	Man	Acc	QMP	Man	Acc	QMP	Man	Acc	QMP
Highly educated	2.4	2.9	3.4	2.8	3.2	3.7	2.4	2.5	3.5
Technically competent	3.7	4.5	4.6	3.6	4.5	4.6	3.5	4.5	4.5
Broadminded approach to problems	4.5	3.8	4.7	4.4	4.2	4.6	4.5	4.0	4.3
Possess communication skills	4.6	4.1	4.6	4.8	4.3	4.4	4.6	4.2	3.9
Understand the management process	4.2	3.7	3.9	4.6	3.9	3.8	4.7	3.7	3.8
Project a business image	3.1	3.1	2.7	3.2	2.6	2.4	3.0	2.7	2.4
Willing to play company politics	2.5	2.2	2.1	2.4	1.8	1.8	2.4	1.6	1.5

Man = top management

Acc = accountants

QMP = quantitative methods people

Highly educated

It was the opinion of all respondents that the quantitative methods person be highly educated relative to managers and accountants. There was a slight difference, in that while managers saw accountants as less educated than quantitative methods people they did see them as more highly educated than managers. The other respondents did not make such a distinction.

Technically competent

All groups rated it less important for managers to be technically competent than for accountants or quantitative methods people.

Broadminded approach to problems

All groups were consistent in rating it less important for an accountant to have a broadminded approach to problems than the managers or quantitative methods people.

Possess communication skills

The groups were not consistent in the discrimination for this attribute. Quantitative methods people saw this attribute to be equally

important for themselves and for top management while less so for accountants.

Management on the other hand grouped the quantitative methods people with accountants and considered it more important for themselves to possess this attribute.

Management consultants saw all the groups differently in that the possession of communication skills was rated most important for top managers, then for accountants and least important for the quantitative methods people

Understand the management process

All groups were consistent in distinguishing the top management as the group for whom it is most important to possess this attribute.

Project a business image

This attribute discriminated between the groups of respondents. The quantitative methods people considered this attribute to be less important for themselves than for the other groups. Managers, however, lumped the accountants and the quantitative methods people together and saw the attribute as being more important for themselves.

Willing to play company politics

Managers were distinguished as the group to whom this attribute was more important. All respondents concurred.

The above discriminant analysis is summarised in Table 7.25.

The last two questions tested the opinion of the respondents as to the potential for accountants and quantitative methods people for positions in top management.

The responses (Table 7.26) show vastly diverging opinions. Quantitative methods people consider themselves to be better top management potential than accountants while consultants hold a strongly opposite view.

Both these groups are naturally biased. It is to be expected that quantitative methods people would consider themselves well suited to senior positions and likewise for accountants (a large number of consultants are accountants). What is revealing is the size of the difference with consultants showing a very large

TABLE 7.25	PERSONAL ATTRIBUTES – SUMMARY		
	In the opinion of		
Attribute	Q.M.People	Managers	Consultants
Highly educated	QMP more	QMP most Man least	QMP more
Technically competent	Man less	Man less	Man less
Broadminded approach to problems	Acc less	Acc less	Acc less
Possess communication skills	Acc less	Man more	Man most QMP least
Understand the management process	Man more	Man more	Man more
Project a business image	QMP less	Man more	QMP least Man more
Willing to play company politics	Man more	Man more	Man more

Man = top management

Acc = accountants

QMP = quantitative methods people

TABLE 7.26	POTENTIAL FOR TOP MANAGEMENT		
	Percentage responses Not a candidate for top management In the opinion of		
Profession	Q.M.People	Managers	Consultants
Quantitative methods people	16.1	30.6	50.0
Accountants	28.6	8.3	12.5

negation of the quantitative methods person's potential for top management.

Perhaps the group best suited to express an opinion on this matter are the managers themselves, as they surely are aware of the requirements needed and the potential of their subordinates. It is thus all the more telling that the managers' view is even more accomodating to accountants and strongly negative to quantitative methods people relative to the quantitative methods people themselves.

SUMMARY

The groups were consistent in the following views regarding the importance of attributes for a quantitative methods person:

- The most important attributes are technical competence, a broadminded approach to problems and the possession of communication skills
- Less important but still desirable are an understanding of the management process and a high education
- Relatively unimportant are the projection of a business image and the willingness to play company politics.

The groups were consistent in identifying the following attributes which discriminate between quantitative methods people, top managers and accountants:

- it is more important for quantitative methods people to be highly educated.
- it is less important for top management to be technically competent.
- it is less important for accountants to possess a broadminded approach to problems.
- it is more important for managers to understand the management process.
- it is more important for managers to play company politics.

The following incongruencies were noted:

- the quantitative methods person distinguishes between himself and an accountant as far as the possession of communication skills (more important) and the projection of a business image (less important). Management makes no such distinction between quantitative methods people and accountants.
- a strong difference of opinion was noted in the potential for top management. Quantitative methods people saw themselves as potential top managers and more so than accountants. This view was not

supported by top managers and in fact was strongly reversed.

Table 7.27 presents the mean ratings for each of top manager, accountant and quantitative methods people as scored by the managers.

With the exception of highly educated, the mean ratings for the quantitative methods people are closer to those for the top manager than are those for the accountants or the difference between quantitative methods people and accountants are small.

In the light of this the managers' relative rejection of quantitative methods people for top managerial positions is inconsistent. This may indicate that some other attribute(s) truly separates the managers from the others. This aspect will be further investigated during the interviews.

TABLE 7.27	PERSONAL ATTRIBUTES FOR PROFESSIONS		
	Mean ratings (Scale 1=low 5=high) In the opinion of MANAGERS for		
Attribute	Q.M.People	Management	Accountants
Highly educated	3.7	2.8	3.2
Technically competent	4.6	3.6	4.5
Broadminded approach to problems	4.5	4.4	4.2
Possess communication skills	4.4	4.8	4.2
Understand the management process	3.8	4.6	3.9
Project a business image	2.4	3.2	2.6
Willing to play company politics	1.8	2.3	1.8

CONCLUSION

The perceptions of quantitative methods people and of their managers were generally consistent, and also generally showed a similar thrust to that of the previous survey.

The following differences which are considered to be important were noted:

- the level at which the head of the quantitative methods section should be was seen to be higher by the quantitative methods people.
- management valued the use of interactive models more highly and sensitivity analysis less so than quantitative methods people.
- quantitative methods people consider themselves to have greater potential for senior positions than do their managers.

These gaps are consistent with the gaps between the current and the desired situations found in some of the factors.

Management desire more use of interactive models, and management consider these to be of more importance than do the quantitative people. This gap could be due to quantitative methods people not giving management what

they want or management desiring something that is not technically possible, or logistically possible or for which they are not yet ready.

The other differences concern the status of the quantitative methods individual and this too is consistent with the gap between the current and desired situation found in the first survey. While in the first survey management would prefer more of the quantitative methods people to be potential top managers than is currently the case, this survey shows that the quantitative methods people consider themselves nearer that goal than do management.

The other gaps identified in the first survey are consistent with those arising from an analysis of the second questionnaire, e.g. first survey - more masters desired - second survey all parties agree masters is the most desirable level. From this one can suggest that it would not require much effort to close those gaps as both parties start from a point of congruence.

The difference in the perception of the importance of interactive models is also likely to close. Given the general congruence this gap should disappear as technical or personal competence increases or the right communication takes place.

The question of status of the quantitative methods person is more serious. Since management will decide on promotions it is up to the quantitative methods people to either develop managerial skills or to show they have these skills already if they wish to aspire to managerial positions.

FOOTNOTES AND REFERENCES

1. The list was drawn up from the yellow pages directories for the Johannesburg, Pretoria, Durban, Port Elizabeth and Cape Town areas.

2. Both surveys showed this in several places.

3. Graham, RJ. Management science process - on the culture of management science. Interfaces, Vol. 10 No. 1, February 1980, p. 48.

CHAPTER 8

COMPARISON OF THE SURVEYS

INTRODUCTION

While the two questionnaire surveys reported in chapters 6 and 7 had different objectives it is still possible to compare the normative results from each.

In chapter 6 the position in South Africa was established as well as the position the managing directors of listed companies would like to have. In chapter 7 the opinions of managers and of quantitative methods people, as well as those of consultants were sought about factors surrounding the use of quantitative methods. The purpose in the latter case to identify differences or similarities of opinion. While the same ground was covered in both questionnaires, the second probed somewhat further, and besides using single answers, ordinal as well as rating scales were

used. In chapter 7 some comments were made in passing linking the findings in chapter 6 to those in chapter 7. The purpose of this chapter is to see if the findings in both surveys compliment each other, and so strengthen the suggestion for direction in quantitative methods.

This is to be done by comparing the position desired by the managing directors of listed companies with the opinions presented by the respondents to the second questionnaire.

THE RESPONDENTS

The respondents to the first questionnaire were the managing directors of listed companies, while those to the second questionnaire were managers, quantitative methods people, and management consultants. A wide spectrum of the business community has thus been sampled.

ORGANISATION STRUCTURE

Both surveys showed similar results regarding the preferred organisation structure, with about twice as

many respondents preferring a centralised as opposed to a decentralised function.

The team approach to problem solving was very strongly favoured as a management style in both surveys.

NATURE OF APPLICATION

The position desired by the managing directors of listed companies, and the ratings for frequency, importance and potential growth of applications are compared in Table 8.1. It is evident that providing an answer to which management applies judgement, and providing a range of answers are consistently highly rated, while providing a final answer is not. The use of sensitivity analysis while not as highly rated as some of the other applications is nevertheless an important application.

The use of interactive modelling was strongly desired by the managing directors of listed companies but it rated relatively less strongly in the second questionnaire. While there are differences in the opinions of the various groups of respondents none are large enough to distort these results. It is thus difficult to explain this anomaly, especially as this

TABLE 8.1	NATURE OF APPLICATION			
Nature of application	Percentage Desiring M.Directors	Mean ratings (Scale 1=low 5=high) In respect of Importance	Frequency	Growth
Provide a final answer	13.8	1.9	1.7	1.8
Provide an answer to which management can apply judgement	69.0	4.1	4.0	4.0
Provide a range of possible answers	51.7	4.0	3.9	4.1
Structure the problem to carry out sensitivity analysis	44.0	3.7	3.6	3.7
Long range planning through simulation and interactive models	62.1	3.3	2.8	3.4

application showed favourably during the course of the case studies described in the next section.

EDUCATION

The responses to the questions on education for quantitative methods people are not really comparable across the two questionnaires. However the general thrust of the responses is that a relatively high level of education (Master) is desirable and that quantitative methods people should receive some form of business education.

PERSONAL ATTRIBUTES

The opinions regarding personal attributes for quantitative methods people were consistent in both surveys. (Table 8.2). Technical competence, broadminded approach to problems, communication skills, and understanding the management process were all rated very highly. Projecting a business image was only moderately scored, while the involvement in company politics was lowly rated.

TABLE 8.2	PERSONAL ATTRIBUTES–Q.M.PEOPLE	
Personal attribute	Percentage Desiring M.Directors	Mean ratings Scale 1=low 5=high
Technically competent	75.2	4.6
Broadminded approach to problems	63.7	4.6
Possess communication skills	62.8	4.4
Understand the management process	69.9	3.8
Project a business image	31.0	2.5
Willing to play company politics	5.3	1.6

TOP MANAGEMENT POTENTIAL

While the quantitative methods person is not rejected as a potential top manager it is submitted that the relatively high rating is due to anybody being a potential top manager rather than any particular attributes of the quantitative methods person himself. The reason for this deduction is that when compared with the accountant the quantitative methods person fared significantly worse, notably in the opinion of the managers themselves. During the interviews for the case studies this preference was confirmed and in fact emphasised.

CONCLUSION

This chapter merely set out to compare the two surveys conducted and reported on in this thesis. It is evident that the findings are complementary and the results of one survey tend to support the results of the other. While this thesis is exploratory in nature and there is no intention to make proven statements it is comforting to know that while two surveys were carried out with four different groups of respondents and the questions

were differently asked, the responses are largely compatible.

The only major exception was the opinions regarding the use of interactive models. The managing directors of listed companies found this desirable, and in the case studies reported on later it will be seen that this application is looked towards for more application in the future, yet the respondents to the second questionnaire did not rate this application as enthusiastically.

PART 3

POST SURVEY INTERVIEWS

In the first part of this thesis a literature search was undertaken to identify those factors which had an impact on the use of quantitative methods. Those factors were subjected to two questionnaire surveys to establish opinions regarding them in South Africa. The surveys formed the second part of this study.

In this, the third part of the thesis, the use of quantitative methods was investigated in three companies. Interviews were conducted with members of management and quantitative methods people, the ground covered was much the same as that covered by the questionnaires.

The purpose of the interviews was not to draw conclusive evidence about any of the factors, but rather to be able to carry out a more free flowing

investigation into the subject matter. Questionnaire surveys tend to be static and since this study deals to a large extent with perceptions, opinions and attitudes it was considered appropriate to be able to talk to people, to place their comments into context, and to be able to question them further where single answers may be ambiguous, or insufficient to express the full answer.

There has been controversy about the place in research for a less rigid approach. At one extreme are the empiricists whose view is that unless a rigid scientific approach can be adopted towards a research effort the results are useless. At the other extreme are those who contend that much empirical research permits the researcher to make statistically valid statements about nothing. Following on from this is the contention that the observation of the subject of the research in its contextual setting is of considerable value. While this may be less rigid and inhibits any statistically valid inferences to be drawn, the argument is that the results are nevertheless more meaningful and more useful.

Mintzberg[1] makes a strong case for what he calls "direct" research particularly when dealing with organisational matters. He contends that an

organisation is rich in flows and processes, to slice through that and study only some cross-section may be limited. He makes the point however that direct research does not imply unsystematic research, but rather that systematic data is supported by anecdotal data.

It is the opinion of the writer that there is room and value to any research technique depending on the circumstances. In this case it was considered appropriate to undertake some direct research so that the factors that were investigated more rigidly could now be observed in the context of their organisational settings.

FOOTNOTES AND REFERENCES

1. Mintzberg, H. An emerging strategy of "direct" research. in Bateman TS and Ferris GR. Method and analysis in organizational research. Reston Publishing Co. Reston, Virginia. 1984.

CHAPTER 9

THE INTERVIEWS

INTRODUCTION

Some of the issues arising out of the surveys are investigated in practical situations, to try to gain a better insight into the issues concerned.

THE COMPANIES

Three diverse companies were selected, all of which requested complete anonymity due to the sensitive nature of the discussions.

The three companies are:

Alpha - listed on the JSE, with turnover of R300 million.

Gamma - unlisted, controlled from the United States of America, with turnover in excess of a billion Rand.

Zeta - unlisted, young, fast growing, turnover of R1.5 million.

THE INTERVIEWS

Interviews were conducted with a senior member of management (member of the board of directors) and a senior quantitative methods person (where applicable) in each company. The interviews were independently conducted so that the interviewees would be free from the influence or constraints of colleagues. Through the interviews it was hoped to gain a deeper insight into some of the factors identified earlier insofar as they impact on the use of quantitative methods in the companies selected for investigation. .

The details of the interviews for each company will be described in turn. Each company will be started with a brief description of the company and then the information will be presented under the broad headings used in the literature search and in the second questionnaire namely, organisation structure, nature of application, education, and personal attributes.

Attention will be drawn to instances where the sentiments of the quantitative methods and the managerial interviewees differed.

Since the interviews were informal and free flowing it is impossible to rigidly categorise all the responses and comments under the headings mentioned. Some observations apply to more than one area, while others are somewhat forced into the categories selected. The allocation of comments to the various headings has been made as considered appropriate.

ALPHA

DESCRIPTION

Alpha is a company listed on the Johannesburg Stock Exchange. It is a retail organisation with stores throughout the country. Annual turnover is in the region of R300 million.

The company was developed by an entrepreneurial individual. Approximately fifteen years ago he realised that the company had grown beyond his personal control,

he therefore introduced professional management into the company and assumed the position of chairman of the board of directors. The company continues to grow and is regarded by the business community as a progressive, well managed company with a modern image.

The use of quantitative techniques was started shortly after the introduction of the professional management and has evolved over the years. Its introduction was at the instigation of the financial manager, initially through a need for financial modelling, particularly for the analysis of alternative conditions, commonly known as the "what if" type of application. From thence it grew to the position where quantitative methods are now an integral part of the company's decision making process.

ORGANISATION STRUCTURE

There was initially a problem of credibility as the results generated by the quantitative methods were not in agreement with the results intuitively expected by management. This no longer poses a problem for the following reasons:

- management is supportive of the use of quantitative methods and consequently there exists

a positive attitude towards the use of the techniques

- the techniques used are carefully chosen to suit the objectives of the application and the circumstances surrounding that particular application
- the quantitative methods people in this company have a practical awareness and therefore can relate to management and vice versa
- management's expectations are not too high, they understand the purpose of using quantitative methods and are not expecting the techniques to provide that which cannot be provided

Alpha has an unusual situation regarding the positioning of quantitative methods within the organisation. The quantitative methods section reports to an individual and not to a position. The head of quantitative methods was in the planning department where quantitative methods were housed under him. On his transfer to an operational area the quantitative methods section still reports to him although functionally this is not a natural home for the section.

A committee headed by a senior executive screens requests for the services of quantitative methods and

sets priorities. Small problems are not channeled through the committee but rather are dealt with directly on a day to day basis.

There is a preference in the company for people to work as teams. While certain problems are not suitable for the team approach most projects ultimately receive the attention of an interdisciplinary team. The team approach has been found to be very successful in this company.

Those who work on a project are involved in the decision making, however they are not responsible for the decision. This involvement extends the process so decisions are not reached as quickly as they might be[1], on the other hand the inputs to the decision are better. There are additional indirect benefits in the enhanced motivation of the people concerned.

The head of quantitative methods is at a relatively high managerial level. It was classified as being between middle and top management. The point was made that he could not really be lower because he would then be in too specialised a position. This would imply a sacrifice of the broad business understanding.

NATURE OF APPLICATIONS

One of the major benefits arising from the use of quantitative methods in this company was the enhanced decision making which resulted. A number of reasons were suggested, including:

- the ability to manipulate data to suit the needs of the decision maker
- the presentation of data in a new way which may highlight important details which could otherwise have been overlooked
- a general improvement in the presentation of data
- the increased speed with which decisions are made

There is no doubt that the use of quantitative methods is on the increase. The desk-top computer has had a significant impact in facilitating the diffusion of quantitative methods. The reason offered is that even people who are not numerate are finding it easy to manipulate data and are carrying out analyses in a way they would not previously have attempted.

The quantitative methods manager indicated that care should be taken not to give too much too soon. By this he meant that the use of techniques for which management were not yet ready would be

counterproductive. New techniques should be introduced at a simple level and after successful introduction, their exposure gradually increased with applications where appropriate . The business awareness, as evidenced by this concern, was a feature of the interviewee's approach.

The senior manager in commenting on the negative aspects, expressed concern at becoming overdependent on quantitative results as this could hinder "seat of the pants" management, and being in a trading environment, this style of management was necessary at times. This comment must be viewed in the context of the professionalism of this management and their use and acceptance of quantitative methods.

The company is using the sensitivity analysis type of application mostly with some interactive modelling being applied. The quantitative methods people are eager to get involved in interactive modelling to a greater extent while senior management are of the opinion that the company is not quite ready. This apparently leads to some minor frustration but there are sufficient applications to maintain interest and motivation among the quantitative methods people.

The use of interactive models is expected to develop and be fully applied within a few years. Management is already aware of the usefulness of the interactive applications, however they are of the opinion that they should be in a position to use these techniques properly rather than "play with them".

The company is currently experiencing a period of organisational development. It's modus operandi will become settled over the next 12 to 18 months after which it will be able to cope with more sophistication and develop the use of interactive models. The development would come at the instigation of the chief executive officer, which is consistent with the top management support for the use of quantitative methods mentioned earlier.

Current applications are mainly in sales forecasting, distribution planning and in the financial area. In the future applications in strategic planning are expected to develop.

The current applications are valued more for the issues they raise than for the answers generated, the senior executive's comment was "we use a technique to get a direction rather than find a destination". This comment

is consistent with much of the discussion in chapter 4 of this thesis.[2]

The positive attitude towards the use of quantitative methods has grown as the non-specialists have themselves gained experience at using the various models. The business-like approach of the quantitative methods people will also have helped.

EDUCATION

The management have a relatively low level of quantitative methods skills but they would like greater skills. To this end they attend seminars, which on balance, are found to be beneficial.

There does not appear to be much lack of understanding between management and quantitative methods (a cross-discipline gap) at Alpha. This is attributed to the team approach and the respect for the disciplines of others.

PERSONAL ATTRIBUTES

The company is professionally managed and in the opinion of management needs professionals. Hence its quantitative methods people are mainly Masters or Honours graduates. Although the head is a PhD. this is not regarded as the norm.

In general the technical competence among the specialists was well regarded but the managerial competence was a little lacking. The manager thought this was due to a lack of exposure to the business at large. In the opinion of the head of quantitative methods this was not a serious deficiency as he felt that the ability to communicate was necessary more so than managerial skills. The reason being that the quantitative methods people do not have to manage but rather have to deal with management. The people working in quantitative methods were considered to have communication skills.

Some of the quantitative methods people did not have a broad enough approach to problems nor did they sufficiently project the business image. These shortcomings tended to inhibit the quality of the inputs to their tasks and kept them restricted in the specialist functions.

Some were also willing to play the company politics, which was considered desirable if properly done. It was also seen to indicate ambition.

The quantitative methods function is not considered to be a path to senior management in this company. The primary reason being the lack of a broad understanding of business. The training and education in the quantitative methods would make it difficult for him to make the transposition to becoming a trader. This view echoes the comment made earlier by the senior manager regarding the need for a certain amount of "seat of the pants" management.

Despite the above, the company does have people from the quantitative functions in senior positions but these are considered to be exceptions.

Opinion as to why accountants succeed to managerial positions focussed on the finance function. An interesting observation by the quantitative methods head was that finance is an essential part of business whereas quantitative methods is less clearly defined and while useful is regarded as an optional extra. It was also suggested that the training of an accountant was more directed towards business. Furthermore the

succession of accountants to managerial positions has generated its own momentum.

The executive was of the opinion that an important attribute for a senior position is an empathy for people, he added that neither quantitative methods people nor accountants typically showed empathy for or tolerance of people lower down in the organisation.

SUMMARY

The most striking features of this company are the professionalism and the modern approach. The company is not afraid to try things and learn new ideas. There is evidence of respect for colleagues and their disciplines.

The growth of quantitative methods has come about through small simple applications as and where needed. On the success and benefits derived from these more applications were sought. Another feature, related to this, is the acute awareness by the quantitative methods people to adopt a business-like approach to their discipline. The head of quantitative methods commented that he would only employ people who had a

business awareness or in whom he felt this could be installed.

GAMMA

DESCRIPTION

Gamma is a large multinational company controlled from the United States of America. It operates throughout the world. The South African subsidiary has a turnover in excess of R1 billion, and employs many thousands of people. The company is involved in a variety of activities which encompass most of the normal functional areas although its primary functions are those of manufacturing and retailing.

Quantitative methods were introduced into the organisation some 20 to 30 years ago. Gamma had a specific problem and set about seeking a solution. This was found in the area of quantitative methods and was successfully executed. In the years that followed the procedure was similar, as problems were identified so solutions were sought, as a result the incidence of quantitative methods within the company grew.

Some of the applications showed benefits which were both significant and clearly visible. Middle management in certain operational areas were fully aware that rational decisions could not be made without the use of quantitative models. This was particularly true in the case of a linear programming model.

Some of the earlier problems the company experienced in using quantitative methods included:

- implementation not proceeding according to expectations
- data was difficult to capture
- limitations to the number of alternatives with which the models could cope
- limitations in the ability to change the assumptions which formed part of the model

In addition to the above problems computers at that time were not user-friendly, operation was therefore difficult and limited to specialists.

ORGANISATION STRUCTURE

The quantitative methods function is designated as a centralised function in this company, however the use

has spread and permeated to such an extent that the company now maintains only a small team of three specialists who can advise and help on applications. Other than that, the applications are carried out by the people from other functional areas, who are not normally quantitative methods specialists. As is the case in Alpha on-line and desk-top computing facilities have been a most important contributor to the permeation.

The company did not have quantitative methods specialists in the functional areas because it was felt that this would probably lead to the classic management control problem of a conflict and confusion between the dotted line and the solid line relationships. This comes about when an individual reports to the head of an operating division as well as having links with his functional speciality. This frequently results in either or both of a confusion of loyalty and a division of loyalty. This manifests itself further in a lack of trust and acceptance towards the individual by those in the operating division.

Problems tend to be worked on using the team approach, although people may work on part of the problem individually, it usually then reverts to the team. The

major projects involve various disciplines hence the team approach is essential.

People who work on the project usually participate in the decision making process and are often involved in the implementation and subsequent monitoring of the project itself.

The participation and involvement in the decision making has been a contributing factor to the successful use of quantitative methods in this company, mainly for two reasons:

- firstly the person making the detailed analysis can show the strengths (or weaknesses) of the proposed application.
- secondly, it is important that the person doing the analysis is the one who will ultimately carry out the project. Most analyses require assumptions, and the person who is involved in the operation is likely to have the best perception of those assumptions.

These comments must be viewed in the context of the permeation of quantitative methods within this organisation. They explain the permeation to a large extent, and in fact suggest that the permeation is necessary.

The head of the quantitative methods section is at the middle management level. It was felt that so long as the senior management had a commitment to the use of the techniques, a technical person was sufficient for the position. It was noted that he reported to a senior manager.

NATURE OF APPLICATIONS

It was mentioned earlier that problems in the introduction of quantitative methods into Gamma had included the difficulty of using computers. These problems have been eased by the developments surrounding computers in recent years. Hardware is easier to use and more accessible, desk-top micro-processors abound in the organisation and more are planned. The development of software has also had an impact not only in its power and capabilities but also in its ease of use, particularly for the non-specialist. It is to be expected that these events should lead to greater decentralisation of quantitative methods, and indeed this has taken place in the company under discussion. It is not unreasonable to suggest that as computer hardware and software become more

accessible, so will greater decentralisation of quantitative methods in general become evident.

In addition to and as a consequence of the developments mentioned above, there has been a change in attitude towards the computer. Whereas it was previously considered to be an accounting tool it is now seen as a management tool. This change was considered to have made a significant impact on the development of quantitative methods in the last 5 years.

The enhanced decision making that has resulted from the application of quantitative methods is seen as the most significant positive feature arising out of their use in this company. On the negative side there is a need to guard against using quantitative techniques when they are not justified. To quote the interviewee "with the positive results we've had we must be careful that it (quantitative methods) doesn't become the end and not the means."

This company is likely to experience far greater use of quantitative methods in the future. Indicators which point in this direction are:

- in the opinion of management the incidence of usage is "going geometrically upwards"

particularly among senior and senior middle management.

- the company is in the process of constructing a new headquarters. It is the intention to have a terminal at every desk.
- there has been a permeation of quantitative methods into the functional areas, so that many of the applications are carried out by functional and not by quantitative methods specialists.
- the company is intending to set up a databank which will be available to management so that they may manipulate the data to suit their own particular needs.

Applications are to be found across all functional areas. Extensive use is made of sensitivity analysis and management is very comfortable with this type of application, it was suggested that they would not be able to live without it now. Sensitivity analysis is the norm, the company is very conscious of assumptions and the impact of varying assumptions needs to be tested.

Interactive models are also widely used and these together with the sensitivity analysis are considered to be the more important types of applications. These are also the quickest growing applications with the use

of interactive models being slowed only by data requirements.

A large data base is required which may be manipulated to suit the needs of the various users. The people in the company are ready to use this facility, progress will depend on the ability to construct the data base, significant progress has already been made in this regard.

While applications are made across all functional areas and the expectation is that this will continue, future growth is seen by both management and quantitative methods people to be in the field of marketing. This is partly because marketing has lagged in the past, hence there is a backlog to recover, and partly through the development of the data base mentioned earlier.

The company derives great benefit out of carrying out projects over and above the benefits of the implementation itself. This is particularly true with regard to strategic issue. While also true with regard to operational issues, the benefits of actual implementation in this case are considered to be substantial.

The benefits from carrying out the exercise itself were not always valued by management, however through usage and particularly experience in using the models themselves their viewpoint changed.

EDUCATION

The senior management themselves are not very skilled in quantitative methods. This is somewhat of a hindrance insofar as they often unaware of areas where there may be feasible applications. On the other hand they are very supportive and are constantly acquiring skills through usage.

The quantitative methods people in Gamma have Honours or Master's degrees. The adequacy of the technical expertise was differently perceived by the interviewees. Management considered the quantitative methods people to be adequately skilled however the quantitative methods interviewee felt the skills could be better.

The management of this company are mainly accountants, as such their education in quantitative methods is limited. This is seen as a problem to the quantitative methods people, because management may not even know

that quantitative techniques can assist in a problem and furthermore that this gap would not be closed because of cultural differences. This was not considered to be a serious problem by the quantitative methods interviewee.

Management do attend seminars, both in-house and public, which are of benefit particularly insofar as they expose management to quantitative methods and so facilitate communication.

There is a gap between quantitative methods and other disciplines in Gamma. However as a result of the diffusion of quantitative methods throughout the company, the cross-discipline gap is not too serious. It is bridged both formally and informally at the initiative of either party by such activities as:

Formally - bringing together colleagues from different functional areas. This is done at all levels.

Informally - talking to the colleagues concerned when there is knowledge of a potential problem.

Primarily the gap is bridged by day to day communication between individuals as they go about their normal duties.

PERSONAL ATTRIBUTES

A divergence of opinion was evident with regard to the management skills of the quantitative methods people. While both parties did not consider the management skills of the quantitative methods people to be adequate, management did not see any need for them. They felt they, as managers , had access to the specialist and "after all you don't want technicians to run your business".

At first this attitude may seem surprising particularly when considered against the advanced stage of quantitative methods within this company. On reflection however the permeation of quantitative methods into the functional areas leaves the quantitative methods specialists as just that, specialists, involved in the technically complex applications.

It appears then that within this company for the quantitative methods person to aspire to higher positions he must break out of his discipline into a functional area and the onus is on him to do so. When one considers this against the comments made as to why accountants and not quantitative methods people reach senior managerial positions then the views expressed are not so surprising.

The quantitative methods people in this company do not have an adequate array of managerial skills, while this presents a problem in limiting the scope of the problem to be investigated it is not likely to cause serious disruption due to the permeation that exists in the company. As a result communication and understanding is constantly improving through regular usage.

The general feeling in this company is that quantitative methods people are not going to become senior managers. It is considered that they do not have sufficient general managerial skills. In comparing the top management potential of accountants and quantitative methods people, the following points were made:

- South African accountants receive a good general financial and business training.
- the experience gained during an accountant's articles gives him a head start in that he can observe many diverse businesses.
- top management is reached through line rather than staff positions. Quantitative methods people tended to stay in staff positions whereas accountants tended to move out in the operational areas .

- it is expected of an accountant to progress to managerial positions. This provides its own impetus.
- quantitative methods people are in the habit of advising and not doing.
- quantitative methods people tend to over analyse whereas there are times when the cost of obtaining additional information is not warranted by the expected benefits. In managerial positions it is necessary to be able to assess when additional analysis or information is required.

SUMMARY

The most striking feature in Gamma is the use and impact of micro-computers. Coupled with and largely because of this is the permeation of quantitative methods into the functional areas, where applications are carried out by non-specialists.

Gamma seems to have made significant progress along the road towards total acceptance and integration of quantitative methods. The use of many of the techniques has become a part of the everyday operations of the organisation without giving it any special attention. An analogy may be drawn with the use of calculators in

that they are simply used without special concern. Similarly many of the computer based applications have also become everyday occurrences.

ZETA

DESCRIPTION

Zeta is a private company in the construction industry. It is owned by one individual who is also chairman of the board, which consists of three members.

He recently removed his senior management and replaced them with two professionals. The chairman has a rather high propensity for risk, as a result the company has shown phenomenal growth over the last few years during which period turnover has increased from R400 000 to R1.5 million.

The introduction of the professionals has stabilised the company, while it continues to grow (despite the recession), this is now done in a more orderly fashion in keeping with the objectives of the company and the realities of its environment.

ORGANISATION STRUCTURE

This company has no quantitative methods division as such, however quantitative methods are applied by the financial division which is a central function. Because of the size of the company this is regarded as the only viable alternative.

Financial people have been engaged who have a tendency towards quantitative methods, this has facilitated the development. The senior management appreciate the value of the techniques but they have a limited view of the extent to which they may be applied. It is interesting that similar comments were made with regard to Gamma[3] which is a company at the other end of the spectrum in respect of size and sophistication of operations. As a consequence of the limited perception by management developments in the use of quantitative methods tend to be introduced from the lower levels in the organisation.

The most immediate impact thus far experienced from using quantitative methods has been to temper the chairman's risky approach. The venture into

quantitative methods is considered valuable for this achievement alone.

The team approach to problem solving is extensively used, with almost all problems ultimately being dealt with by interdisciplinary teams. Those who work on projects are involved in the decision making process. This is of course inevitable in Zeta since the applications are carried out by the users.

NATURE OF APPLICATIONS

Although the company does not have any quantitative methods specialists, some techniques are used. These applications emanated from the introduction of micro-computers into the company, and perhaps more importantly, the attitudinal change in the company from regarding the computer as a transaction processor to regarding it as an information generator. Again attention is drawn to similar sentiments expressed in Gamma[4].

Increased usage is expected, particularly in the area of financial modelling. In addition the company is also starting to apply construction planning and control techniques such as network analysis.

The senior management has a tendency to place too much reliance on single answers generated by the application of quantitative methods. Through usage and the exposure to the value of applications like sensitivity analysis, management's attitude is changing and more use is being made of these techniques.

Management was initially hesitant towards using quantitative methods. It is felt that this hesitance has had a detrimental effect in that it slowed the growth in using the techniques. However, it is unlikely to have a lasting detrimental effect since the attitudes are already changing. Lack of experience by management in using the techniques was considered to be the reason for the discomfort.

Similarly the chairman is apparently impatient and wants answers quickly, hence the benefits derived from carrying out the analysis, such as the highlighting of the issues to be considered, are not as great as they could be. This attitude, too, is changing through increased exposure following successful applications.

The company appears to be committed to the use of quantitative methods on an increasing scale,

particularly in the areas of finance and operations control.

EDUCATION

The lack of specialists may hinder progress into the more sophisticated applications. Management would prefer their quantitative methods people to have an academic background in the discipline, but cannot at this stage justify an appointment on these skills alone. Although the professionals on the senior management team are able to use some techniques, they themselves do not want to acquire further skills in quantitative methods, but recognise that at some stage they may want a skilled person on the team.

PERSONAL ATTRIBUTES

The people using quantitative methods in this company have adequate managerial skills but they need more technical skills. The current opinion is that as skills are needed either the existing people will develop accordingly or people who have the necessary skills will be hired.

SUMMARY

The benefits from using quantitative methods are recognised and appreciated and future development in this area is desired, however there is still a lot of development possible within the existing capabilities in the company. Naturally this slack would have to be taken up before serious thought can be given to acquiring additional skills.

A feature of the development of quantitative methods is that it took place despite the chief executive not being supportive. The chief executive did however recognise the need for professional management and clearly respects these individuals. They in turn have supported the development of the techniques and have gradually exposed him to them and to their benefits, with success has come increased confidence.

SUMMARY AND CONCLUSION

Despite the fact that the three companies investigated were different in size, industry and stage of development, they displayed certain commonalities which

seemed to impact on the use of quantitative methods within these companies.

These common areas focus around

- computers
- mutual respect
- non-specialists using the techniques
- growth through exposure and usage

Perhaps the most significant impact has been the growth of the desk-top computer. This together with the development of software has put reasonably sophisticated analyses at the disposal of every individual. All the companies interviewed made reference to the ease of data processing as an important aspect.

Coupled with the developments in computers has been the attitudinal change towards the computer, from a data recording tool to a managerial tool and further developments in this direction are desired.

Another important feature has been the gradual growth in applications from small simple applications or well defined applications for specific needs towards interactive models.

In each case the growth has followed success in the earlier applications, even though the success may only have been partial. With the success came confidence in the applications, so that future applications were more readily ventured into.

The other points mentioned above probably grew out of the growth in applications, so that all the companies to some extent have non-specialists using quantitative techniques (which is seen to be a positive feature). In the case of Gamma, which is the company most advanced in its quantitative methods, the degree of permeation is extensive with the non-specialists using techniques as a matter of course.

A mutual respect was evident for the other people and for their disciplines, it is likely that this also developed from the above.

Each company's quantitative methods function was structured in a different way, without this having seriously affected the development. It is not possible to draw any conclusion from this except to suggest that attitude and commitment are likely to have more impact than the defined structure. Supporting this is the fact that the questionnaires did not show overwhelming preference for either type of organisation structure.

A businesslike approach was also evident in all the companies, with the people using the techniques taking care to present their analyses in terms familiar to the management, and conversely management involved the quantitative methods people in the decision making process. This is consistent with the mutual respect noted.

All the companies are now professionally managed, whether this has any influence is difficult to say, except that the professional should have the skills to bring out the best in his people. Of interest is the fact that two of the three companies were managed by entrepreneurs till exponential growth caused the chief executive officer to bring professionals onto the management team. Again, one may speculate that if the entrepreneur has the foresight to realise when he needs professional help he is also more likely to be susceptible to the use of decision aiding tools.

FOOTNOTES AND REFERENCES

1. Note that this refers to the involvement in the decision making process and is not in conflict with the observation made later that the use of quantitative methods speeds up decision making.

2. An example is Ansoff's comment cf footnote 26 chapter 4.

3. Cf. p.253

4. Cf. p.250

CHAPTER 10

CONCLUSION

This study investigated the following areas regarding factors surrounding the use of quantitative methods in South Africa:

- are the factors suggested by the literature present in South Africa's listed companies and is senior management satisfied with the situation? The findings were that the position in South Africa is to a large extent consistent with the literature and that the senior management finds this desirable. Where the senior management differed the differences were mainly among the local and national companies and the tendency was towards the position suggested by the literature. It was noticable that if a company has international association this has an impact on the desired position. Such companies show a desire

which is closer to that suggested by the literature. There is therefore little doubt that the internationalality has an impact on the applications in South Africa.

- are the opinions regarding the factors, by people working in quantitative methods and by senior management, similar or not? Opinions were mainly similar and the position found in the first survey was strengthened. A difference in the status of the quantitative methods person was evident, both in his level of seniority and in his potential for a position in top management.

- three companies which are using quantitative methods were investigated to establish the impact of the factors identified and to obtain an insight into the reasons for successful use.

It was a feature in the companies investigated that although independently interviewed, both the management and the quantitative methods people gave similar answers to the questions and, more importantly, opinions as to the impact on the company were similar.

Evident in all the companies was the impact of the computer, particularly recent developments in the ease of access and use. Also evident was a mutual respect for each other which seemed to assist in successful usage. The application of quantitative methods in all the companies evolved from simple applications to a point where integration and permeation of the techniques is occurring. The computer brought the techniques within the grasp of management and the success with simple applications brought about an increase in confidence. In addition the people using quantitative methods in these companies have a managerial awareness, which they inject into the applications.

In addressing the issue of top management potential, varied comments were forthcoming but seemed to focus around the fact that the education and training of quantitative methods people did not give them a good enough start for management.

It appears that the position among the companies is that the use of quantitative methods is well rooted and growing naturally as technology and capabilities increase. However the interviews and the second questionnaire survey were directed specifically at

companies using quantitative methods. The first questionnaire was directed at all listed companies, approximately 30% responded of which over 70% were users. It is likely that the incidence of users will be lower among non-respondents. Barring a few exceptions the listed companies are the more sophisticated, hence the incidence of quantitative methods throughout the country is likely to be lower yet. There must be very many companies which do not use but could benefit from the use of quantitative methods. It is evident from the aforegoing chapters that the use of quantitative methods enhances the decision making skills within an organisation.

Some suggestions towards facilitating the passage into using quantitative methods are presented:

- have a computer readily available. The acquisition of a computer, even a relatively small one, would certainly be of assistance in financial modelling at the very least.
- start with small simple applications. Even these can aid decision making. More sophisticated applications are likely to develop as confidence and skills grow through exposure.
- involve the people carrying out the application in the decision making process. This has behavioural as well as operational benefits.

Factors which should not hinder the use of quantitative methods include:

- the specific organisation structure. While there may be preferable structures the organisation's commitment to using the techniques should override any problems of structure.
- lack of quantitative methods skills by management. While the skills are desirable they are not a pre-requisite, management can acquire some skills as and when needed.

The quantitative methods people seem to be doing most of what is required of them, and their technical skills are well respected. However if the quantitative methods graduate wishes to progress in the organisation he needs to acquire some managerial skills.

It is submitted that this could be done through the "profession". Appropriate courses could be introduced into the curriculum and periods of practical training instituted before qualification. Alternatively the onus is on the individual to break out of his specialist function into a managerial function. Towards this end he could take the initiative and enhance his quantitative skills by acquiring a managerial qualification such as an MBA or similar degree.

It is clear from both surveys that the masters level of education is preferred. In addition a broader education generally as well as an emphasis on applications and a managerial education is desired by most resapondents. It is evident that a career orientated masters degree is needed. One that is part of the package which prepares the individual for a career in the chosen discipline. This degree is to be distinguished from the traditional masters by dissertation only, which is regarded really as a training ground towards a doctorate. This would be taken by people persuing an academic career or simply for personal satisfaction.

A possible route the quantitative methods person seeking a business career may follow is the Master of Business Administration. However the MBA of necessity ignores the source discipline and hence has the problem of a class of participants at vastly differing levels of skill in the discipline being taught. What is being suggested is a masters degree which is career orientated and while focussing on the discipline broadens it into related areas and into the practical context. Examples of such a degree may be found at UCT in the Departments of Accounting, Business Science, Engineering, Psychology and Sociology. Noticably though

the departments of Mathematics and Statistics have no such programme.

It is submitted that a business career oriented masters programme in Statistics or Operations Research would be an invaluable service not only for the graduands but also for the business community. Such a programme while satisfying the obvious need for a masters level of education as well as providing the high level technical skills desired, would also be likely to improve the personal attributes which were indentified earlier to be lacking. In so doing it would have a bearing on organisation structure and certainly give the quantitative methods person a better opportunity for succession to senior management.

Finally there was a time lag of approximately one year between carrying out the surveys and the interviews. While the interviews were conducted with only three companies the developments of the micro computer together with packaged software seemed to have a significant impact on the use of quantitative methods in the companies interviewed. A further study at this stage directed specifically at the impact of the micro computer would be of value. It is possible that the micro computer will have a bearing on attitudes towards centralisation and in the case of South Africa is

likely to bring the companies more into line with the other industrialised nations in preferring greater decentralisation. Furthermore the quantitative skills of management will increase as they use techniques in the course of their duties and conversely the managerial skills of quantitative methods people will need to increase of necessity, thus strengthening the need for a career orientated masters as discussed earlier in this chapter.

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1. Nature of the business:

Mining	01
Banks and financial services	02
Insurance	03
Investment	04
Property	05
Manufacturing	06
Retailing	07
Building and construction	08
Industrial holding	09
Other - please specify	10

2. Is the company

local	1
national	2
international	3

3. Where is the head office

Witwatersrand (Vaal Triangle)	1
Durban - Pietermaritzburg	2
Western Cape	3
Other - please specify	4

4. Employees

less than 250	1
250 to 1000	2
1000 to 5000	3
More than 5000	4

5. Turnover

less than R10m	1
R10m to R100m	2
R100m to R500m	3
more than R500m	4

	The situation in my business organisation	What I would like it to be
6. Location of the quantitative methods section within the organisation		
Centrally located	1	1
Decentralised in each operating division	2	2
No quantitative methods section	3	3
7. Quantitative methods may have a wide range of applications. Please tick the appropriate boxes (you may wish to tick more than one box).		
Provide a 'final unqualified' answer to a problem	0 1	0 1
Provide an answer which will then be used as a base to which management applies judgement	0 1	0 1
Provide a range of possible answers	0 1	0 1
Structuring the problem to carry out sensitivity analysis	0 1	0 1
Long range planning through the use of simulation and intra-active models	0 1	0 1
Other - please specify	0 1	0 1
8. Level of education for a person working in quantitative methods		
Bachelors degree	1	1
Masters degree	2	2
Doctorate	3	3
Other - please specify	4	4
9. The person working in quantitative methods deals with a problem		
Individually	1	1
As part of a team	2	2

	The situation in my business organisation	What I would like it to be
10. Extent of quantitative methods education for the managing director		
None	1	1
Awareness of the discipline	2	2
Awareness of some techniques	3	3
Ability to use some techniques	4	4
Full understanding of the techniques used	5	5
Formal education in statistics and Operations Research	6	6
Formal education in mathematics	7	7

11. Attributes of a person working in quantitative methods. Please tick the appropriate boxes (you may tick more than one box).		
Technically competent	0 1	0 1
Broadminded approach to problems	0 1	0 1
Possess communication skills	0 1	0 1
Understands the Management process	0 1	0 1
Projects a business image	0 1	0 1
Willing to play company politics	0 1	0 1
Other - please specify	0 1	0 1

12. The quantitative methods person is a potential top manager		
Yes	1	1
No	2	2

Thank you very much.

UNIVERSITY OF CAPE TOWN

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Engineering Mall, Upper Campus.
Private Bag,
7700 RONDEBOSCH.

Tel. Add: ALUMNI, CAPE TOWN.
Telex No. 57-22208
Telephone: 69-8531
Extension:

8 September 1983

Dear Sir

I am undertaking research toward an MCom at the University of Cape Town on factors surrounding the use of quantitative methods in business.

I have selected four areas to investigate - organisation structure, type of application, education, and personal attributes.

This questionnaire (which should take no more than 10 minutes of your time to complete) is to investigate what you, the top management, perceive the situation to be in your organisation and at the same to establish what you think the situation should be.

Once these results are to hand I shall extend the study with a more rigorous interview of selected managers and of people working in quantitative methods, and finally conduct some case study investigations whereby the matter may be viewed in practice.

The success of my thesis depends very much on a good response to this survey. Please fill in the attached questionnaire and return it to me in the reply paid envelope provided.

Your identity and that of your company is completely safeguarded, I have no means of identifying either. As a result it will be necessary to send a reminder to all survey participants in a few weeks.

Many thanks for your co-operation.

Yours faithfully

E ULIANA

PS: I use the term quantitative methods to apply to any statistical, operations research or management science technique, such as regression, correlation, forecasting techniques, linear programming, economic order quantities etc., as well as discounted cash flows and computer modelling.

UNIVERSITY OF CAPE TOWN

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Tel. Add: ALUMNI, CAPE TOWN
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Telephone 69 8531
Extension:

3 October 1983

Dear Sir

I would like to take this opportunity to thank you for your cooperation in replying to a questionaire which I recently sent to you. This questionaire forms part of the work towards an MCom.

If, however, you have not yet responded, may I urge you to do so as your views now adopt added significance, since they will represent the views of persons who were less inclined to respond in the first instance. Furthermore, a response from you will bolster my reply rate, thus adding validity to the study.

A further questionaire and reply envelope are enclosed for your convenience.

Please reply soon.

Yours faithfully

E O ULIANA

APPENDIX 4

LOCATION OF QUANTITATIVE METHODS SECTION WITHIN THE ORGANISATION				
	Centralised	Decentralised	Both	None
CURRENT				
Full Sample	42.5	22.9	6.5	28.1
Dispersion				
Local	40.5	21.4	0.0	38.1
National	44.0	22.7	8.0	25.3
International	41.7	25.0	11.1	22.2
Size				
Turnover <R10m	14.3	14.3	71.4	0.0
R10m – R100m	44.8	17.2	1.7	36.2
R100m – R500m	36.0	32.0	14.0	18.0
>R500m	62.1	20.7	6.9	10.3
DESIRED				
Full Sample	56.2	29.8	5.0	9.1
Dispersion				
Local	63.0	22.2	0.0	14.8
National	57.8	28.1	6.3	7.8
International	46.7	40.0	6.7	6.7
Size				
Turnover <R10m	50.0	25.0	25.0	0.0
R10m – R100m	55.3	34.0	0.0	10.6
R100m – R500m	48.8	34.1	9.8	7.3
>R500m	70.8	16.7	8.3	4.2

APPENDIX 4A

RELATIONSHIP BETWEEN CENTRALISED AND DECENTRALISED		
	Centralised	Decentralised
CURRENT		
Full Sample	65.0	35.0
Dispersion		
Local	65.4	34.6
National	66.0	34.0
International	62.5	37.5
Size		
Turnover <R10m	50.0	50.0
R10m – R100m	72.3	27.7
R100m – R500m	52.9	47.1
>R500m	75.0	25.0
DESIRED		
Full Sample	65.3	34.7
Dispersion		
Local	73.9	26.1
National	67.3	32.7
International	53.9	46.1
Size		
Turnover <R10m	66.7	33.3
R10m – R100m	61.9	38.1
R100m – R500m	58.9	41.1
>R500m	80.9	19.1

APPENDIX 5

NATURE OF QUANTITATIVE METHODS APPLICATIONS					
	Nature of application				
	1	2	3	4	5
CURRENT					
Full Sample	8.6	73.4	57.8	40.6	38.8
Dispersion					
Local	13.4	70.0	56.7	33.3	30.0
National	4.8	75.4	58.5	41.5	43.1
International	12.1	72.7	57.6	45.5	42.4
Size					
Turnover <R10m	16.7	33.3	83.3	33.3	16.7
R10m – R100m	4.2	81.3	56.3	31.3	25.0
R100m – R500m	15.6	73.3	60.0	46.7	55.6
>R500m	3.7	70.4	55.6	51.9	40.7
DESIRED					
Full Sample	13.8	69.0	51.7	44.0	62.1
Dispersion					
Local	23.1	73.1	42.3	23.1	57.7
National	10.0	66.7	51.7	46.7	61.7
International	13.3	70.0	60.0	56.7	66.7
Size					
Turnover <R10m	22.2	55.6	66.7	33.3	33.3
R10m – R100m	9.1	79.5	50.0	43.2	50.0
R100m – R500m	23.7	68.4	57.9	47.4	73.7
>R500m	4.2	58.3	41.7	45.8	75.0

Legend

1 Provide a final answer

2 Provide an answer to which management can apply judgement

3 Provide a range of possible answers

4 Structure the problem to carry out sensitivity analysis

5 Long range planning through the use of simulation or interactive models

APPENDIX 6

LEVEL OF EDUCATION FOR QUANTITATIVE METHODS PERSON				
	Bachelor	Master	Doctor	Other
CURRENT				
Full Sample	61.6	29.6	8.8	22.4
Dispersion				
Local	63.0	11.1	7.4	33.3
National	55.4	36.9	6.2	20.0
International	72.7	30.3	15.2	18.2
Size				
Turnover <R10m	62.5	12.5	12.5	50.0
R10m – R100m	50.0	23.9	6.5	32.6
R100m – R500m	76.7	27.9	7.0	11.6
>R500m	57.7	50.0	15.4	11.5
DESIRED				
Full Sample	52.9	42.3	11.5	17.1
Dispersion				
Local	68.2	27.3	4.5	13.0
National	46.3	42.6	11.1	16.7
International	53.6	53.6	17.9	21.4
Size				
Turnover <R10m	57.1	28.6	14.3	37.5
R10m – R100m	41.9	37.2	9.3	25.6
R100m – R500m	69.7	45.5	9.1	6.1
>R500m	50.0	50.0	20.0	10.0

APPENDIX 7

WORK CARRIED OUT BY INDIVIDUALS OR BY TEAMS			
	Individuals	Teams	Both
CURRENT			
Full Sample	21.3	63.0	15.7
Dispersion			
Local	28.6	60.7	10.7
National	21.2	62.1	16.7
International	15.2	66.7	18.2
Size			
Turnover <R10m	28.6	71.4	0.0
R10m – R100m	25.0	68.8	6.3
R100m – R500m	23.3	51.2	25.6
>R500m	11.1	66.7	22.2
DESIRED			
Full Sample	6.3	77.7	16.1
Dispersion			
Local	12.5	70.8	16.7
National	7.0	78.9	14.0
International	0.0	80.6	19.4
Size			
Turnover <R10m	12.5	75.0	12.5
R10m – R100m	11.1	82.2	6.7
R100m – R500m	2.9	71.4	25.7
>R500m	0.0	78.3	21.7

APPENDIX 8

LEVEL OF EDUCATION IN QUANTITATIVE METHODS FOR MANAGEMENT							
	None	Aware of the discipline	Aware of some techniques	Able to use some techniques	Full understanding of techniques used	Education in stats and O.R.	Education in mathematics
CURRENT							
Full Sample	10.1	20.3	18.1	20.3	16.7	6.5	8.0
Dispersion							
Local	15.2	15.2	24.2	9.1	30.3	0.0	6.1
National	10.0	18.6	18.6	27.1	12.9	5.7	7.1
International	5.7	28.6	11.4	17.1	11.4	14.3	11.4
Size							
Turnover <R10m	0.0	22.2	11.1	22.2	33.3	11.1	0.0
R10m – R100m	5.8	23.1	19.2	25.0	11.5	9.6	5.8
R100m – R500m	14.6	20.8	14.6	18.8	18.8	0.0	12.5
>R500m	14.8	14.8	25.9	14.8	11.1	11.1	7.4
DESIRED							
Full Sample	0.0	10.3	16.4	18.1	37.9	11.2	6.0
Dispersion							
Local	0.0	12.5	33.3	12.5	25.0	12.5	4.2
National	0.0	6.6	14.8	23.0	39.3	9.8	6.6
International	0.0	16.1	6.5	12.9	45.2	12.9	6.5
Size							
Turnover <R10m	0.0	0.0	0.0	28.6	42.9	14.3	14.3
R10m – R100m	0.0	6.4	19.1	14.9	44.7	10.6	4.3
R100m – R500m	0.0	18.9	13.5	21.6	29.7	8.1	8.1
>R500m	0.0	8.3	20.8	16.7	33.3	16.7	4.2

APPENDIX 9

PERSONAL ATTRIBUTES OF QUANTITATIVE METHODS PEOPLE						
	Technically competent	Broadminded approach to problems	Possess communication skills	Understand the management process	Project a business image	Willing to play company politics
CURRENT						
Full Sample	69.6	58.1	50.0	67.7	24.2	8.9
Dispersion						
Local	59.3	57.7	34.6	69.2	7.7	7.7
National	74.2	53.0	54.5	62.1	25.8	12.1
International	68.8	68.8	53.1	78.1	34.4	3.1
Size						
Turnover <R10m	33.3	44.4	33.3	77.8	22.2	11.1
R10m – R100m	60.9	69.6	47.8	69.6	28.3	6.5
R100m – R500m	83.3	50.0	61.9	73.8	21.4	9.5
>R500m	73.1	56.0	40.0	48.0	24.0	12.0
DESIRED						
Full Sample	75.2	63.7	62.8	69.9	31.0	5.3
Dispersion						
Local	58.3	54.2	50.0	58.3	16.7	4.2
National	77.6	62.1	62.1	65.5	36.2	8.6
International	83.9	74.2	74.2	87.1	32.3	0.0
Size						
Turnover <R10m	37.5	62.5	50.0	37.5	37.5	0.0
R10m – R100m	71.1	71.1	64.4	73.3	31.1	4.4
R100m – R500m	83.3	55.6	66.7	75.0	33.3	8.3
>R500m	82.6	60.9	56.5	65.2	26.1	4.3

APPENDIX 10

SUITABILITY OF Q.M.PERSON FOR TOP MANAGEMENT			
	Yes	No	Could be
CURRENT			
Full Sample	66.1	26.8	7.1
Dispersion			
Local	56.7	36.7	6.7
National	71.2	24.2	4.5
International	64.5	22.6	12.9
Size			
Turnover <R10m	63.6	18.2	18.2
R10m – R100m	78.3	17.4	4.3
R100m – R500m	57.1	35.7	7.1
>R500m	65.4	26.9	7.7
DESIRED			
Full Sample	73.3	19.0	7.6
Dispersion			
Local	77.3	22.7	0.0
National	78.2	18.2	3.6
International	60.7	17.9	21.4
Size			
Turnover <R10m	85.7	0.0	14.3
R10m – R100m	79.1	14.0	7.0
R100m – R500m	60.6	30.3	9.1
>R500m	81.0	14.3	4.8

ORGANISATION DETAILS

1. Nature of the business:

- Mining
- Banks and financial services
- Insurance
- Investment
- Property
- Manufacturing
- Retailing
- Building and construction
- Consultants
- Stock broker
- Other - please specify .....

2. Is the company

- local
- national
- international

3. Where is the head office

- Witwatersrand (Vaal triangle)
- Durban - Pietermaritzburg
- Western Cape
- Other - please specify .....

4. Employees

- Less than 250
- 250 - 1000
- 1000 - 5000
- More than 5000

5. Turnover

- Less than R10m
- R10m - R100m
- R100m - R500m
- More than R500m

1. Location of the quantitative methods section within the organisation

- Centrally located
- Decentralised in each operating division
- No quantitative methods section

2. It has been suggested that each division should have its own section, as large as it can afford and this to be supplemented by a central section. Do you think this feasible with regard to

	Yes	No
Cost		
Organisation problems		

3. Problems involving quantitative methods are best suited to be resolved by

- Individuals
- Teams

4. At what level of management should the head of the quantitative method section be ?

- Top
- Middle
- Lower

5. Within which functional area should the quantitative methods section be located - rank the following six functions in order of preference, 1 being first preference and 6 being least preferent

- Data processing
- Management accounting and/or finance
- Corporate or other planning
- Statistics and operations research
- Marketing
- Research and development
- Other (please specify) .....

6. How much feedback regarding the ultimate fate of the project should there be to the person/s who actually carried out the analysis?

- None
- Informed of action taken
- Involved in the decision regarding possible action

7. Comments :

TYPE OF APPLICATION

1. Quantitative methods may have a wide range of applications. Please rate each of the following applications on a scale of 1 to 5, in terms of its importance as an aid to management's decision making.

LOW ← IMPORTANCE → HIGH

	1	2	3	4	5
Provide a 'final unqualified' answer to a problem					
Provide an answer which will then be used as a base to which management applies judgement					
Provide a range of possible answers					
Structuring the problem to carry out sensitivity analysis					
Long range planning through the use of simulation and intra-active models					
Other - please specify					

2. What do you think the frequency of the various quantitative method functions should be? Please rate on a scale of 1 to 5, with 5 being most frequent.

LOW ← FREQUENCY → HIGH

	1	2	3	4	5
Provide a 'final unqualified' answer to a problem					
Provide an answer which will then be used as a base to which management applies judgement					
Provide a range of possible answers					
Structuring the problem to carry out sensitivity analysis					
Long range planning through the use of simulation and intra-active models					
Other - please specify					

3. Within which broad functional area do you see the greatest potential application? Please rate on a scale of 1 to 5, 5 being greatest potential.

LOW ← POTENTIAL → HIGH

	1	2	3	4	5
Finance					
Marketing					
Corporate planning					
Personnel					
Production					
Research and development					
Purchasing					
Other (please specify)					

4. It has been suggested that one of the main benefits to be derived from the use of quantitative techniques is gained through carrying out the exercise and not in actually arriving at an answer. Do you agree with this view?

Yes	
No	

Comments:

5. Do you ever halt a project before it is fully completed?

Yes	
No	

Comments:

6. Please rate on a scale of 1 to 5 when you think the greatest likelihood of growth in acceptability of quantitative techniques will occur.

	LOW ← LIKELIHOOD OF GROWTH → HIGH				
	1	2	3	4	5
Within the next 5 years					
Between 5 and 10 years					
Longer than 10 years					
Never					

7. In which type of application do you think the growth in acceptability is most likely to occur. Please rate on a scale of 1 to 5, 5 being most likely.

	LOW ← LIKELIHOOD OF GROWTH → HIGH				
	1	2	3	4	5
Provide a "final unqualified" answer to a problem					
Provide an answer which will then be used as a base to which management applies judgement					
Provide a range of possible answers					
Structuring the problem to carry out sensitivity analysis					
Long range planning through the use of simulation and intra-active models					
Other (please specify)					

EDUCATION

1. Do you believe university education in quantitative methods should

	Yes	No
Teach more techniques		
Teach more theory (mathematics)		
Focus more on applications		
Provide a broader education generally		
Provide some management education specifically e.g. management accounting, financial management		

2. Assuming there were an additional 50 hours available in the quantitative methods graduate's university career - so that the graduate should be of greater use in business the extra 50 hours should be spent on - rank in order of preference with 1 being most and 5 least preferent.

Techniques	
Mathematics	
Applications	
Broader education	
Management education	

3. Level of education desirable for a person working in quantitative methods - rank in order of preference with 1 most and 5 least preferent.

Bachelors degree	
Masters degree	
Doctorate	
Other - please specify	

1. Rate the personal attributes listed below in terms of importance for a TOP MANAGER. Rate on a scale of 1 to 5, 5 indicating high importance.

	LOW ← IMPORTANCE → HIGH				
	1	2	3	4	5
Highly educated (masters or over)					
Technically competent					
Broadminded approach to problems					
Possesses communication skills					
Understands the management process					
Projects a business image					
Willing to play company politics					
Other (please specify)					

2. Rate the personal attributes listed below in terms of importance for an ACCOUNTANT. Rate on a scale of 1 to 5, 5 indicating high importance.

	LOW ← IMPORTANCE → HIGH				
	1	2	3	4	5
Highly educated (masters or over)					
Technically competent					
Broadminded approach to problems					
Possesses communication skills					
Understands the management process					
Projects a business image					
Willing to play company politics					
Other (please specify)					

3. Rate the personal attributes listed below in terms of importance for a QUANTITATIVE METHODS PERSON. Rate on a scale of 1 to 5, 5 indicating high importance.

	LOW ← IMPORTANCE → HIGH				
	1	2	3	4	5
Highly educated (masters or over)					
Technically competent					
Broadminded approach to problems					
Possesses communication skills					
Understands the management process					
Projects a business image					
Willing to play company politics					
Other (please specify)					

4. Do you consider an accountant to be a potential top manager?

Yes ☐
No ☐

Comment:

5. Do you consider a quantitative methods person to be a potential top manager?

Yes ☐
No ☐

Comment:

Thank you for your cooperation.

UNIVERSITY OF CAPE TOWN

(WITH WHICH IS INCORPORATED THE SOUTH AFRICAN COLLEGE)

Department of Accounting,
Leslie Commerce Building,
Engineering Mall, Upper Campus.
Private Bag,
7700 RONDEBOSCH.

Tel. Add: ALUMNI, CAPE TOWN.
Telex No. 57-22208
Telephone: 69-8531
Extension: 724

21 November 1983

Dear Sir

Recently I sent out a questionnaire which asked a few short questions of the senior management of listed South African companies regarding the use of quantitative methods.

This questionnaire which forms a substantial part of the work towards my MCom, expands those earlier questions and is furthermore aimed at three separate categories of respondents:

1) People working in quantitative methods
2) The senior management of companies employing such people
3) Independent management consultants.

Your name was on a list kindly provided me by the OR Society as a member working in commerce or industry whose response would be relevant to my study. The areas investigated are organisation structure, type of application, education and personal attributes, with a view to establishing differences in perceptions among the groups mentioned above.

While these questions require a little thought, 30 minutes should be sufficient for completion.

Because of the relatively small population, it has been necessary to code the questionnaires for follow-up purposes in the case of non-response. I assure you that neither your identity nor that of your company will in any way be linked to your responses.

I received an excellent response to my first questionnaire and a similar response rate will be most gratifying. I hope you will participate.

Yours faithfully

E ULIANA

PS: I use the term quantitative methods to apply to any statistical, operations research or management science technique, such as regression, correlation, forecasting techniques, linear programming, economic order quantities etc, as well as discounted cash flows and computer modelling.

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2) The senior management of companies employing such people.
3) Independent management consultants.

The areas investigated are organisation structure, type of application, education, and personal attributes.

While these questions require a little thought, 30 minutes should be sufficient for completion.

Because of the relatively small population it has been necessary to code the questionnaires for follow-up purposes in the case of non-response. I assure you that neither your identity nor that of your company will in any way be linked to your responses.

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Telex No. 57-22208
Telephone: 69-8531
Extension:

December 1983.

Dear Sir

I wrote to you on 21 November 1983 asking you to complete a questionnaire which forms part of the work towards an M.Com. It appears that you have not yet replied.

As I am dealing with a fairly small population it is imperative that as many people as possible respond.

I hope you will co-operate; another questionnaire and envelope are enclosed for your convenience.

Thank you for your attention.

Yours sincerely

E. ULIANA

Encl: