

University of Warwick institutional repository: <http://go.warwick.ac.uk/wrap>

A Thesis Submitted for the Degree of PhD at the University of Warwick

<http://go.warwick.ac.uk/wrap/74387>

This thesis is made available online and is protected by original copyright.

Please scroll down to view the document itself.

Please refer to the repository record for this item for information to help you to cite it. Our policy information is available from the repository home page.

SOME EMPIRICAL RESULTS CONCERNING
THE MODELLING OF INDUSTRIAL
DISTRIBUTION SYSTEMS.

D.R. Atkins, M.A.

Being a thesis submitted to the University of
Warwick in accordance with the regulations
governing the Ph.D degree.

JANUARY 1972

BEST COPY

AVAILABLE

PAGE NUMBERS AND
TEXT CUT OFF IN
ORIGINAL THESIS

**BEST COPY
AVAILABLE**

Poor quality text in
the original thesis.

P R I N C I P A L

C O N T E N T S

	Page
PART ONE	1
PART TWO : SECTION A	34
PART TWO : SECTION B	161
PART TWO : SECTION C	221
PART TWO : SECTION D	339
REFERENCES	380
APPENDIX ONE	389
APPENDIX TWO	395

ACKNOWLEDGEMENTS

I wish to take this opportunity to thank the numerous merchants involved in the distribution system investigated. In particular I owe a great debt to the Merchants' solidarity movement, which came to be known as the "Merchant's of the South West". As a participant observer I shared their lives for several months and I apologise to them that my models could not reflect their warmth, friendship and humour.

Also my thanks are due to my many colleagues in the firm and particularly to my supervisor Professor Brian Houlden.

I declare that this thesis bears no relation to any other that I have submitted for a degree or other qualification at any University.

Derek R. Atkins 28.1.72
.....

ABSTRACT

This research thesis aims to add to the understanding of industrial distribution systems and to develop our ability to model such systems. The work is empirically based, taking a particular distribution system, studying it in depth and observing it during a period of change and reorganisation.

The thesis is also part of a wider research programme to investigate the problems of applying Operation Research to decision making in unstable environments. Change in distribution systems often provides good examples of this form of decision making, and some tentative generalisations are drawn as a contribution to this wider programme.

Empirical research into either distribution systems or decision making in unstable environments poses the problem of access. A characteristic of this form of decision making is its informality, without the usual stress on committees and reports found with more formal long range planning. In order to ensure access to the real decision making process the researcher became an indispensable part of that process. The research method adopted was of a type since become known as the dual researcher/change agent type. With this method the researcher had the two responsibilities of solving the particular problem while

recording material as objectively as possible for research analysis. Hence a subobjective of the research programme was a project to diagnose and cure a problem arising in the distributive system under study.

To do this two models were developed. Firstly a channel choice model which summarised the economic variables of the distributive system. By exploiting a particular structure inherent in the model, this could be recast into a form similar to the classical transportation algorithm. As the cost matrix was of a predominantly block-diagonal form an extended application of the saddle-point theorem allowed an efficient dual decomposition procedure to be developed.

The second model relied on attitudinal data, and attempted to model merchants' behaviour in terms of how they construed their role in the distributive system and of the pressures placed upon them through the bargaining relationship.

These models were used in tandem, the first demonstrating the ideal channel choice configuration from the manufacturer's point of view, the second showing what could feasibly be achieved in spite of the power structure maintained by the merchants.

INTRODUCTION

P A R T I

1.	<u>THE DISTRIBUTIVE SYSTEM.</u>	4
2.	<u>OUTLINE OF THE ECONOMIC MODEL.</u>	9
3.	<u>INADEQUACIES OF THE ECONOMIC MODEL.</u>	11
4.	<u>MERCHANT POWER AND RELATIONSHIPS.</u>	15
5.	<u>CALIBRATION OF THE BEHAVIOURAL MODEL.</u>	21
6.	<u>THE MODEL IN PRACTICE.</u>	24
7.	<u>A SERIES OF CONJECTURES REGARDING THE APPLICATION OF OPERATIONAL RESEARCH IN UNSTABLE ENVIRONMENTS.</u>	28
8.	<u>CONCLUSIONS.</u>	32

INTRODUCTION.

This research thesis aims to add to the understanding of industrial distribution systems and to develop our ability to model such systems. The work is empirically based, taking a particular distribution system, studying it in depth and observing it during a period of change and re-organisation.

The thesis is also part of a wider research programme to investigate the problems of applying Operational Research to decision making in unstable environments. Change in distribution systems often provides good examples of this form of decision making, and some tentative generalisations are drawn as a contribution to this wider programme.

Empirical research into either distribution systems or decision making in unstable environments poses the problem of access. A characteristic of this form of decision making is its informality, without the usual stress on committees and reports found with more formal long range planning. In order to ensure access to the real decision making process the researcher became an indispensable part of that process. The research method adopted was of a type since become known as the dual researcher/change agent type. With this method the researcher had the two responsibilities of solving the particular problem while recording material as objectively as possible for research analysis. Hence a sub-objective of the research programme was a project to diagnose and

cure a problem arising in the distribution system under study.

Part I of the thesis is intended to be an extended summary of the research programme and is best read as a whole in the order given to avoid minimum loss of continuity. Part II provides all the detailed material and can be entered at any appropriate point if supportive evidence to Part I as required. The sequence of material in the two parts is roughly the same, and at the end of each section of Part I an indication is given to the relevant section in Part II.

As it is the intention to make the results of the research freely available and as many of the personalities involved are still working for the organisations studied, it has been necessary to conceal names.

The bulk of the research, which includes the particular project, was carried out between September 1967 and May 1970.

4.

1. THE DISTRIBUTIVE SYSTEM.

The project concerned a firm manufacturing and distributing engineering components in the United Kingdom. The distribution of these components was undertaken by a three-tier system of manufacturer, distributors and merchants. Both distributors and merchants are usually independent businesses, being the legal owner of goods in their possession. The firm delivered to national distributors who were paid discounts proportional to their yearly trade. The distributors stocked goods and delivered to local merchants. The merchants stocked goods and delivered to users as required. Practically all combinations of by-passing occurred, both by the manufacturers who delivered direct to merchants and users and also by distributors going straight to users. Nevertheless this by-passing never constituted more than 10% in any region and this discussion here will focus primarily on the three-tier system. The discount rate for merchants was naturally higher the more trade they handled, but marginal discount rates were decreasing. Brokerage was not a significant factor.

User markets could be fairly well classified by geographical position, product ranges and the order sizes in which they purchased. An unusual and crucial aspect of this system was the importance of the stockholding function in allowing smaller orders to be assembled into larger

reorders and hence reducing the impact of the spread of order sizes on the manufacturers.

Engineered components were normally needed either in larger quantities for assembling into new machinery or in smaller amounts for replacement in existing machines. Some customers bought just replacement or production, others for both.

As frequently occurs with distribution channels, this system had adapted to changes in the past by a series of defensive manoeuvres, each making it a little more out of step with economic reality. The costs associated with warehousing, maintaining a lorry fleet, promotion and office costs had forced the merchant to press for increased discounts from the manufacturer. The total market had been shrinking steadily for a couple of years, and this combined with pressure from their own organisations to reduce costs had encouraged users to seek higher discounts, thus eroding the merchants margins further. In order to cut costs, merchants had begun to reduce the range of goods stocked and to cut reorder quantities for the rest. This meant that even though the total sales reaching the firm had already dropped by 20% - 25% due to the economic recession experienced from 1965 to 1967, on top of this was the effect that a very much higher proportion of sales came in the form of small orders. This in effect means that a large proportion of orders (40% - 45%) did not cover the administrative costs of processing the order. Thus in the firm the clerical staff were working

harder than ever on orders that were still making a net loss, while the stocks of standard products soared forcing the men on the bulk production machines onto short time working. The non-standard and special items which were not stocked were now being ordered in smaller quantities increasing unproductive downtime on the shopfloor and hence causing a major backlog on customers unfilled orders.

Because merchants were keeping lower stocks all round they tended to place greater urgency on reorders. Thus profitable runs on machines were interrupted for rush orders again increasing costs. The increasing number of small orders to be processed caused serious delays in delivery causing further loss of trade. Merchants, users and distributors all extended credit to themselves by delaying payment on goods received as long as possible. The firm could not do likewise because of the low percentage of raw material cost in the finished product. All this time merchants had been pressing for 'informal' discount increases over and above the published rates, using as leverage their influence with customers.

This sequence of events had placed the company in a serious financial position, having made a substantial net loss for two consecutive years; the second one being approximately £0.5 million on a turnover of £19.0 million. They, as well as their competitors both required and anticipated some major reorganisation of the distributive system. At that time not only was there no general

agreement amongst the senior management of the firm on the type of change required but also it was ^{not} clear at what level changes were anticipated. Some people argued for tactical changes such as a realignment of discount structures at the merchant level, while others were just as seriously discussing the need for the establishment of a completely new distributive system.

The main options open to the firm centered round the purchase of one or more of the three major distributors, or purchasing selected merchants in various regions.

Other options open were the establishment of their own depots providing a brand new distribution channel, or part-ownership of merchants, franchise, dealership or agency agreements, financial assistance for merchants to assist in stockholding and the seriously considered option of offering the entire marketing and distribution function to a sole agency.

For more detailed discussion of the distributive system reference should be made to section A.1 and A.2. For details concerning the firm in the period immediate before the study, see section C.2 and for a longer term history of the firm, C.1.

Those involved in the distributive system felt that the limit of piecemeal manoeuvring had been reached and that the next major change would cause an avalanche of competitive actions and reactions.

Rising costs and the continued pressure for discount increases, combined with the firm's serious financial situation, had made it clear to the senior management of the firm that change was imperative within the distributive system. This fact was also recognised by other manufacturers, merchants and distributors in the system. In consequence a hypersensitive state had been achieved in which everyone knew that change was inevitable but were unwilling to make the first move, fearing it would cause an avalanche of competitive actions and reactions.

It was in this environment of considerable instability that the firm, on corporate advice, requested assistance from Operational Research. The project commenced in September 1967. The terms of reference originally concerned the choice of which distributor, if any, to purchase, but were soon widened to allow us to consider any restructuring of the distribution system. The study reported directly to the Board and the Managing Director.

2. OUTLINE OF THE ECONOMIC MODEL.

Because of the wide variety of options open, an economic model of the distributive system was needed for management to experiment with the effects of possible future policies. It would then be possible to compare alternative options systematically in a wide range of possible future cost and sales environments.

For each product range the distribution of users' orders and merchant's reorders were discretised, making it possible to model the merchant's stockholding policy by a linear transformation. Then the merchant's discount structure was approximated by a piecewise linear curve. No entry restrictions were required on this curve because of the convex monotonic increasing nature of the discount payment. The same procedure was used at the distributor level leaving finally a large linear model. An application of the Kuhn-Tucker optimality conditions enabled the model to be cast into the 'transportation' form having a block diagonal structure apart from a block of complicating constraints. Each of the diagonal blocks referred to a geographical region and the complicating constraints reflected the fact that a merchant normally serviced several demand regions. A decomposition method based on Takahashi was developed whereby the dual master problem was approximated by a series of supporting hyperplanes. The major motivation for using decomposition was to avoid the necessity of using

tape or disc files during computations. Additional benefits though arose almost immediately, such as offering the facility to take certain extra constraints into account, and also the information gained in using the dual variables in the master problem as 'macro' control variables on channel flows. After the research was finished and time was available to do comparative work it became clear that significant time savings had occurred with decomposition.

The option to establish depots led, of course, to the familiar local/global problem of non-convex programming. In practice the space over which non-convex search was required was never more than 3-space. Although a simple application of Zoutendijk's method of feasible directions was developed, this was never needed in practice, as it was found that a crude grid search interpreted with certain contextual knowledge was quite adequate. Interestingly, the problem was so structured that when using Zoutendijk's method, the solution of the quadratic programme to determine the best directions from boundaries was entirely removed as an analytical procedure was possible.

The economic model is described in section B.2, and the extension to the depot case, which was never actually applied, in Appendix 1. The ad hoc procedure used in practice for the depot case can be found in the discussions of section C.

3. INADEQUACIES OF THE ECONOMIC MODEL.

For each problem situation a series of possible strategic decisions were evaluated. The results presented to management contained the following information. For each option the expected funds required offset by expected savings both immediately and over the first three years. Then some estimate of the time scale that was needed to implement the change. This knowledge eliminated several options immediately by showing that action could not be completed early enough to forestall major competitive reactions. The major sources of risk associated with the option were then listed. These included such points as leaving large sections of the market vulnerable to competitive activity or indicating that although a certain channel configuration was the cheapest it was necessary to almost reach the optimum point before any savings began to show. Thus another option might not be quite so cheap at the optimum but it was possible to begin to make some savings much earlier. It was found that management paid more attention to this 'cut-in' point, i.e. when savings begin to show, than to optima as such.

The last information presented was termed initialisation actions, and were of two types. Firstly contextual actions such as 'begin negotiations' or 'begin capital requestion procedures'. The second type come directly from the model when the present situation was used as an initial feasible solution, thus suitable interpretations

of the dual variables associated with cells, rows and columns gave information concerning the initial changes that would be of most use. It was found that management valued the extra information provided by the dual variables and readily accepted the limitations that they must only be interpreted at the margin.

The researcher then worked with management to select firstly a short list of these options and then the final decision using criteria such as :-

- a) Are expected savings worth making the change ?
- b) Is the liquidity position of the firm such as to make the expected funds flow possible ?
- c) Is the risk associated with a certain expected savings acceptable ?
- d) Is action possible within the required time scale ?
- e) Do certain initialisation action leave several strategic options open at a later stage ?

In so far as the model was still economic in structure rather than behavioural it was still clearly inadequate. Consideration had to be given to possible competitive action. Competitive action from other manufacturers was no different than in any other situation. What was new was competitive action within the distributive system itself.

The economic model showed the flows that were required through certain channels, but as the firm did not necessarily own all or even part of some of these channels, it had no power to instruct merchants to handle what was required, other than a certain financial coercive power.

Over a period of time a belief had developed, especially amongst sales management of the firm, that the autonomy of the merchant level was inviolable. During discussions, whenever an option was considered which substantially affected the ownership of the merchant level, such as :-

- a) Purchase merchant A, or
- b) purchase a 51% holding in Merchant C, or
- c) give selected area franchises to merchants F, H and K, or
- d) set up a depot to operate at the merchant level and serve users,

then these options were immediately vetoed by the sales management. Their arguments were basically similar in every case and followed the lines of "if you attempt to substantially affect the status quo of the merchant level, then the merchants will rise as a body and cut you out of that particular market". It was this dogmatic belief in the strength of 'merchant power', as it came to be called, that prohibited any real progress towards selecting the best option.

The core of the problem was that their argument was initially both untestable and unable to be challenged on empirical grounds. It was considered that the merchant power concept was not entirely a myth and must be treated seriously. Nevertheless it was also considered that the sales management were making an over-generalisation and over-extending their argument. A sharper instrument was needed which could pinpoint where merchant power could be expected to be a potent force and where it could be safely ignored. This problem, of course, was not recognised here for the first time. Research had begun at an early stage of the project towards understanding the sources and internal dynamics of this 'merchant power', in order that its strengths and weaknesses might be identified and exploited. The discussion now turns to look at this topic in more detail.

Rather than refer directly to one section of Part II this section has been rather of the nature of a connective. Further details about choosing between options and some working documents used with management can be found in section C. Further introductory remarks about merchant power can be found in sections A.1, A.4 and B.3.

4. MERCHANT POWER AND RELATIONSHIPS.

Merchants range in size from the small family concern to organisations with a centralised management structure controlling several branches. Only the largest would ever have sufficient economic and market power to directly challenge the manufacturers. The smaller merchant, by himself, might be able to convert a few user accounts onto alternative products, but he could do little more. The merchant power that management feared was formed rather from the collectivity and solidarity of merchant behaviour.

Each merchant would be affiliated to several informal groupings of other merchants. These might be based on the geographical locality, they might all serve the same industry, or they might have some other characteristic in common. These groupings provide local networks of information giving merchants access to such information as, the 'going discount rate for standards' or the credit extensions offered by distributor X. This information is seldom available to merchants not belonging to the relevant groupings. One consequence of these local nets of information is the disproportionate power that might rest with a merchant by being the only merchant common to two different groupings. Another consequence is the time merchants spend cross checking information and checking on the reliability of their sources.

relations to channel structures.

Another use merchants make of their group affiliations is for self-definition of their roles in the distributive system. These roles are primarily defined in terms of the merchants relationships with others in the system. These relationships can be crudely separated into two types, vertical relationships with suppliers and customers; horizontal relationships with other merchants.

4.1. Vertical Relationships.

At one extreme a merchant might consider himself practically an appendage to the user, working in close collaboration with the user's purchasing agent and seeing the user's problems of supply as effectively his own. At the other extreme he might see all the user's needs and demands as lying in direct conflict to his own. We can delineate similar extremes in his relationship with the distributor and/or manufacturer. He might consider himself the manufacturer's agent, protecting him from small orders and the day-to-day exigencies of the market place; he might even request some institutionalisation of this process with contracts, franchises or agreements. On the other hand, from which manufacturer he buys may be a source of indifference to him. His aim is to keep minimal stocks whilst maintaining as high a discount as possible. Different identification by merchants between these extremes will lead to different reactions to channel disturbance.

4.2. Horizontal Relationships.

At one extreme a merchant might have little to do with other merchants, treating them as rivals at whose expense only can he expand his trade. On the other hand they might work in close collaboration to 'carve-up' the demand in their region. In this case victimisation will occur if individuals attempt to overstep their traditional territories, and collective action will prevent new entrants into the field. Most merchants occupy a position somewhere between these extremes and the manufacturers will from time-to-time either encourage or discourage this collectivisation, depending on particular circumstances. Horizontal cohesion is to some extent institutionalised in local and national trade associations. These trade associations provide a focus for dissent in times when merchants have a felt need for some defensive collectivity.

Through his group affiliations a merchant will compare his own role in the distributive system as he construes it with what he considers a desirable role. If these seem roughly the same then he will seek to maintain his role; on the other hand if he observes significant role discrepancy he will seek to adapt his present role. The principal channel for role adaptation and maintenance is via the bargaining relationship.

4.3. The Bargaining Relationship.

Each order that passes between user and merchant or between merchant and supplier requires agreement on several product characteristics such as quantity, discount, price, delivery dates and credit extension. If agreement cannot be reached immediately those involved will begin to trade one characteristic off against another.

"If you are prepared to double your order then I could let you have that discount, but not otherwise".

If agreement was not reached, an across-order compromise might be attempted.

"If you are prepared to wait for your order, I'll be able to get this one to you directly".

And then perhaps a sequential compromise,

"If you are prepared to place a regular order we might manage those terms, but not otherwise" and so the procedures used to reach agreement get more and more serious right up to the direct refusal to continue trading.

By placing different pressures on different parts of this bargaining relationship, or by resisting certain pressures placed by others, a merchant could maintain or adapt his construed role. If it became obvious that this was not going to be successful and the role discrepancy was still significant he might well resort to structural changes, such as offering 51% shareholdings or seeking sole agencies.

4.4. Some Consequences.

Thus a crude descriptive model of merchant behaviour has been developed, whereby a merchant learns and defines his role by interaction within group affiliations and relationships with user and suppliers. He then maintains or adapts this role via the bargaining relationship using the local networks of information available to him through group membership. If this fails he may resort to structural change or just "learn to live" with his new role.

An important consequence of this model is that a merchant's response to certain economic pressures is unlikely to be predictable without some knowledge of his group affiliations and of how he construes his role in the distributive system. Thus under the same economic pressure different merchants might react in quite different ways, and also the same behaviour might result from different merchants under quite different economic pressures. Thus a refusal for a discount increase might be taken by a merchant to mean a routine "tightening-up" by the manufacturer in times of relative peace. During a critical change period, though, the same merchant could see it as "the thin end of the wedge", or "the last straw" or a "shot across the bows" signalling a start of a policy of aggression towards merchants.

Thus the model demonstrates that critical attention must be paid to how actors see their roles and how they construe the options open to them at any one time. Thus using just an economic model some merchant behaviour might appear bizarre and extravagant compared with the modest ^{moves} ~~changes~~ made against them. But viewed in conjunction with the action model above his behaviour becomes much more comprehensible.

This behavioural model of merchant action is more fully developed in section A.4.1, a wider ranging description of group affiliations in A.4.2, a discussion of merchants' construed roles is in A.4.3 and more about the bargaining relationship in A.4.4. A series of sketches illustrating the variety of merchant establishments forms section A.3.

5. CALIBRATION OF THE BEHAVIOURAL MODEL

The behavioural model described above was not in a form suitable for use as an analytical tool for assisting managerial decision-making during the change period, that was expected to be initiated by the firm or one of its competitors making a major change within the distributive system. It was necessary to, at least partially, calibrate this descriptive model. The crucial aspect that required calibration was the cognitive position of a merchant in the system as construed by himself. Empirical work made the researcher confident that three five point scales were suitable. One describing the horizontal position and one each for the vertical positions vis-a-vis the users and suppliers respectively. Using these instruments and observing how merchant's adjust their construed positions as changes occurred would give an opportunity to see where strong merchant cohesion was occurring. Also isolated merchants could be identified as could those with either strong or weak integration with users or suppliers. A consequence of the general model was that role adaption was likely to occur fairly vigorously before any structural changes. Thus it was hoped to be able to use these results as, at best, a predictor, or at least as a warning light of merchant reactions to channel disturbance.

Initially the measurement of merchant cognitive position was done empirically by direct measurement. It came as a surprise that this was found to be fairly easy; merchants'

questioned found little difficulty in locating their view of their role within the scheme. This success was put down to two reasons. Firstly, the crudeness of the calibration. Secondly, the instruments were developed in context, using the sort of sentiments and language that merchants would often use themselves. The resulting instrument thus struck them as meaningful and relevant to their day-to-day operations.

This direct measurement, although successful, could not be applicable during the actual change period when access to merchants would either be impossible, or if possible would not produce reliable results. An instrument was thus needed capable of indirect application.

In order to develop such a tool, it was investigated how the sales management of the firm could claim to know whether or not certain merchants were "getting together to hit back" or "not prepared to tolerate any further incursion by direct supplies."

It was gradually appreciated that this was an aggregate affect: a "feel" deduced from a large number of small events each apparently trivial in themselves but sufficient when aggregated to cause the sales management to be prepared to stop a policy at Boardroom level. These events arose mainly out of the bargaining relationship that we have discussed above. By using the sales clerks and the salesmen from the firm and certain selected purchasing agents from users it

was possible to develop a measure of the severity of procedures used to come to agreement on orders. To do this the frequency of occurrence of each procedure was weighted by a consensus opinion of their severity. In this way a tool to measure the integration of the bargaining relationship was calibrated. Extensive testing showed that there was by and large, agreement by both sides as to the procedures used and also showed that changes in horizontal cohesion were associated with shifts in the integration of the bargaining relationship as reflected in the procedure used.

As an immediate consequence of beginning to measure the content of this aggregate affect, the sales staff began to feel less misunderstood and were able to move away slightly from their defensive position of being continually forced into the role of censoring change and defending the status quo. Previously when they had tried to convince their colleagues of the possible backlash developing amongst merchants they could only produce as evidence a series of minor instances each apparently trivial in themselves. The only safe route for them had thus been to generalise their argument and sustain the dogma of merchant power. This sharper instrument gave them the opportunity of discussing with their colleagues on the Board which merchant groups were particularly sensitive at that time.

Fuller details of the calibration of the behavioural model are in section B.3. Descriptions of it in use can be found in section C.

6. THE MODELS IN PRACTICE.

There was an immediate opportunity to test the model in practice on a modest scale, before tackling the whole of the U.K. This was in the South West of England and the South Wales industrial region. A merchant in Swindon was requesting a substantial loan in order to expand his business throughout the region. Rather than just investigate this one alternative it was used as an opportunity to look at the area in general. The model indicated that a depot at the merchant level in the Swindon region was a very desirable proposition. The best and quickest way to achieve this facility was to purchase a 51% shareholding in the merchant. This was to be accompanied by a gradual by-passing of the distributor level in the region and a build up of direct supplies to users and merchants, particularly in South Wales. The results were implemented but the merchant reaction against the moves were so fierce that management was prepared to reverse the decision and withdraw completely. The cognitive model though showed that only selective withdrawals were really needed rather than a 'blanket' move. By the time the study ended an annual saving of about £50,000 was being made, using the reorganised system.

Then the main national study was embarked upon, treating the three areas of the South West, Midlands and the North separately. Overall the balance of the results recommended the purchase of one of the national distributors, but before

this could be done a competitor made a surprise purchase of another distributor. It was critical that the immediate reactions that the firm took to counter this offensive did not jeopardise their long term flexibility. To ensure this, the economic and attitudinal models were used several times to evaluate possible courses of action and to pinpoint groups of merchants where defensive solidarity could prove either advantageous or a stumbling block. It was discovered en route that the texture of merchant relationships in the North, Midlands and South East were all quite different.

The purchase of the distributor was then made for about £½ million and the next eighteen months mainly devoted to the integration and rationalisation of the two previously overlapping distributive systems. This proved a long job but it gave the firm time to get to know the distribution business and get used to the idea that they were now a major distributor of engineered components.

Included in the rationalisation at this stage was the establishment of a large warehouse in the North to serve merchants and selected users in the area.

Both models were then used again to try and resolve the contradictory position of the one remaining independent distributor. The recommendation to purchase him for a price not much exceeding £900,000 if possible was accepted. The purchase was made and this distributor integrated into the distribution system, with the consequent rationalisation

of salesmen, lorry schedules and stockholding procedures. This also took longer than anticipated because of a considerable public concern over redundancies caused by the rationalisation, redundancies mainly drawn from workers in the joint distribution systems.

Overall conclusions on the results are difficult to define because of the impossibility of separating out the particular contribution of Operational Research, but the following major changes had occurred either directly or indirectly as a result of the study.

The total reorganisation of the distribution system including vertical integration one level nearer the market.

From making a £½ million loss the year before the study the firm passed to an almost £0.8 million profit the year after the study.

A complete shift in managerial attitudes from being solely concerned with production and engineering, to considering distribution and marketing a principal part of the firm's business.

On arrival at the firm in 1967, a possible strategic option was to give a sole agency and withdraw completely from distribution. On leaving the firm in 1970 a seriously considered possibility was to close the manufacturing facilities and use them for distributing imported components.

As it was impossible to describe the whole series of events in detail, two regions have been selected for detailed comment, the rest being treated in summary. Section C.4 details the South West and C.5.1 the South East in the initial stages. The rest of C.5 concerns other regions in the initial phase. Section C.6 describes the second phase beginning in January 1968. Section C.7 concerns the third phase commencing July 1969, and the final phase, starting August 1970 is described in section C.8.

7. A SERIES OF CONJECTURES REGARDING THE APPLICATION OF O.R. IN UNSTABLE ENVIRONMENTS.

Strategic change in industrial distribution systems provides a particularly good example of studying the application of O.R. to decision making in unstable situations.

Because of this, the opportunity has been taken to draw some tentative conjectures out of the empirical work, as generalisations about this form of behaviour. These conjectures are listed here in summary, reference must be made to section D of Part II for further details.

- a) In decision situations characterised by considerable instability in the environment, analysts need to be specifically trained to recognise and deal with the pitfalls of reasoning that occurs in groups, as time does not now allow the natural control of informed scepticism, reflection and discussion to develop to a sufficient degree. The nine types of pitfalls that were encountered most frequently during the empirical work are discussed and examples of where they arose given. In some instances there is a report on how they were avoided. These pitfalls overlap, to some extent, the expected sources of distortion which arise from information

bias, selective information being available and sectional interests. The guiding principle behind the investigation was that knowing about a pitfall assisted in avoiding it.

b) The problem of access in these situations can be solved satisfactorily by the change-agent or the dual consultant/researcher method. In this discussion the main focus is to compare the published results of other workers in the field with those of the present work. The major results is the similarity of the conclusions of this thesis with those published towards the end of the project period. We are optimistic then that a convergence of ideas is occurring and look forward to the development of a sounder and more robust methodology in the future.

c) The situation forced the analyst to use hypotheses for diagnostic purposes and interpretations as mechanisms of change, as much as for explanation and prediction. Interaction with clients tended to become more speculative rather than just informative. Relationships with clients became more of a dialogue or combined effort at formulation or clarification rather than a technical service.

- d) Discussions with colleagues beforehand had left us with the impression that using O.R. in situations where decisions were required urgently meant taking smaller samples of whatever data was required and generally weakening our criteria as to what constitutes valid information or conclusions in the study. In practice we found this to be only part of the truth. It also becomes necessary to have more frequent recourse to alternative sources of data, especially where that means obtaining personal judgements of the situation from actors involved. This tends to shift the concern to the reliability of the source itself rather than the data. Criteria to judge this reliability were not found to be consistent and were a function of the source and type of the information and the purposes for which it was required.
- e) The relationship between strategic and tactical decisions becomes more complex in unstable situations, with the direction of cause and effect influence less a predominantly one way affair. The assumption of a certain stability implies that tactical deviations caused by unexpected environmental influences can be accommodated within existing strategic plans. A stream of such deviations would then feed back to a realignment of the

strategic position over a period of time. It is typical of an unstable system though, that a series of tactical changes are the first significant warning that the organisation receives concerning the approach of a sudden change. The immediate response to these changes, although often tactical itself, can significantly affect which long term options remain open. No solution is offered to this problem, which is a matter for further research, but it is merely placed on record as an empirical observation.

That concludes the list of conjectures.

8. CONCLUSIONS.

This thesis had three objectives and conclusions can be drawn about each of them separately.

Firstly it must be judged whether our work adds to the understanding of industrial distribution systems and whether it develops our ability to model such systems. We believe that the detailed description of the changes in the economic variables and of the growth and internal dynamics of merchant power does give significant insights into such a system. We also consider that both of the mathematical and altitudinal models are able to be translated, with the minimum of restructuring, to assist in decision making in other industrial distribution systems of a basically similar type.

Conclusions from the second objective take the form of an assessment of the contribution made towards the methodological problems involved when applying Operational Research to situations where reasonable environmental stability cannot be arrived. It is our contention that the work supports the conjectures listed above. We make no claims at this level of generalisation, other than our results provide supporting evidence for these conjectures.

The third objective was the solution of the specific industrial problem to reorganise the distributive system of the firm manufacturing engineered components. This is to be judged as either a poor or good piece of Operational Research. Our model was accepted by management and used frequently and successfully over a period of two and a half years to assist in the decision making at Boardroom level.

PART TWO

SECTION A

A. THE DISTRIBUTIVE SYSTEM.

A.1.	<u>GENERAL DESCRIPTION OF MARKET AND PRODUCT COMPETITION.</u>	38
A.1.1.	<u>The Market.</u>	38
A.1.2.	<u>Replacement and Production Markets.</u>	42
A.1.3.	<u>Comparison with Competitive Distribution Systems.</u>	47
A.2.	<u>ECONOMIC VARIABLES WITHIN THE DISTRIBUTIVE SYSTEM.</u>	
A.2.1.	<u>Discounts.</u>	
A.2.1.1.	<u>The 'formal' system.</u>	55
	<u>Distributors' discounts.</u>	56
	<u>Merchants' discounts.</u>	59
	<u>Users' discounts.</u>	66
A.2.1.2.	<u>The 'informal' system.</u>	71
A.2.2.	<u>Credit Conditions.</u>	77
A.2.3.	<u>Guaranteed Margins.</u>	85
A.2.4.	<u>Areas Serviced by Merchants.</u>	93
A.2.5.	<u>Representation.</u>	98
A.2.6.	<u>Stockholding.</u>	
A.2.6.1.	<u>Range of stockholding.</u>	100
A.2.6.2.	<u>Stock quantities.</u>	105
A.2.7.	<u>Minimum Order Sizes.</u>	111

A.3.	<u>EXAMPLES OF TYPICAL MERCHANTS.</u>	
A.3.1.	<u>The 'Jobber' or 'Pirate'.</u>	113
A.3.2.	<u>The Old-established Firm.</u>	115
A.3.3.	<u>The 'Professional' Merchant.</u>	117
A.3.4.	<u>The 'Average' Merchant.</u>	119
A.4.	<u>THE WEB OF THE MERCHANT'S GROUP AFFILIATIONS.</u>	123
A.4.1.	<u>A General Model of Merchant Action.</u>	124
A.4.2.	<u>Group Affiliations.</u>	
A.4.2.1.	<u>Between merchants.</u>	129
A.4.2.2.	<u>Between Users.</u>	140
A.4.2.3.	<u>Between Suppliers.</u>	143
A.4.3.	<u>The Merchant's Cognitive Position.</u>	
A.4.3.1.	<u>Towards users and suppliers.</u>	145
A.4.3.2.	<u>Towards other merchants.</u>	149
A.4.4.	<u>The Bargaining Relationship.</u>	154
A.5.	<u>THE INTERNAL ORGANISATION OF THE COMPONENT FIRM.</u>	159

A. THE DISTRIBUTIVE SYSTEM.

A system for distributing engineering components in the United Kingdom will be described in five sections.

Firstly an overall view of the market served will be given and a brief comparison with the distribution of competing products. Rather than do this for the whole country a particular geographical region is considered as representative. Secondly, a detailed investigation of the economic variables of the system is given and their changes over recent years traced. Thirdly, specific merchants are considered in detail to demonstrate the scope of alternative merchant establishments. Fourthly, consideration is given to the relationship between units operating in the system and lastly a very brief description of the internal operations of the component firm is given for completeness.

The intention is to be descriptive, but it can be considered research in the same sense as the work of Roy (55).

A.1. GENERAL DESCRIPTION OF MARKET AND PRODUCT COMPETITION.

This section makes particular reference to one area; the South West, including Devon, Gloucestershire, Somerset, Wiltshire, Bristol and South Wales. This was chosen in consultation with the marketing personnel as being fairly representative and also an area where a participant observer would be least likely to 'put the backs up' of merchants. It was unrepresentative in as far as no major producer of these components has manufacturing operations in the area. The area had a lower average density of usage and larger customers were often more widely dispersed. Nevertheless, it was considered that the differences were not too great to unduly influence the organisational structure and that the 'custom and practice' was broadly representative.

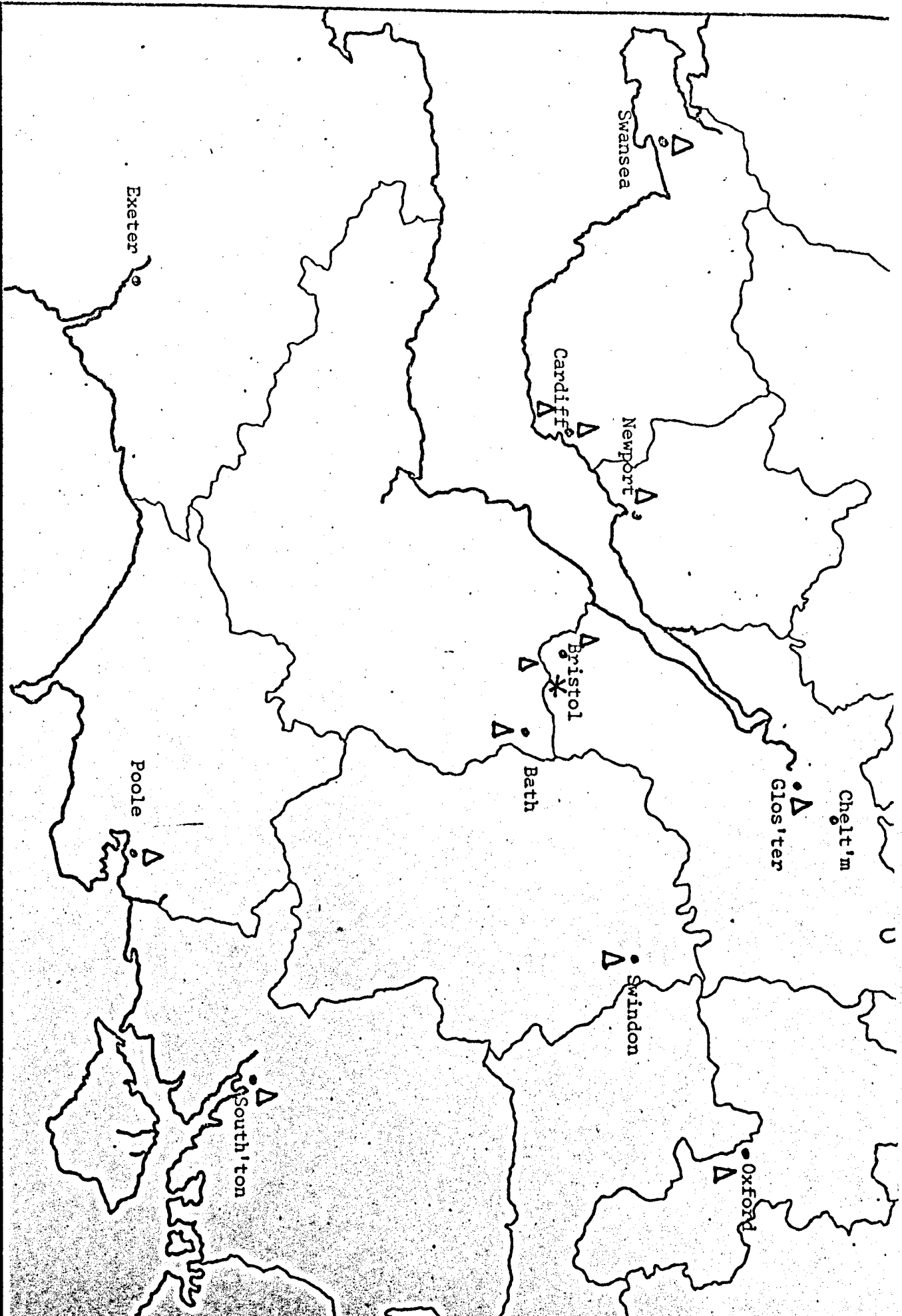
A.1.1. The Market.

The area concerned is shown with distributors and merchants marked in Fig. A.1.

An indication of the flows of goods occurring is shown in Fig. A.2. Product usage is not homogenous but relative to the principal industries.

Thus mining and steel industries of South Wales require heavier and stronger components and are not interested in precision tolerances. The aircraft industry around Bristol require light components, with great strength and very close tolerances.

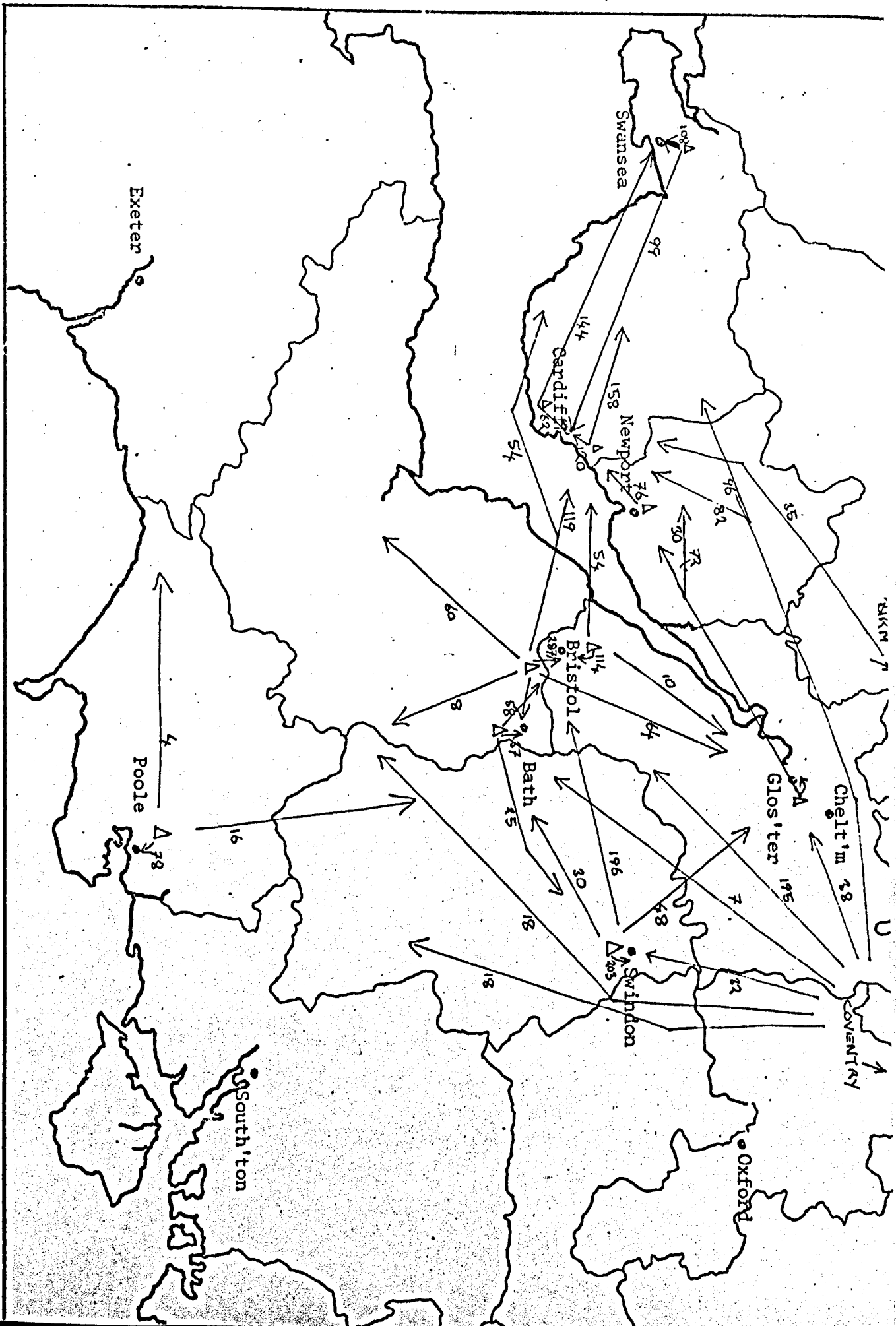
Special steel and close tolerances can increase the price by anything up to 100 times. We would expect this difference in market requirements to



△ Merchants

* Alpha Branch depot

flows in £1000's



reflect itself in the type of merchant servicing it. A merchant servicing the heavy industry need have little technical knowledge, he can cut corners and prices by having inadequate and over-loaded warehousing. If he runs out of an item he will usually be able to get some more, at a price, from the next merchant. His warehouse handling equipment can be old and crude, if a few items are seriously damaged as a result, it matters little. His stock value is low and he can float variations without negotiating special overdraft facilities with his bank. He doesn't have to employ skilled salesmen. He knows that his customer is interested primarily in keeping his machinery working. If a component break-down stops machinery he needs a merchant who will get a replacement without delay. The wrong component will do, as long as it gets the machinery working again.

On the other hand a merchant servicing an industry with an advanced technological base will be keeping a valuable stock which he will need help and capital to float. He will have to know how to contact and deal with sources of capital or loans. His warehouse facilities will have to be excellent, most likely being temperature controlled. His salesmen will have considerable technical expertise to deal not just with purchasing agents but also with designers. Price and quality are going to be critical marketing factors.

A.1.2. Replacement and Production Markets.

Components are required for two main purposes. Firstly they are required for assembly into new machinery being produced; secondly when that machinery has been sold and is in use, components are required for replacement. Components for production are often tendered for, either informally by asking for quotations from several sources or formally by asking for tenders. They are bought in considerable quantities and often involve only a few different items from the product range. The major factors affecting purchasing are price, including quantity and 'single-type' discounts; design factors such as quality and suitability; and ability to keep delivery dates. A few extra points need to be made about each of these. Concerning price, we must mention the continued growth of central purchasing departments. Most component manufacturers will offer a central purchasing office of a corporation collective terms. He then supplies each of the production facilities in the country with goods at this centrally agreed price. Local purchasing agents are informed that they will purchase a certain list of items from a certain source, unless they have a very good reason not to. Concerning design it means that much of the selling offered must be directed towards the designer instead of just at the purchasing office. In many organisations, and particularly the one under study, the purchasing

function in newly designed products for manufacture is quite distinct from the purchasing of replacement items. Frequently a customer will maintain two separate accounts, one for each. Concerning the ability to keep to delivery dates we must explain the function of the 'call-off'. Here the customer will negotiate with the manufacturer for a certain price, discount and delivery date; and he also will stipulate that he wishes to 'call-off' at his local merchant supplier. Then rather than accept delivery of the whole batch quantity requested he relies on his merchant doing the necessary storing and progress chasing. He merely makes an agreement with the merchant that they will require up to so much delivered per month, say, and a certain quantity capable of being delivered immediately in case of emergencies. With that stipulation the merchant is free to organise supply as he wishes. It is said in the trade that the merchant who services 'call-offs' is just acting as a storage unit for the customer, that he is effectively under the control of the customer. This, though is not quite the case, and we consider that it is an error to think in these terms. The only difference between 'call-off' service and 'merchant' service is that certain contractual agreements have been made over time. The customer has lowered the risk to his supply at a certain financial cost.

When we turn to the replacement market we find that the emphasis shifts to availability, merchants being able to supply rapidly and moves away from price and discount negotiating. Of course these two types of purchasing are seldom found in isolation and we give some examples below.

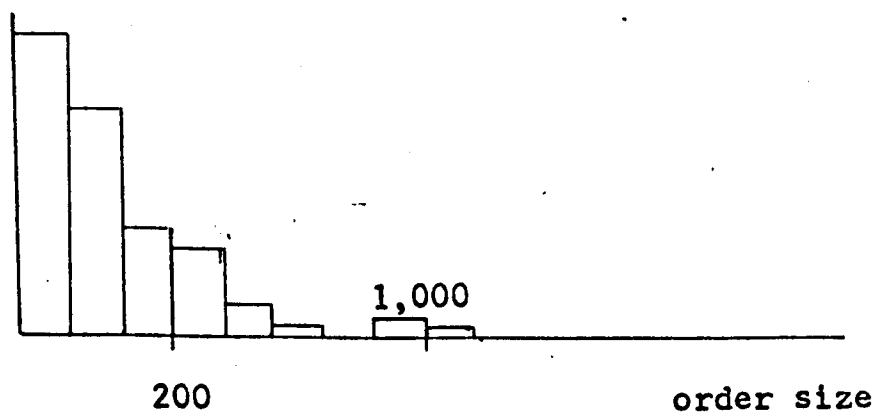
FIG. A3

Replacement alone :

Transport firm : Swindon

sample size : 83

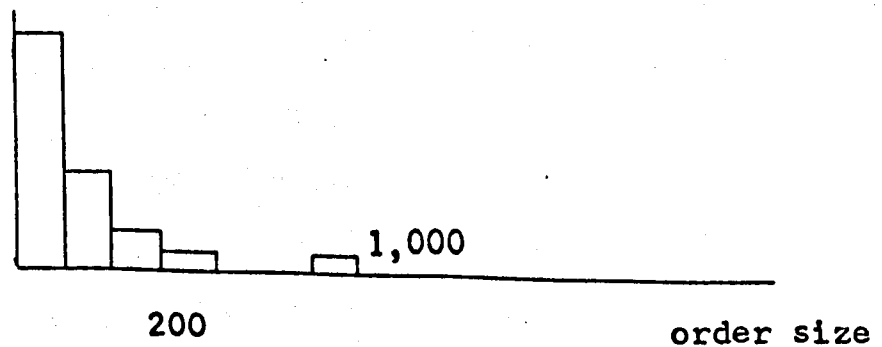
freq.



Electronics firm : Swindon

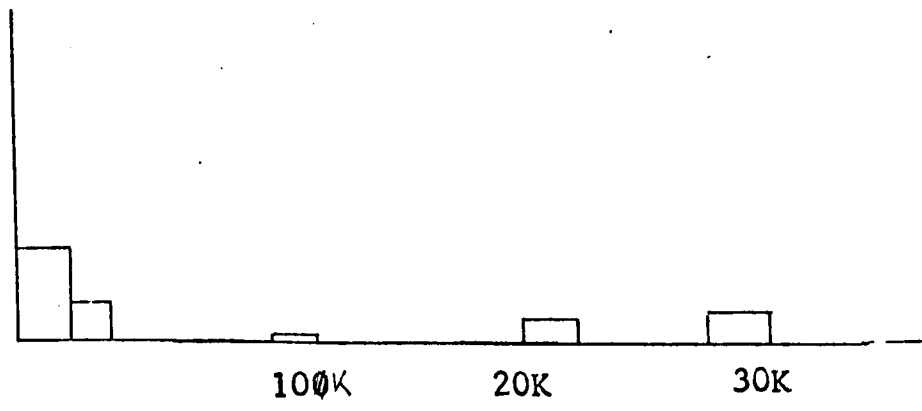
sample size : 166

freq.



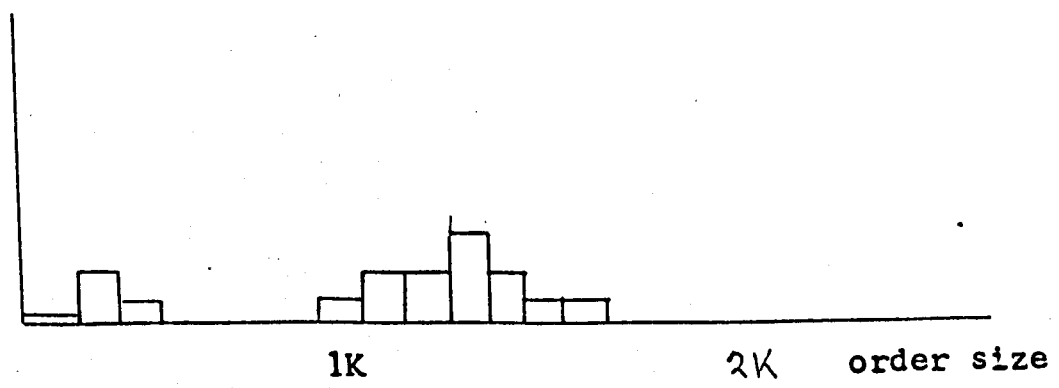
Production alone :

Aircraft component manufacture : Wiltshire
sample size : 28



Steel firm : Swindon
sample size : 77

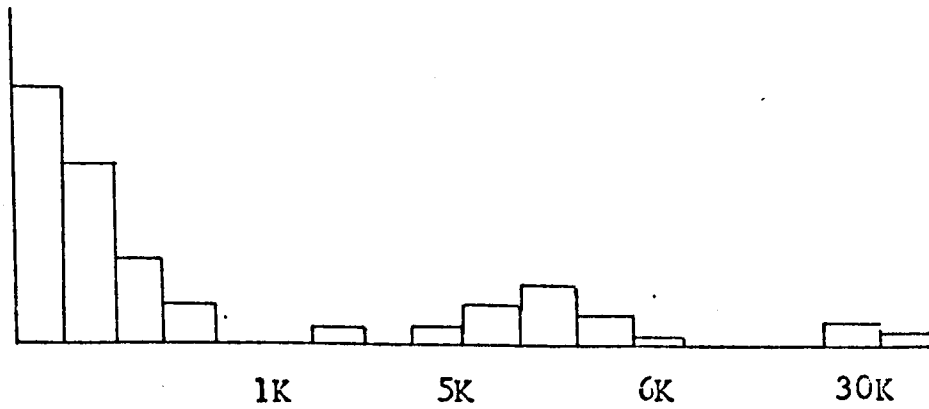
freq.



Both replacement and production :

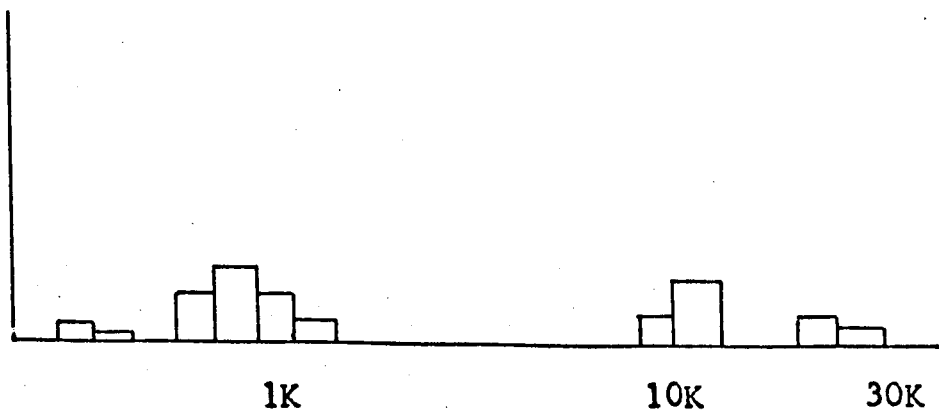
Hydraulics firm : Somerset

sample size : 240



Instrument manufacturer: Oxfordshire

sample size : 287



A.1.3. Comparison with Competitors' Distribution Systems.

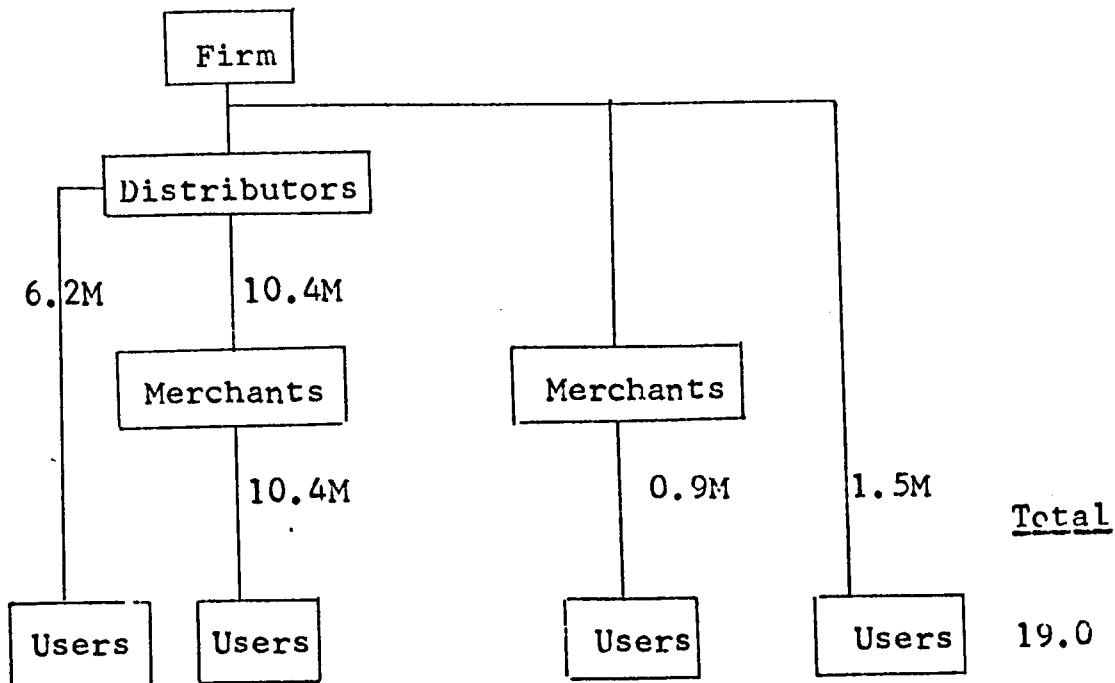
The manufacturers sell to either the distributors or merchants or else go direct to the user. The distributor sells to the merchant or customer and the merchant just deals with the customer. There are of the order of 12/15 distributors dealing with the components under study here and perhaps 400/450 merchants, with basically four manufacturers. The difference between a distributor and a merchant is one of degree rather than type. A big merchant with many branches will 'feed' other merchants and will most likely get 'distributors terms' or something near to them. A small distributor will be acting rather like some of the larger merchants. The difference is shown by the characteristics of :-

- size, distributors are generally bigger;
- coverage, a distributor is usually national, a merchant local;
- terms, distributors get better discounts etc.;
- stocking, a distributors major sales effort is meant to be towards merchants rather than customers.

In this industry there is only negligible amounts of brokerage, and the little that does exist is on an informal basis.

For the firm we are considering the flows of standard products are nationally :-

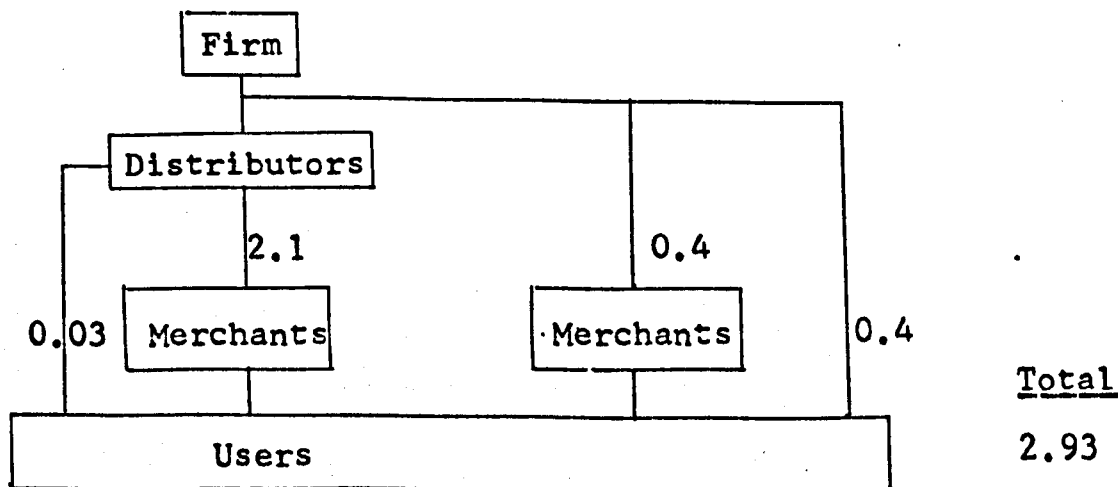
FIG A.4



Figures in £ Millions

and for the South West region

FIG A.5



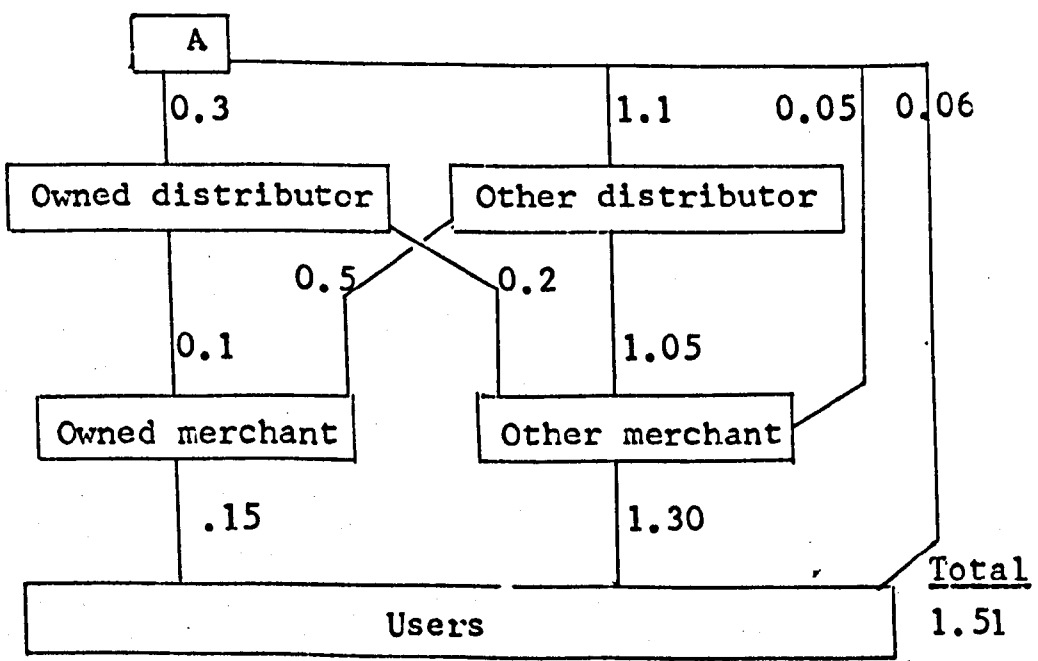
Figures in £ Millions

We notice from this that the S.W. has a higher proportion of sales going through merchants, that Firm-Mech and Dist-mech are higher proportions with Firm-User and Dist-User being correspondingly lower. Notice that 85% of sales in this area go through the merchants and 72% through the channel Manuf-Dist-Mech-User. We would expect then to find in this region that Merchants enjoyed somewhat more power than the country, as a whole; the proportions nationally being 59% and 55% respectively. The patterns for competitors was somewhat different. Competitor A.

This competitor had acquired distributors operating in this area as well as a merchant. His trade pattern was as follows :-

In the South West;

F I G. A, 6



Thus he was competing with his own distribution system. He gave the same discounts to both owned and not owned distributors, and the owned distributors and merchants were independent financially. Nevertheless certain policy rules were imposed by the organisation. Because of the fear of retaliatory action by other merchants, their owned merchant did not aggressively compete in the market, but competed defensively by improved service and stock availability. Stocks were kept high in the owned channel, this meant that other channels drew from them as required and consequently gave as good a service. If supplies did get tight they could switch to other brands whereas the owned channel was tied to the one. Thus this configuration was not treated as a potent threat by other merchants and distributors but they welcomed the improved service it afforded them. But this was not a stable ^{position} ~~optimism~~, they knew that the longer the manufacturer owned a channel he was 'learning the distribution business', was developing contacts and skills which would be valuable if ever he wanted to 'go it alone'. Other merchants knew that the manufacturer could begin to squeeze them out of the market, that he could begin to give priority to his own customers, and that ultimately his financial backing would carry him through any extended discount war. This short-term security and long-term uncertainty led naturally to opportunism and profit-taking at the individual level with defensive

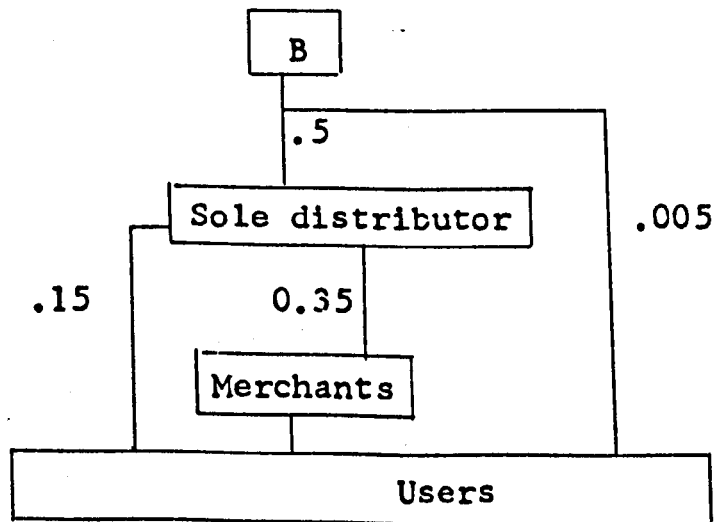
movements forcing merchants together for solidarity concerning their long run existence. What company A was going to do next became a frequent topic of conversation combined with defensive manoeuvring and posturing.

With company A structuring its channels in this way, a defensive wariness was maintained in all transactions and relationships. Merchants began to spread the risk of having their supply dry up and began to open new contacts or renew old ones. Merchants began to search, although perhaps not very actively, for alternative sources of supply. 'Call off' accounts were at a premium because of the security involved. Stocks were built up by some in case supplies began to fail, while others cut back so that they might the more easily switch brands. Similarly some attempted to extend credit hoping by this to reduce the risk of being shut out, while others did the exact opposite for the same reason, thinking that the most 'credit-worthy' customers would be the least likely to be dropped. Pressure was applied on discounts and guaranteed margins in an attempt to 'get more while the goings good', but not too much pressure, because this would force the manufacturer to take action. Attendances at informal area gatherings of merchants rose now that they had something to discuss that affected them all.

Competitor B.

Company B was in an unusual position. It still had only a small market share but had grown from nothing rapidly. To help speed its growth and allow it to concentrate on manufacturing, a job the management considered they knew best, they had given the sole-agency for distribution to a nation wide professional industrial distributor. This distributor had branches in most industrial regions and provided a wide marketing coverage for them initially. But now that they had 10 - 15% of the market, this was beginning to act as a bottle neck. Their distribution pattern was as below.

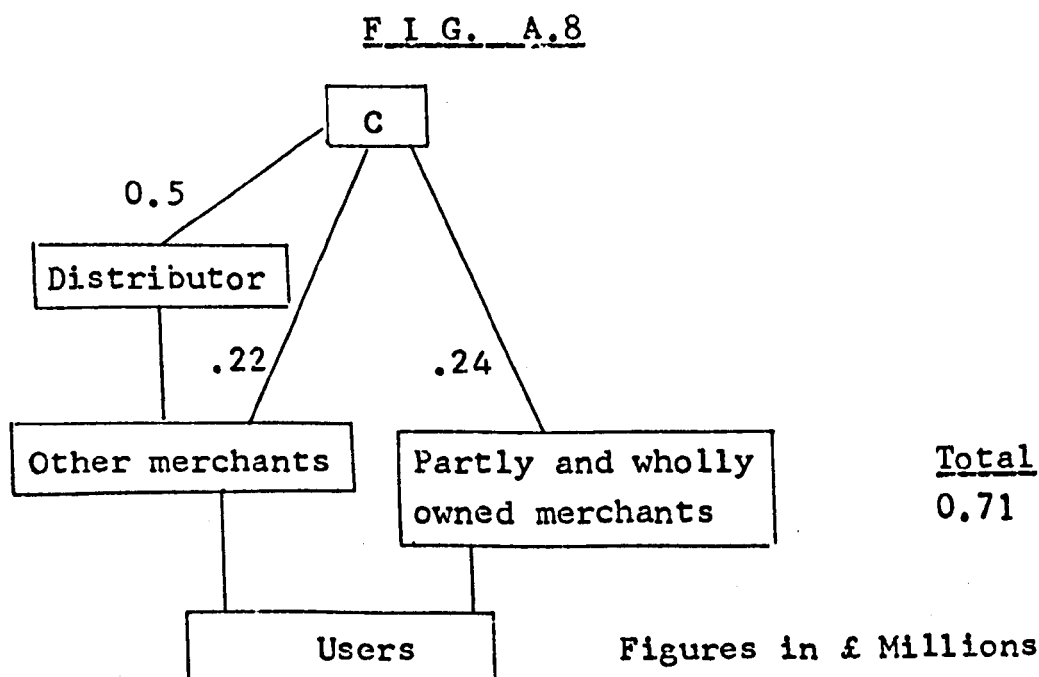
F I G. A. 7



Only one major conflict remained apart from brand competition and that was between Company B and the distributor. B was attempting to develop a second distribution channel while the distributor was attempting to squeeze 'that extra 2½%' out of Company B.

Competitor C.

The distributive pattern was as confused for C as for A, but in this case the friction was not so apparent, partly because the total sales were so much smaller and partly because the pattern had remained unchanged for some time. Company C owned several merchants and partly owned others. Little of their trade in this area was through distributors as such. The flows were as below :-



We had difficulty finding out much about the working of this system except that most of the accounts were with long established customers of the parent company which owned company C. The accounts specifically for the components in question were newer since they only effectively entered the

market about 8/10 years previously.

Most of the remaining analysis will focus on the distribution system for the firm in question but reference will be made to A, B and C when necessary.

A.2. ECONOMIC VARIABLES WITHIN THE DISTRIBUTIVE SYSTEM.

The important economic variables concerned with both the maintenance of the existing structure and providing an impetus for change, are each investigated separately.

A.2.1. Discounts.

These can be considered under various headings. Firstly a distinction must be made between user, merchant and distributor discounts. Then between what can be termed the 'formal' and the 'informal' discount structures.

A.2.1.1. The 'formal' system.

This is the discount structure as published by the manufacturers. 'Standard' items will be meant as referring to the standard catalogue of the manufacture where he undertakes to supply any standard item from stock. There is an awkward division for non-standard items but one which it is worth continuing. A non-standard item which has still the formal geometry of a standard item but perhaps just varies in dimensions will be referred to as 'non-standard'. A non-standard item which is of an entirely distinct design to the standard range will be called 'special'. Most of the manufacturers keep to a classification near enough to this for our purposes. We are not claiming that they make the same allocation of items into

these groups. What is standard to one manufacturer will often be claimed as non-standard to another. The published gross discounts only refer to the 'standard' and 'non-standard' ranges.

Distributors' discounts.

All manufacturers give standard discounts to distributors. This means that taking the previous few years sales into account a discount is agreed upon between manufacturer and distributor; and then applied to all purchases from there forward regardless of product value or quantity ordered. From time to time discount review will take place, which in practise means the distributor has asked for an increase. Fig. A.9 gives an indication of how discounts have varied over time.

F I G. A.9

<u>Year</u>	<u>Discount range</u>
57/58	17½% - 22½%
63/64	25% - 27½%
66/67	27½% - 30%
68/69	35% - 40%

Notice the sharp rise indicated during the period of the study, and the quite substantial rise in the ten years proceeding. No figures were available before 57/58, but people claimed

that there had been only gentle rises inter-laced with long stable periods before then.

For comparative figures we turn to Fig.A.10.

F I G A.10

<u>Year</u>	<u>Study firm</u>	<u>Comp A</u>	<u>Comp B</u>	<u>Comp C</u>
57/58	17½% - 22½%	22½%	20% (iii)	20%
63/64	25% - 27½%	30%	(iii) 30%	27%
66/67	27½% - 30%	(i): 35%	30%	35%
68/69	35% - 40%	(iv) 40%	(ii) 40%	37½%

(i) changed to 35% about 65.

(ii) changed to 40% end of 67.

(iii) figures unreliable.

(iv) changed about end of 67.

From these figures it is seen that the study firm has lagged continually behind competitors for the last decade. The slight lagging by Company B could be said to reflect their single agency type distributive system. The overall picture is of A, B, C making the running, ^{despite} although or perhaps because of, the study firm's still dominant position in the market

Turning to the 'non-standard' range, there are the corresponding figures in Fig. 11.

F I G. A.11

<u>Year</u>	<u>Study firm</u>	<u>Comp A</u>	<u>Comp B</u>	<u>Comp C</u>
57/58	15%	(iii)15%	(iii)15%	(iii)12½%
63/64	17½%	20%	22½%	(iii)20%
66/67	(iv)26%	(i)25%	27½%	25%
68/69	30%	(ii)30%	(ii)40%	37%

- (i) changed about 65.
- (ii) changed end of 67.
- (iii) figures unreliable.
- (iv) figures unreliable because of major changes in the definition of what was standard or non-standard.

These figures show much the same sort of trends as for standards except that the final figures for B and C race ahead. Here it must be remarked that C does not have such a wide range of non-standards as either A or the study firm; and B has a particularly narrow definition of standard. This is, many items classed as non-standard by B, others would take as standard, also the items that are in B's non-standard range tend to be 'not-so' non-standard as for A and C's range. They do not tend to manufacture some of the more bizarre sizes that others do.

Distributors as a rule handle few 'specials' and also Companies B and C tend not to make very

many. When they do handle 'specials' they usually come under the terms of non-standards unless they need special storage or treatment, in which case the discount is individually bargained for. In neither case are there published figures.

Merchants discounts.

Each of the companies tend to try and grade their merchants according to the total sales that they place with them. Rather than have a continuous sliding scale, a series of 'categories' of merchants has usually been created.

The classification for the study firm in 1966 is shown below :-

Fig A.12

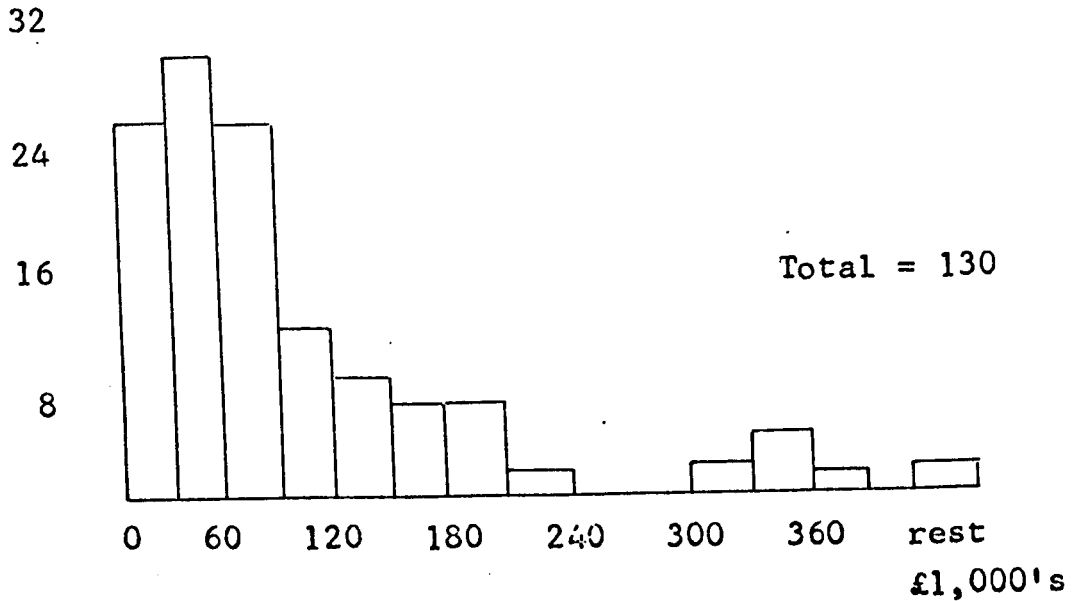
<u>Class</u>	<u>Average annual purchases</u>	<u>Number in this class</u>
AA	above - £30,000	124
A	£15,000 - £30,000	45
B	£5,000 - £15,000	74
C	£2,000 - £5,000	24
	Total	<u>267</u>

Comparable figures for competitors were unobtainable, but the class range was ascertained to be much the same. Both competitors B and C combined classes B and C together.

To get some idea of the spread of sizes within these ranges, data was obtained for the annual purchases for 1965 by AA merchants only.

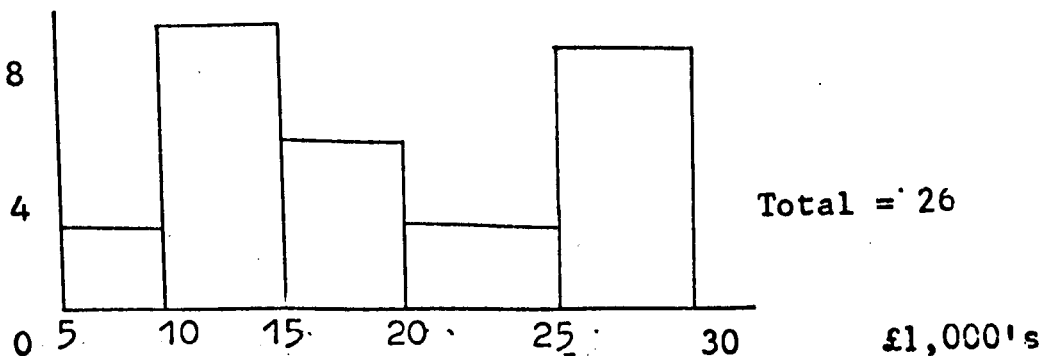
This is shown in the histogram Fig. A.13.

FIG. A.13



The breakdown by annual purchasers for those below the £30,000 criteria level is displayed in Fig. 14 below :-

FIG. A.14



It can be seen from this that most probably two distributions have been sampled, the group in the last peak being those falling naturally

into the AA category but who for some reason did not manage to achieve the requisite £30,000 sales. This sort of case is overlooked by the manufacturer and the merchant is not penalised for this temporary lapse. The other peak represents a population which is not really of the AA category but who the manufacturer have favoured with better terms. These may include merchants who total trade with all manufacturers is substantial and more of his trade is trying to be lured this way. It might be a merchant who was owned by another firm who had an 'across the board' agreement with all its suppliers.

It must be remembered here that most merchants deal with more than one supplier and would thus be classified differently by each. Merchant discounts are given in Fig.A.15 for standard items.

F I G A.15

	<u>MERCH</u> <u>CLASS</u>	<u>STUDY</u> <u>FIRM</u>	<u>COMP A</u>	<u>COMP B</u>	<u>COMP C</u>
57/58	AA	17½%	17½%	15%	15%
	A	10%	10%	NA	NA
	B (iv)	7½%			
(i)	C	5%	(vii)	(vii)	(vii)
63/64	AA	20%	25%	22½%	22½%
	A	12½%	15%	NA	15%
	B	10%	10%	NA (ii)	10%-12½%
(i)	C	5%	(viii)	(viii)	(viii)
66/67	AA	25%	30%	27½%	27½%-30%
	A	15%-17½%	17½%	15%-17½%	17½%-30%
	B	10%-15%	12½%	NA (ii)	15%
(i)	C	7½%	7½%-10%	NA	NA
68/69	AA	30%	30%	30%	30%-40%
	A		17½%	15%-17%	17½%-30%
	B (iii)	20%	15%	NA	15%
	C (vi)	NA	NA	NA (ii)	NA

- Notes :
- (i) C includes non-stockist.
 - (ii) Not available because of being within single agency.
 - (iii) Study company discarded differentials between A and B.
 - (iv) This formal class structure not in existence then, has been recreated from figures for report convenience.
 - (v) Type C class did not exist until 1960.
 - (vi) Type C effectively discontinued after 1967, although still formally announced.
 - (vii) Did'nt classify there at this time.
 - (viii) Type C did'nt exist for them at this time.

This data again gives the impression that the study company was always a little behind the others in giving merchant discounts on standards. Notice the substantial rises that have occurred over the decade and in particular the remarkable rise between 1964 and 1967. Notice also that this discount competition was not just limited to the largest companies, but was active at all levels. Included is the rather uneven history of class C not because of any particular intrinsic interest in the discount but rather because of the way companies attempted to accommodate it. As a backlog of pressure from merchants began to

build up, there was an attempt to with stand it from the companies by dividing the merchants into classes. This divided the solidarity and made them able to gear discounts with turnover of sales. The spotted history of class C is where they were attempting to go just too far. Notice that neither of companies B or C took any notice of this lowest class.

Comparable figures for the non-standard range are shown in Fig. A.16.

We notice in this data that the rise has not been so marked as in the standard case, which reflects the competitive position. But notice one piece of rather aberrant behaviour and this was the way that the two smaller companies B and C put considerable discount pressure on non-standards, and effectively treated them as though standard. This has been partly explained above but we think that it can still be concluded that these companies made a definite competitive drive to increase their share of the non-standard market.

FIG. A.16

	<u>MERGH</u> <u>CLASS</u>	<u>STUDY</u> <u>FIRM</u>	<u>COMP A</u>	<u>COMP B</u>	<u>COMP C</u>
57/58	AA	10%	10%	10%	7½%
	A	5%	5%	NA	NA
	B	NA	NA	NA	NA
63/64	AA	12½%	12½%	20%	17½%
	A	12½%	7½%	-	15%
	B	7½%	5%	NA	5%
66/67	AA	15%	15%	27½%	27½%-30%
	A	12½%	10%	15%-17½%	17½%-30%
	B	7½%	7½%	NA	10%
68/69	AA	20%	15%	30%	30%
	A	10%	10%	17½%	20%-30%
	B		7½%	NA	NA

In interpreting compare with notes of Fig. A.15

User discounts.

User discounts are of two types, quantity and single type. Quantity discounts only operate on scheduled orders and items must lie within a product range of standards and certain non-standards. Most manufacturers operated with three or four sub-ranges within their product range. These were usually based on value of the component. There were little differences among the firms and any short run differences that did occur were soon made good by others 'coming into line'. Also data was not available to show movements over the decade. Data was available for the 1962/63 period and again when it changed in 1965/66 but the data available for 1959/60 was felt to be somewhat unreliable. Another difficulty is now that in 1965 the definition of ranges for three out of four of the manufacturers was changed from four categories to three. The approx. relationship is depicted in Fig. A17 overleaf. The top line referring to the product ranges in 62/63; the lower referring to 65/66.

F I G. A.17

1962/63	RANGE 1	RANGE 2	RANGE 3	RANGE 4
1965/66	Range 1	Range 2	Range 3	

The available quantity discounts are given below :-

F I G. A.18

	<u>RANGE 1</u>	
<u>QUANTITY</u>	1962/3	1965/6
10,000 - 50,000	2½%	5%
50,000 -100,000	7½%	10%
100,000 -250,000	10%	12½%
250,000 -500,000	12½%	15%
above 500,000	on application	

	<u>RANGE 2</u>	
<u>QUANTITY</u>	1962/3	1965/6
2,500 - 5,000	2½%	(i) NA
5,000 - 10,000	2½%	5%
10,000 - 50,000	7½%	(ii) 12½%
50,000 -100,000	12½%	15%
above 100,000	on application	

RANGE 3

<u>QUANTITY</u>	1962/3	1965/6
500 - 750	2½%	5%
750 -1,000	5%	10%
1,000 -2,500	10%	12½%
2,500 -5,000	12½%	15%
above 5,000	on application	

RANGE 4

<u>QUANTITY</u>	1962/3	1965/6
500 - 750 (iii)	5%	NA
750 -1,000	7½%	NA
1,000 -2,500	12½%	NA
above 2,500	on application	

- Notes :
- (i) This entry was quoted in published tables.
 - (ii) An intermediate figure of 7½% was quoted for the 10,000 - 20,000 range, the 12½% figure began at the 20,000 mark.
 - (iii) A lower figure of 2½% was quoted for the range 100 - 500.

Single type discounts are additional discounts for purchasing a considerable quantity of one product and for placing this order on a scheduled basis, giving the manufacturer several months warning. Most of the same warnings regarding interpretation apply here as for quantity discounts. The discounts are given in Fig. A.19 overleaf.

From both of these tables it can be seen that considerable discounts can be gained by Users. For example a production firm purchasing 50,000 of one type of component in range 2 would get a total discount of 35%. The intention of these discounts schedules is to encourage smaller buyers to deal through merchants and major 'production' buyers to deal directly with the manufacturer.

F I G. A.19

<u>QUANTITY</u>	<u>RANGE 1</u>	
	1962/3	1965/6
10,000 - 50,000	2½%	5%
50,000 - 100 K	5%	7½%
100 K - 250 K	7½%	10%
250 K - 500 K	10%	20%
above 500 K	on application	

<u>QUANTITY</u>	<u>RANGE 2</u>	
	1962/3	1965/6
2,500 - 5 K	2½%	5%
5 K - 10 K	2½%	7½%
10 K - 50 K	7½%	10%
50 K - 100 K	10%	20%
above 100 K	on application	

<u>QUANTITY</u>	<u>RANGE 3</u>	
	1962/3	1965/6
500 - 750	2½%	5%
750 - 1 K	5%	7½%
1K-2,500	7½%	10%
1.5K- 5 K	15%	20%
above 5 K	on application	

77

RANGE 4

<u>QUANTITY</u>	1962/3	1965/6
500 - 750	5%	NA
750 - 1 K	7½%	NA
1 K - 2.5 K	12½%	NA
above 2.5 K	on application	

For customer orders direct to the factory which are not scheduled the single type discounts are roughly used, but here discounts are only given on an informal rather than a published basis. Nevertheless a good order or customer will often be able to get either 2½% or 5% off. Only about 6% - 8% of total business comes in this fashion so it will not be pursued any further here.

A.2.1.2. The 'informal' system.

It is unlikely that 'blanket' terms such as those above would be flexible enough to meet the varied conditions of the merchant. Thus an informal system has arisen which 'bends' the rules to suit particular circumstances and it is this system which is going to be particularly important in this work. Step functions such as the formal system are of no use in the analysis if practical usage merely makes them continuous again.

The distributors.

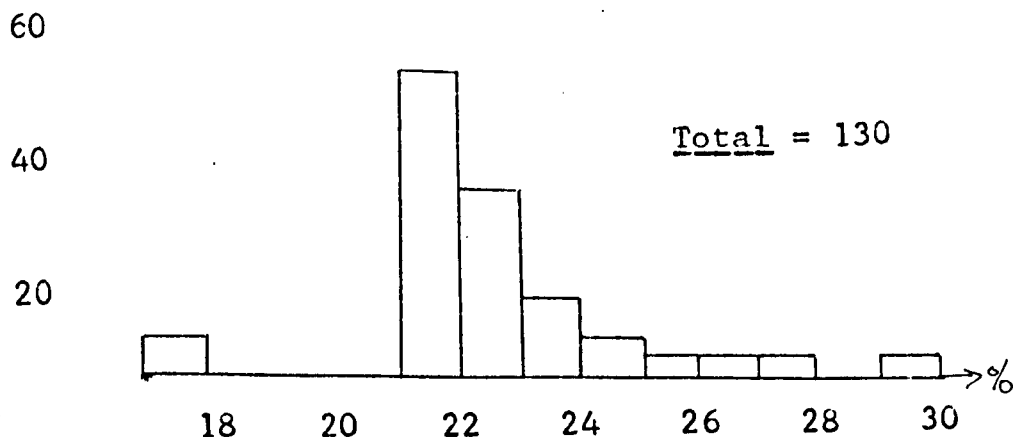
There is no significant informal system at this level that could be discovered, mainly because of the fixed nature of the distributors terms. There are frequent 'bendings' of the rules, but on a level which can be ignored.

The users.

Again there are only marginal adjustments to the formal system. A customer may be encouraged in the hope of another order, or because of reciprocal arrangements etc. This has not been found significant enough to include in the analysis of the discount structure.

The merchants.

The merchants are the only case where the informal structure is important. Consider the Histogram Fig. A20. This shows the distribution of discounts actually received by AA merchants in 1965.

FIG. A.20

This has an average of 23.6%, eighteen months later the official figure was 25% and a year earlier was 20%. The two main reasons for this discount drift are, firstly, the increasing pressure for discount rises between 'official' rises makes the manufacturer increasingly to 'give' a little. Secondly, the existence of special conditions. A merchant with a favourable potential will be tempted to place more of his business, or a merchant who holds the loyalty of a big customer account might have more leverage. A merchant who regularly collects his own supplies might get 'an extra 1%' if he comes along way, $\frac{1}{2}\%$ if not. A merchant in a strategic position might also be able to command above the norm. For example one AA merchant was the only real outlet in the Poole/Bournemouth area and received a 26% discount.

Another merchant held a dominant position in Sheffield and received 29%, another in Bristol with 27½%.

The official discount rates are changed infrequently by a committee of the manufacturer that meets for that sole purpose. Not every time they meet do they decide upon a change, changes of an official nature are expensive. If someone is demoted, he might be lost, if someone is promoted you give him a bigger cut and he has even less incentive to increase sales. There is no pretence of acting as pure 'economic man' by the merchants. Going into a higher discount rate means to many merchants that they can get more money for the same amount of work, thus why try and expand sales ?

Also when discounts are changed, the suite of computer programmes handling customer order maintenance and invoicing have to be changed, the new schedules have to be circulated internally and externally, price lists and sales publications have to be changed. Thus there is an invested interest to try and accommodate marginal changes without having to officially change the rate.

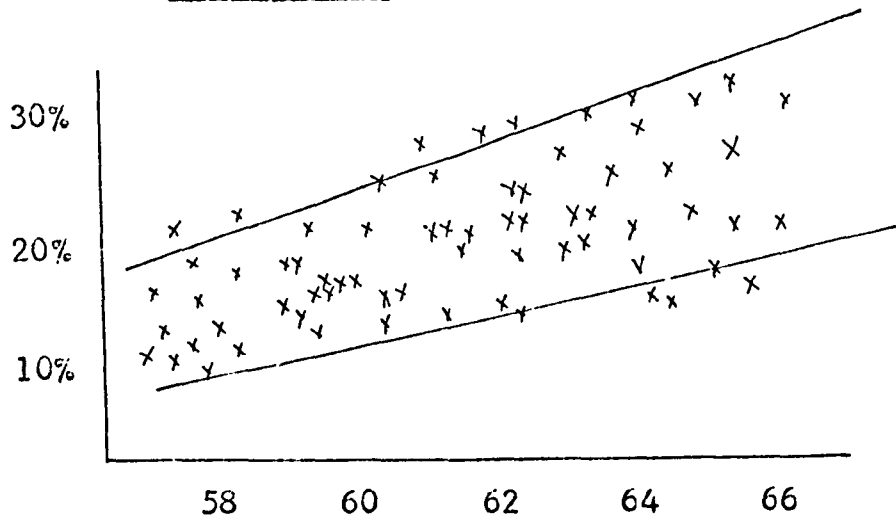
Thus an 'informal' system arises naturally because of the varying power of merchants and the establishment cost of change. The sales manager will not readily admit that discounts

are 'bent'. Information on informal discounts are localised within merchant affiliations. Friendly merchants will 'let on' what they have 'forced' out of the manufacturers, it is often something to boast about. But these affiliations as we will discuss later are rather restricted to lie within a merchant category.

Manufacturers are in the worse position and have great difficulty in discovering what is the 'going rate' on the informal market.

One might wonder whether this informal system could be removed by the imposition of a continuous sliding scale. Being non-linear this would be technically difficult to operate, but more importantly we must recognise that the category classification had now achieved the level of 'custom and practice'. There would be substantial organisational problems from all sides to attempt to remove this.

It is important to try and isolate these two factors of 'drift' and 'special conditions'. Consider cluster diagram Fig. A.21 of AA discounts actually agreed on invoices over a period of nine years. This upward trend is highly significant with a correlation of 0.74 with 90 pieces of data.

FIG. A.21

Over a period of time these informal discounts become the norm and people begin to expect a 'few % over the list', so much so that those with a good case and plenty of leverage begin to be earning up to 5% above the list price. At a suitable time the new rates will be formalised, or something near it, and this begins the whole process off again. Thus it can be deduced that formal discount declarations are not a major competitive action but only a tactical move realigning figures as a post facto declaration of intent after gradual erosion on a day to day basis. One factor remains and that concerns the part that size plays in the special conditions. That is, in reality can the discount be taken as a continuous function of size or must it remain

a step function defined on categories ? In Fig. A.22 AA merchant sales are plotted against discount received. All the outliers that have been circled can be explained separately by certain factors. No reason, other than 'custom and practice' could be discovered why discounts should almost always be at the $\frac{1}{2}\%$ marks. In Fig A.23 we have plotted similar results for a sample of all merchants. This completes our discussion on discounts earned at all levels in the distributive system.

A.2.2. Credit Conditions.

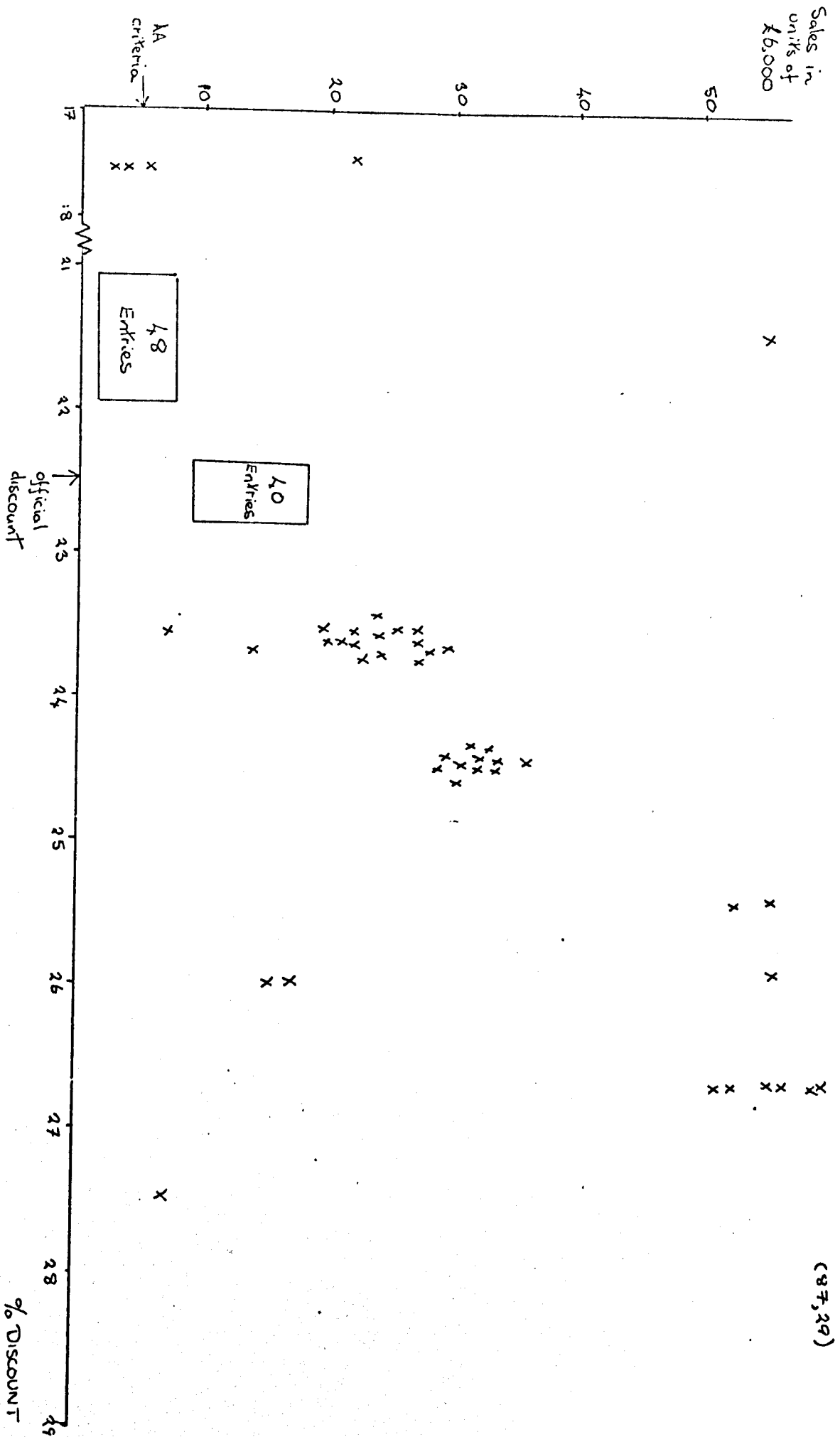
Another significant economic variable in the distributive system is the extension of credit facilities.

Credit to users.

Little need was found to investigate the credit extended to Users because preliminary investigations showed it was scarcely used as a decision variable. Certainly, considerable credit was given to users by manufacturers and merchants alike, but it seldom appeared among the factors which they were willing to trade off against each other such as discounts, delivery dates and quality. Speaking crudely and anticipating somewhat it could be said that actors engaged in bargaining transactions in the distributive system only manage to juggle with very few

Figure A.22

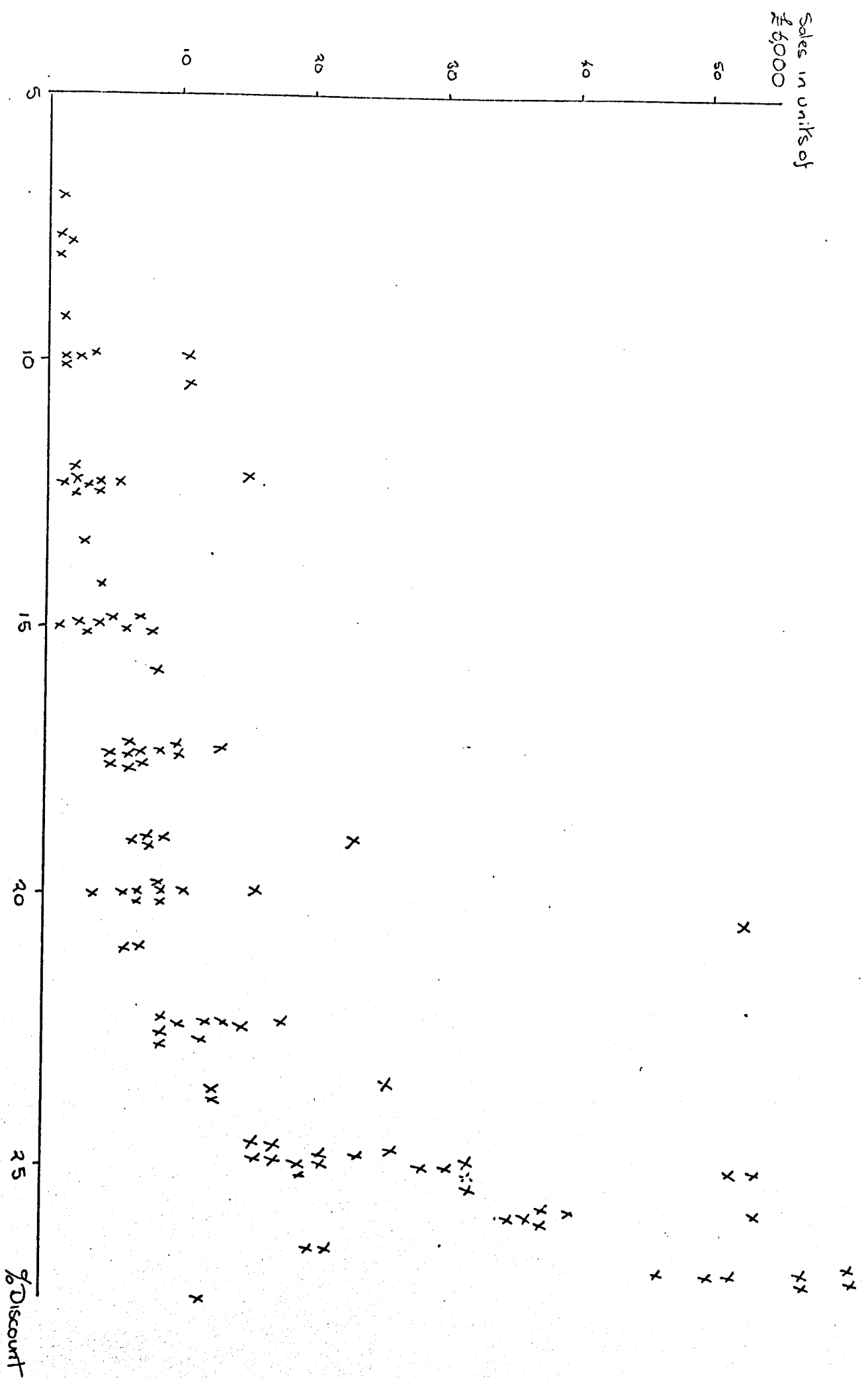
AA merchants' sales/% discount



(87, 29) ↑

Figure A.23

Sample from all merchant's sales / % discount received



factors at one time. As credit is usually rated fairly low in importance compared with, for example discount or delivery it tends to be neglected. Early investigations showed credit extensions of from a couple of weeks to several months from manufacturer to User. From Users to merchants it was slightly shorter say, from cash transaction to six weeks in most cases. It was also found that many of the internal procedures of users for honouring outstanding accounts were somewhat cumbersome and could often account for between a half and three-quarters of this delay. These sort of delays in payment were accepted as normal. If an outstanding account got much too large it would seldom be used as leverage in negotiating. It would be common in fact for a purchasing agent to be quite unaware of outstanding debts and if a supplier mentioned it he would rather thank him for bringing it to his notice than consider it an indictment. One more word needs to be said about why credit was so low on the Users list of priorities. Purchases made for replacement or for production have a major factor in common that their absence would put at risk the efficient use of major capital equipment for the sake of components which were comparatively cheap. Thus availability and quality tend to gain at the expense of such factors as credit. Regarding the placing of discount as more more important we have two arguments; firstly the possible gain from improved discount is

considerably more than from credit: for example, a months' credit means about $\frac{1}{2}\%$ extra discount; secondly, the major actor involved on the user's side in the transaction is the purchasing agent. In most manufacturing concerns of any appreciable size organisational tendencies to departmentalisation tend to separate the accounts department and purchasing personnel, making for localised information only. The purchasing agent is often simply not aware of the credit situations unless quite exceptional, and if he is aware of their existence does not realise their financial implications.

Credit to distributors.

Distributors are at the other end of the scale to Users in that all their trade is in these components and is usually from one major source. This means that the paperwork systems for manufacturer-distributor relations tend to become formalised and institutionalised. It is usual for distributors to make a blanket agreement with suppliers to pay an accumulated invoice, say, every month. A few special orders, on exceptionally large 'non-standard' for example, or a 'call-off' might receive special treatment but on the whole credit is removed from the transactional process that is being investigated here. There is little difference between distributors as regards credit extensions and again it was found necessary to conclude that credit was not a potent

decision variable.

Credit to merchants.

Credit extended to merchants by distributors and manufacturers was found to be different. The credit facilities that merchants could enjoy varied substantially from supplier to supplier. It thus became an important criteria for purchasing. In Fig. A.24 total debt outstanding is plotted against weekly sales. In Fig. A.25 total debt/weekly sales is plotted against weekly sales.

F I G. A,24

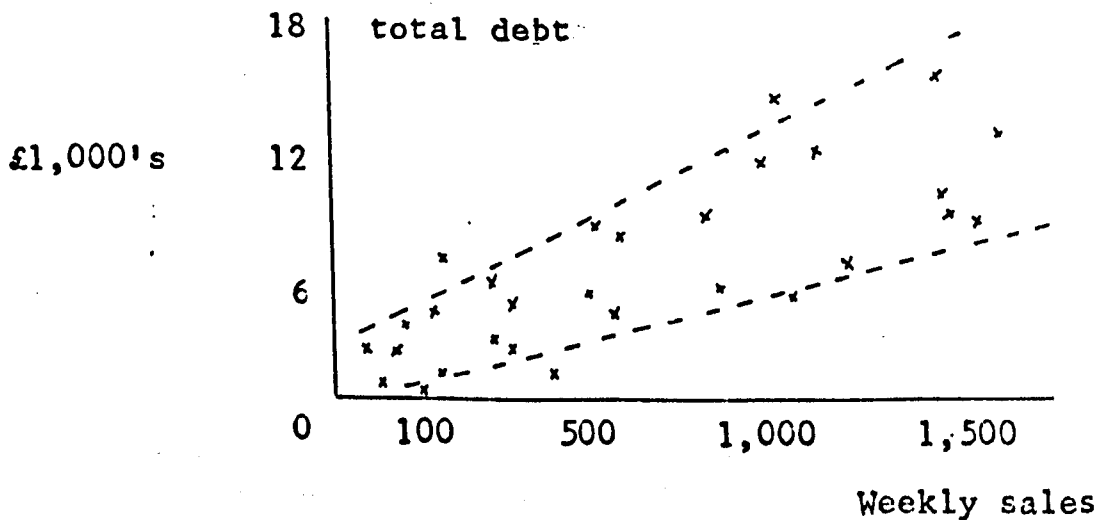
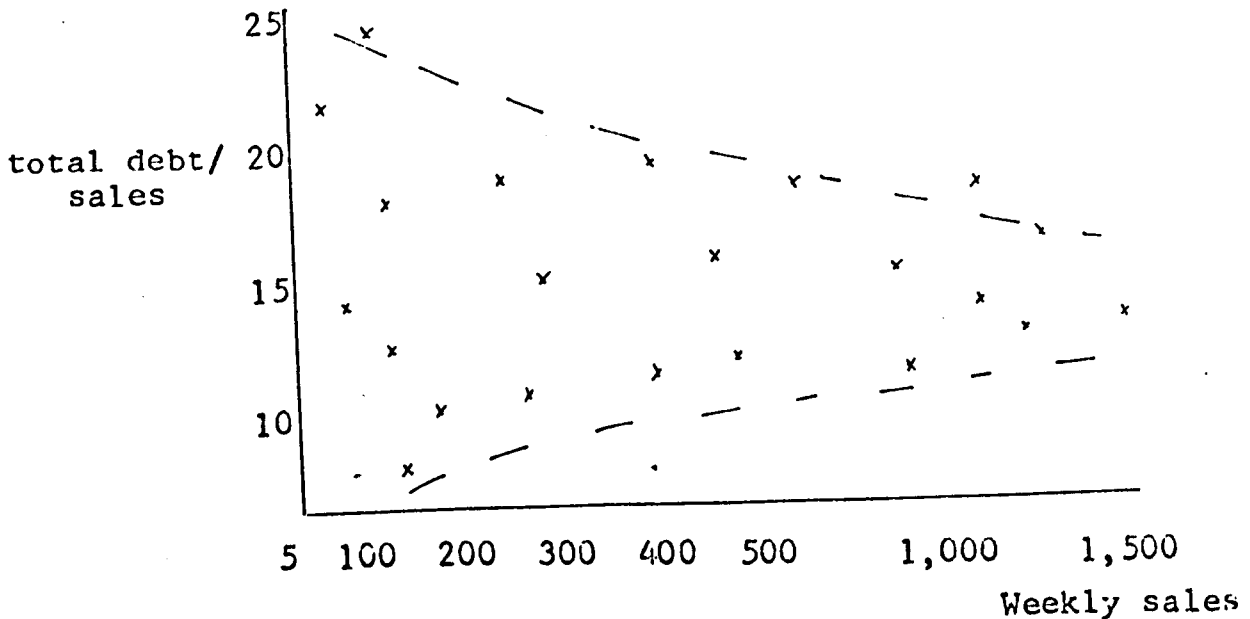


FIG. A.25



The major facts to be gleaned from this data are firstly the clear demonstration of the variation in existing credit. Secondly the considerable sum outstanding that this overall represents. The third point is the existence of broad boundary trends. The top most showing that the maximum credit available is not just a function of weeks but of the absolute size as well. It appears to be much easier to get a longer credit period if your average purchases are fairly low. The lower boundary we believe reflects the formal procedures and administrations that arise with larger businesses. The fourth point to be gleaned is that the distribution within these boundaries is skewed to the lower end. We believe

this to be a function of the decreasingly importance of the marginal week. Thus when negotiating for 21 rather than 20 weeks actors are conscious that a 5% rise is in question. When arguing for 6 rather than 5 weeks, a 20% rise is in question. This change of scale from x previously to y now gives us $Dy = \frac{Dx}{x}$

or the transformation $x = e^y$, and a normal distribution of x becomes skewed to a Log-normal. This is not intended as a deep analysis of a phenomenon but as a plausible explanation of an inconsistency in the data. One word of warning to any researcher repeating the experiment is that different orders in different stages of being paid and processed will automatically give a wide spread of weeks outstanding from zero to the maximum. Adjustments must be made in collecting the data, as was done here, to stop this obscuring the actual credit extensions. Similar credit patterns were found with merchant-manufacturer relationships as with merchant-distributor although the latter tended to be a couple of weeks shorter on the average.

An important prediction can be made from this data. If credit was the sole purchasing criteria then merchants would spread their purchases as wide and as evenly as possible. It would appear that 5 accounts of £100 a week allows much more credit than one of £500, but discounts work against this.

Thus in the case of the manufacturers purchasing decision credit seemed to be treated as additional to discount if it was considered at all, here the two are opposed as counteracting forces.

Even so the data offers us no explanation to the source of the variation in credit extended. A reasonable question would be, does the variation arise within the same merchant over time or rather between different merchants, with each merchant remaining much the same for long periods. Evidence will be brought later to bear on this question.

A.2.3. Guaranteed margins.

A distributor may receive goods at 35% discount and sell them to a merchant for a 27½% discount only receiving a margin of 7½%. barely enough to cover his own costs and certainly not allowing him to make much profit. Similarly a manufacturer may have agreed a 30% discount with a particularly important User who wishes to buy through a merchant who is only receiving 20% discount. Unless some compensatory mechanism was developed the merchant would be losing 10% for the privilege of serving this customer. The compensatory mechanism is that of 'guaranteed margins' on transactions. The problem with describing them is that they are a solution to more than one dilemma. It shall be attempted to trace each of them.

The practice of manufacturers and users agreeing on discounts together, even though they intend trading through third parties, is an increasing one and some explanations shall be listed of where it has arisen.

1. Firstly, a user often requires that a stock of components be nearer to him than the manufacturer's nearest branch depot, and he is often unwilling to hold sufficient stocks himself. Thus although his intention is to buy directly from the manufacturer, he finds, in practice, that he deals through his local 'middleman' because both he and the manufacturer are not prepared to stock locally. This arrangement is often of the 'call-off' type. It is frequently the case that the merchants' discount is less than the users, and a 'guaranteed margin' is agreed upon between him and the manufacturer.
2. Another case is when a User has historically dealt with a merchant but due to external circumstances the leverage that the User can command for earning increasing large discount has risen faster than the merchants' own. At this point the merchant will approach the manufacturer and say that he can no longer service this User with the margin he is achieving, either he must be given a guaranteed margin or the user will be forced to turn to other merchants which could

possibly mean other brands. A case in point is a large order from a Scottish firm, receiving from quantity and single type discounts a gross of 35%, was offered to a local merchant because of the reputation for good service he had achieved in the area. The order had previously been through a competitors distributor. The merchant, although an AA category, received only 22½%. The merchant approached the manufacturer and received a margin on that order of 5% of list value.

3. Thirdly, central purchasing schemes by large corporations have led to fairly modest orders from plants to local merchants receiving disproportionate discounts.
4. Reciprocal agreements on mutual purchasing often lead to unusually high individual agreements between users and manufacturers.
5. Fifthly, some manufacturers find it necessary to make localised franchise arrangements where his only merchant outlet in a certain area services all his trade in that area. This means that he encourages all trade in the area to go through the merchant and is willing to pay substantial 'guaranteed margins' to secure this.
6. The sixth explanation is a particularly recent one, and one which partly includes the other five.

The section on discounts has shown that all have been rising steadily over the last decade. The merchants costs have to be covered by the margins gained and these costs have also risen steeply, especially labour, petrol and overdraft charges. The everpresent fear in any distributive system of being 'bypassed' either from above or below has been emphasised by this tightening in the cost situation. The establishment and maintenance of this 'guaranteed margin' mechanism is to some extent meant as an intention from users and manufacturers alike that they respect the merchants sovereignty and are prepared to back their intent with money if necessary.

7. The last explanation is a technical one that recently 'G.M's' have been used as a more flexible tool and is often agreed individually on orders, releasing the discount to stand as a longer term agreement. The margin situation with distributors is much simplified and is merely a tool for adjusting the 'gearing' between discounts given to distributors and merchants. Having received an 'across-the-board' discount themselves and having to deal with merchants with widely varying terms, a more sensitive tool is needed to deal with anomalies. This is provided by the 'guaranteed margin' mechanism.

Because many margins are agreed individually it is difficult to extract coherent data, nevertheless Fig. A.26 exhibits how the average guaranteed margin given to distributors has moved over time.

F I G. A.26

	<u>STUDY FIRM</u>	<u>COMP A</u>	<u>COMP B</u>	<u>COMP C</u>
57/58	(i)	(i)	(i)	(i)
63/64	5%(ii)	5%(ii)	5%	5%
66/67	8.75%	8%	6%	8%
68/69	10%	(iii)	7%	8%(ii)

Notes : (i) ^{Did not} ~~Did not~~ really exist.

(ii) Unreliable.

(iii) Unknown.

The same information for merchants is given in Fig. A.27 overleaf.

F I G. A.27

	<u>STUDY FIRM</u>	<u>COMP A</u>	<u>COMP B</u>	<u>COMP C</u>
57/58	(i)	(i)	(i)	(i)
63/64	5% (ii)	5%(ii)	5%	5%
66/67	5% to 13%(iv)	8%	5%	8%(ii)
68/69	(v)	(iii)	8%	8%

- Notes :
- (i) ^{Did not} ~~Didn't~~ really exist as such.
 - (ii) Unreliable figures.
 - (iii) Unknown
 - (iv) See Fig.A.28 below.
 - (v) See Fig.A.29 below.

More data is available on the study firm for 66/67 and 68/69.

F I G. A.28

1966/67 Data for Study Firm.

<u>MERCHANTS DISCOUNTS</u>	<u>MANUFACTURER/USER AGREED DISCOUNT</u>	<u>MARGIN GUARANTEED TO MERCHANT</u>
30%	less than 27½%	10%
30%	between 27½% & 35%	5%
25%	less than 27½%	8%
25%	between 27½% & 35%	5%
20%	less than 25%	7½%
20%	otherwise	5%
17½%	all	5%
10%	all	5%

By 1968/69 the situation had been somewhat simplified to :-

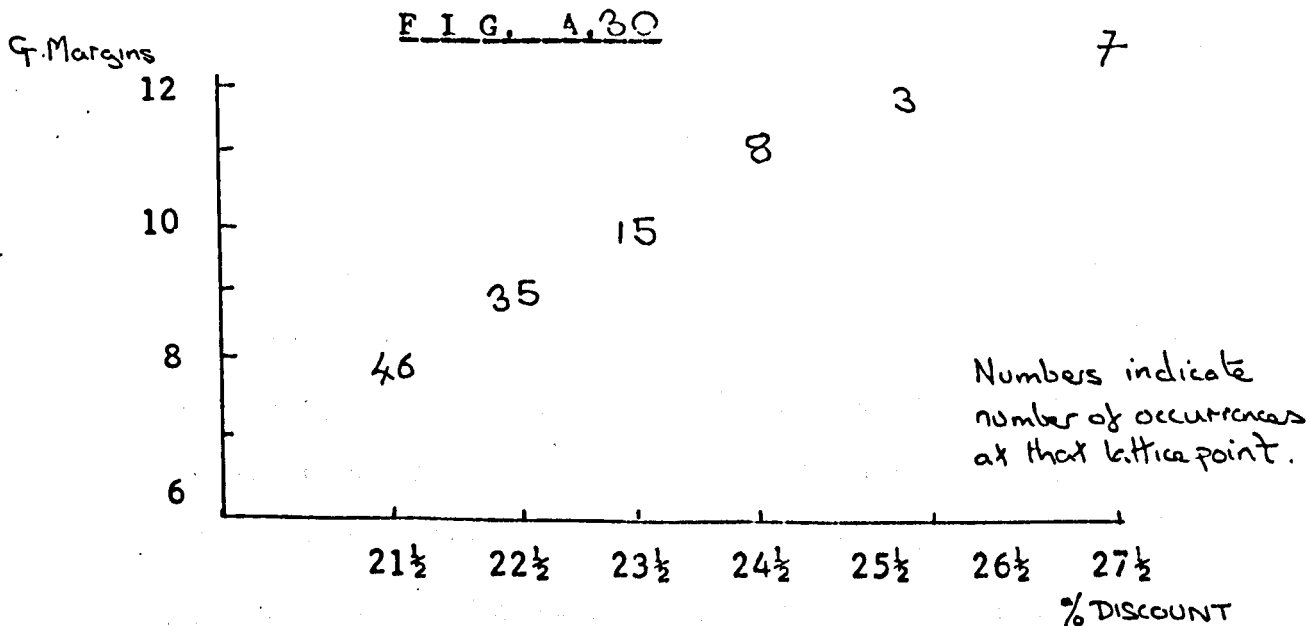
FIG. A.29

AA Merchant receives $12\frac{1}{2}\%$

A Merchant receives 8%

all others by negotiation.

Thus for most purposes guaranteed margins will mean a minimum boundary on profit margins at each level. In individual cases it will be necessary to consider guaranteed margins as something distinct from and more flexible than discounts. The only significant variation about the average for these margins occurs within the AA merchant category. Displayed below in Fig. A.30 are figures comparable to Fig. A.22 for discounts.



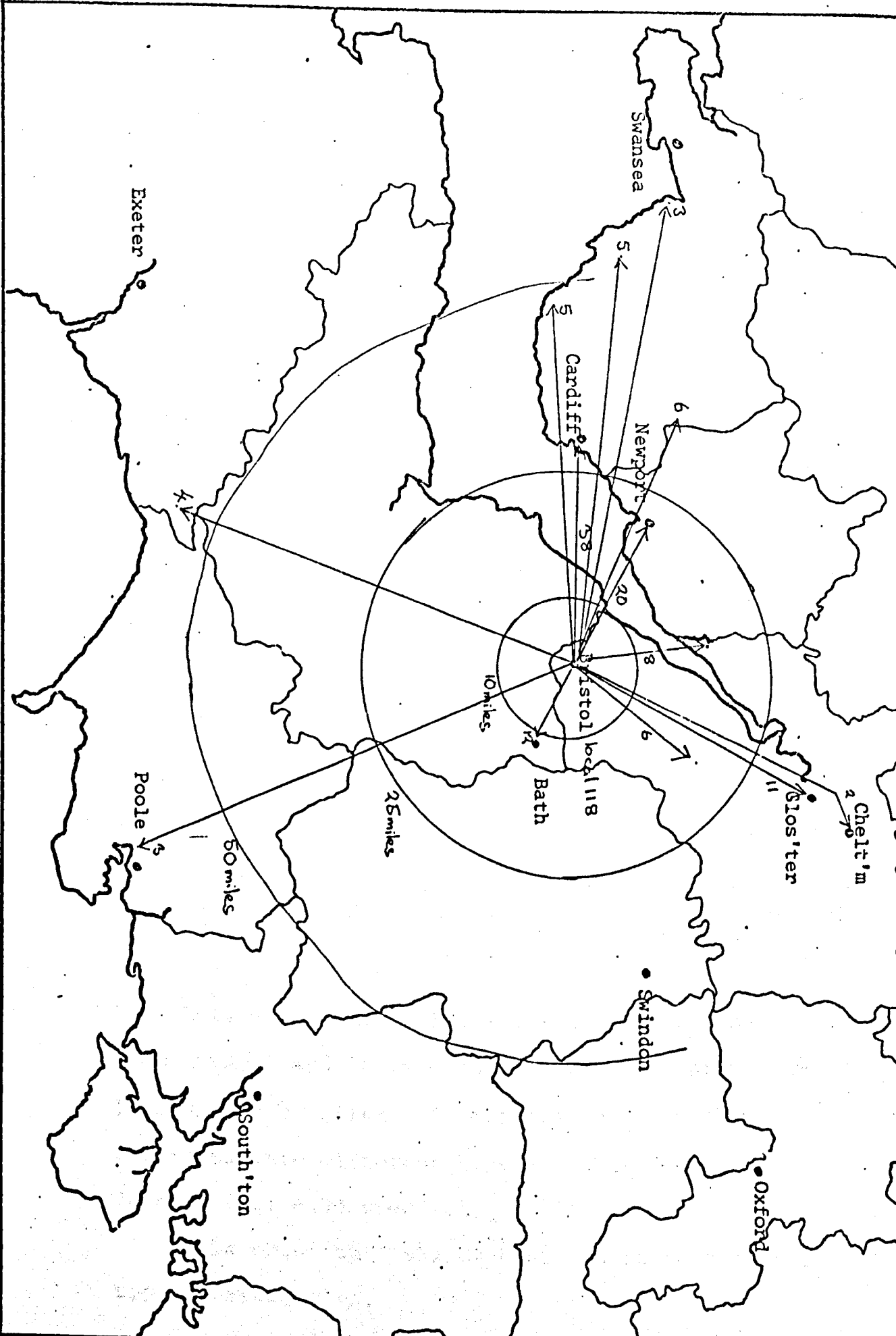
This unexpected result led the analyst to investigate whether any precise rule was used for calculating G.M.'s and although this was at first

denied, it was later conceded when the evidence above was presented. Notice the slight attempt to cope with non-linearity by drawing out the discount scale to intervals of $1\frac{1}{2}\%$ at the right hand end. This concludes our discussion of 'guaranteed margins'.

A.2.4. Areas Serviced by Merchants.

As indicated in our detailed description of types of merchants the dimensions of the area serviced will vary markedly between merchants and the geographical area served. But preliminary investigations did show that the geographical densities of customers did appear to vary reasonably regularly away from the merchant as did also the mix of customers served. One merchant's delivery area is analysed in detail to serve as a standard for the rest.

The merchant chosen was in Bristol and served the South West area. ~~It~~^{He} was an AA merchant running two vans, and annual sales of approx. £150,000 in 1965, a discount of $21\frac{1}{2}\%$ and a guaranteed margin of 8%. He services users for both replacement and production. Like many other large merchants he also undertakes some deliveries to other smaller merchants in the region. A map indicating the major flows of goods to and from him measured against concentric circles indicating number of miles from Bristol, is shown in Fig. A.31.

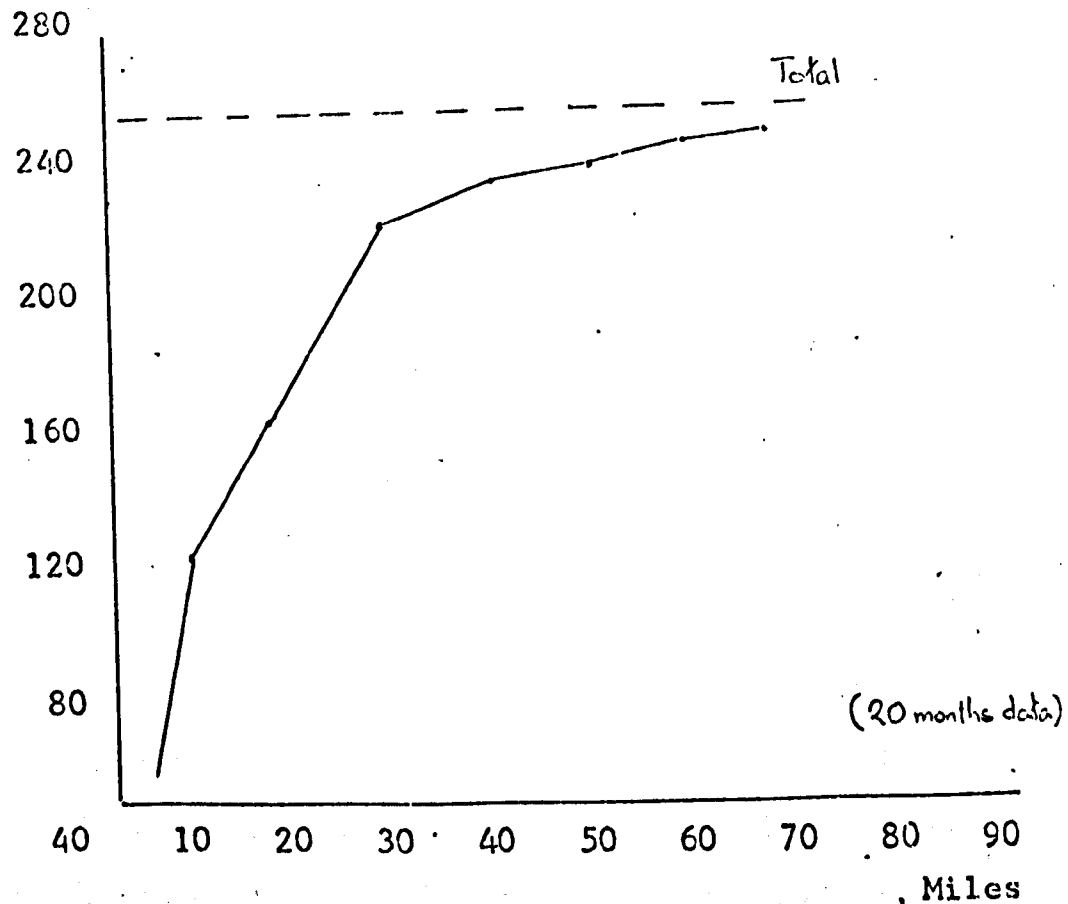


all figures in £1000's
(20 months data)

Notice at once the rapid falling away in trade on moving away from Bristol, in fact almost 50% of his business lies within 10 miles of his offices. In order to investigate this further, consider Fig. A.32 below :-

FIG. A. 32

Cumulative Sales



This shows cumulative sales against distance from Bristol and it is seen that over 80% of business lies within 30 miles. In order to see how this separates into different size accounts, consider the data in Fig. A.33 overleaf.

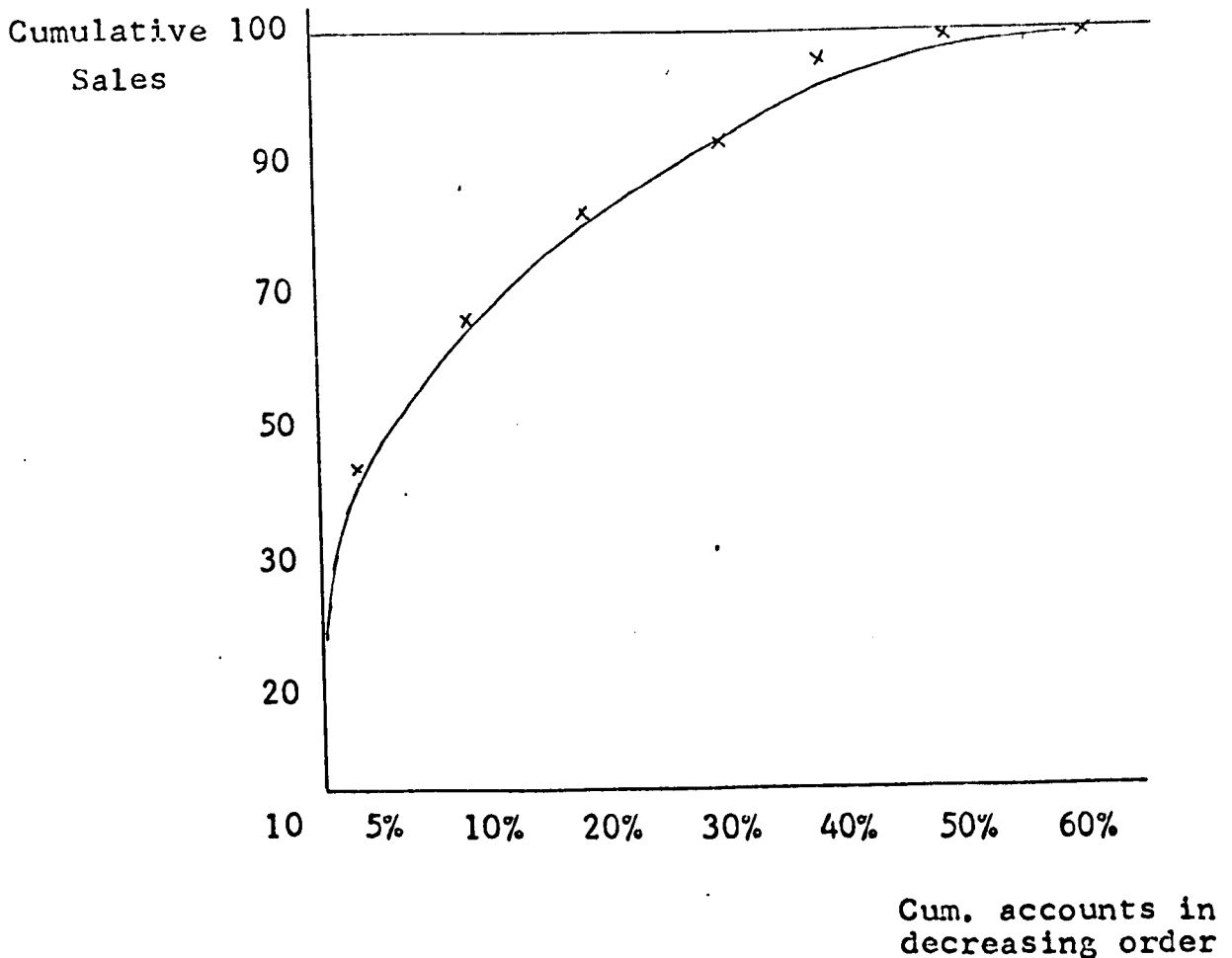
This shows that 92% of business is done in the top two categories.

F I G. A. 33

Distance	ACCOUNTS LESS THAN £100		ACCOUNTS BETWEEN £100 & £1½K		ACCOUNTS BETWEEN £1½K & £12K		ACCOUNTS GREATER THAN £12K	
	No.	Value	No.	Value	No.	Value	No.	Value
10 miles	23	0.8K	5	3.5K	3	18.2K	3	90K
10 20	8	0.3K	2	0.6K	3	5K	1	34K
20 30	5	0.2K	10	4.5K	4	12.5K	1	31K
30 40	8	0.2K	9	3.8K	3	6.3K	0	0
40 50	2	0.1K	4	2K	1	2.5K	0	0
50 60	5	0.2K	5	2.2K	3	11.2K	0	0
60 70	3	0.05K	2	0.4K	1	2.3K	0	0
Totals	54	£1.85K	37	£17.0K	18	£58.0K	5	£155K

(18 months data)

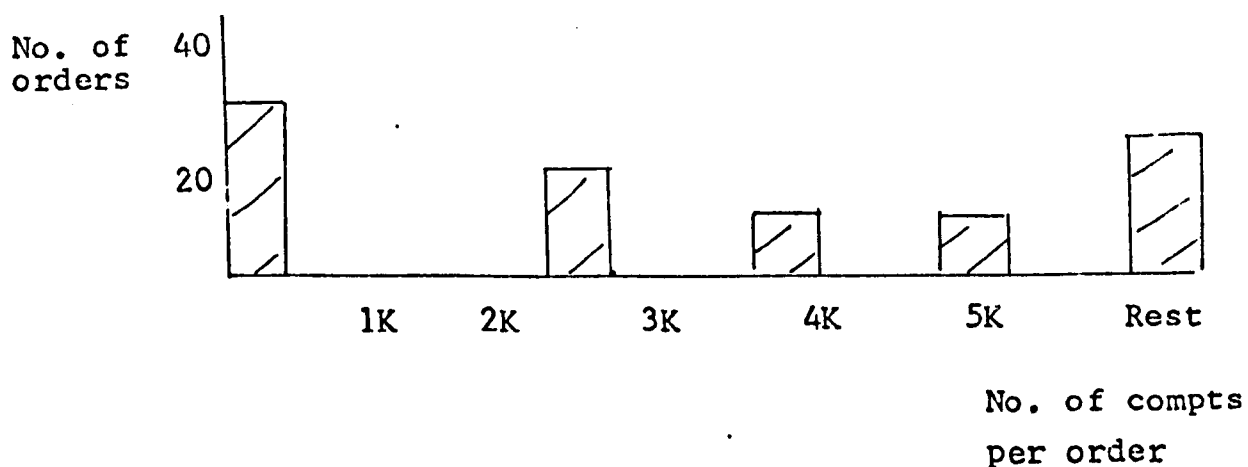
In fact, further than this, 67% of business is done by trading with only 5 firms in the largest category. The largest single account of £35,000 per annum is 23% of his total business. In Fig.A.34 overleaf is plotted cumulative % of total business against cumulative % of accounts in decreasing order of magnitude.

FIG. A. 34

From this material we see how heavily a typical merchant depends on a few accounts. Of course heavy expenses are incurred servicing them; for example, one account which was for replacement and production, and was his third biggest account with a value of £15,000 per annum, issued on average 240 orders per annum. Each order paper may have requests for several different items on it, yet these had to be processed and delivered, on average once every working day. On the other hand the most valuable account (£35,000 per

annum) issued on average one order per fortnight and these seldom had more than a couple of items on each. This was a good example of production type user. A histogram of his order sizes is shown below, Fig. A.35

FIG. A. 35



This account was a 'call-off' account, in common with the second and fourth biggest.

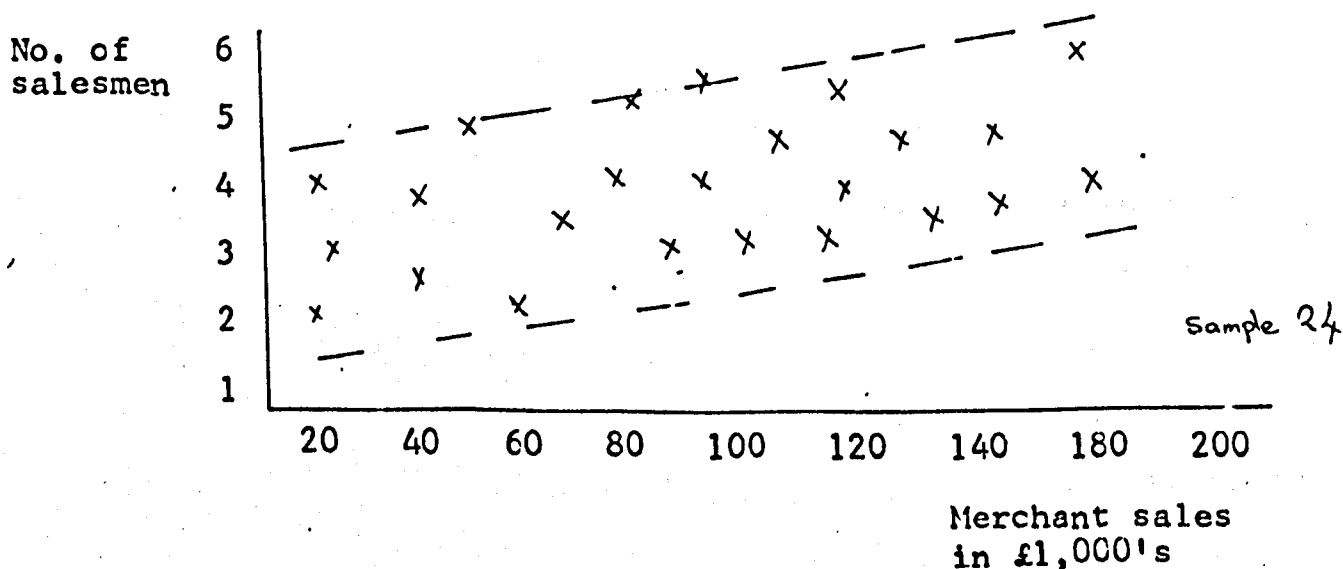
This concludes the discussion about delivery areas, except perhaps to indicate that one of his vans was always occupied in the Bristol area, the other doing the longer runs in rotation.

A.2.5. Representation.

A major function of a merchant is sales representation. Firstly the number of salesmen that merchants employ is considered. This is difficult to measure because of the dual role that

many employees play. A branch manager will always look after the good customer. A salesman in a small merchants' will double as a clerk when necessary. One aspect of distribution that strikes a researcher coming from an engineering production background is the almost complete absence of restrictive practices and demarcation agreements. Because of these difficulties it was only possible to obtain any reliable measures from AA merchants and distributors. Fig. A.36 below indicates the number of salesmen employed by AA merchants ^{of} and various sizes. There is practically nothing that can be deduced with any reasonable sharpness from this data, except to note the total numbers involved. Given this number of salesmen employed by the AA merchants, and assuming one or two salesmen to be employed by each of the category A and possibly B merchants there are two or three hundred potential representatives in the field.

FIG. A, 36



For information about the salesmen, such as what product ranges they cover, their frequency of visits and, most importantly, who their contacts are in User firms; this data gives almost no help. The treatment of the effects of salesmen will thus have to be an implicit one; it will be included in the measurement of the strengths and weaknesses of the purchasing relationships between merchant and user. In as far as the salesmen are prominent actors in this relationship this was felt to be a valid approach.

A.2.6. Stockholding.

A primary function of merchants is to hold stock. This is meant to serve the purpose of meeting customers's requirements promptly, to protect the manufacturer from a continuous stream of small orders and to provide some economics of scale in distribution by acting as a 'break-bulk' service.

There are two major decision areas, one of the stocked range and the other the stocked quantity.

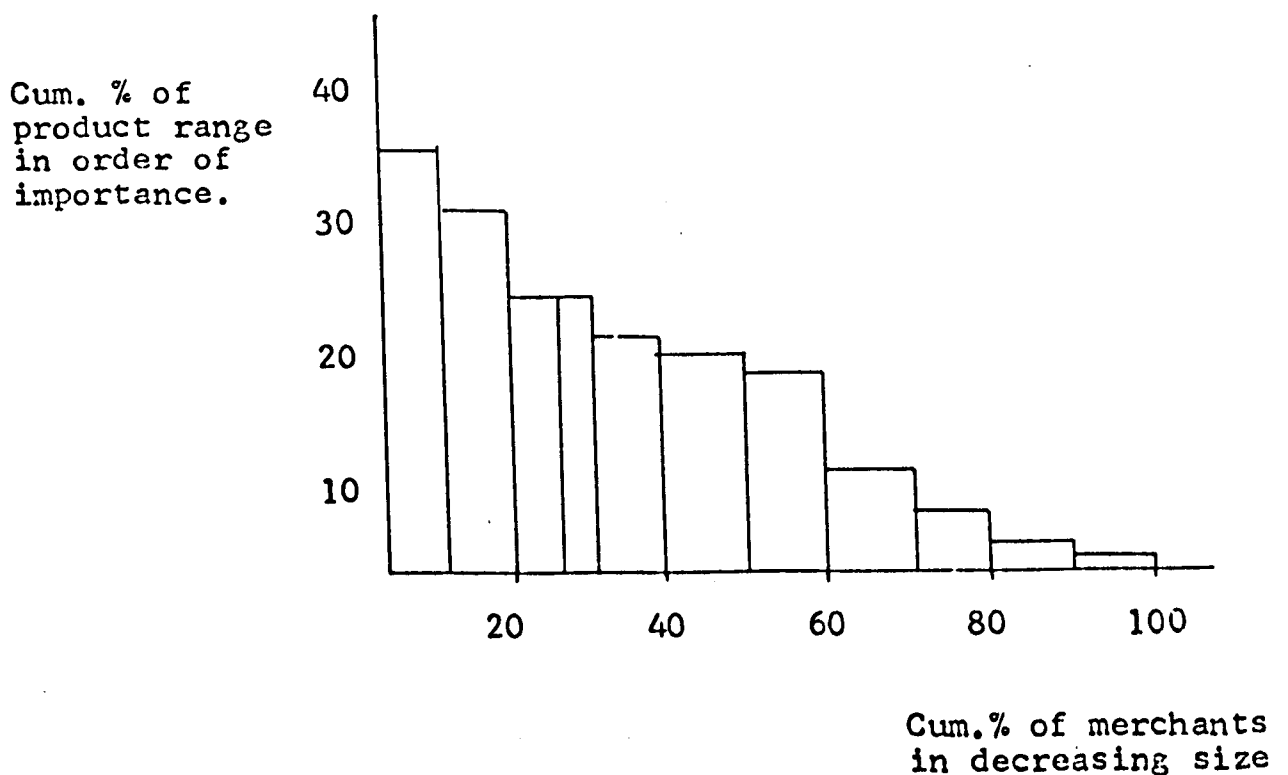
A.2.6.1. Range of stockholding.

Local needs and requirements will mean that the stocked range varies from region to region. Nevertheless a broad consensus does arise concerning how popular or unpopular products are and whether they need to be stocked. Stocks of non-standards and specials are not considered here, as they

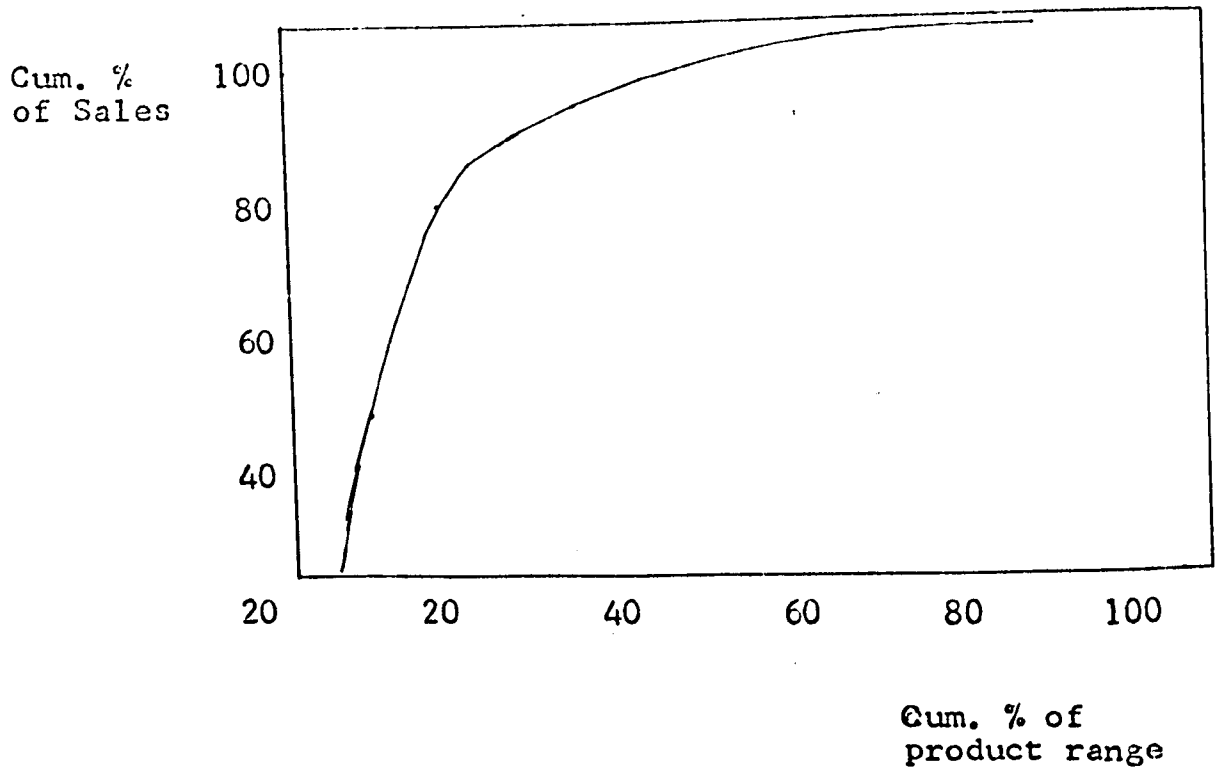
must be decided on an individual basis.

Listing the standard product range of about 15,000 items in decreasing order of sales contribution by number, Fig. A.37 below indicates the range stocked by merchants of different sizes.

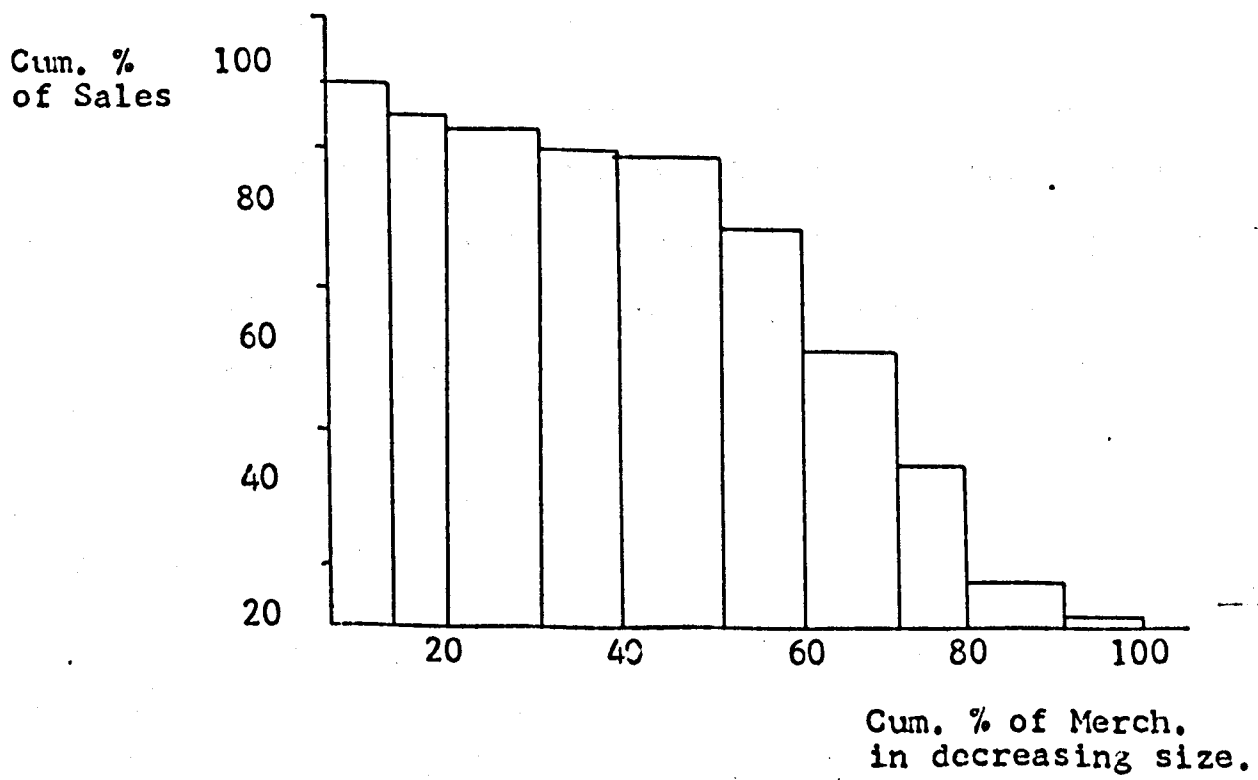
FIG. A. 37



Distributors carry between 35% and 45% of the product range. The relationship between product range and contribution to total sales is known. For example, by a typical curve as in Fig. A.38 overleaf.

FIG. A. 38

This data was obtained from manufacturers figures. Thus combining these two graphs gives Fig. A.39.

FIG. A. 39

This data shows the ^{percentage} $\frac{1}{2}$ of sales that they could service from stock, and gives a curve with a shallower gradient than that for ^{percentage} $\frac{1}{4}$ of range stocked. But this is included for theoretical interest rather than as a practical result, because it makes a quite unwarranted assumption. The assumption is that if a certain product is officially stocked then they could service orders against it. This would only be the case if considerable quantities were stocked. The result in practice is that a merchant will service a portion of the order immediately and place a reverse order with the distributor or manufacturer for the rest.

In order to deal analytically with the stocking problem at the merchant level a broad classification of products were made. The classification was along two axes, the cum. % of product range in decreasing order of importance was one, and the size of order was the other. This gave a market classification that crudely accounted for the range the merchant stocked and the production/replacement dichotomy. An empirical histogram for this classification is given overleaf in Fig. A.40.

FIG. A. 40

		very large	size of orders		
			large	medium	small
% of product range	Top 5%	0.3	1.7	6.1	27.8
	Next 10%	0.05	0.9	5.9	22.3
	Next 20%	0.0	0.11	3.1	18.4
	Bottom 65%	0.0	0.0	0.5	13.1

This gives the ^{percentage} % of orders falling into each category. The sample size was 210 invoices, and thus cannot be used safely with much confidence. The same sample also gave a histogram for the % ^{percentage} contribution to sales from each cell, see Fig. A.41 below.

FIG. A 41

		very large	size of orders		
			large	medium	small
% of product range	Top 5%	9.2	9.1	8.2	3.5
	Next 10%	3.1	9.2	12.1	5.6
	Next 20%	0.0	3.4	16.1	10.5
	Bottom 65%	0.0	0.0	3.1	7.8

This data will be considered further in the section on stocked quantity below. The immediate point to note is the substantial proportion (81.6%) of orders classed as small (less than 1,000 cmpts) even though their contribution to sales is only 27.4%.

A.2.6.2. Stocking quantities.

The more stock that a merchant or distributor keeps the cheaper for the manufacturer. Stockholding allows merchants to be break-bulk points as well as protecting the manufacturer from the considerable costs associated with paperwork. For the manufacturer selling and delivering orders to merchants most of the distribution costs thus incurred are clerical rather than physical distribution costs: e.g. lorry costs, drivers' wages etc. It is thus important to know how the stockholding policies of merchants affect the resulting distribution of order sizes reaching the manufacturer. Thus using a crude classification of orders as above and considering firstly only one product range, let x_j ^{be the} tonnage received by a merchant, of orders of size j . Let P_{kj} be the probability that an item received in a reorder of size k finds its way into a customer's order of size j . Also let y_k be the tonnage requested in a reorder of size k . Then

$$P \underline{x} = \underline{y}$$

Thus for each merchant a set of transition matrices P^i , one for each product range, form a suitable definition of their stockholding operations.

The product ranges used above were suitable for studying reorder rules for most merchants studied. Few merchants effectively used more than five categories of products for deciding how quickly to 'turn their stock over', and one of these was always 'do not hold stock at all'. But difficulty was experienced with fitting order size ranges into the four suggested above and usually six was used. The most usual configuration is displayed in Fig. A.42 below.

FIG. A.42

Order Size	Range
A	0 - 99
B	100 - 499
C	500 - 999
D	1,000 - 2,499
E	2,500 - 9,999
F	10,000 - and above

/Fig.A.42 contd....

The trade split within these categories from one merchant, which is quite typical, is :-

Category	No. cmpts sold	% Sales	No. Orders	% Orders
A	52,000	1.3	1167	34.1
B	216,000	7.0	832	24.3
C	540,000	13.8	796	23.3
D	342,000	9.2	284	8.3
E	1,410,000	35.2	274	8.0
F	1,300,000	33.5	66	1.9

The transition matrices for merchants to which access was possible were estimated by direct deduction from invoices. These were usually fairly close to the stockmans stated policy. For merchants for which access was impossible the reorders were known and a substantial proportion of the input could be gained from documents sent by them to the manufacturers for calculation of the guaranteed margin allowance. The accounting procedure of only paying the margins in retrospect which required merchants to submit invoices proved a most valuable source of data. Of course there was some over-fitting occurring if only the x_i and y_i ($i = 1 \dots 6$) were available and it was necessary to estimate the 21 entries in the

diagonal transition matrices. After some experience it was found possible to get reliable results by using the equations plus 'contextual' information and the salesmen's judgement.

Because of this, for the merchants with which no business was transacted and where access was impossible, salesmen's judgement and comparative analysis could still be used to build up a reasonable estimate of their stocking policies. It is worth recording here that later in the study, when the manufacturer purchased some of these merchants thus allowing access, only one case in twelve proved to be substantially incorrect.

Typical results for one merchant are shown overleaf, Fig. A.43.

F I G. A, 43

product range 1							product range 2						
Input							Input						
Output	A	B	C	D	E	F	Output	A	B	C	D	E	F
A	0	0	0	0	0	0	A	0	0	0	0	0	0
B	0	0	0	0	0	0	B	0	0	0	0	0	0
C	.1	0	0	0	0	0	C	.4	.1	0	0	0	0
D	.5	.2	.1	.1	0	0	D	.6	.3	.3	.3	0	0
E	.4	.8	.8	.6	.3	0	E	0	.6	.7	.6	.6	0
F	0	0	.1	.3	.7	1	F	0	0	0	.1	.4	1

product range 3							product range 4						
Input							Input						
Output	A	B	C	D	E	F	Output	A	B	C	D	E	F
A	0	0	0	0	0	0	A	.6	0	0	0	0	0
B	.1	0	0	0	0	0	B	.3	.6	0	0	0	0
C	.5	.3	.1	0	0	0	C	.1	.3	.7	0	0	0
D	.4	.6	.5	.4	0	0	D	0	.1	.3	1	0	0
E	0	.1	.4	.6	.8	0	E	0	0	0	0	1	0
F	0	0	0	0	.2	1	F	0	0	0	0	0	1

Thus if this merchant had the following
input profile :

	A	B	C	D	E	F	Totals
Product Range							
1	10	30	30	30	50	100	250
2	20	40	20	50	10	0	140
3	30	30	60	10	0	0	130
4	10	30	10	0	0	0	50

In
1,000's

He will have the following reorder
profile :

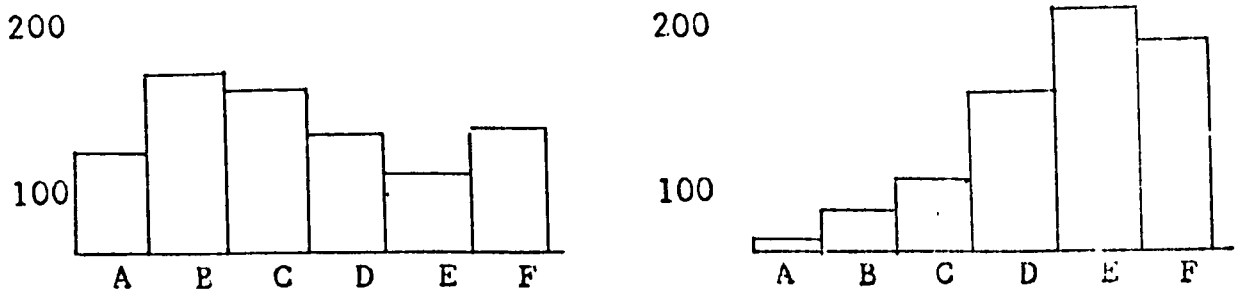
	A	B	C	D	E	F	Totals
1	0	0	1	17	85	147	250
2	0	0	12	45	74	9	140
3	0	3	30	64	33	0	130
4	6	21	17	6	0	0	50

In
1,000's

Giving input/output order size distributions
as below :

F I G. A.44

Sales



Order Size

This concludes the discussion of the
measurement of stockholding policies.

A.2.7. Minimum Order Sizes.

The only place in the distributive system where it was necessary to have a policy concerning order sizes was when purchasing from the manufacturers. All manufacturers had by 1967 adopted a policy of not 'splitting boxes', that is a whole box of several components must be bought. Minimum order values of £5 had recently been introduced by the study firm and competitive firm A had also recently introduced a

similar £25 unit. From available data it would appear that 'by-and-large' firms were keeping to these units. The paperwork processing costs certainly amount to much more than £1 which eliminates the 20% profit margin on £5 orders.

This includes the description of the economic bargaining variables present in the distribution system.

A.3. EXAMPLES OF TYPICAL MERCHANTS.

To illustrate the variety of organisations within the merchant category, four typical examples will be discussed. Each example is based on an actual case but names and precise distinguishing characteristics have been removed.

A.3.1. The 'Jobber' or 'Pirate'.

Jones of Bristol was an order-clerk for one of the manufacturers until a few years ago. He had known Stanton, a component buyer for one of their customers near Bristol, by dealing with him professionally, usually over the telephone. They had frequently joked together about the poor service that the manufacture was supplying and said how much better they could do 'by themselves'. It was still at the level of a joke as far as Jones was concerned when Stanton 'phoned him one day to say that he had been made redundant, and intended using his redundancy payment to buy a little stock and go into business for himself. Did Jones want to join him? Jones did join him, together they got advertising space, note-paper printed and one of their garages fitted-out with suitable shelvings. Stanton used his buyer's contacts to get half-a-dozen good orders while Jones bought a small van and a typewriter. Jones' wife had been a secretary and was to handle all the correspondence. Jones' house was chosen as the office because

he already had a telephone. Armed with these orders Stanton went to each manufacturer in turn and demanded 'merchant terms'. He only got a discount of $7\frac{1}{2}\%$, which he knew would not be enough for long. Within a couple of weeks of Stanton being made redundant business had started. As a sales clerk at the previous firm Jones had entertained customers and had taken them home; now many of these customers freely transferred to the new partnership because they wished Jones and his wife well. Their method of operation was this. In the early morning they would open correspondence and receive telephone orders, after 'phoning customers themselves to see if they were short of anything. A list of orders would be made. Jones would drive to the manufacturers own depot where there was a 'counter-trade' service. Mrs. Jones would type invoices and Stanton would act as a sales representative getting more orders. Jones would request all his orders to be made up separately, waiting for them to be packaged. He would place orders for any not available from stock. He knew all the stockmen well and they often managed to fill an order although there was not any 'officially' available. Jones would be away from the manufacturer after lunch and would deliver each of the orders directly. Customers were most impressed by this 8 hour service. Jones kept a few 'special' components himself in the garage, these were the ones that he

knew production delays always occurred on. Jones would be home by six or seven p.m. He claimed money from customers as soon as possible, saying that small merchants like himself ^{cannot} ~~can't~~ afford to give credit. He nevertheless held credit of the order of 2 or 3 months with each of the manufacturers. When trade had increased Stanton returned to the manufacturers and described how pleased customers were by their service, a point which he had particularly asked customers to make to the manufacturers. He described how he ^{did not} ~~didn't~~ like having so much credit but explained how necessary it was because of the low discount he was offered. The researcher was at Jones' house the evening Stanton returned to celebrate the newly acquired 12½% and to discuss plans for expansion.

A.3.2. The Old Established Firm.

Carter's of Bristol was dealing in industrial equipment before this century began and the present owner is a descendant of those founders. They came into distributing these components right at the beginning because the new manufacturers sought distribution outlets with the most experience and naturally chose them. Their main office is still where Bristol's economic centre used to be 50 years ago and the old building is in a bad state of repair. They opened small sub-branches in South Wales and Bridgewater many years ago and are now wondering

whether it is right to keep them going especially since the new Seven Bridge^{made access to S. Wales easier}. The managing director is a well-known figure among the 'old-boy' network of the industry. Each branch manager still sees all the orders received for that day, employees call him Mister, and warehouse staff use the back door. Their advertising is uninspiring and they do not speculate in stocking. They will stock when it has been shown there is a demand. They carry a huge stock much of it of components seldom used nowadays. The warehouses are cramped and not accessible to new handling equipment, and much of the old stock has seriously deteriorated. Their old style of yearly stock evaluation and the slow rate at which they depreciate stock means that it is likely to stay like that for much longer. The second in command was treated by the managing director as someone still learning the trade, although he had been there 23 years. The managing director was the target of continuous minor grumbles by the staff mainly about office conditions and him being 'so old-fashioned'. Nevertheless, throughout the firm and throughout the trade we found a respect, we could perhaps say fondness, for him based on his honesty and what one salesman described by saying 'if you are fair to him, he will always be fair to you'. Sadly he was a casualty of new aggressive marketing methods. In confidence to the researcher,

he spoke of his son's lack of interest and thought that he might someday sell the firm and retire comfortably. The researcher did not demonstrate to him that he had nothing to sell. The goodwill and loyalty shown by customers was not to the firm but to himself. Even the property was in the "wrong part of town". To anticipate, fortune did shine on him at the last. In the scramble and change with which section C is concerned, a panic purchase by company C greatly overvalued the goodwill and Mr. Carter has retired comfortably. When asked afterwards how he would describe the objectives of his firm, he replied that it was to act in a 'business like and unrepachable way' to provide a 'service to our customers and employment to our staff'. When prompted regarding profit and growth his only reply was, 'yes, perhaps that's what is important now'.

A.3.3. The 'Professional' Merchant.

Based in Gloucester, Superspeed Ltd., have seen the changes occurring in production and have learnt from them. As a manager there told us - "as mass production and flow line techniques developed, resulting in industry's need for, on the one hand, large runs and, on the other, regular intakes of components, the whole problem of manufacture, storage and supply has become an increasing problem. This was the breeding ground of the 'professional' specialised distributor".

This 'professional' saw the distribution channel "merely as extension of the production line". His job is to "break bulk" and stop the small orders from congesting the manufacturers operation. He described his firm as -

.." a specialist, serving a limited area; (he) has a specialist knowledge of (components) and an intimate knowledge of the trends, needs and requirements of the users in (his) area. If you prefer it (he) is part of a market research team with a very limited market in which to conduct research. Logically he must become a "professional" in the expert sense of that word, within that area ".

He continually used this word "professional" and it certainly meant something very real for him. When asked about the objectives of his firm, he adapted to a large extent the language of 'big business', and to the researcher, who having spent some months working in and around the distribution system, it seemed bizarre and strangely out of context. He spoke of "profit being my major purpose" gained by "firm budgetary control" and "sound capital investment decisions in warehouse equipment". To the old style merchant, warehouse equipment would be a 'cost' not an 'investment'. 'capital' is something in the bank not a fork-lift truck. He spoke of 'marginal benefits possible from selected sales incentives' and of 'sales targets' and 'five year plans'. He had sent one of his trainee

managers on market research courses and his room was decorated with maps, graphs and photographs of the most advanced machinery yet using his components.

His salesmen were trained by the manufacturers and all his advertising stressed the technical ability of his staff. His relationship with customers and suppliers was straightforward and strangely formal. When asked whether he liked working in this component trade he replied that he was a distributor, that was his profession, it ^{did not} ~~didn't~~ matter to him what he was distributing. The advertising was clean and crisp usually centered on statements such as -

"A new era dawns in (component) distribution" or

"The modern conception of (component) distribution".

Other merchants dismissed him as having 'too many big ideas' when in public, but in confidence with the researcher, said that this was the way the future lay; with "professional distributors".

A.3.4. The 'Average' Merchant.

Having described what, in all fairness, must be considered 'Polar' types an attempt will be made to delineate characteristics of an 'average' type of merchant.

Perkins of Glamorgan served the South Wales industrial area. He had been long established in the merchant trade and had branched out into components just after the war. Most of his trade was now with

components. He had two salesmen on the road, one going East the other West ^{in general} roughly. He had three sales clerks, one was a newly acquired girl trainee and one he had recently promoted to supervise the other two. There was one girl keeping stock record cards up-to-date and two stockmen. Two drivers operated the two mini-vans. There was a copy-typist, two invoice clerks and an accountant. An office 'junior' did odd jobs, operated the switchboard, acted as receptionist and served the very small (4 or 5 a day) counter trade. These sixteen people had a combined wage bill of about £15,000. He made long distance runs usually twice a week, served the South Wales region 3 or 4 times a week and his local area either once or twice daily. He had five major call-off accounts, the rest of his business being spread right across the spectrum of industries and sizes and products. His declared intent was to make a 'reasonable' profit each year; to increase the size of his business, if economics make this necessary; and to sell the business ultimately to retire comfortably. His intent matched his behaviour insofar as he in no way resembled the "profit maximiser" of classical economic theory. He had certain aspiration levels, but as long as these were attained he considered business was satisfactory. He would fall reasonably into that vague category that H.A. Simon has called a 'satisfier'. He met his competitor merchants at

various trade meetings but did not seem to view them as competitors. A few accounts provided the bulk of his trade and his only real competitive effort was in maintaining these. There was a tacit agreement that merchants could try and grab the smaller customers from each others, they all knew perfectly well that these customers kept accounts with all the merchants in the neighbourhood anyway. But to entice a major customer away was to go outside 'trading norms'. The model of one firm expanding its sales at the expense of the other is barely the case here. The whole affair was at a much more personal level. This was Perkins taking away a considerable slice of one of his merchant colleague's livelihood. If another merchant failed to keep business up to the level required for a 17½% discount and was reduced to 15% status, other merchants would not seize on this as a chance for their own gain. They would be indignant and angry to the manufacturers representatives, and might even help him with 'bridging' finance.

Too much must not be claimed for this merchants solidarity, but on the other hand, as future work will show, a model of a merchant as "economic man" is a very poor predictor of behaviour.

Status levels were quite marked and confidently maintained by this sort of 'middle merchant'. These were mostly defined in discount terms, which provided

significant aspirations for merchants. Other status variables were type of industry served with aircraft and electronics being out in front, and the number of 'production' versus 'replacement' accounts handled. A merchant with the bulk of his business placed in half-a-dozen major production accounts was a local figure head compared with one whose trade went in small lots over the counter. His attitudes towards helping other merchants 'of his own kind' would often run very strong. For example, many instances were recorded of one having an urgent delivery when his own van was not doing that run until the next day. He would ask another merchant who was 'doing that run' to drop his parcel off. The same worked for picking up deliveries from distributors. Another example is when a merchant gets out of stock on a required item, another merchant could often willingly 'fill the gap' until replenishments arrive. More will be said about this form of co-operation in the section entitled, 'The Web of the Merchant's Group Affiliations'.

This completes the list of examples of typical merchants.

A.4. THE WEB OF THE MERCHANTS' GROUP AFFILIATIONS.

Any attempt to describe the distributive system in terms of the economic variables of section A.2 would be liable to render incomprehensible the behaviour of merchants in that system. Although originally the existence of a three-tier distributive system as described here may have been a necessity there was no longer any economic logic in maintaining it, especially with the recent rapid increase in discount rates and the increased credit extensions demanded by merchants. Yet the obvious solution; either by-passing one or more levels or of vertical integration towards the market had been steadfastly resisted by the manufacturers for more than two decades. Even during the change period of section C, when the existing system was clearly crumbling in ruins, fierce rearguard actions would be fought across the board-room tables in an attempt to veto any policies that substantially affected the sovereignty of the merchants' status quo. Considering that most of the manufacturers and many users were multimillion £ enterprises and a typical merchant might have a dozen staff and a couple of old vans it is a non-trivial question to ask why this was so. The answer usually advanced would contain some reference to 'merchant power'. This was not a property of a single merchant but something that flowed from his relationships with other merchants, users and suppliers. It was a function of the collectivity of merchants and resulted from the solidarity of their behaviour. It was

clear that in order to be able to satisfactorily predict and explain merchant behaviour, a thorough understanding of the sources and internal dynamics of this 'merchant power' concept was needed. To do this a overall general model of merchant action will be described, and then the argument will focus on three critical areas.

A.4.1. A General Model of Merchant Action.

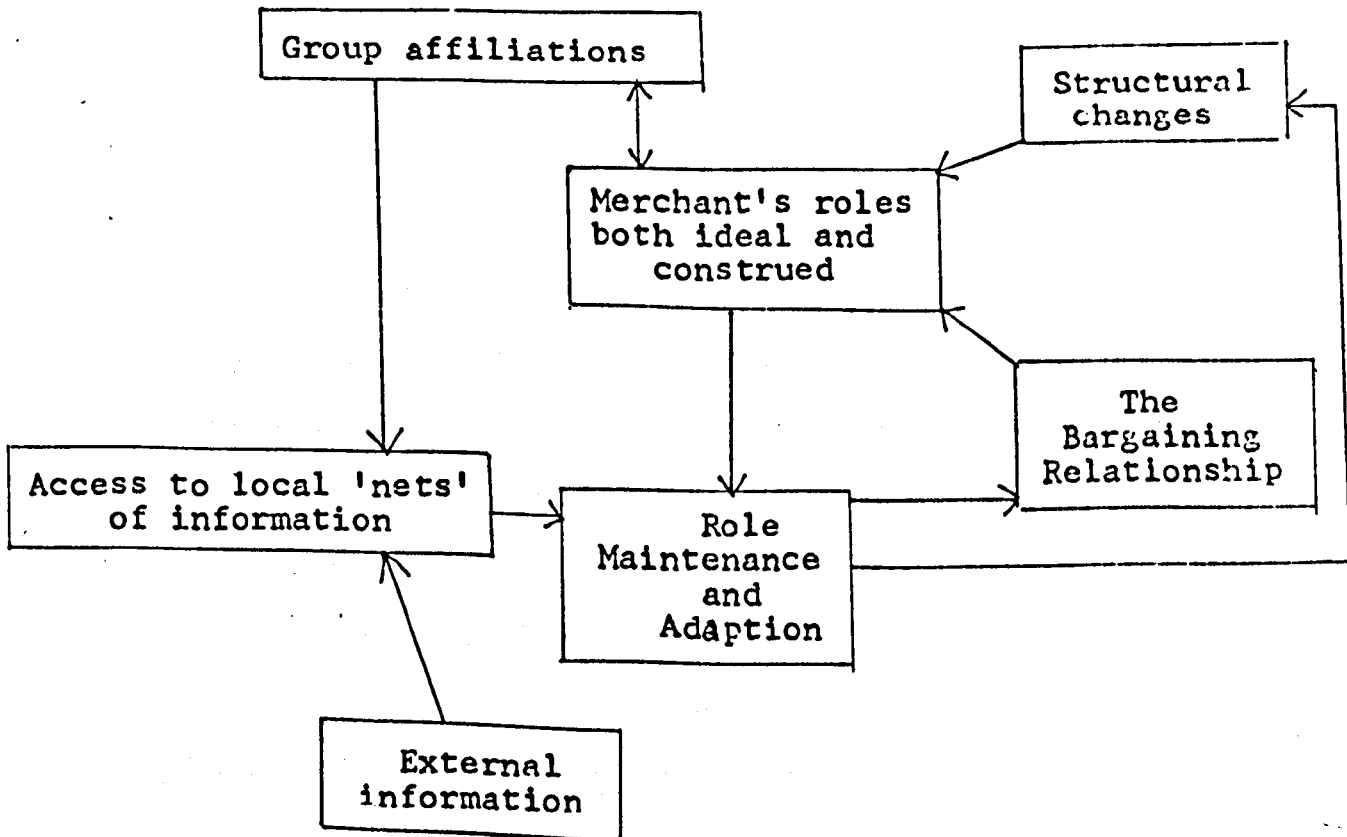
Stated briefly the model is :-

1. Actions occur not in response to economic variables per se, but rather in response to the actors' interpretation of them. Thus action is to be described by the actors' attitude towards changes in the economic variables.
2. This attitude will be fashioned by the effect of the economic variables on how he see his role in the distributive system. If there is a substantial discrepancy between what he construes as his present role and that which he considers desirable his attitude is liable to be different to his attitude if this was'nt the case.
3. His desirable role and what he construes as his present role will severely influence the group affiliations that he both seeks and retains. Similarly his existing group affiliations will substantially affect how he construes his present role and what he considers as desirable roles.

4. His group affiliations will furnish him with a network of information which when supplemented by external information will cause him to either maintain or adapt his role.
5. The principal actions aimed at role maintenance or adaption will occur within the bargaining relationship that he shares with both customers and suppliers.
6. If the role discrepancy is so great as for him to be unable to remove it via actions within the bargaining relationship, structural change is liable to occur.

This model can be crudely summarised below :-

F I G, A, 45



This model is self-explanatory but some consequences will be noted. As a consequence of 1. quite different actions could occur in response to the same economic situation and similarly the same actions could occur in response to different economic changes. Examples of this are plentiful. The refusal of a manufacturer to give an 'extra 1%' on certain orders could be construed in peaceful times to be an attempt to stop discount erosion. In times of imminent change it could be construed as the beginning of a policy of aggression towards merchants. Many actions by the manufacturers would be taken by merchants as quite reasonable in quiet times and yet could be considered as the 'thin edge of the wedge' or a 'shot across the bows' in times of critical tension in the system.

As a consequence of 3. the merchant would be expected to actively seek membership of certain groups while being prepared to drop others. Notice it is not claimed that the need for comparison was the generator of these groups. The complete opposite is more likely to be the case. Groups arise for many reasons as shall be seen below. Here it is claimed that once in existence they provide a convenient focus for role definition and maintenance on 'neutral' territory where a merchants position has not been compromised a priori by the very act of his attendance.

Some example of the sort of information referred to under 4. would be the 'going discount rate for non-standards', or 'merchant X has been receiving one or two shipments a week from competitor Y'. Much of the information contained in these 'local nets' will be accessible only to members. Thus one manufacturer may find it impossible to discover what the informal 'going rate' from another manufacturer is. Or a user attempting to 'play off' one manufacturer against another on a price estimation may be quite ignorant of the fact that the manufacturers freely talk about his order with each other. Anticipating section C for one moment, for most of the merchants the take-over of one of the manufacturers' three distributors by a competitor was an accomplished fact three weeks before the manufacturers' management read about it in their morning Financial Times.

Another consequence of 4. is that certain actors occupying key. positions by being the only common member of several local 'nets', have an influence often out of all proportion to their economic position. Two difficulties are experienced by merchants using these 'local nets'. Firstly, information contained in them tends to be partial and incomplete, secondly the reliability of much so-called information can be dubious. As a consequence, a considerable period of each merchants day is spent in 'filling gaps' in his knowledge of situations or seeking confirmatory

evidence via either a 'new angle' or checking that the source was 'to be trusted'.

A consequence of 5. and 6. is that structural changes are likely to be preceded by a considerable period of increased pressure in the bargaining relationship. This was certainly the case with the distributor takeover mentioned above, and if the 'signs had been read right' it should never have been a surprise to the management.

The model above was developed from a careful analysis of the detailed texture of relationship within the distributive system. Presented in the form of abstract concepts as above it loses much of its impact and most of its insight. To repair this the next three sections are devoted to describe the group affiliations, the merchants construed and ideal roles, and the content of the bargaining relationship respectively.

A.4.2. Group Affiliations.

A.4.2.1. Between merchants.

The principal factors determining groupings are geographical, size, type of industry served and a fourth that will be termed establishment. Of these, geographical is the most potent.

Geographical groupings.

It has already been seen during discussions of the economic variables how located a merchants' trade is. In that example 88% of trade lay within 50 miles, 80% within 30 miles and almost 50% in the immediate vicinity. This example from the West Country was also not representative in that industry there was more widely dispersed than in the Midlands or the North. A more representative example would have been even more localised. Merchants in the same area would know each other well, initially either by trade-fairs, dealers meetings sponsored by manufacturers, local traders association meetings, or they might have common connections in the area. Small trade exhibitions

are often a local affair such as sponsored by Chambers of Commerce etc., and merchants would often welcome the chance to meet in a 'neutral atmosphere, although their advertised reason for attendance would be to meet and attract custom. The manufacturers sponsor dealers meetings, mainly for public relations purposes, to convince merchants of how much the firm is committed to their existence and prosperity. The merchants are much on their guard here, they are quite aware that historically the engineer is proud of his skill and look with some scorn on 'middlemen' and 'shopkeepers' who get rich on unreasonable markups on the 'sweat of his brow'. This is not a foolish notion left by inertia from the last century, it is a real and potent attitude. There are few merchants who would not react with emotion against the label 'middleman' and it was common for merchants to deny the title vehemently even before it had been suggested.

Trade associations both local and national play a crucial role here. The business of these associations is usually confined to common trading problems. A typical seasons programme would perhaps contain a talk on the 'problem of pending decimalisation' and how it affects business, given by a representative of the Decimal Currency Board,

a County Surveyor would talk about plans for redevelopment, a tax inspector might explain the effect of S.E.T., or, rarely, a protest meeting to decide an action against new rate increases. These meetings provide a most important function for merchants, they maintain open the possibility of contact between merchants. Even if they seldom attend and don't speak to each other when they do, the opportunity for contact is still there and can be taken advantage of if necessary, removing the major inhibition of one merchant having to make the first move. One such meeting of many that the researcher attended, was concerned with 'decimalisation day'. Seven of the eight merchants in the immediate (10 miles radius) area attended. Normally one would not have expected to see more than two at the most. This was three days after some discount changes had been announced. The conversation afterwards was heated and in terms of 'us' merchants and 'them'. All clearly had much to say and a joint response was arranged. There had been no pre-arranged plan to meet that evening. This was just one of many similar meetings that must have occurred during the change period and served as a key focus for dissent.

Trade associations formed at a local level tend to have membership from many types of merchant traders simply because not enough component merchants exist in a small locality to make a viable group. Newsheets distributed by these associations tend to be primarily advertising with articles of local business interest. Thus it is natural that local associations tend to assist merchants in allocating business in the area between themselves, rather than comparing their terms with merchants in other areas. They are particularly useful for maintaining and making contacts with users, about which more will be said later.

National associations, on the other hand, draw their membership solely from component merchants, although they are likely to admit manufacturers and some very large users as honorary members. Their regional branch meetings provide most of the information regarding informal discounts and margins, and are normally well attended by merchants. The association usually publishes broad-sheets on specific topics of interest, and the monthly journal often has a 'glossy' cover, devoting each issue to a different major theme. There are sections for readers' letters, for announcements about appointments

and usually a digest of the technical literature. The magazine with typically 60-80 pages is normally circulated to members at a very low cost, and at a prohibitively large cost to others. Membership of the society is restricted to those 'who have been accepted by the committee as sufficiently qualified' in addition to three sponsors.

National associations also act as spokesmen on matters of public legislation, especially with regard to such items as price maintenance, selective employment tax, and the numbers of hours delivery drivers can operate each day. This political role is somewhat away from the main stream of the material here and reference could be made to Assael (68) for further reading and citations.

A few special associations existed which intermeshed with the above but did not possess the same cohesive power as them. Examples were the industrial marketing sections of marketing associations. They were mainly frequented by the 'professional' type of merchant.

A factor which assisted geographical affiliations, was the existence of common

connections. Apart from all the personnel connections that frequently exist amongst people with roots in the same community, there were often more direct connections which are of greater importance here.

It was common for a buyer or designer in a user industry, if he decided to leave that job, to consider 'setting up by himself', and what more natural than as a merchant utilising his existing connections to 'get him started'. Due to his previous position he is likely to know the other merchants well. The same sort of choice was often made by people leaving the manufacturing industry or even a previous merchant partnership splitting up. Entry to the merchandising market required little capital and could be undertaken fairly easily by people with a reasonable knowledge 'of the trade', and having a few 'contacts'. One of two things usually happened to these people, either they carved out a particularly small section of the market and just survived servicing it or they left the merchant trade after a couple of years often having lost their capital. Very few got established and became a recognised merchant, nevertheless a fair proportion of existing merchants had begun in this way.

A second method of entry was for an existing merchant in another trade to diversify, using his capital and knowledge of the region to help him over difficulties. This particular component trade had only really flourished since 1945, several of the existing merchants had joined in this way. This gave them considerable affiliations with other merchants carried over from previous trade. The third major entry route applied to only a few merchants although these tended to be amongst the biggest. This was when a small engineering manufacturer gradually diversified into distribution until the overhead cost of engineering machinery led him to concentrate all his effort in just selling and distributing, eventually closing down his workshop. Again the source of local affiliations is obvious.

Size groupings.

The second most important strata into which merchants divide is that of size. This is paralleled by the discount and guaranteed margins received. Thus AA merchants are more

liable to have the same sort of problems, deal with the same customers and have contacts in user firms at the same managerial level than an AA and a small merchant are. Also the trading stabilities differ somewhat. With only a couple of staff but considerable credit small merchants can and need to be more flexible in their trading. A minor recession will see a small merchant dealing in 'other bits and pieces' or 'doing the odd job'. On the other hand the large merchant must continue with considerable fixed costs. An experienced salesman or sales clerk is a valuable asset and he doesn't think in terms of reducing costs by laying them off, but rather seeing them as a heavy investment in training being idle for a period.

Merchants gain considerable status satisfaction from their discount rating, giving larger merchants a shared sense of achievement and an accepted hierarchy of superiority. Smaller merchants, on the other hand, treat this as a shared sense of grievance, marvelling at how manufacturers expect them to make a living on their pittance. Smaller merchants are looked upon as 'grasping' by larger when they ask for increased discounts, but amongst themselves this behaviour is treated as 'fair game'. One merchant obtaining an increase will be used as leverage

157

for the rest. A merchant achieving rapid growth will try and stop others following by disassociating himself from them, yet will find it difficult to be accepted by the larger merchants until he can prove that he does not constitute a real threat to them. The criteria that a merchant uses to force discount increases varies over time, at one time he might use rising costs, another comparability with other merchants, or perhaps he might exploit some geographical or other advantage he has. One merchant in the Poole region received an increase because he claimed that a Swindon Merchant was using the extra $2\frac{1}{2}\%$ he received to service the Poole region in competition.

Soon after this increase, now that the Poole merchant could afford to give a better service to his local customers it became clear to the Swindon merchant that it would soon cease to be economical to make this run and he withdrew from the area. Some six months later the Poole merchant was again requesting increases using as leverage that he was now the sole representation in that area.

Industrial groupings.

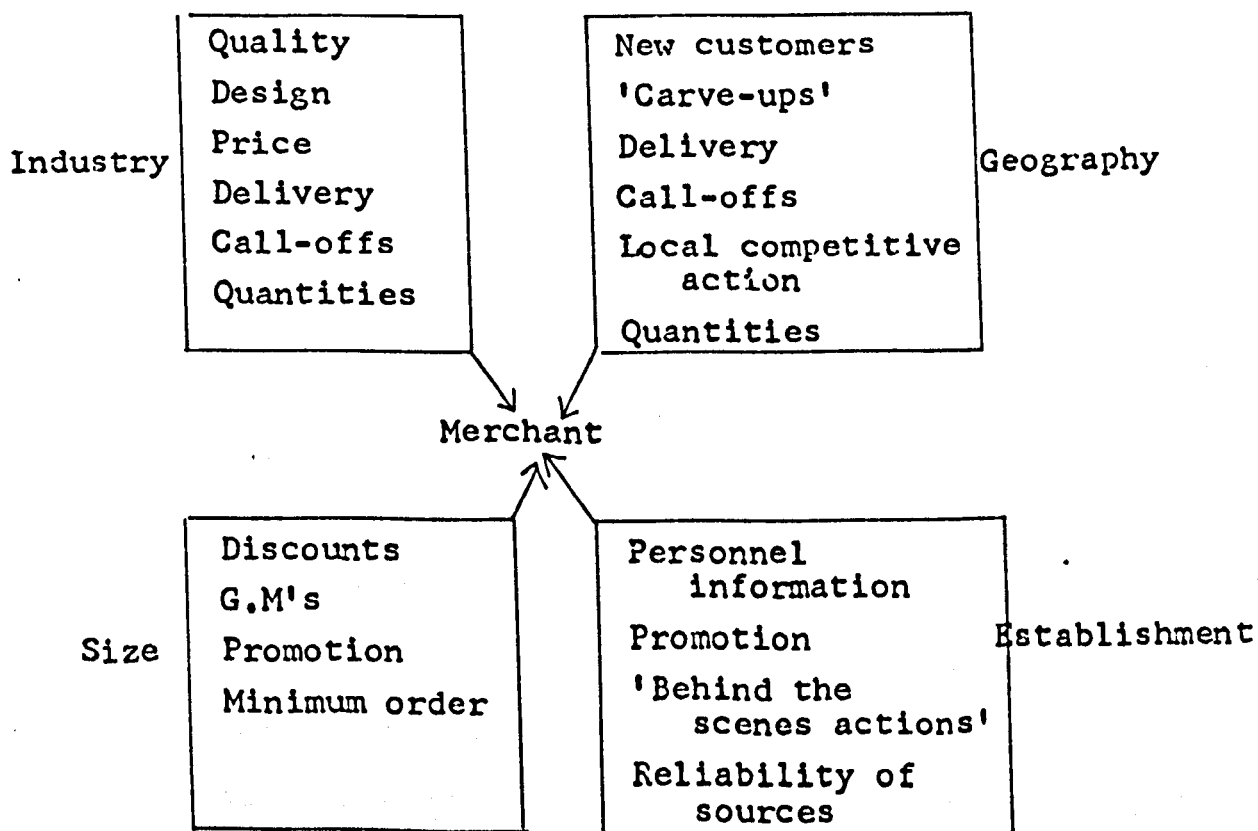
The third affiliation grouping for merchants is by type of industry. For most of the time this is coincident with the geographical grouping. The main distinction comes when the natural geographical region contains a sufficient number of merchants for there to be a likelihood of subgroup affiliations being formed. If there is no natural subgeographical unit, subgroups are often formed based on industrial type. Every case of such subgroup development that was observed occurred between merchants serving technologically advanced industries e.g. aircraft, computers, electronics and traditional heavy industries e.g. mining, shipbuilding etc.

Establishment groupings.

The fourth grouping of merchants by establishment type is less important. It refers to the major 'polar types' observed in the descriptions of merchants above. Thus the 'old established' merchants feel they have more in common with each other and less with the new aggressive types. The only cases where this type was needed to explain affiliation groupings was when individual merchants were excluded from other groups which it appeared logical they ought to belong to.

'Old Boy' networks fall into this category and were generated by either ex-employees of a certain manufacturer or the group of people who were 'in the field' before 1945.

Thus industry, geography and discount rate (size) groupings are seen to account for the major group affiliations. Any particular merchant is likely to belong to several such groups and a summary of the position with the sort of information that each grouping might contribute is shown below :-



A.4.2.2. Between users.

This is the most complicated of the areas in which to seek group affiliations. There are a wide range of potential users of these components, from production assembly lines requiring tens of thousands in each batch to an amateur mechanic with a lathe in his garage who might require one from time to time. How to investigate the extent to which they are influenced by various affiliations. The task would form a major research study into purchasing and as such cannot be contemplated here. Nevertheless, some of the aspects that such a study might involve shall be indicated.

For the 'small' purchaser of these components the affiliations most likely to sway him would be those through which promotion is channeled. Examples might be technical associations or, as a different example, occupational peer groups e.g. Working Mens' Clubs.

Within all these groups the consensus on the 'best brand for the money' is likely to be weak. Just how much brand loyalty or manufacturer's specification affect repurchase decisions must remain a matter for speculation.

With the 'larger buyer there is added difficulty of isolating the man who makes the purchase decision. Is the purchasing department balancing out other demands or are the design engineers specifications so tight as not to allow the purchase agent any choice ? Or have the finance department allowed such a restricted budget that no-one else has any choice other than select the cheapest available ? These are dynamic not static questions, the room for manoeuvre left on a purchase decision by various sway groups changes with the fluctuations of almost any other organisational characteristic. For example, a change in the personalities managing departments, 'end of the year' budget restrictions, increased production downtime due to poor quality components causing delays etc. Group affiliations at this level would need to include almost the whole user organisation.

Between User organisations, Engineering Journals can be isolated and, most importantly, the rapid growth of a Professional Organisation with its own entry restrictions for Purchasing Staff. A further important between User affiliation that must be mentioned is group-purchasing. The rise of corporate group purchasing has been publicly much remarked upon.

It is a phenomenon that, in Engineering Manufacturing, was encouraged by corporate acquisition and agglomeration and also by organisational policies of centralisation. When there has felt to be a need for organisational decentralisation, rather than destroy the idea of co-operative group purchasing, it has tended rather to institutionalise and reinforce the movement by the establishment of group purchasing as a part of a service division.

In most companies where group purchasing existed, negotiations were between User and Manufacturer, the distributive system servicing the agreements afterwards. When this research was done, group purchasing was still fairly rare in the engineering industry but was a growing phenomenon. Comparative research started now would have to look at this problem afresh.

Thus some aspects of possible group affiliations at the user level have been delineated, but it must stay in this rather unsatisfactory position. For to try and build generalisations on users affiliations would be to move too far from the research topic.

A.4.2.3. Between suppliers.

Suppliers here means either distributors or manufacturers. For two reasons this did not turn out to be an important area and it shall be quickly dispensed with.

The first one is a theoretical point. Because of their increased size and wide coverage of users, suppliers were less vulnerable to the daily exigencies of trading and tended to react with more thought.

Secondly a practical point, even at the start of the study there were only eight or nine organisations that could really be termed distributors. As the work of section C progressed several of these were purchased by the manufacturers, making access to them difficult or impossible. Thus information was somewhat piecemeal.

Each distributor had several branches and thus the most important affiliation of the distributor was his head office. Instead of behaviour within affiliations being informal 'custom and practice', there was now a considerable institutionalisation within formal organisational procedures.

The second affiliation is again the geographical one, and notice immediately that this grouping is quite orthogonal to that with

the parent company, branches were such that two never appeared that close. Attitudes towards competition and co-operation were much the same as at the merchant level only less volatile. The manifestations of this group cohesion were quite different though. Sanctions were only operative at the trade level and never become personal victimisation. The weapons were business based such as undercutting or poaching customers. Social or community sanctions were never used. We must remember at this point that the branch managers were more akin to a company's middle management than to a merchant entrepreneur. If the business failed he lost his job, he didn't also lose his livelihood and accumulated capital. If business worries assail him he can speak either to his most senior staff or his parent company, the merchant has to turn to either his bank manager or wife. The branch manager has formal records and accounting procedures, the merchant often doesn't really know his financial position until the yearly stocktaking and audit.

Manufacturers met at trade fairs or technical symposia. Their sales staff would know each other over the telephone if not personally. But further than this it is impossible to claim

any powerful role for groups commitments they might have in common. Thus overall it is seen that the multitude of strong cohesive influences operating at the merchant level are matched between neither the users nor the suppliers. Also it is seen that user or supplier membership of the merchant's groups is very rare. This rules out any possibility of affiliations occurring between users and manufacturers, relationships here being forced to be on a one-to-one basis.

A.4.3. The Merchant's Cognitive Position.

The merchant's cognitive position will refer to how he construes his role in the distributive system. It will be investigated in two parts concerning users and supplies, and then other merchants.

A.4.3.1. Towards users and suppliers.

At one extreme merchants can identify very closely with the needs and problems of customers, acting almost as a 'warehouse outside the walls' as one merchant put it. He will keep in close contact with the firm's purchasing agent and support him in any discussions with manufacturers. If he is dependant on one very large customer, his internal procedures are likely to match those of this customer, especially the beginning and ending of the financial year, or the formal

layout of invoices etc. This close identification may or may not have been formalised with contracts and agreements, but lower level agreements were found most frequently. Examples would be the user offering their vehicle maintenance bay for the merchants use, or their printing facilities for merchant's publicity documents and in one case user and merchant placing a joint order for racking and shelving and hence gaining a larger discount.

Moving away from this extreme we see the merchant insisting on maintaining a certain amount of independence. He will avoid becoming so dependent that losing that customer could cause his business to fail. He will still claim that looking after the users' interests is the prime job of a merchant but will add the rider that this ^{must not} be done at the expense of alienating the suppliers. Moving even further away we come to the merchant who sees himself as balancing out the conflicting demands of supplier and user as 'fairly as possible'. He will take a considerable pride in not being unduly biased one way or the other. When he considers the user has had a 'rough deal' over certain deliveries he will support him against the supplier. If at any time, though, he considers the user is taking advantage of this

support to make 'unreasonable' demands he is quite likely to shift his support to the supplier. He sees the whole point of the merchant level to present user's and supplier's demands to each other 'fairly and squarely'.

Moving closely to the supplier the merchant will begin to act as the suppliers representative in the marketplace, protecting the manufacturer from small unprofitable orders and promoting not just his services but the manufacturers' product as well. But he won't go 'all the way along' with the supplier, and is prepared to back users if he thinks manufacturers aren't giving the sort of service they ought to. At the other extreme, the merchant sees himself as effectively part of the manufacturers distribution department and considers it a critical part of his job to smooth the demand for the production facilities. He identifies with the manufacturers' problems and is likely to have close contact with the manufacturers marketing personnel. Some institutionalisation of this identification may have occurred in the way of franchises, dealerships or agencies; or if not at least some contractual agreement may have been exchanged. Accounting and administrative procedures are often closely tied with those of the manufacturer

and the same kind of informal assistance can occur as between closely identified merchants and users.

In practice these identifications will permeate the whole of the merchant's organisation. One vivid example of this was two merchants in Newcastle situated about $\frac{1}{2}$ mile apart in the same industrial belt. One served the Tyneside shipbuilding industry and the manager's office was decorated with pictures of ships both built and under construction. On a pile on the table were various journals related to shipping. In the other merchant's office in place of the ships was a photograph of the manufacturers plant and the journals covered the component industry which supplied him. It was this example that really focussed the researchers attention on the critical role played by how the merchant sees his position in the distributive system when he was investigating why those two merchants had reacted in totally different ways to some competitive activity.

It would have been convenient to be able to consider all merchants as lying somewhere between these extremes. Unfortunately this was impossible, because there seemed to be a certain independence between the integration achieved with users and

suppliers. Some merchants saw themselves at both ends of the scale at once, being closely integrated with both user and supplier. Others saw themselves as quite independent of both and totally isolated. It must not be asked how it was possible in practice to be closely integrated with both, the important point is that this is how the merchant construed it and this was confirmed by both his suppliers and users. Thus it was necessary to consider the identification and integration of merchants with users and suppliers as two separate variables, although complete independence cannot be claimed.

A.4.3.2. Towards other merchants.

This basically reduces to a scaling of attitudes to other merchants ranging from complete competition to complete co-operation. At the competitive end of the scale merchants were bitter enemies fighting each other for any customers they could get, undercutting where necessary and taking every opportunity to undermine the customers confidence in other merchants. Moving along the scale, merchants are willing to co-operate on aspects of business above the level of trading. This is where trade associations become valuable, maintaining open the possibility of meeting on neutral territory.

Midpoint on the scale competitive and co-operative attitudes are finely balanced. Merchants know each other socially and will often help each other out in times of difficulty, perhaps by supplying the odd component or delivering the odd parcel. Rules of behaviour regarding customers begin to arise now and the most flagrant acts such as poaching a major customer are condemned, yet each side would still be proud to say he believed in 'strong healthy competition'.

Moving towards the other end of the scale we find the consolidation of rules of co-operative behaviour and the emergence of demarcation agreements. Merchants have 'their own customers and specialities' and others respect these boundaries. Poaching of any form is frowned upon and likely to make a merchant ostracised amongst peers. New-comers in an area can stand this but families with deep roots in a community will find the pressure for conformity seeping through their personnel contacts, or of those of members of their family. This phenomenon is common enough; examples would be a merchant's wife complaining that 'people were talking behind her back' or another merchant's wife had 'cut her dead', his children would return with stories that another merchant's children had overheard their father say 'he's getting a bit above himself' or 'he just ought to watch himself',

if I find that he's been sniffing around any of my accounts then' invitations will begin to drop off and company salesmen will mention confidentially they are 'finding it difficult to keep coming to you, other merchants have threatened to switch some of their trade unless I stop servicing you '. He will find that some of his orders from the distributor have 'got lost in transit'. If the merchant persists in his expansionist policies and the local market is a particularly well established and stable one served by several merchants he is likely to bring serious victimisation on himself and his family. One case in particular begun with the merchant being 'cold-shouldered' in local meetings so he stopped going, then his vans started to have a suspicious number of flat-tyres, his child was ostracised at school and his best clerk was enticed away to a competitor by a mixture of threats and an improved position. His new level of trade entitled him to request an increased discount, but he was discreetly warned by the manufacturing firm that this could place him in an impossible position. He ignored the warning, but very soon a couple of his biggest customers said that they had received a very attractive offer from a consortium of other merchants which it would be

impossible to refuse unless he could go part of the way to matching it.

At this time his health deteriorated with the worry and having to do the work of his sales clerk as well. Debating with his wife about what to do, they decided that 'it would be for the best if we trimmed our ambition a little'. As a concession he withdraw a quotation from a customer normally serviced by another merchant whom he was trying to gain. This was recognised by others as a signal and the pressure began to relax. Within six months of the whole affair beginning it was over again, albeit with the merchant operating at a level 10% - 15% above his previous. By obscure references he indicated that any further ambitions would be confined to increasing trade in a neighbouring area, which was developing some new light industry. The affair was over but was never forgotten.

This was perhaps a particularly severe example of the rules and norms that a professional peer group exercises on a member when he shows deviant behaviour. The problem was how to handle this sort of behaviour in an analytic fashion.

Some researchers faced with similar processes, especially in production planning, say that they are only concerned with strategic issues and that

these tactical displays of behaviour are ignored for the sake of gaining at least a workable model. The people who do consider these problems usually have them as their prime focus, e.g. industrial sociologists investigating the legitimisation of rules of behaviour for work groups concerning demarcation disputes. But when studying strategic decision making in volatile environments, such as distribution systems, the actions of decision makers is seldom based upon long-term economic considerations. In these cases strategic change is the agglomeration of series of tactical changes each heavily dependent on the attitudes held by actors at the time of the decision. To cut these factors out of the analysis would be like trying to explain why the branches of a tree took up certain patterns while ignoring the existence of the trunk.

To finish off the scale there is the completely co-operative end. Here merchants act as one voice, they 'carve up' the market amongst themselves and agree on prices and discounts. They are then free to concentrate on stopping new entrants and making sure that the manufacturer cannot possibly go direct to the user. The 'custom and practice' described above is rigorously enforced with heavy sanctions against cases of infringement. This extreme is very unlikely to

come about although the attitudes that it involves can well happen and remain for a certain period when an already cooperatively active merchant body is threatened from without.

A.4.4. The Bargaining Relationship.

For every order passing between user and merchant or merchant and supplier agreement must be reached on discounts, quantities, delivery, credit extensions etc. It is the process whereby agreement is reached that is here termed the bargaining relationship. The bargain might never be contested, or it may proceed by letter, telephone or face to face. It is usually drawn out over a period of time and interim agreements are frequently made. Bargaining of one form or another will occupy most of the sales clerks and salesmen's day at both the merchant's office and the sales office of the manufacturer.

The bargaining relationship is the vehicle used by merchants to maintain or adopt their position in the distributive system. Unlike transactions internal to a firm which have to be maintained regardless of antagonism between sender and receiver, c.f. Lawrence and Lorsch(1967) or Walton et al (1966), there is a strong possibility here that complete breakdown will occur and the relationship cease. It is thus in the interests of both parties to have a finely graded

series of stronger and stronger bargaining procedures so that there is adequate warnings to both sides that the point of total breakdown is being approached. This series of procedures will be described ranked order given by actors. Thus, if an agreement isn't immediately found the two sides would attempt to find some kind of compromise, usually on the factor about which there is most disagreement. They could 'meet each other half way' or 'give and take a little'.

If this didn't work satisfactorily actors would begin to introduce other factors to trade-off against each other. Merchants would say to users 'we will get the goods to you now but we won't be able to offer such generous terms' (delivery against discount), Again, 'you can have some now and the rest later' (delivery against quantity). Again, 'you can have the goods but I can't extend any credit if I agree to those terms' (discount against credit) or 'I can only let you have them on those terms if you are prepared to take a few extra' (discount against quantity). Notice all these are pairwise comparisons, there was seldom found evidence of tryad relationships.

If trade-off such as these 'parallel' trade-offs don't work actors may try what will be termed 'sequential' trade-offs. Examples might be 'I'll get these goods to you this time but remember that this is a favour if ever I want one in return' or 'we went out of our way to keep

you supplied last, I think you could give us more flexibility now', or again 'if you are prepared to place a regular order we might consider better terms'.

If none of these measures work, more drastic steps may be needed but these begin to strain the stability of the relationship altogether. One example is 'stonewalling', one side refusing to move from his established position. Where any further progress is impossible and the decision cannot be delayed any further a mediating authority can be sought. The sales clerk and purchaser might refer the matter to their respective managers, or the manufacturers sale representative in the area might act as 'go-between. Either way, it is a preliminary declaration that the maintenance of the relationship is moving out of their control.

Past this point the order may be taken elsewhere, but in such a way as to leave open the chance of doing business on an alternative order at a later date.

More serious than this is when disagreement is so intense as to threaten business trading on all goods in the foreseeable future and the account is effectively closed. This is a extremely rare event outside of some structural changes occurring in the

distributive system, and is usually caused by personality differences generated outside the sphere of business influence.

From the analysis made within the distributive system it was clear that merchants who identified more closely with users would be prepared to fight a harder bargain with suppliers and vice-versa. Of course, from order to order this would fluctuate widely, but the average trend was there.

By varying the pressure used to come to agreements with users and suppliers, an individual merchant could manoeuvre himself into a position of being more closely allied with either the user or the supplier. If he wished to move into a position of close cooperation with other merchants then it would be necessary for him to 'fall into line' concerning what was judged in the merchant community to be the 'right sort of trading terms'. Conversely if he felt no more need to be part of the merchant community, then when an opportunity arose for him to demonstrate his independence by accepting or rejecting terms that the other merchant thought reasonable, he would take it.

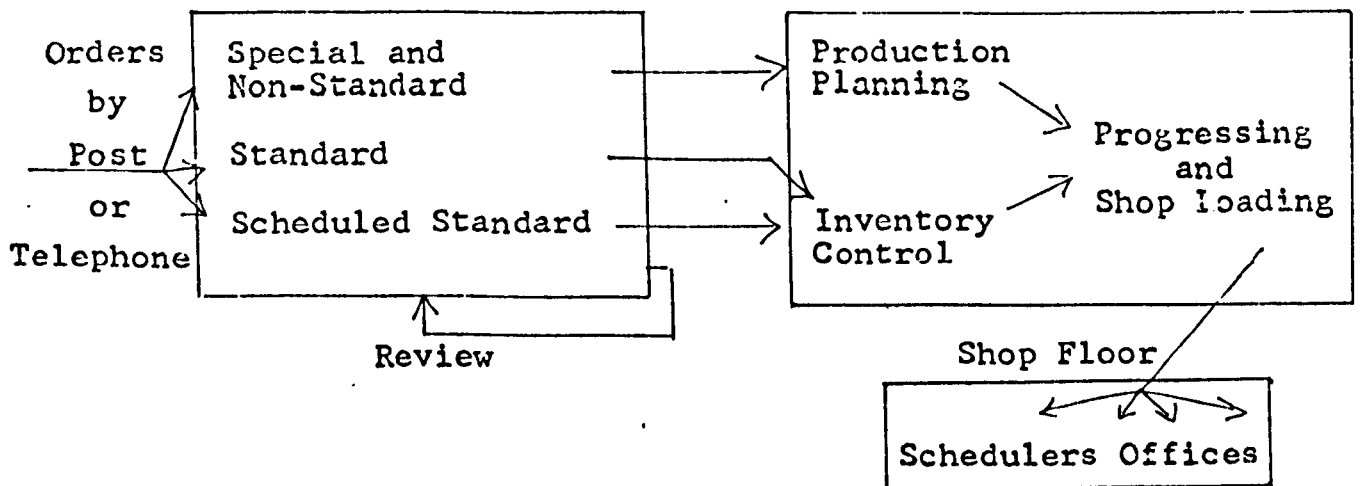
With this general model of merchant action it is now possible to explain in a descriptive way much that previously either could not be explained or had to be explained away using particular details about each

case. Of course, the model here is still very crude, and much merchant behaviour can only be explained by considering the special cases. Nevertheless it was felt by analyst and management alike that given the problem of attempting to predict a merchant's response to a certain set of economic variables, then the prediction could be made more accurately and more reliably if information about his cognitive position was known. Similarly on presenting a whole geographical region containing several merchants with the same changes in the economic variable, it was thought possible to decide which merchant would do one thing and which another by using their individual cognitive positions.

Thus the bargaining relationship that merchants maintain with users and suppliers provides a delicate balance of power across the boundaries of the organisations in the distributive system. Changing this balance either reflects or generates changes in how actors in the system see their roles in relation to others.

A.5. THE INTERNAL ORGANISATION OF THE COMPONENT FIRM.

For completeness a very brief summary will be made of the internal operations of the component firm. Thus consider the highly simplified diagram below;



The Sales Office.

For standard items the sales clerks have to agree with the customer on discount, delivery and quantity. He knows the stock situation and of any replenishments already in the pipeline. He also knows the pressure of demand on that item and also the pressure on each section of manufacturing. He will attempt to retain the customer's business without jeopardising either the production of other goods or other customer's orders. For special or non-standard

items he needs to liaise with Production Planning for them to estimate for a quotation or for advice on whether the design is feasible. For scheduled standards the clerks maintain a file of customers orders that have been scheduled over a period of usually 6 to 12 months. He reviews this frequently and issues orders from stock as necessary.

The clerk thus makes decisions on discount, delivery, first delivery quantities, guaranteed margins, manufacturing priorities and stock allocation.

Production Planning and Control.

For special items PPC is responsible for estimation and methods. For standard items they maintain the stocked standard inventory. They also undertake all the progress chasing of orders on the shop floor. Their major room for manoeuvre is in loadings, priorities, delivery dates, stock replenishment quantities and reorder points.

The Shop Floor.

Although the bargaining continues down to the individual setter or operative, for the present purposes we can consider it finished when the scheduling clerk fixes a machine loading schedule with certain priorities attached. Although the internal procedures of such a firm are on the surface exceeding complex, the above simplified account shows that the transactions continue through the firm in much the same way as they have already travelled from the customer. Each organisational unit within the firm has to bargain with

the next on certain product characteristics. Also the degree of identification and integration varies between units in much the same way as has already been seen for merchants. Thus at one time sales might consider it their role to protect the production facilities and at another to concentrate on servicing the needs of distributors, merchants or users. Similar data to that drawn from the distributive system was collected here, and initially it was the intention to see how changes in cognitive positions and bargaining procedures within the distributive system were transmitted through the firm. It was also the intention to see how the dynamics of integration compared between autonomous organisational units in distribution, and organisational subunits within a company, with the coordination and overall control implied by that. Although all the data was collected, there was not enough time to analyse and make deductions from it. Also it was rather away from the main stream of this research. It is hoped to complete that work and publish it separately at a later date.

This completes section A, the description of the distributive system. Section B will describe the models used to both change and predict the results of changes in that system.

PART TWO

SECTION B

B.	<u>THE ECONOMIC AND BEHAVIOURAL MODELS.</u>	
B.1.	<u>INTRODUCTION.</u>	165
B.2.	<u>THE ECONOMIC MODEL.</u>	166
B.2.1.	<u>The Two-stage Channel Choice Model.</u>	166
B.2.2.	<u>The Three-stage Channel Choice Model.</u>	171
B.2.3.	<u>The Linearisation of the Discount Payments.</u>	175
B.2.4.	<u>Primal Decomposition.</u>	181
B.2.5.	<u>Dual Decomposition.</u>	182
B.2.6.	<u>Tangential Approximation to Dual Surface.</u>	185
B.2.7.	<u>Adjustments for the Depot Case.</u>	187
B.3.	<u>A BRIEF REVIEW OF OTHER ECONOMIC MODELS FOR THE CHANNEL CHOICE DECISION.</u>	188
B.4.	<u>THE CALIBRATION OF THE ALTITUDINAL INSTRUMENT.</u>	193
B.4.1.	<u>The Cognitive Variables.</u>	194
B.4.2.	<u>Direct Versus Indirect Measurement.</u>	197
B.4.3.	<u>Standardisation of the Bargaining Process.</u>	199
B.4.4.	<u>The Procedure Variable.</u>	202

B.5. SOME EXAMPLES.

B.5.1. Situation One. 206

B.5.2. Situation Two. 211

B.5.3. Situation Three. 214

B.5.4. Situation Four. 216

B.6. CONCLUSION OF SECTION B. 220

B.1. INTRODUCTION.

The economic model is studied first. In the two-stage model only the manufacturer-merchant-user system is considered, but then the three-stage model introduces the distributors. A section then describes the linearisation of the merchant discounts, and the decomposition method is developed. The theoretical extension to the depot case can be found in Appendix 1. Then the detailed calibration of the behavioural model is described. This followed by a section describing some examples of its use in measurement.

The development of the economic model has previously been published as

Discussion Paper W.17

Centre for Industrial and Business Studies

University of Warwick

October 71

and some comparative computational work between decomposed and undecomposed models will shortly be published as an appendix to the above.

B. 2 THE ECONOMIC MODEL

Firstly, we shall consider the 2-stage problem, where the distributors are absent, then the 3-stage problem, followed by a discussion of our decomposition methods.

B.2.1 The 2-Stage Channel Choice Model

Consider M merchants, one geographical area, one product range, and an order size classification with N groupings. These restrictions can easily be dropped at a later stage. Use the following notation.

T_i ($i = 1 \dots N$) is total market for group i

S_j ($j = 1 \dots M$) is total trade through merchant j .

z_i ($i = 1 \dots N$) is direct sales from manufacturer to group i .

y_i^j ($i = 1 \dots N, j = 1 \dots M$) is sales from manufacturer to merchant j falling into group i .

x_i^j is similarly sales to group i from merchant j .

p^j is transition 'stock holding policy' matrix for merchant j .

α_i^j the cost of delivering group i to merchant j per component.

β_i the cost of delivering group i direct per component

Thus the total cost to the manufacturer is:

$$\sum_{j=1}^M \sum_{i=1}^N \alpha_i^j y_i^j + \sum_{i=1}^N \beta_i z_i + \sum_{j=1}^M f_j (S_j)$$

where f_j is the discount paid to the j th merchant.

With the conditions, $x_i^j, y_i^j, z_i \geq 0 \quad V_{i,j}$

$$\text{and } \sum_{j=1}^M x_i^j + z_i = T_i \quad V_i$$

$$\sum_{i=1}^N x_i^j = S_j \quad V_j$$

$$y_i^j = p^j x_i^j$$

Thus substituting for \underline{y}^j
 Cost = $\sum_j t_{\alpha^j} p^j \underline{x}^j + t_{\beta} z + \sum_{j=1}^M f_j (S_j)$

(superscript t implies transpose)

which is a model fairly similar to the classical 'transportation' model with cost matrix $[t_{\alpha^j} p^j \mid t_{\beta}]$. The difference between this model and the classical one is that the column totals S_j ($j = 1 \dots M$) are decision variables with a non-linear cost component. Forming the Lagrangian, with the obvious definition of multipliers;

$$L = \sum_j t_{\alpha^j} p^j \underline{x}^j + t_{\beta} z + \sum_{j=1}^M f_j(S_j) + \sum_{i=1}^N u_i (T_i - z_i - \sum_{j=1}^M x_i^j)$$

$$+ \sum_{j=1}^M v_j (S_j - \sum_{i=1}^N x_i^j) - \sum_i \sum_j \lambda_i^j x_i^j - \sum_{j=1}^M \mu_j S_j$$

$$- \sum_{i=1}^N \theta_i z_i + \phi \left(\sum_{i=1}^N T_i - \sum_{j=1}^M S_j \right)$$

then the Kuhn-Tucker conditions give:

$$\frac{\delta L}{\delta x_i^j} = t_{\alpha^j} p^j(i) - u_i - v_j - \lambda_i^j = 0 \quad v_{i,j} \quad (1)$$

$$\frac{\delta L}{\delta z_i} = \beta_i - u_i - \theta_i = 0 \quad v_i \quad (2)$$

$$\frac{\delta L}{\delta S_j} = \frac{\delta f_j}{\delta S_j} (S_j) + v_j - \mu_j - \phi = 0 \quad v_j \quad (3)$$

$$\lambda_i^j x_i^j = 0 \quad v_{i,j} \quad (4)$$

$$\theta_i z_i = 0 \quad v_i \quad (5)$$

$$\mu_j S_j = 0 \quad v_j \quad (6)$$

and also the original constraints.

N.B. the notation $P^{j(i)}$ means the i -th column of the matrix.

Equations (1) and (4) give the result that either flow x_j^i is zero or $\sum_i P^{j(i)} - u_i - v_j = 0$ which is the usual optimality condition on the cells of the 'transportation' method.

Equations (2) and (5) give exactly the same results for \underline{z} except that because the problem has been formulated in a rather convenient way the shadow price corresponding to the \underline{z} column is taken to be zero.

Equations (3) and (6) give the result, either no business passes through merchants j ($S_j = 0$) or $\frac{\delta f_j}{\delta S_j} + v_j - \phi = 0 \quad V_j$

Referring to the merchants with non-zero flow as 'active' with notation

$$A = \{j | S_j \neq 0\}$$

$$\text{then } \frac{\delta f_j}{\delta S_j} + v_j - \phi = 0 \quad j \in A$$

$$\frac{\delta f_j}{\delta S_j} + v_j - \phi > 0 \quad j \notin A$$

Thus defining the function,

$G(\underline{S})$ on M -space represented by the vector \underline{S} as

$G(\underline{S}) = \text{Min value of the 'transportation' problem with these values of } \underline{S}; \text{ with the direct path absorbing the slack demand, that is goods not passing through a merchant goes direct.}$

The above problem reduces to:

$$\text{Min } G(\underline{S}) \text{ such that } \underline{S} \geq 0 \text{ each } S_i \geq 0$$

$$\text{and } \sum_{j=1}^M S_j \leq T = \sum_{i=1}^N T_i$$

and the optimality conditions become,

$$\frac{\partial G(\mathbf{S})}{\partial S_j} = \frac{\partial f_i}{\partial S_j} + v_j - \phi = 0 \quad j \in A$$

$$> 0 \quad j \notin A$$

implying that the gradient vector on the $G(\mathbf{S})$ surface climbs away from any optimum on the boundary, a result to be expected. As an aside, now that the optimality conditions have been developed the plausibility of the result in economic terms is noted. It states that, at the optimum, the marginal discount payment to a channel must cancel out the shadow price. The parameter ϕ gives information about the direct channel, being zero when there is some direct flow. In the special case when discounts are a fixed proportion, that is, when f_j is linear, the results simplify as below:

$$\text{Min } \sum_{j=1}^M C_j S_j + \text{transport solution for } S_j \geq 0 \text{ and}$$

$$\sum_j S_j \leq T$$

This very simple linear model has the optimality conditions;

$$C_j + v_j - \phi = 0 \quad j \in A \quad (7)$$

$$> 0 \quad j \notin A \quad (8)$$

$$t_{\alpha}^j p^j(i) - u_i - v_j = 0 \text{ active } x_i^j \quad (9)$$

$$> 0 \text{ otherwise} \quad (10)$$

$$\beta_i - u_i = 0 \text{ active } z_i \quad (11)$$

$$> 0 \text{ otherwise} \quad (12)$$

if x_i^j is active $j \in A$ and (7); (9) give

$$C_j + t_{\alpha}^j p^j(i) - u_i - \phi = 0$$

Thus if both z_i and x_i^j are active

$$C_j + t_{\alpha}^j p^j(i) - \beta_i = \phi = 0$$

Thus it can be concluded that both can only be active under the freak conditions

$C_j + t_{\alpha}^j p^j(i) - \beta_i = 0$, and in general z_i will be active when $C_j + t_{\alpha}^j p^j(i) - \beta_i > 0$ for all $j = 1 \dots M$. x_i^j will be active when

$C_j + t_{ij}^j P^j - \beta_i < 0$ for any j and the $\text{Min}_k \{ C_k + t_{ik}^k P^k(i) - \beta_i \}$ occurs at $k = j$. From physical considerations this is obvious and states that if there exist no channel economies of scale business will flow along the path with least unit cost.

The importance of the optimality conditions derived above stem from the efficiency of the search routines that are possible over the surface $G(\underline{S})$ in M -space of \underline{S} . Thus considering the problem of optimum seeking on the constrained surface $G(\underline{S})$ such that $\sum_j S_j \leq T$, $\text{each } S_j \geq 0$ and $\sum_j S_j \leq T$, supposing \underline{S}^0 is a feasible point. Then the downward gradient direction is given by

$$-\nabla_{\underline{S}} |_{\underline{S}=\underline{S}^0} = -\underline{d}$$

where $d_j = \frac{\delta f_j}{\delta S_j} + v_j - \begin{cases} \phi & \text{if } j \in A \\ & \text{or if } j \notin A \text{ and } \frac{\delta f_j}{\delta S_j} + v_j - \phi < 0 \end{cases}$

$d_j = 0$ otherwise

But every iteration of the 'transportation' procedure gives ϕ and v_j ($j = 1 \dots M$) as a by-product (that is using any dual variable approach such as the stepping-stones method). Thus each function evaluation gives the gradient direction as well.

B.2.2 The 3 Stage Channel Choice Model

The restrictions about product range and geographical area are retained but the analysis extended to include the distributor level.

There is no loss of generality if the direct bypass path past the distributors is treated as an extra distributor with a unit transition stock matrix, and also do the same for the direct bypassing of the merchants. The following notation is additional to the two-stage model;

Let D^k be the distributors transition matrix

Let Γ_k be total throughput of k^{th} distributor.

Let $\epsilon_k(\Gamma_k)$ be the discount function of the k^{th} distributor.

Let w_{ik} be flow of i th good from distributor k to manufacturer.

Let α_{ik} be unit cost of i th goods from distributor k to manufacturer.

Thus;

$$\sum_{j=1}^M x_i^j = T_i \quad V_i \quad (1)$$

$$\sum_{i=1}^N x_i^j = S^j \quad V_j \quad (2)$$

$$x_i^j \geq 0 \quad V_{i,j}$$

The order-passing relationships at the merchant level.

$$\underline{y}^j = P^j \underline{x}^j \quad \gamma_j \quad (3)$$

Then there are the conservation conditions between merchants and distributors, where z_{ijk} is the amount of the i -th good going to the k^{th} distributor from the j^{th} merchant.

$$\sum_{k=1}^E z_{ijk} = y_i^j \quad V_{i,j} \quad (4)$$

If t_{ik} is the amount of the i -th good going to the k^{th} distributor then

$$\sum_{j=1}^E z_{ijk} = t_{ik} \quad V_{i,k} \quad (5)$$

and then

$$w_k = D^k t_k \quad V_k \quad (6)$$

$$\Gamma_k = \sum_{i=1}^N t_{ik} \quad V_k \quad (7)$$

The cost to the manufacturer is

$$\sum_{k=1}^E t_{\alpha \cdot k} w_k + \sum_{k=1}^E \epsilon_k (\Gamma_k) + \sum_{j=1}^M f_j (S^j) \quad (8)$$

Now by (6) and (5)

$$\sum_k t_{\alpha \cdot k} w_k = \sum_k t_{\alpha \cdot k} \cdot D^k \cdot t_k = \sum_{k=1}^E t_{\alpha \cdot k} \cdot D^k \sum_{j=1}^M z_{jk} \quad (9)$$

also

$$\Gamma_k = \sum_i t_{ik} = \sum_i \sum_j z_{ijk}$$

also (3) and (4) give

$$\sum_k z_{jk} = P^j x^j \quad (10)$$

This has eliminated the variables t_{ik} and y_i^j .

When discussing the economic variables in the distribution system it was indicated that distributor discounts are always 'blanket' type, just being a percentage of total business value and not being dependent on total volume for the discount rate

Given that the margins gained by a distributor will be different for each merchant traded with, we have;

$$\epsilon_k (\Gamma_k) = \sum_i \theta_{kj} \sum_j z_{ijk} \quad V_k$$

Where θ_{kj} is the constant margin on distributor k discount for merchant j.

The problem thus reduces to;

$$\text{Min} \sum_{i=1}^E \left\{ t_{\alpha \cdot k} \cdot D^k \sum_{j=1}^M z_{jk} + \sum_i \theta_{kj} \sum_j z_{ijk} \right\} + \sum_{j=1}^M f_j (S^j)$$

such that (1), (2) and (10) hold.

The first part of the cost function can be rewritten as

$$\sum_{k=1}^M \sum_{j=1}^N \sum_{i=1}^N \left\{ t_{\alpha \cdot k} \cdot D^{k(i)} + o_{kj} \right\} z_{ijk}$$

With $\Delta_{ijk} = t_{\alpha \cdot k} \cdot D^{k(i)} + o_{kj}$ and forming the Lagrangian,

with the obvious definition of multipliers we obtain.

$$\begin{aligned} L = & \sum_i \sum_j \sum_k \Delta_{ijk} z_{ijk} + \sum_j f_j (S^j) + \sum_i u_i (T_i - \sum_j x_i^j) \\ & + \sum_j v_j (S^j - \sum_i x_i^j) - \sum_i \sum_j \lambda_i^j x_i^j \\ & - \sum_i \sum_j \sum_k \mu_{ijk} z_{ijk} - \sum_i \sum_j \eta_{ij} \left\{ \sum_k z_{ijk} - \right. \\ & \left. \sum_{l=1}^N P_{il}^j x_l^j \right\} - \sum_j \phi_j S^j + \psi (T - \sum_{j=1}^M S^j) \end{aligned}$$

The Kohn-Tucker conditions are then;

$$\frac{\delta L}{\delta z_{ijk}} = \Delta_{ijk} - \mu_{ijk} - \eta_{ij} = 0 \quad V_{i,j,k} \quad (1)$$

$$\frac{\delta L}{\delta x_i^j} = -\mu_i - v_j - \lambda_i^j + \sum_{l=1}^N P_{li}^j \eta_{lj} = 0 \quad V_{i,j} \quad (2)$$

$$\frac{\delta L}{\delta S^j} = \frac{\delta f_j(S^j)}{\delta S^j} + v_j - \phi_j - \psi = 0 \quad V_j \quad (3)$$

$$\lambda_i^j x_i^j = 0 \quad V_{i,j} \quad (4)$$

$$\mu_{ijk} z_{ijk} = 0 \quad V_{i,j,k} \quad (5)$$

$$\phi_j S_j = 0 \quad V_j \quad (6)$$

As well as all the initial constraints.

From equation (5) if z_{ij1} and z_{ij2} are both $\neq 0$ then

$$\mu_{ij1} = \mu_{ij2} = 0 \quad \text{which from (1) implies}$$

$$\Delta_{ij1} = \eta_{ij} = \Delta_{ij2} \quad : \text{ or even further if}$$

$z_{ijk} \neq 0 \quad \forall k \in A_{ij}$ (i.e. distributors active on (i,j) path)

$$\text{then } \Delta_{ijk} = \eta_{ij} \quad \forall k \in A_{ij}$$

This nonsensical result implies that no two such z_{ijk} can exist both $\neq 0$, except by the chance result of their costs Δ_{ijk} being equal. Thus all the other $\mu_{ijk} > 0$, or equivalently $\Delta_{ijk} - \eta_{ij} > 0$

Thus, clearly, the one z_{ijk} with non-zero flow with respect to k must

be the one which has minimum Δ_{ijk} .

$$\text{Let } \eta_{ij} = \min_{k=1}^E (\Delta_{ijk}) = \Delta_{ijk}^* = \rho_{ij}$$

and thus $z_{ijk} = 0$ if $k \neq k^*$

Thus in the minimum cost position particular reorders from particular merchants will go to the same distributor.

The problem now reduces to:

$$\text{Min } \sum_i \sum_j \rho_{ij} q_{ij} + \sum_j f_j (S^j)$$

$$\text{such that } \sum_j x_i^j = T_i \quad V_i$$

$$\sum_i x_i^j = S^j \quad V_j$$

$$\text{where } \rho_{ij} = z_{ijk}^* = \sum_k z_{ijk} = \sum_{l=1}^N p_{il}^j x_l^i \quad V_{i,j}$$

this simplified to:

$$\text{Min } \sum_j \sum_l b_l^j x_l^i + \sum_j f_j (S^j)$$

$$\text{such that } \sum_j x_i^j = T_i \quad V_i$$

$$\text{and } \sum_i x_i^j = S^j \quad V_j$$

$$\text{and } x_i^j \geq 0$$

where the cost coefficients are;

$$b_l^j = \sum_i p_{il}^j \min_k \left\{ \sum_{r=1}^N a_{rk} d_{ri}^k + \theta_{jk} \right\}$$

This is on 'almost transportation problem' as before, again leaving a constrained non-linear optimisation problem made easier by using equations (3) and (6) so that;

$$\frac{\delta f_j(S^j)}{\delta S^j} + v_j - \psi = 0 \quad j \in A$$

$$> 0 \quad j \in A$$

There is no trouble extending the model to deal with both 3-stages

and a multiple set of geographical regions.

Defining T_i^k as the market for product group i in region k and defining b_{ij}^k as before except that the k -index refers to a merchant's transactions in the k -th region, then;

$$\text{Min } \sum_k \sum_i \sum_j b_{ij}^k x_{ij}^k + \sum_j f_j(S_j) \quad (S_j)$$

$$\text{where } \sum_j x_{ij}^k = T_i^k \quad V_{i,k}$$

$$\sum_i x_{ik}^k = S_k^j \quad V_{j,k}$$

$$x_{ij}^k \geq 0 \quad V_{i,j,k}$$

$$\sum_k S_k^j = S_j^j \quad V_j$$

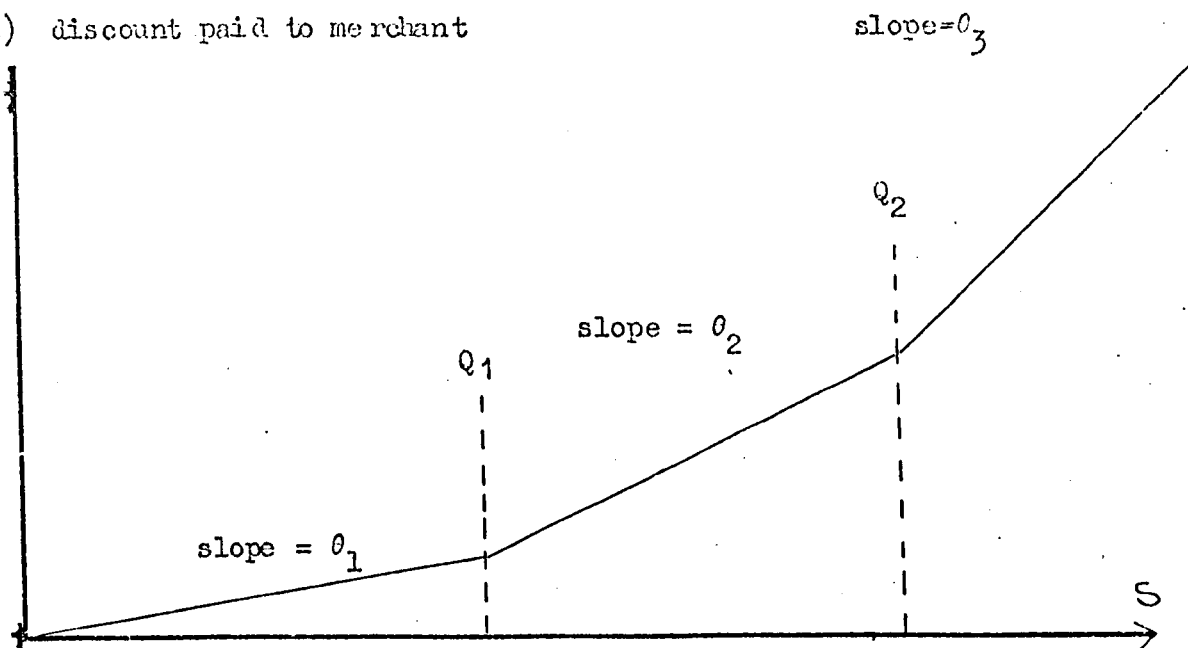
Apart from the last 'complicating' constraint set this is separable.

B.2.3 The Linearisation of the Discount Payments

Concentrating now on the functions $f_j(S_j)$ which up to now have been considered the discount payments per merchant. Merchants can be interpreted as either autonomous merchants to whom the firm pays discounts or owned depots. For the former, the greater the S_j the greater the discount rate, although characteristically the marginal change in the discount rate w.r.t. S_j will be decreasing. Thus $f_j(S_j)$ is convex w.r.t. S_j . For depots on the other hand the cost of maintenance is characteristically concave, reflecting economics associated with increasing scale of operations. Thus one may anticipate trouble with local versus global optima when considering depots, and this is discussed further below.

At the moment only autonomous merchants shall be considered, and we have a convex problem. Linear approximations to these discount functions were made. Thus, as below, $f(S)$ has been approximated by three linear segments;

f (S) discount paid to merchant



The strict approximate function is

$$\begin{aligned}
 g(S) &= \theta_1 S \text{ for } 0 \leq S \leq Q_1 \\
 &= \theta_1 Q_1 + \theta_2 (S - Q_1) \text{ if } Q_1 \leq S \leq Q_2 \\
 &= \theta_1 Q_1 + \theta_2 (Q_2 - Q_1) + \theta_3 (S - Q_2) \text{ if } Q_2 \leq S
 \end{aligned}$$

But this would require entry-restrictions on the set of basic variables in the transportation procedure. Fortunately this is not necessary, for in practice the program will never load the second segment at a marginal cost of θ_2 before the first segment is full, as $\theta_1 < \theta_2$. Thus the entry restrictions can be dropped and each merchant is considered as three merchants; the first with a maximum capacity of Q_1 , the second and $(Q_2 - Q_1)$ and the third unconstrained.

Setting $b_{ij}^{kr} = b_{ij}^k + \theta_r$ and using index r to refer to linear segments, the problem becomes.

$$\text{Min} \sum_k \sum_r \sum_i \sum_j b_{ij}^{kr} x_{ij}^{kr}$$

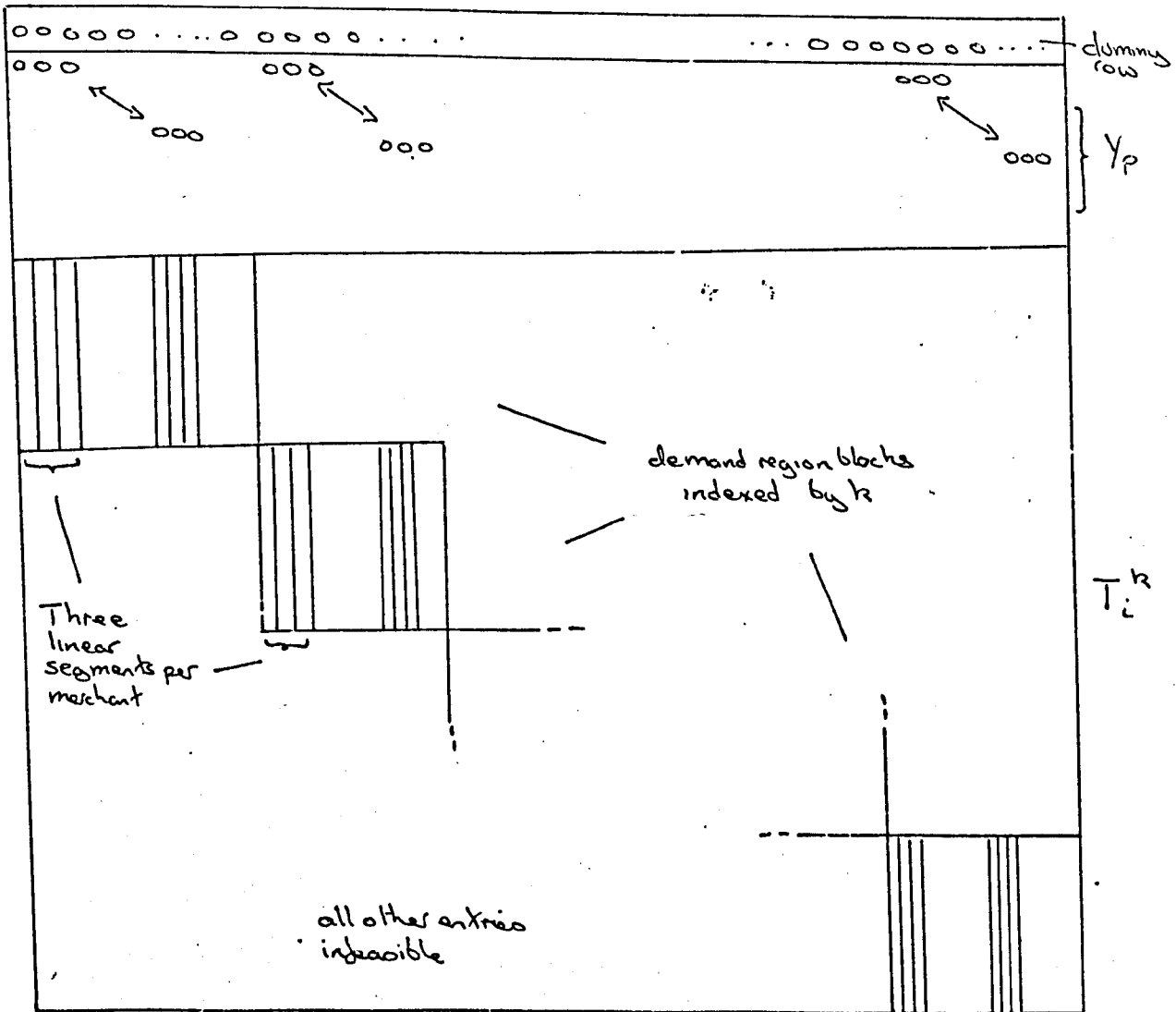
$$\text{where } \sum_r \sum_j x_{ij}^{kr} = T_i^k \quad V_{ijk}$$

$$\sum_i x_{ij}^{kr} = S_{kr}^j \quad V_{jkr}$$

$$x_{ij}^{kr} \geq 0 \quad V_{ijk}$$

$$\sum_k \sum_{kr} S_{kr}^j \leq Q_r^j - Q_{r-1}^j \quad (r = 1, 2) \quad V_j \quad \text{where } Q_0^r = 0$$

Again only the last are 'complicating' constraints. At every opportunity results were tested for sensitivity to these linear approximations and in only a few cases were they found particularly sensitive. The above problem can be formulated as a transportation type problem, thus;



This formulation needs some further description. Firstly each of the diagonal blocks refers to a demand area. The column totals in each block give the flow on a particular linear segment through a merchant from a particular area. This gives the opportunity to include groups of constraints which it had become apparent were necessary; this was the potential in market k that could be serviced by merchant j , referred to as Z_j^k . Thus however attractive it may have been to the firm for a certain merchant to handle a distant market there was always some limit on the trade he could capture. The shadow prices on these constraints then give a measure of attractiveness of increasing the penetration of certain merchants to certain markets. Thus finally

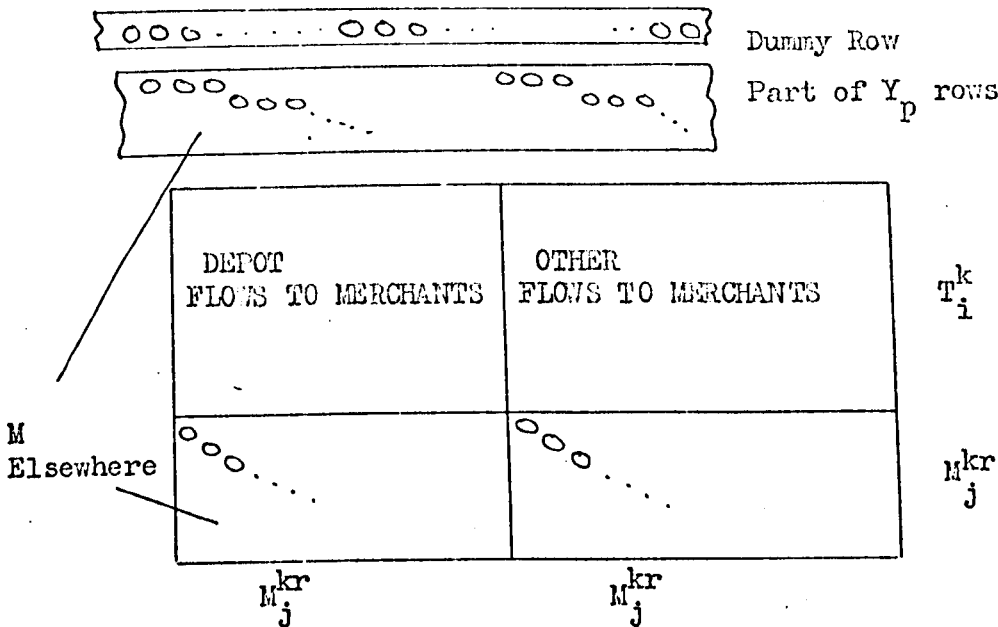
$$\begin{aligned} M_j^{kr} &= \text{Min} \{ Z_j^k, Q_r^j \} \quad r = 1 \\ &= \text{Min} \{ Z_j^k, Q_r^j \} - Q_1^j \quad r = 2 \\ &= Z_j^k - Q_2^j \quad r = 3 \end{aligned}$$

The entries in the matrix other than the main diagonal are all infeasible i.e. $M =$ suitably large number. The top row is a dummy row to absorb excess capacity. The row totals Y_p are the demand that could be filled by a certain linear segment of merchant, but cannot be because of the Q_r^j constraints. Thus;

$$\begin{aligned} S_{kr}^j &\leq M_j^{kr} \text{ for all } k \text{ and} \\ \sum_k S_{kr}^j &\leq Q_r^j - Q_{r-1}^j \text{ thus} \\ \sum_k M_j^{kr} - Y_p &= Q_r^j - Q_{r-1}^j \text{ or} \\ Y_p &= \sum_k M_j^{kr} - (Q_r^j - Q_{r-1}^j) \text{ with the slack in the dummy row.} \end{aligned}$$

Some practical points may be stressed here. The direct shipments from manufacturer to merchant are to be handled via a distributor with D as a unit matrix and no discount margins to charge. Similarly with direct deliveries bypassing merchants a unit stock policy matrix is used and no discount is charged. When considering the depot case, because of the

non-convex nature of the cost curve reflecting the economies of scale associated with the depot, using proportional costs θ_{jk} are just not adequate. It is necessary in this case to isolate all the depot shipments as the diagram of one of the transportation 'blocks' below shows.



The block 'other flows' was the $(b_{ij}^{kr} + \theta_r)$ matrix as before, the depot block has entries.

$$\sum_{i=1}^N \sum_{r=1}^j \alpha_r d_{ri} \text{ where } (d_{ri}) \text{ is the matrix of the depot's}$$

stockholding policy. This follows directly from the definition of b_i^j above. The constraints beneath the blocks reflect that the column constraints M_j^{kr} operate on the sum of the trade to a merchant from both the depot and other distributors, including direct. Otherwise one pair of columns could total $2 \times M_j^{kr}$. Although the constraints look tediously large, in practice the majority could be very rapidly suppressed because they never received any allocations.

This formulation allows the total throughput of the depot to be extracted as a sum after the solution of the transportation problem. Once extracted this sum would be treated as an extra 'complicating constraint' having its own dual multiplier, as discussed below in section B.2.5. Thus a multiplier would be chosen, π say, and added to each cost entry in the 'depot flow side' of the above transportation block. But this makes

another simplification possible as the cost entries in the 'other flows' side are given by $b_1^j + \theta_r = \sum_{i=1}^N p_{i1}^j \text{Min}_k \left\{ \sum_{r=1}^N r_k d_{ri}^k + \theta_{jk} \right\} + \theta_r$

To anticipate the results of B.2.5 slightly, the cost entries are finally $b_1^{jr} + \theta_r + \lambda^{jr}$ where λ^{jr} is a dual variable on the total channel flow. Thus instead of the two 'blocks' thought necessary above, they can be collapsed into one 'block' with cost entry equal to

$$\text{Min} \left\{ b_1^{jr} + \lambda^{jr} + \theta_r, \sum_{i=1}^N p_{i1}^j \sum_{r=1}^N r d_{ri} + \pi \right\}$$

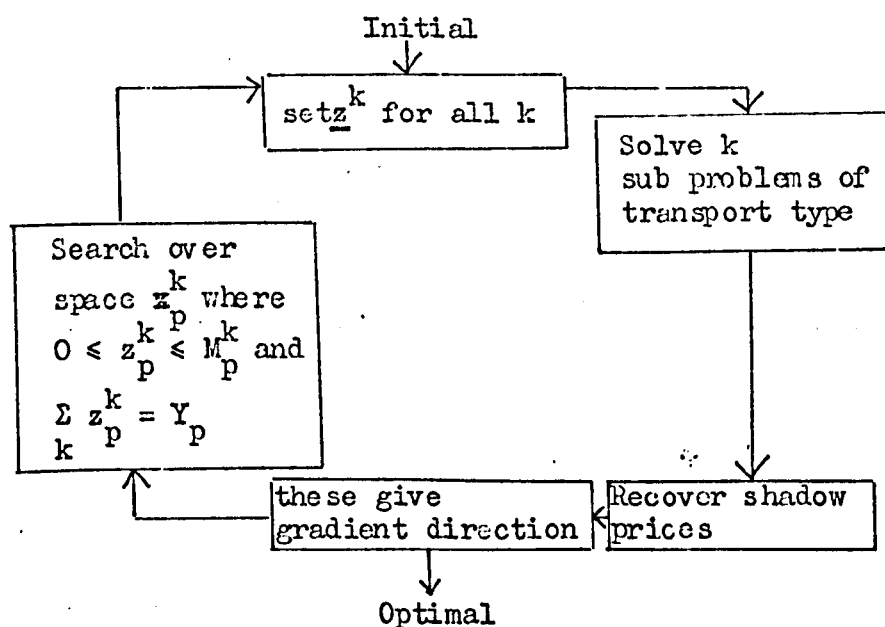
This means of course, that a cost matrix generation pass has to be made for each dual iteration but as this is a series operation it is not very time consuming.

Thus in summary we have returned to the original transportation formulation, where the costs are re-evaluated for each run with a different value of π .

A word at this point must be said about the size of the problem. With K areas, J merchants, 6 product ranges and three linear segments the above problem was used with J = 10, k = 8 giving a 69 x 240 matrix. At the time this was substantially bigger than could be accommodated on the computer available. As well as arranging for backing store to be available it seemed reasonable to investigate the possibilities of decomposition, considering the rather special structure of the matrix. Two approaches were tried, primal and dual decomposition.

B.2.4 Primal Decomposition

If the entries in the Y_p rows are given by $z_p^k > 0$ then $\sum z_p^k = Y_p$ for all constraints p . Thus given a row vector \underline{z}^k over index p , we have a series of small transportation type problems indexed by k . The results of each one will give shadow prices on the columns giving information of how to adjust the \underline{z}^k for the next iteration. Thus the problem reduces to the iteration;



The problem with this procedure is that the search is a constrained one over $2KJ$ - space. Also this space being piecewise linear the gradients are not well-defined on corner ridges leading to a rather inefficient search pattern. The main objection to this primal method though is that the space is just too large; for even the modest figures above, 160. Clearly a better method is needed. Since this research was completed recent work by Geoffrion (68) and, Grigoriadis and Ritter (69) have made the above approach more tractable.

B.2.5 Dual Decomposition

If the actual column totals are S_{kr}^j as previously, thus $\sum_i x_{ij}^{kr} = S_{kr}^j$;

and the value of the subtransportation problem

$$\begin{aligned} \text{Min } & \sum_i \sum_j \sum_k b_{ij}^{kr} x_{ij}^{kr} \\ \text{such that } & \sum_i x_{ij}^{kr} = S_{ir}^j \\ & x_{ij}^{kr} \geq 0 \\ & \sum_r \sum_j x_{ij}^{kr} = T_i^k \end{aligned}$$

be represented by

$$\phi_k(S_{kr}^j; V_{j,r})$$

then the problem becomes

$$\begin{aligned} \text{Min } & \sum_k \phi_k \\ \text{such that } & \sum_k S_{kr}^j \leq Q_r^j - Q_{r-1}^j = R_r^j \text{ for all } j; r=1,2 \end{aligned}$$

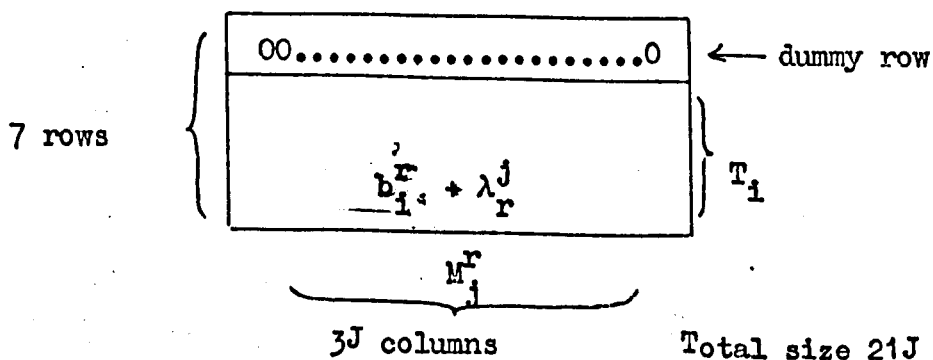
Forming the Lagrangian we have that the above equals

$$\text{Max}_{\lambda_r^j} \text{Min}_{S_{kr}^j} \left\{ \sum_k \phi_k + \sum_{j,r} \lambda_r^j (\sum_k S_{kr}^j - R_r^j) \right\}$$

by the saddle point theorem. Thus given a fixed value of $\lambda_r^j, V_{j,r}$ there is the problem

$$\text{Min}_{S_{kr}^j} \left\{ \sum_k \left(\phi_k + \sum_{j,r} \lambda_r^j S_{kr}^j \right) - \text{const} \right\}$$

This is now separable, giving cost coefficients of $(b_{ij}^{kr} + \lambda_r^j)$ in each cell of the transport matrix thus;

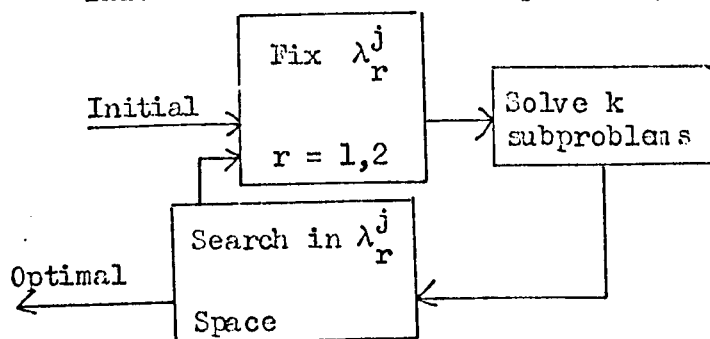


or equivalently

$$\left. \begin{array}{c} -\lambda_r^j \\ \\ b_{ij}^r \end{array} \right\} T_i$$

M_j^r both with k index suppressed

Thus there is the following scheme;



This has reduced the size of the search space to $2J$, in the above cases to 20, a major reduction. Also there is a byproduct of solving the subproblems, the subgradients of λ_r^j in the $2J$ -space. These are given by the constraint slacks

$$\left(\sum_k s_{kr}^j - R_r^j \right)$$

Thus if too much is allocated this subgradient is +ve. To maximise, increase λ_r^j which increased the cost in that column, which in turn reduces the amount allocated in that column and the constraint is better satisfied.

Another advantage of this formulation is that the space has only the simple constraints $\lambda_r^j \geq 0$

Other advantages are;

- 1) The λ_r^j gives a macro-control figure. Thus in effect there are only J at most of interest which show the marginal value of increasing that merchants' capacity by one unit. In practice it was found that the dual variables were increasingly used for decision making rather than the primal flows, which would just be used at the implementation stage.

2) The possibility of incorporating extra spurious constraints.

For example suppose the $i = 3$ $j = 4$ $r = 2$ cell in each area could only have flows totally a certain amount D .

Thus $\sum_k x_{3,4}^{k,2} \leq D$. It is only necessary to add the constraint $\mu(\sum_k x_{3,4}^{k,2} - D)$ to the above lagrangian, adjust the (b_{ij}^{kr}) matrix by adding μ to the relevant cells, and then search over the $(2J + 1)$ space defined by (λ_r^j, μ) . It was frequently found that there was occasion to consider such constraints.

3) There are no 'complicating' constraints in the dual space, search is conducted over the +ve segment only.

4) Unnecessary constraints are not considered as they never become +ve, thus if their duals begin at zero, they never change. This was most important. For example in the above example with 20 dimensions, seldom more than 6 or 7 were ever positive, which effectively reduced the search space to 6 or 7 dimensions.

This dual method was developed almost entirely from Takahashi (64), but more recent work has further developed the field by Geoffrion (65) (69) and Lasdon (68). When developing this work a simple gradient method was used, but because of the piecewise linear nature of the surface this proved to be most inefficient mainly because of the ambiguity of the gradient on sharp ridges. Closely following the ideas of Takahashi (64) a tangential approximation method was developed.

B.2.6. Tangential Approximation to the Dual Surface

Dropping the index r , the position to date may be summarised by stating that it is required to find

$$\text{Max}_{\lambda_j} \text{Min}_{\text{all } \Gamma_k} \left\{ \sum_k t_k(b_{ij}^k) - \sum_j \lambda_j (R_j - \sum_k \sum_i x_{ij}^k) \right\}$$

where $t_k(b_{ij}^k)$ is the optimum of a transportation problem with cost coefficients (b_{ij}^k) and constraints defined by the region Γ_k .

The outer maximisation is a search over a piecewise linear surface defined on λ -space where $\lambda \geq 0$. Fixing λ gives an evaluation, say $\phi(\lambda)$ and also the subgradients at that point; $q_j = R_j - \sum_k \sum_i x_{ij}^k$ and hence there is the supporting hyperplane to the surface given by

$$\phi(\lambda^1) + (\lambda - \lambda^1) \cdot q^1$$

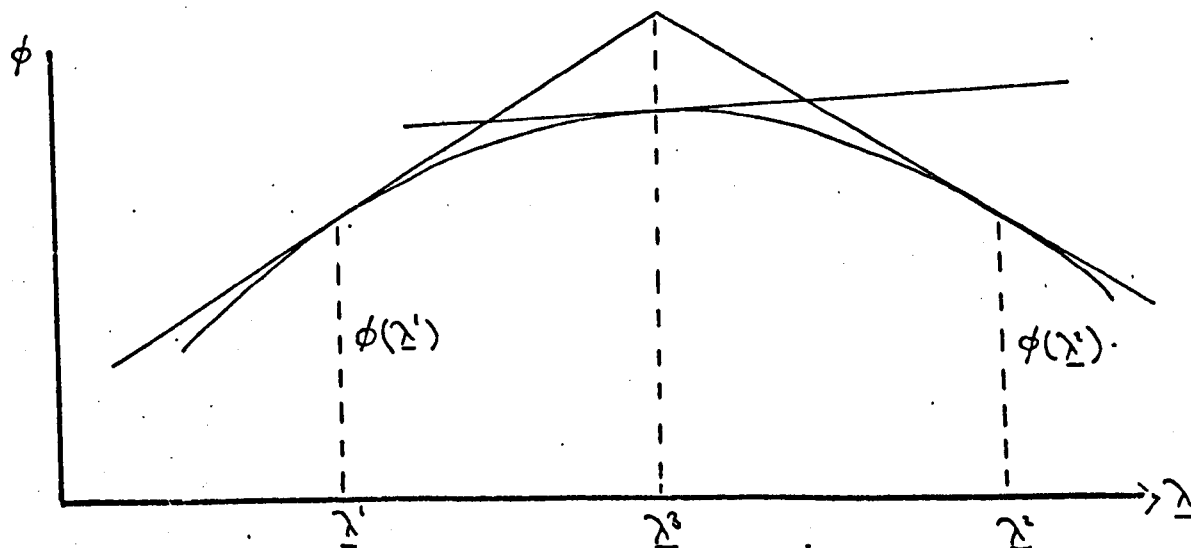
which touches the surface at λ^1 , at least.

Considering the diagram below it is seen that if there is a series of such supporting planes indexed by L , then

Max w

$$\text{where } \phi(\lambda^l) + (\lambda - \lambda^l) \cdot q^l \geq w \quad \forall l \in L$$

gives an upper bound to the surface. Also each $\phi(\lambda^l)$ is a lower bound.



If the optimum to the above problem occurs at (w^{i+1}, λ^{i+1}) then reoptimise subproblems at λ^{i+1} , which gives a new supporting hyperplane in the problem above. Then this is used to find a new $\max w^{i+2} \leq w^{i+1}$, and so on.

The cycle may be stopped when

$$\text{Max } w - \max (\phi(\underline{\lambda}^i) \mid i \in L) < \epsilon$$

i.e. at ϵ -optimality. As the surface is piecewise linear, though, it is quite possible that the tangential approximation becomes exact at some point.

The master problem above is clearly a linear program in $(w, \underline{\lambda})$ and could be rearranged as

$$\begin{aligned} & \text{Max } w \\ \text{s.t. } & w - \underline{\lambda} \cdot \underline{a}^i \leq b^i \quad i \in L \\ & \underline{\lambda} \geq 0 \quad \text{for suitable } b^i. \end{aligned}$$

Rather than having to generate a new row at each cycle and hence increase the size of the basis matrix of the master, the above L.P. was dualised to

$$\begin{aligned} & \text{Min } \underline{y} \cdot \underline{b} \\ \text{s.t. } & \sum_{i \in L} y_i = 1 \\ & \sum_{i \in L} y_i a_{ij}^i \leq 0 \quad j = 1, \dots, m \\ & y_i \geq 0 \quad i \in L \end{aligned}$$

Notice that the first constraint is an equality because w was not restricted in sign.

In this form there is a fixed basis size for the master problem and one can easily apply the column generation methods of the revised simplex algorithm. The physical interpretation of this dual master problem is that of minimisation within a convex polytope with its vertices indexed by L , which acts as an inner linearisation of the curve to be minimised.

Clearly other corners can be cut in the detailed programming of the master problem by exploiting the simple form of the R.H.S., but these shall not be pursued here as they are trivially obvious.

B.2.7 Adjustments For The Depot Case

It has been seen that for the depot case the total throughput of the depot can be extracted as a sum after a solution. To deal with non-convex problems arising from the depot costs two methods were tried.

Firstly, a theoretical development of Zoutendijk's method of feasible directions. This was never used in practice because search was seldom more than one dimensional. Only in one case was a two-depot option seriously considered in a region, and a few trial runs soon reduced this to effectively two one dimensional searches. Nevertheless the ideas are presented in Appendix one because of an interesting simplification possible. The feasible region over which search was to be undertaken had such a simple structure that an analytical solution was possible of the quadratic programming problem required to find feasible directions at a boundary.

Secondly, in practice, a simple grid search was used, with a very crude grid. At each grid point, the depot throughput was constrained to be exactly a certain amount. This gave an extra 'complicating' constraint in the dual decomposition B.2.5, and could be treated in the same way as the 'spurious' constraints of note 2 in section B.2.5, by introducing just one new dual variable.

The computer program used was written originally in Fortran 4 for use on a Honeywell machine and later rewritten in Algol 60 for use on an Elliott 4130. It used a 'transportation' subroutine for the subproblems and used the dual of the master problem gained through tangential approximation as described immediately above.

B.3. A BRIEF REVIEW OF OTHER ECONOMIC MODELS FOR THE CHANNEL CHOICE DECISION.

We could not find in the literature any published accounts of channel choice models which had been used and implemented for a series of channel choice decisions in the sort of industrial distribution system with which we are concerned here. Nevertheless there were some accounts of channel choice or similar models that had to be rejected as unsatisfactory for our purposes and these shall be reviewed briefly.

Artle and Bergund.(59)

This paper addresses itself to the choice of distribution channels but does so at too tactical a level for our work. There was no need in our study to consider such micro-questions as the 'salesman's waiting time per call'. So, although a sound enough paper in itself, it was pitched at too detailed a level for our work, wasn't able to consider other than a very few decisions at one time without being completely rebuilt and generally assumed a rather static situation. There was no indication of the model ever having been applied.

Aspinwall (58)

A theory relating certain characteristics of good to the broad type of distribution required. As a descriptive tool it gives significant insight, but it is not meant to be prescriptive and cannot be adapted to be such.

Balderston (64)

Many interesting descriptive points but although he begins to develop a prescriptive model ^{does not} ~~doesn't~~ cast this in a workable form. His model is a set of linear equations stating that the various activities involved in distribution must be shared out between channel alternatives to maximise revenue. As he leaves the topic there, the end result is not very helpful.

Bucklin (65) (66)

A article and book with many descriptive insights to give into the operation of a distribution channel. He develops a principle of 'speculation' to weigh against Alderson's principle of 'postponement', and then investigates how much this determines channel structure. No prescriptive models are developed.

Balderston and Hoggatt (62)

An interesting and informative monograph. The simulation of a distribution channel process developed is capable of being used in many different environments. They apply the model to the lumber industry in particular. The results are important to the further development of the theory of distribution channels, but we wished to have a model capable of giving results in a short period of time. This a simulation model seldom does, and our programming model was quite able to do. Also the structure of their simulation model was not well suited to our

purpose and to use simulation at all would have meant starting from the beginning again rather than picking up where they left off. The main purpose of their work was to investigate the changes and stability of a distribution system for an industry in general, and as such addresses itself to rather different questions from our own work.

Balderston (58)

Considers the economic number of intermediaries in a distribution channel between manufacturer and user. As such it considers the total industry problem and is not applicable to our case. Also it is far too oversimplified ever to be practicable or useful.

Baligh and Richartz (67)

This is the most important text in the economic study of distribution systems yet available. The work is thoroughly done and well presented, and studies the cheapest distributive system given certain costs, requirements and rebates. Unfortunately, for our purposes, like the previous work it considers mainly the total industry problem, except for one chapter which is not very helpful to us either. Also it has no parallel in its theory to play the role of stocktransition matrix for merchants and distributors, and hence no classification of the market by order size. These drawbacks made it impossible to base our work on their models although it must be stressed

that much of our early thinking about the model was significantly affected by this book and we owe a great deal to it.

Baligh (65)

This paper develops a theoretical model of some theoretical interest. The basis of the analysis being the varying degrees of control exercised by each level of the distribution system on the others. The structure of the channel under scrutiny is again quite different ^{from} ~~to~~ ours and also many points are included which are of no real concern in our case. The model has been pitched at a very general level, there is no indication of it having been calibrated on any real model, and consequently no information on the problems that would be bound to arise if this was attempted. This is a pity because there are some ideas in the model that it would be interesting to have empirical evidence about. In practice we received almost no help in our own modeling from this paper.

Conclusions.

This reviewed list is short and comment on each brief, and this is a fair assessment of our debt to them. Published results of implemented and tested channel choice models appears to be almost non-existent. The material which does exist concerns mainly an economic analysis of channel structures in general and any insights

we have gained about the operation of distribution channels come chiefly from these sources.

It is hoped that the empirical results of this thesis go a little way towards closing this gap in the published literature. We say published, because it is our opinion that much first class work on distribution channels has been done within companies, but its publication is forbidden because of the contentious nature of the decisions and results.

B.4. THE CALIBRATION OF THE ALTITUDINAL INSTRUMENT.

As argued above, section A.4.1, the economic variables within a distribution system were inadequate as predictors of the actors' behaviour. Action occurred partly as a function of the support the actor could expect from others in the system, or from fear of the actions of other 'power blocks' in the system. Decisions within the system were usually taken with incomplete knowledge of the relevant economic variables. Access to information concerning such things as the 'informal discount rate' going to various units in the system was usually at best second hand. What information there was, was usually drawn from local 'nets of information', which were characteristically maintained and serviced by the unit's group affiliations. Secondary criteria on the reliability of data were rife, especially concerning 'business confidence' and 'trading goodwill'. Small actions by others were often exaggerated out of all proportion by speculation on their being 'the thin edge of the wedge' or a 'shot across the bows'.

It has also been argued that in consequence of the above a better predictor of action would be a measure of how each actor construed his role in the environment. This cognitive variable would reflect his attitude towards other actors being either a source of support or a potential threat.

B.4.1. The Cognitive Variables.

The cognitive variables relating to his role vis-a-vis customers or suppliers are termed the cognitive vertical measures. The measurement instruments are detailed in Appendix 2 and closely follow the discussion in section A.4.3.1. It was considered important to preserve consistency within the instrument throughout the system to facilitate comparisons, and this has been attempted as far as possible. A convenient metrification of the scale was -2 to +2.

The cognitive variable reflecting the actors attitude to parallel units was termed the cognitive horizontal measure and was only relevant for merchants. The instrument is detailed in Appendix 2 and follows in detail the discussion in section A.4.3.2. Again a convenient calibration was -2 to +2.

The initial measurements were made by the researcher interviewing various actors. A certain amount of cooperation was needed from actors while the ideas were still in a formative stage and this was forthcoming in most cases. The first experiment was to compare the merchants cognitive position vis-a-vis the user with either the user's or salesmen's estimate of his position. (Exp.1) ^s
The second experiment compared the merchants position vis-a-vis the supplier with similar

estimates from the other side (Exp.2). Then estimates of a merchant's horizontal position were compared with estimates made by other merchants (Exp.3) and also with estimates made by salesmen (Exp.4). These were analysed using the Wilcoxon matched pairs signed-rank test. The null hypothesis in this test is that the difference between the pairs does not vary significantly from zero.

The numbers in this initial sample are shown below :-

<u>Experiment</u>	<u>Primary Measurement</u>	<u>Secondary Measurement</u>	<u>Wilcoxon Statistic</u>
1	40	32	.216
2	45	39	.294
3	45	44	.154
4	45	42	.018

This shows that the null hypothesis is a long way from being rejected in the first two experiments, the third showing that merchants seem to agree reasonably about each others position. Unfortunately experiment 4 shows that the salesmen's estimates of horizontal cohesion between merchants are poor mirrors of the actual situation.

The researcher was particularly surprised both with the ease of application of the instrument and the consistency of the results. In particular it was found that merchants readily answered the questions in the instrument and appeared to find them quite meaningful representations of their attitudes. They simply found that one of the statements in the instrument was just the sort of sentiment that they might express any day of their lives. The successful measurement of these horizontal and vertical cognitive variables was attributed to two causes.

- 1) Firstly, they were developed in the context in which they were applied, using the language and nuances of everyday speech in the distributive trade. The researcher did not have to 'interpret' questions, there were no forms to fill in, and the actor was quite ignorant of the quantification underlying the questions.
- 2) Secondly, the crudeness of the calibration led to only distinguishing a few major categories. Thus only substantial changes in attitudes were measured, researcher bias possibly being a second-order error.

B.4.2. Direct Versus Indirect Measurement.

The purpose was to monitor changes in these cognitive variables during the change period. But during this period access to apply the instruments would be frequently impossible, thus it was critically important that an indirect method of measurement was developed.

It has been seen above that the salesclerks and salesmen can make fairly good estimates of the merchants vertical cognitive position with respect to suppliers. This is also the case with respect to users, where estimates are made by salesmen and user's purchasing agents. Thus it was natural to use these two sources as methods of indirect measurement of the vertical position.

But as has also been seen, the salesmen's estimates of the horizontal cognitive position were not reliable indicators. It was thus necessary to develop a new source for this information.

To tackle this task it was first necessary to consider the question of how it was that the sales management of the firm claimed to know the attitudes and states of mind of the people engaged in the distributive system.

Typically, if options arise during the change period that might substantially affect the status quo of the merchant level; then the sales management could well vetoe this option, warning of the risk associated with taking actions that could alienate even the merchants they wished to retain. How did they gain enough information to make them confident enough to vetoe decisions at Board level ? It was gradually appreciated, when this was investigated, that this knowledge was a 'feel' or 'judgement' which had developed from a large number of small instances, each perhaps trivial in themselves. For example, a cancelled order here and there, extra discount claims or smaller quantity orders from certain merchants as they ran down their stocks. Thus their judgement was an aggregate affect. The difficulty of sharing these judgements with colleagues in the Boardroom, was now aggravated by the impossibility of actually 'proving' anything. All they could do was to cite a series of rather minor instances. The consequent isolation of Marketing caused them to move onto the defensive; often to overextend or overgeneralise the strength of their judgement, and to propose 'blanket type' vetoes which were scarcely supported by the facts.

The case of these minor instances which contributed to this aggregate 'feel', arose out of the day-to-day bargaining relationships between the Sales Office and their customers as reported by their clerks and the similar relationships in the rest of the distributive system as reported by representatives. Thus it was considered that there might be the beginnings of an indirect instrument if changes in the bargains struck and the procedures used to achieve agreement could only be measured. The detailed description of the bargaining relationships has already been presented in section A.4.4.

B.4.3. Standardisation of the Bargaining Process.

Initially, when approaching the task of codifying these procedures, the complexity of bargaining behaviour seemed so overwhelmingly great as to prohibit ever extracting a usable instrument. But after listening in, for considerable periods to this process occurring, it became increasingly clear that the rules of conduct of this 'game' of bargaining were tightly drawn and strictly adhered to. The mechanisms which enable a customer and merchant to bargain and barter until arriving at a grudging compromise, and then to part still the best of friends, appeared as complex as any form

of human interaction. Yet on closer inspection one would be tempted to conclude that they were working from a script. There appeared to be a consistency of behaviour in the bargaining relationship that, before it could be exploited, needed to have its sources understood, and which ought not to be accepted on its face value.

This standardisation was not enforced externally as 'allowable' forms of conduct, it was based on a process of internalisation of informal rules found essential to adequately fulfill the task. Five sources of this need for standardisation were identified.

1. Standardised technology.

On any particular bargain the room for manoeuvre was often quite restricted. Seldom more than two of the product characteristics would be available as decision variables on any one order and the degree to which these could be varied might be rather modest. This 'technological' constraint showed through in the standardised procedures. Also the trading-off of one characteristic against another cannot just be done at random. A argument concerning the price of a special component will not be satisfactorily settled by a compromise involving credit extensions, the trade-off is just not

relevant. But it might be extremely relevant to introduce quantity into the discussion.

2. Maintenance of relationships.

Using standardised procedures means that individual disagreements can be treated as part of an ongoing process. The words, gestures and responses are not new or strange, they are part of the fabric of the relationship, and doubts about continuance of the relationship don't arise naturally from them. Bargains are not isolated events, and it will be necessary for the same pair of actors to bargain on another order some time later, or even the next day. If every bargain almost led to the breakdown of the relationship, normal business trading would become intolerable.

3. Consistency.

It would be careless to give the impression of giving favours to one customer and not to another if this was not intended, but happened because it is difficult to maintain a consistent pattern of bargaining pressure. Similarly it could undermine a relationship if one side 'blew hot and cold' simply because consistency was difficult to maintain. People want to 'know where they stand'. Standardised procedures are instrumental in maintaining this consistency.

4. Economy of decision.

Bargaining absorbs a great deal of the day for many people. Standardisation allows each side to come to an agreement with the minimum of effort and time.

5. Tension reduction.

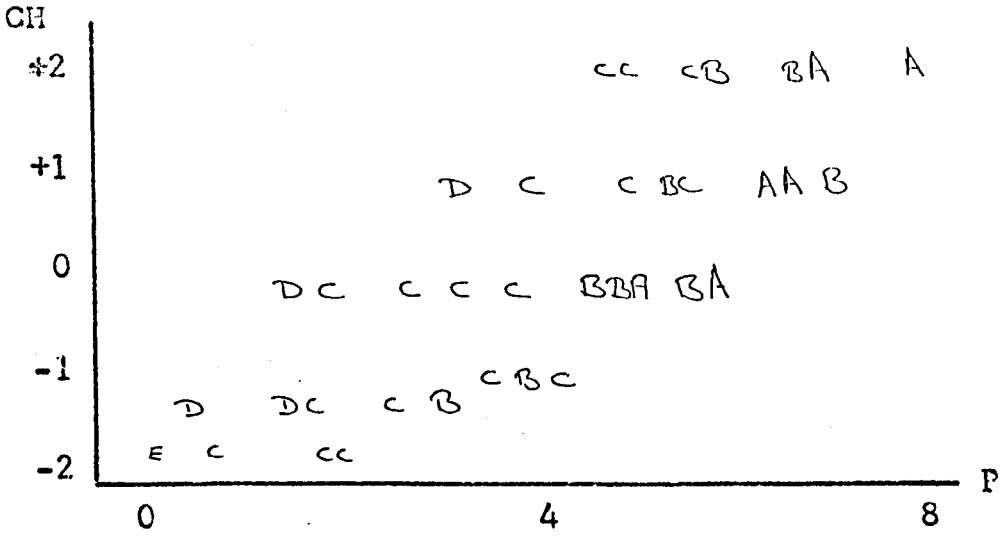
Many business relationships are reinforced by social interaction outside of business hours. If every argument leading to some compromise agreement is a unique event there is the attendant danger that actors develop too personal a commitment to the process. Standardised procedures assist actors in the necessary depersonalisation of the process which must occur if the social relationship is to continue. Actors can 'switch off' and treat it as a game that is over. 'Now that's over, let go and have a drink and you can tell me about!'

B.4.4. The Procedural Variable.

Being now assured that codification was both meaningful and possible, the instrument detailed in Appendix 2 was developed. It closely followed the discussion in section A.4.4, the basis being a consensus rating of the procedures used in the bargaining relationship in order of their estimated severity. Each type was given a score given by its

position in the ranking, beginning at 1 with the least serious. Then in practice each score would be weighted by its frequency of use within that particular relationship.

All the transactions with a sample of 47 merchants over the previous month were analysed with the salesclerk and salesmen who dealt with that transaction. The total number of transactions were 817, but 8 of the merchants had less than 10 transactions in this period and the results for another two were unreliable for other reasons. Of the remaining 37 it was considered that six had recently made a major change to stonger cohesion, nine had made a modest change, seventeen had remained fairly static, four had made a modest change away from cohesion and one had made a major change away. When the 37 points were plotted there was a clear correlation between the two measures; but more interestingly when grouped by the changes made recently it appeared that these affected the procedures used. See diagram overleaf.



A = major up B = modest up C = static D = modest down
 E = major down

Thus although it would be tempting to use a simple formula such as $CH \propto P$ this would tend to over or under estimate CH depending on ΔCH , the amount changed recently. Given another time period's data it would thus have been straightforward to estimate a formula for P of the form

$$P_t = \alpha CH_t + \beta (CH_t - CH_{t-1}) + \text{constant}$$

or solving for CH_t with the position assumed static at k periods in the past;

$$CH_t = \sum_{i=0}^{k-1} \frac{\beta^i}{(\alpha + \beta)^{i+1}} P_{t-i} + \frac{\beta^k}{\alpha(\alpha + \beta)^k} P_{t-k} \quad - 2$$

Typical sizes for α and β are 2 and 1 respectively so that the coefficients of P_{t-i} decay in the following fashion

i	coeff. of P_{t-i}
0	.233
1	.111
2	.037
3	.012

Thus it was considered reasonable to take $k = 1$ and

$$CH_t = 0.33 P_t + 0.17 P_{t-1} \quad (2)$$

This simple formula was found to be reasonably robust, although it must be stressed that this was used as a guide principally, all results being cross-checked by any contextual information available.

There were now available instruments for measuring the cognitive positions of merchants both directly and indirectly.

B.5. SOME EXAMPLES.

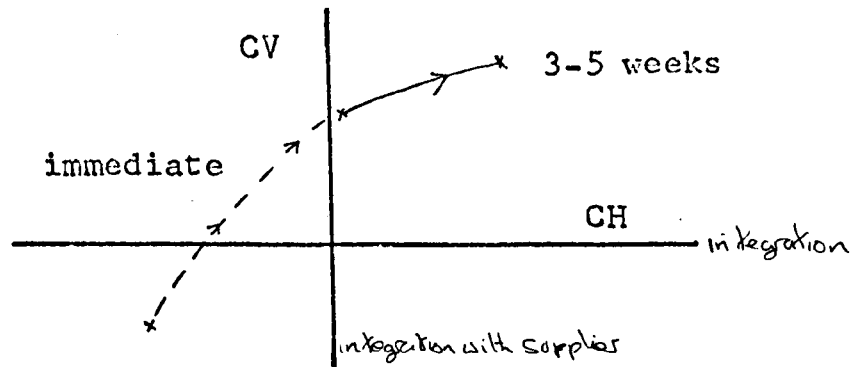
In this section some examples of the use of the instruments developed in B.4 will be demonstrated so that their scope and limitations can be appreciated. All the examples are taken from real case studies which occurred during the change period.

Although not entering the casework described in section C, cognitive vertical measurements were made for the entire distribution chain from shop floor to user in a way analogous to those defined for merchants. These results are not considered in this thesis apart from being mentioned in the examples below. It is intended to analysis the results for the rest of chain at a later date.

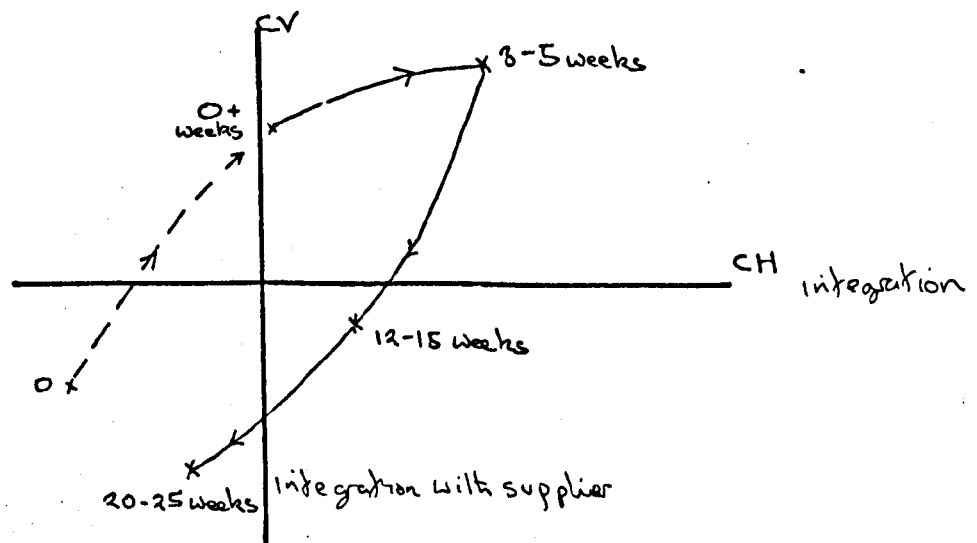
B.5.1. Situation One.

A distributor was purchased by a competitor. Merchants handling the firm's merchandise were uncertain whether to continue trading with the distributor under new ownership, come direct to the manufacturer or use another distributor. There was a sharp change in attitudes amongst merchants and a substantial hardening of bargaining procedures almost immediately. Merchants met together frequently to discuss their position and as they did, began to gain enough confidence among themselves to further increase the bargaining

pressure over the next few weeks. Merchant cohesion was now high and vertical cooperation had practically ceased, see below :-

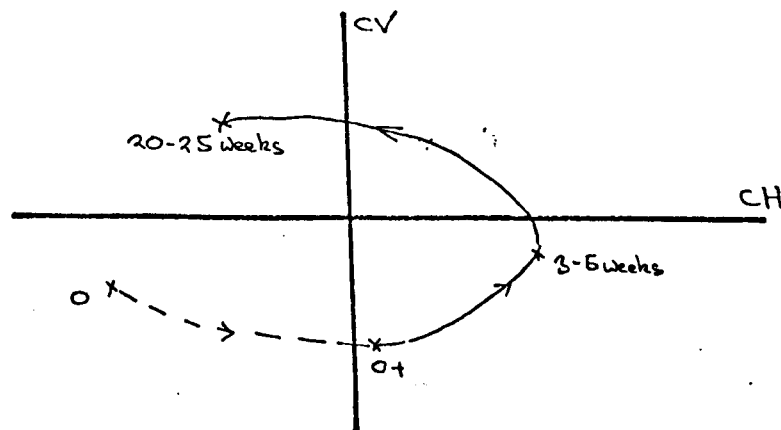


From then on merchants began to see their new roles as one-step intermediaries between manufacturers and users revising their attitudes corresponding. This occurred slowly over a period of months and at first merchants felt it necessary to maintain the solidarity of their "merchants' movement". But as discount rates and credit facilities began to be stabilised reflecting the merchants' changed role vis-a-vis the manufacturer, rivalry began to weaken this movement, see below :-



Six months, or so, after the disturbance merchants saw themselves as the manufacturer's agents in the area providing joint competition against other products.

During the same period their relationships with the users took a different path. Here the underlying left to right shift was compounded with a need to gain support from users, while their relationships with manufacturers were rather strained, see below :-



Then the responsibility towards merchant cohesion began to take precedence and the cooperation between merchants and users gradually weakened. As merchant cohesion then in its turn began to weaken the merchants moved gradually into their new role as the manufacturer's agent. While this was occurring the remaining distributors felt vulnerable from the manufacturers and sought to strengthen links with merchants. Both distributors and merchants moving to less cooperative positions,

left the sales office to try and weaken the effect of their unreasonable demands on production planning and control. PPC nevertheless found themselves forced to protect the shop floor who took advantage of this protection. See the diagram overleaf. As merchants began to integrate closer with their suppliers in the 10 - 15 weeks period, the sales office went out of their way to assist this cooperation. This meant that they accepted many orders which they previously would not have considered. Especially present were very small orders, a few split boxes, and some one-off discounts which were exceptionally high. Goods which merchants didn't stock and the previous distributor had, were now passed straight to the manufacturer. The consequence was that the relationship between sales and PPC deteriorated as sales tried to force through rather unprofitable orders. This should have caused PPC's attitude to the Sales Office to harden as well as sowing the seeds of a rift between PPC and the shop floor. In practice this was avoided. A special meeting accompanied by circulated memoranda informed PPC and the shop floor that the company was struggling and could barely meet its minimum target levels. The order was to 'close ranks' and assist marketing as much as possible. This interference in the normal course of events is shown within a dashed box.

CV VALUES

	<u>Initial</u>	<u>Immediate</u>	<u>3-5 weeks</u>	<u>12-15 weeks</u>	<u>20-25 weeks</u>
Merchants → Users				X	X
Merchants → Distrib. & Manuf.	X	X	X	X	X
Sales Office → Distrib. Manuf. Merchant	X	X	X	X	X
Sales Office → PPC	X	X	X	X	X
PPC → Sales	X	X	X	X	X
PPC → Shop floor	X	X	X	X	X

(The entries thus ? were filled in to complete the table, they were not measured.)

B.5.2. Situation Two.

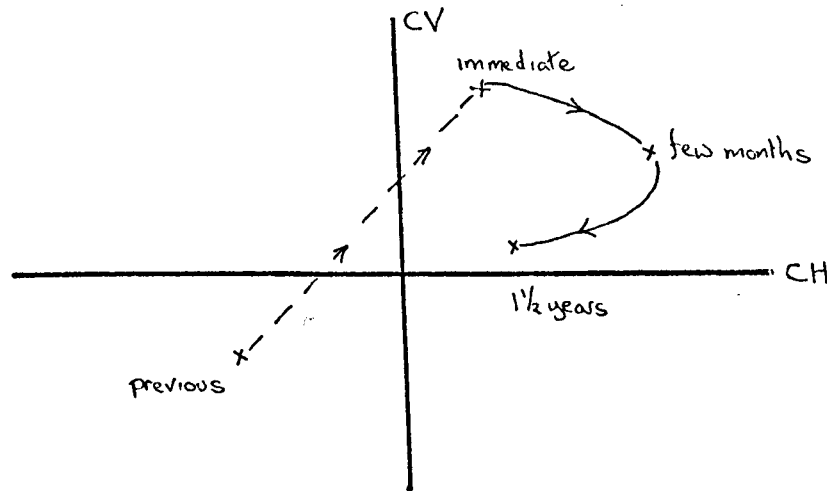
It was planned to open a depot to service two groups of merchants which were geographically separated. Previously they had traded directly with the manufacturer. Apart from geographical separation they were also distinct in the type of markets they serviced. One group (say B) serviced a new, high technology market with a few large firms and many smaller component supply firms. The market was growing and it was thought that a shorter chain of supply could capture most of it. The other merchants (A say) serviced a traditional and declining industry made up mainly of many small units.

Initially it was considered that the depot would service merchants but soon people began considering the possibility of direct supply to customer. When this began to be talked about, A group reacted violently feeling their trade threatened directly, whereas B group made only a mild response. There was also practically nil joint response. Even though plans for direct supplies were shelved it was still difficult to channel A's trade through the depot, they only wanted to be served direct. B on the other hand was ready to let someone else carry the financial and administrative cost of stocking while they concentrated on increasing their trade. Not until the depot had managed to increase its

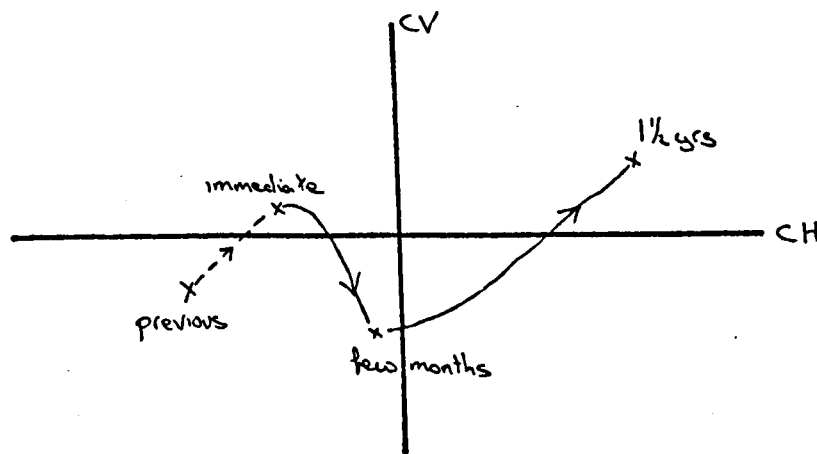
direct customer account to 14% of the total did some form of backlash occur as a collective protective measure by merchants B. The % trade through various channels is shown below :-

	<u>Before depot</u>	<u>Six months after depot built</u>	<u>1½ years after depot built</u>
A from manuf.	58%	53%	42%
A via depot	-	10%	18%
Direct Sales to Customer from manuf.	6%	1%	1%
Direct Sales: Depot-Customer	-	-	2%
B from manuf.	33%	15%	23%
B via depot	-	13%	20%
Direct Sales to Customer from manuf.	3%	-	-
Direct Sales: Depot-Customer	-	8%	14%
Total	100%	100%	100%

The change in the cognitive variables for group A is shown below :-



and for group B;

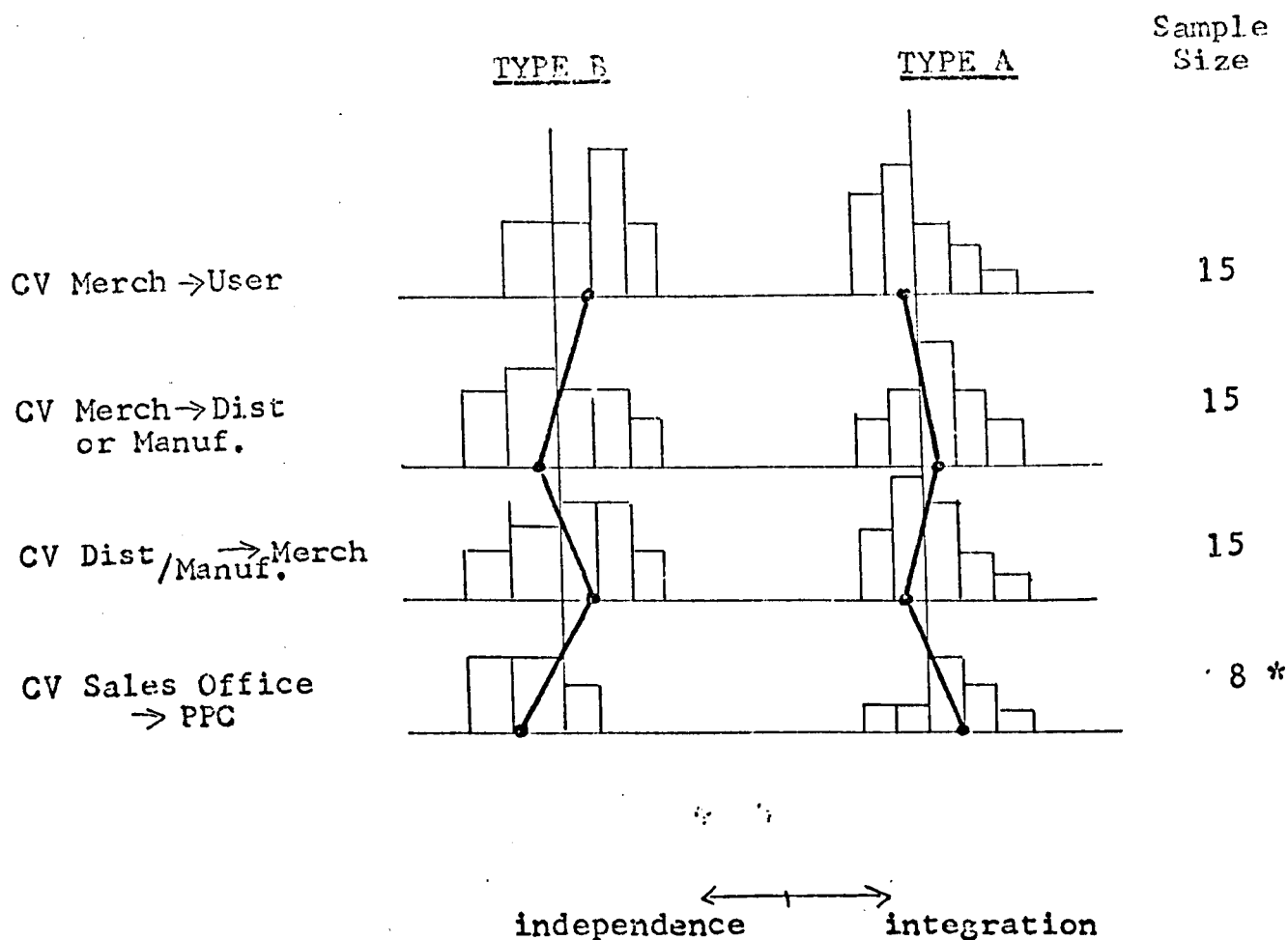


Thus A made a sharp jump when they felt directly threatened and only relaxed over a long period of time when the threat wasn't substantiated. B, on the other hand, took advantage of the position afforded by not carrying the financial burden associated with comprehensive stocking policies. They could do this because the undercutting of their

trade was not the primary source of danger to them in their expanding market; they were rather afraid of overstretching their financial resources in an attempt to grow quickly. As they became established and market growth slowed, they then became apprehensive about the inroads made by direct depot-customer trade.

B.5.3. Situation Three.

Continuing with the distinction between a rapidly growing high technology market B and a declining traditional market A, the diagram overleaf shows histograms for CV positions for channels sampled from one or the other. It is only to be expected that such a crude definition of the A and B dichotomy would lead to considerable overlapping. Nevertheless, a general pattern emerges, with the location of channel power quite distinct.



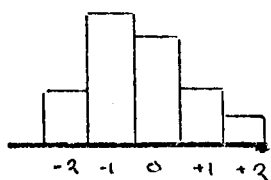
●—● indicates mean value

* sample from Sales Office personnel dealing with A and B type markets.

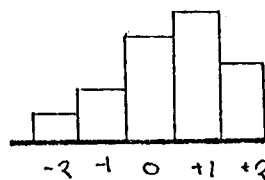
It is impossible to gain much by extending the analysis further towards the shop floor because the A and B streams merge sufficiently to make it impossible to unravel them. Histograms for merchant's CH values in each case are shown overleaf. Despite considerable overlapping the merchants serving the separate markets fall into two broad categories.

TYPE B

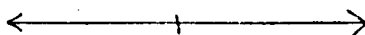
TYPE A



isolation and independence



solidarity and cohesiveness



Sample size 14 for B 15 for A

B.5.4. Situation Four.

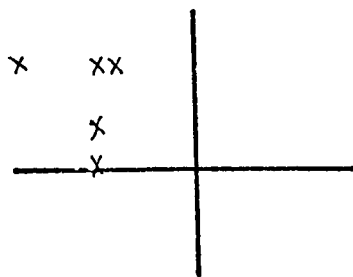
Here an example is included of a typical analysis that might have been made before the change period. This is taken from an example in N.E. England including Tyne and Teesides. The initial merchant position was as shown below :-

	<u>Merchant</u>	<u>Supplier</u>
Initial position	x xx	x
	xx	x x
	x	xx yy
	x	xx x

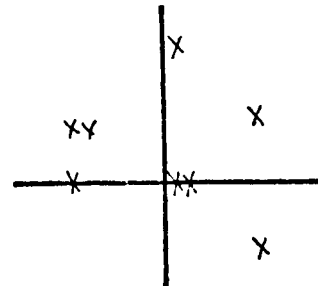
Sample Size = 17

Three geographical areas could be identified, with some merchants in a position to serve more than one.

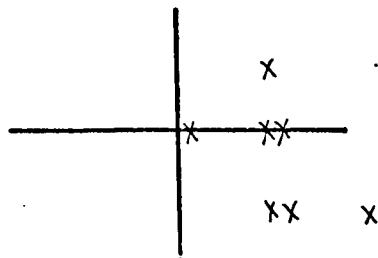
Area 1



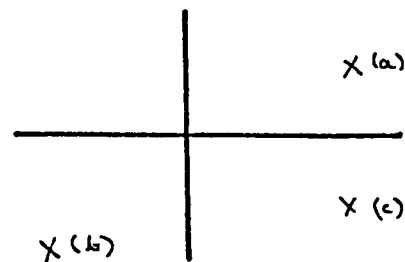
Area 2



Area 3



Outliers



Area 1 was mainly a well established engineering and process manufacturing area with a steadily increasing fairly stable demand, almost entirely for replacement. Particularly relevant were railway carriage and road haulage maintenance plants and petrochemical processing units. The area had a trade association which had fallen somewhat into disuse, and the area was one which would be difficult to penetrate by merchants from

other areas. Merchant cohesion was low but it was felt that potential solidarity was there if it became necessary. There was little integration with suppliers.

Area 2 was a jumble of small and large engineering works needing production quantities and coal mines requiring replacement orders. The area was widely dispersed with a wide variation in attitudes and in the ways that merchants construed their roles.

Area 3 served almost exclusively the Tyneside shipbuilding industry and dealt with large production quantities and frequent call-offs. The industry was declining and merchants maintained a strong trade association. They also kept in close cooperation with their suppliers.

Identifying the outliers we have;

- a) Large merchant servicing a few large accounts for production orders. Quite remote from suppliers, tightly integrated with his customers but views himself as very much part of a merchant community, and is a self-styled leader in that community.
- b) Another large merchant in a fairly remote area servicing many minor accounts. His isolation from other merchants and strong integration with

his supplier reflects exactly how he considers himself and how others view him i.e. as the manufacturer's agent in that area.

- c) A borderline case in area 3. Very active member of the merchants associations and tightly integrated with his supplier. He is an example of what was called earlier the 'professional distributor'. He sees himself as an extension of the manufacturer into the market place, but also considers himself part of a 'profession' of distributors.

Thus if some direct incursion into that area was being planned at the merchant level, extreme caution would be exercised in Tyneside (Area 3) and with any expansion that affected (a) or (c). Area 1, Teeside, would have to be carefully monitored to see if the solidarity expected did in fact occur. Hopefully, little need be feared from area 2; and it would be wise to exploit the particularly cooperative role of (b).

This concludes the list of examples which have hopefully shown the scope available in the descriptive use of the cognitive variables. The next section C, details the use of both the economic and attitudinal instruments during the two year change period.

B.6. CONCLUSION OF SECTION B.

The intention of this section was fourfold. Firstly to describe the economic model in sufficient detail for others to use the same ideas in other distributive systems. Two such systems are never going to be identical, but hopefully much of our development, including the work on decomposition can be reused in new situations. Secondly our brief review of the literature showed why it was necessary to build a new theoretical model. Thirdly we have presented details on the calibration of the altitudinal models, again hopefully sufficient for others to develop similar instruments. Fourthly we have attempted to show the descriptive power of these models by a few examples of measurements taken from real experience.

Reference in this section has been made to Appendix 1 for the theoretical extension of the depot case; to Appendix 2 for the detailed instruments used and section C for the description of the models being used during a two year change period.

PART TWO

SECTION C

SECTION C

C.1	:	INTRODUCTION	223
C.2	:	EARLY COMPANY BACKGROUND	225
C.3	:	PROJECT INITIATION	229
C.4	:	THE SOUTH WEST	
		C.4.1 Sept. 1967 : Initial Study of the South West	232
		C.4.2 Dec. 1967 : The Second Phase	270
		C.4.3 Nov. 1968 : The Third Phase	275
C.5	:	INITIAL NATIONAL STUDY	277
		C.5.1 The South East	279
		C.5.2 The Midlands	298
		C.5.3 The North	306
C.6	:	Jan. 1968 The Second Phase	
		C.6.1 The South East	318
		C.6.2 The Midlands	323
		C.6.3 The North	326
C.7	:	July 1969 : The Third Phase	
		C.7.1 : The Changes So Far	331
		C.7.2 : The Problems Outstanding	334
		C.7.3 : Principal Recommendations for the Third Phase	335
C.8	:	August 1970 : The Final Phase	336
C.9	:	CONCLUSION	336

C.1 INTRODUCTION

This section constitutes a description of the empirical work carried out as part of the research project in the company. The mathematical and attitudinal models developed in sections B.2 and B.14 respectively will here be used within the company and distributive system described in section A .

The sequence of decisions that caused the reorganisation of the entire distribution system were spread over two and a half years. To accurately record all the decisions and revisions, the actions and reactions over this period of time would require a long and indigestible chronologue. To avoid this the material has been clarified and simplified as much as possible. These simplifications have been of the following types. Firstly, timewise, it has been made to appear that at any one time only one set of decisions were being worked upon and when these were made another set were changed to. In reality, several analyses would be engaged upon at any one time and the analyst would be frequently changing between pieces of work. The second simplification has been of geographical details. Many merchants and markets were originally included but later excluded when it was discovered that they played no significant part in the analysis. For example, merchants who were not dealt with originally and for which no recommendations were subsequently made could be safely removed from consideration. Markets with a very small demand or individual scheduled orders which must go direct every three months and similar cases did not constitute real decision areas and could be removed, even though they are part of the distributive system.

Thirdly, most of the sensitivity analyses have been removed. These were mainly used to test the results. Thus if a result was especially sensitive to changes in certain data parameters this was treated as a possible source of error and would be investigated accordingly.

Fourthly, only a few of the options investigated are reported; the majority of the requests made upon the model were minor modifications which seldom made much difference to the overall pattern of distribution.

Fifthly, as the work developed the model used became more sophisticated. It is only the model in its final form that was described in section B.2. This section begins with a brief outline of the history of the firm up to the time when the project began, section C.2. Section C.3 briefly describes the initiation of the project. The empirical work is then embarked upon. Rather than describe all the changes in great detail, a compromise has been chosen. A smaller study in the South West which can be isolated easily from the rest of the work is described first in considerable detail. Then the initial decisions occurring in the South West as part of the main national study is described in as fine a detail as is considered digestible. The work in other regions and at other times is then briefly referred to. A summary of the position of the firm at the end of the two and a half year period is then given in the last section.

C.2 EARLY COMPANY BACKGROUND

Founded just after the turn of the century in the U.S.A: by the 1930's the company decided to develop a market for its engineered components in the U.K. In order to gain a foothold rapidly, a salesman Smith offered the distribution of his goods to a firm, Alpha, who specialised in distributing engineered components. He also gave a three year licence to produce the components to a Coventry engineering firm. Just before the war Smith decided that the time was right to establish a U.K. subsidiary. The American president refused the request and so Smith raised the necessary capital and set up in business under the name of Y. He was assisted by a foreman from the Coventry Engineering firm, Jones who organised the production. Thus although at this time Y was a subsidiary of the American parent company its capital and control were almost autonomous.

After 1945 business expanded ^{rapidly} rapidly with Smith using personnel contacts and his reputation for good service to develop and intricate web of distribution outlets. These included not only Alpha, but Beta and Gamma, merchants and retailers, often with different trading terms, involved in moving goods from the manufacturer to the market. It has been fairly estimated that at this time he supplied 90/95% of the U.K. market for these products. Production methods were chaotic but the huge stocks held in total by the firm and all the organisations distributing managed to keep customers supplied.

Smith and Jones kept all managerial power firmly in their hands and as would be expected the distance between them and other managerial staff encouraged myths and anecdotes concerning them which have far outlasted themselves. This is an important point for appreciation of the organisation as it was when research started. People thought dreamily of the 'good old days' when Smith

was in charge and crises never arose, mainly because, having then no managerial prerogative, important decisions never reached them. It was not just a process of social institutionalisation or a series of defensive entrenchments when times turned bad that led to a development of organisational and decision making rigidity. The formalisation of rules and procedures for internal control and for the maintenance of relationships with other organisations which had been heuristically developed in Smith's era were endowed with a feeling of sanctity. The problem of change was approached with the air of a man about to change his creed.

Smith and Jones were still running the company when Smith had a heart attack. Partly to be ready to control the Coventry factory should Smith go and partly to bring other European subsidiaries under tighter central control, the parent corporate company set up a London office in 1961. Tension soon developed between London and Coventry and it was clear that only Smith's continued presence, albeit a tenuous one by this time as he never really recovered, was keeping the parent from exerting tighter centralised control. Internal politics for control of the parent took the heat out of the situation and Smith continued until another heart attack in 1964. He was then too ill to continue, and the London office took control. A new man Denison was put in charge of Coventry. Jones left the company, a new man Fletcher was at London and soon after Smith died.

By this time the market had been entered by several competitors who by hard selling, discount and price cutting were making substantial inroads into the firm's monopoly. The parent company dispatched experts to Coventry to install detailed budgetary control systems in accordance with the corporate policy of centralised control. The effect of this was to further institutionalise and formalise existing procedures regardless of their actual effectiveness and

to remove large areas of managerial decision making especially concerning strategic matters. Denison entered the company when company sales were still slightly increasing although the market share was steady declining. He was ambitious and soon, 1965, took over the international office in London, while still controlling Coventry. It is impossible to measure the contribution that such a man as Denison can make when he has to work in the shadow of his predecessor^{essor} Smith. The general consensus of opinion would be that he was shortsighted with his policies, over extravagant with his budget (he installed a computer, and built an executive extension to the managerial offices), and over ambitious personally. Yet in hindsight there is very little specifically to illustrate this view and considerable indications to suggest the contrary. He appointed a marketing man, filling the vacuum left by Smith, he tried to modernise the control of production and the office procedures and, most important for this work, he began talks with all the major distributors about their relationship with the company. These talks made it clear that Alpha was rapidly becoming absorbed into a larger British corporation and some form of direct ownership was out of the question. The talks with Beta and Gamma got nowhere.

In 1965/66, with credit tight in the U.K. and a slump developing in the market, sales began to decline steeply. Nevertheless the production control was so chaotic that deliveries were getting steadily worse, causing even more of a decline in orders. U.S. consultants advised a cutback of 16% of the work force, especially indirect workers, allowing direct workers to try and clear the backlog of work.

During an abortive attempt in the U.S.A. to replace the company's president, Denison supported the wrong man. He was now under direct threat of dismissal. To enable himself to devote

more time to the European operation, Denison appointed a new man, Rigby, to take over as plant manager. As expected in mid-1966 Denison was dismissed and Rigby became Managing Director at Coventry. At his appointment the London office was closed. The Marketing Director had soon left after Rigby's appointment as he recognised that Rigby was a production man in attitude and expression. A considerably demoted Sales Manager was appointed in his place. It could also be said of Rigby, that he lacked wide managerial experience.

By mid-1967 he had himself reorganised the management structure and it was at this time that the research contact was made.

Having set the scene historically there are several points that must be brought out again for emphasis.

1. The obsession of the corporate parent for centralised control, even a new lorry required processing through the procedures for new capital requisition.
2. Frequent changes in top management had left the company insecure. Management not knowing how long their jobs would last, and employees losing any confidence that management knew what it was doing.
3. The shadow of Smith still fell long across the boardroom table, and his ways of doing things still adhered to as rituals.
4. Although Smith was a marketing man, the top management had been steadily purged of all else except production and engineering orientated thinking persons. The job of Coventry was just make sure that you produce the 'right goods at the right time' and things will be fine. The tentative movements towards the market made by Denison had stopped, and Denison's and his policies discredited. It was at this point that Rigby, with corporate advice, requested help from Operational Research.

C.3 PROJECT INITIATION

When contact with the firm was made the situation was as described in Part I, section 3 and in the previous section C.2. Rising transport costs, increasing discounts, extended credit, tighter manufacturing profit margins, new entrants in the field combined with an almost static total market were forcing the firm to consider the restructuring of its multi-tier distributive system. There had of late been several modest changes in the competition's distributive system and there was a general feeling that major changes were on the way. To determine which changes were necessary in their distributive system, the firm, on corporate advice, had initiated an Operational Research Study.

On arrival the analyst found discussions about the distributive system in such a state of flux that it was not even at all clear whether the sort of change anticipated was of a tactical or a strategic kind.

Policies involving complete withdrawal from distribution and a concentration of effort on production were advanced by senior production management and some junior marketing executives with as much cogency and conviction, as other staff proposed that a modification to the sales-force incentive scheme would solve the present problems. Elsewhere voices were raised in defence of policies to purchase a distributor or two, or even three. Others supported purchasing merchants and bypassing distributors, and still others conceived of the idea of building an entirely new distribution channel. At the more tactical level plans were made for price or discount changes or for the strengthening of some form of franchise or dealer system. At a more strategic level there was talk of diversification into new markets and a gradual withdrawal from the area of engineering components.

From all this it should be clear that there was only agreement on one point, that something was awry with the distributive system. But there agreement ended. There was no agreement on the tactical or strategic nature of the decision or on the timescale under consideration

In addition no framework existed for evaluating and comparing possible courses of action. To develop this framework was clearly the analyst's first task

Management's Strategic Position

Certain growth targets were required by the corporation for this U.K. division. Even an optimistic forecast for the existing product markets over the next five years left a considerable gap between required and available business. A major diversification was thus necessary. There were two major areas of diversification possible. One was into mass-produced low cost items allied to the existing engineering components, the other was the low quantity high-cost precision components. The recent and expected growth potential of the latter was considerably more than the former. Also the engineering research and development, the available production skills and the backing of the corporation which was moving in the high precision direction made this the desired direction diversification. At this stage the existing distributive system was a somewhat neutral factor in the decision. It could be expanded and developed equally well to serve either of these markets.

The major problem with diversification into high-cost precision components is the high risk associated with investment in research and development, both for machinery and personnel. In the year before the study began the company had lost £ $\frac{1}{2}$ million and was hesitant about further investment. Thus it was decided that the only safe way to diversify would require consolidation and improvement of the existing product market. The existing market would then continue to provide the bulk of cash in flow during the next five or ten years, and might be run down after that if the diversification proved successful.

In order to improve the immediate cash position it was also decided to embark on a programme of cost reduction within existing departments.

Thus the strategic position within which the project was set was the following.

- 1) A long-term diversification decision to move towards high precision components had been made.
- 2) To reduce the medium term risk associated with this decision, the existing product market would be maintained and strengthened.
- 3) To do this required both a programme of cost reductions within the plant and the reorganisation of the distributive system.
- 4) During this reorganisation it will be necessary to maintain as a secondary criterion, the future requirements of the market into which the firm has diversified.

This study is concerned with strategies two and three.

The study began in September 1967.

C.4 THE SOUTH WESTC.4.1 September 1967 : Initial Study of the South West

There was an immediate decision to be made in the South West.

Up to this time the merchants had been serviced by a distributor Alpha in Bristol, Beta in Birmingham, direct from Coventry and a small amount from a distributor Gamma in London. The main merchants were located in Bristol (two), Gloucester, Swindon, Poole, Bath, Cardiff (two), Newport and Swansea, making ten in all. The Bath, Newport and one of the Bristol merchants held little stock and were in general fairly small concerns. One of the Cardiff merchants and the Swindon one held extensive stocks, with all the other merchants lying somewhere between these extremes. The discount curves used for these merchants were basically similar with minor modifications. For example, the discount rate for the Poole merchant had always been $2\frac{1}{2}\%$ higher, because of the leverage he exerts due to the geographical position; there was almost no other way of servicing the steady stream of trade from the Poole Harbour and Bournemouth areas. From previous market surveys and sales data there were satisfactory estimates of market potential for the eight principal demand zones, viz:

- 1) Poole including Bournemouth and South Dorest
- 2) Swindon including about ten miles around Swindon
- 3) Swansea including Llanelli, Neath, Port Talbot and the Morgan Works.
- 4) Cardiff/Newport including Caerphilly, Pontypridd, Cwmbran, Pontypool and the lower valleys.
- 5) Devon being mainly Exeter, Taunton and Honiton and Plymouth, but the total in this area being fairly small overall.
- 6) Gloucester including Cheltenham, Stroud, Cinderford and Lydney.

Continued..../

MISSING PAGE

BEST COPY

AVAILABLE

TEXT CUT OFF IN
ORIGINAL THESIS

7) Bristol

8) Bath and South West Wiltshire including Melksham

Bradford, Westbury, Trowbridge, Frome and Chippenham

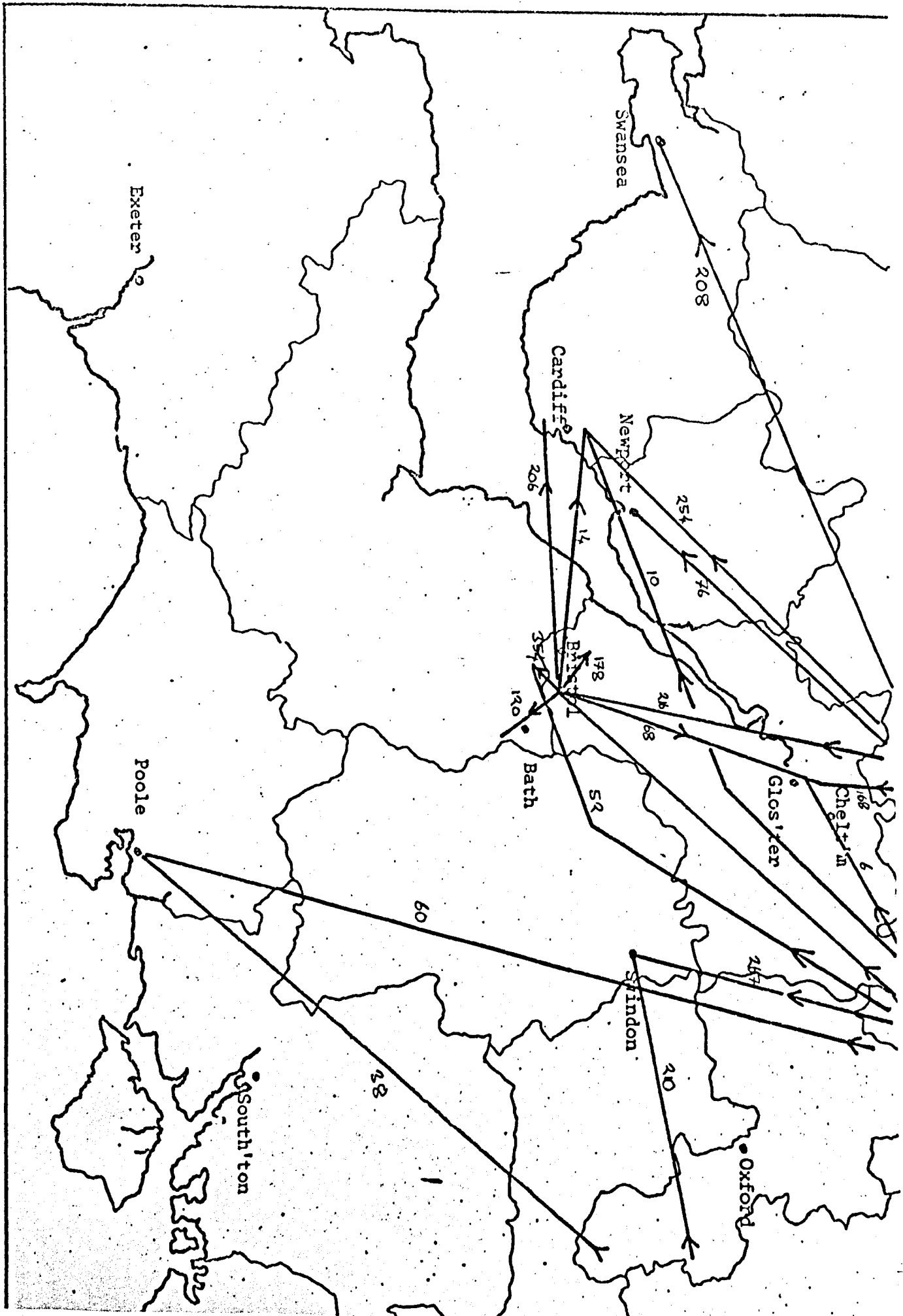
Any significant demand that fell outside these areas could usually be located as specific customers and these were dealt with individually. For example the Westland Company at Yeovil was transferred to the South Wiltshire area and suitable adjustments made in the value of the goods in order to compensate for the miles saved. The extent of these minor adjustments must not be exaggerated, they constituted less than 3% of the total in all areas studies, and was much less in some. The present pattern of distribution to merchants in this area is shown below in Fig. C.1 The pattern of distribution to users for product ranges A, B and C are shown in Fig. C.2, and for product ranges D, E and F in Fig. C.3 It must be noted that orders falling in the F range would very seldom be held by merchants but passed directly back to the distributor or manufacturer. Orders in this range which were call-offs are considered in the range suitable for the call off quantity.

Fig
C.4

Sales to Merchs.	ABC	DEF	TOTAL
Swansea	140	68	208
Cardiff 1	198	80	278
Cardiff 2	144	62	206
Newport	66	10	76
Gloucester	108	134	242
Bristol 1	329	293	622
Bristol 2	120	58	178
Bath	83	37	120
Poole	70	28	98
Swindon	273	204	477

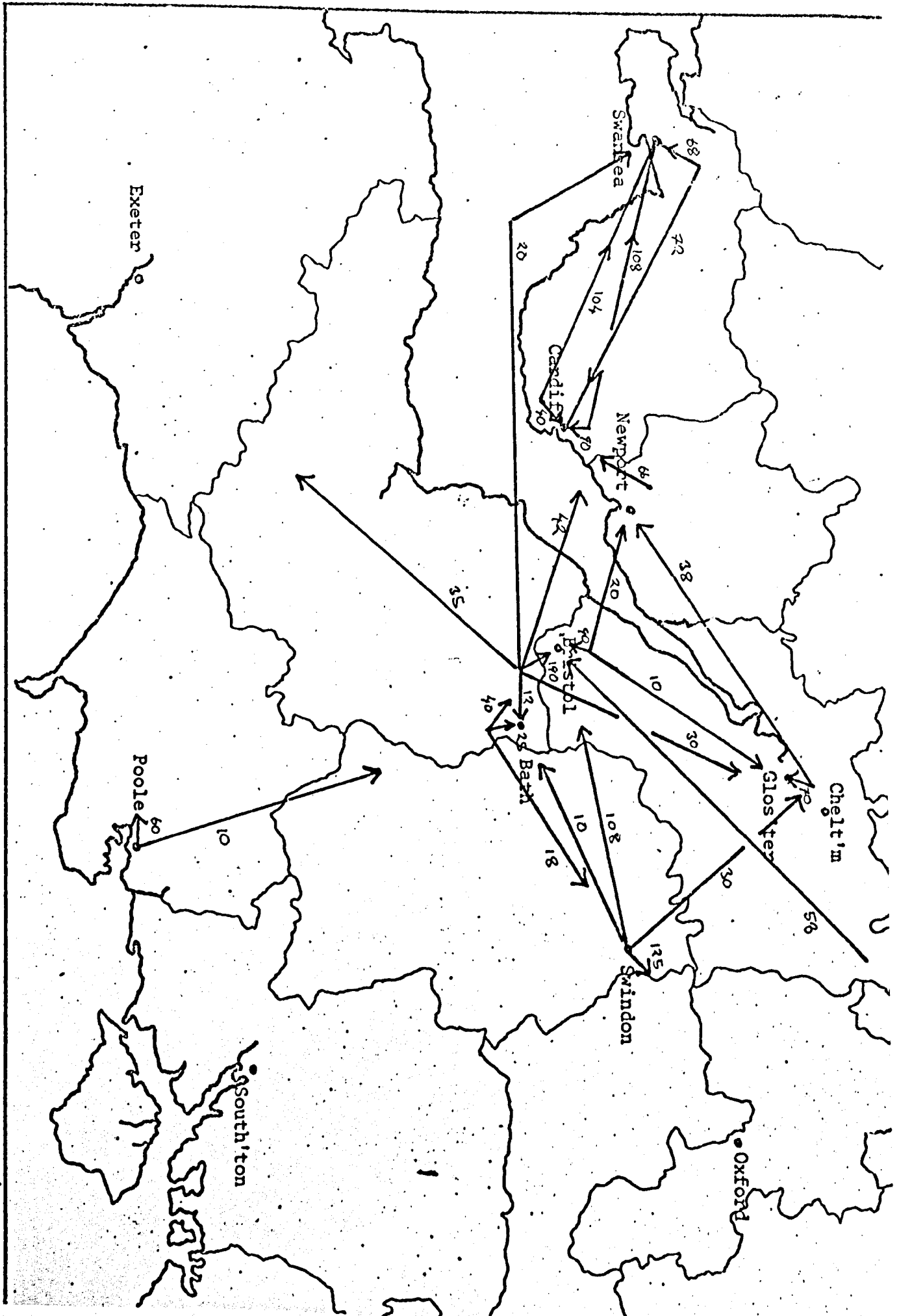
and direct Cov.	53	(1,000's) 433	486
Birmingham	-	35	35
giving totals	1591	1112	2706

Fig. C.1 Deliveries to merchants in the South West: Initially



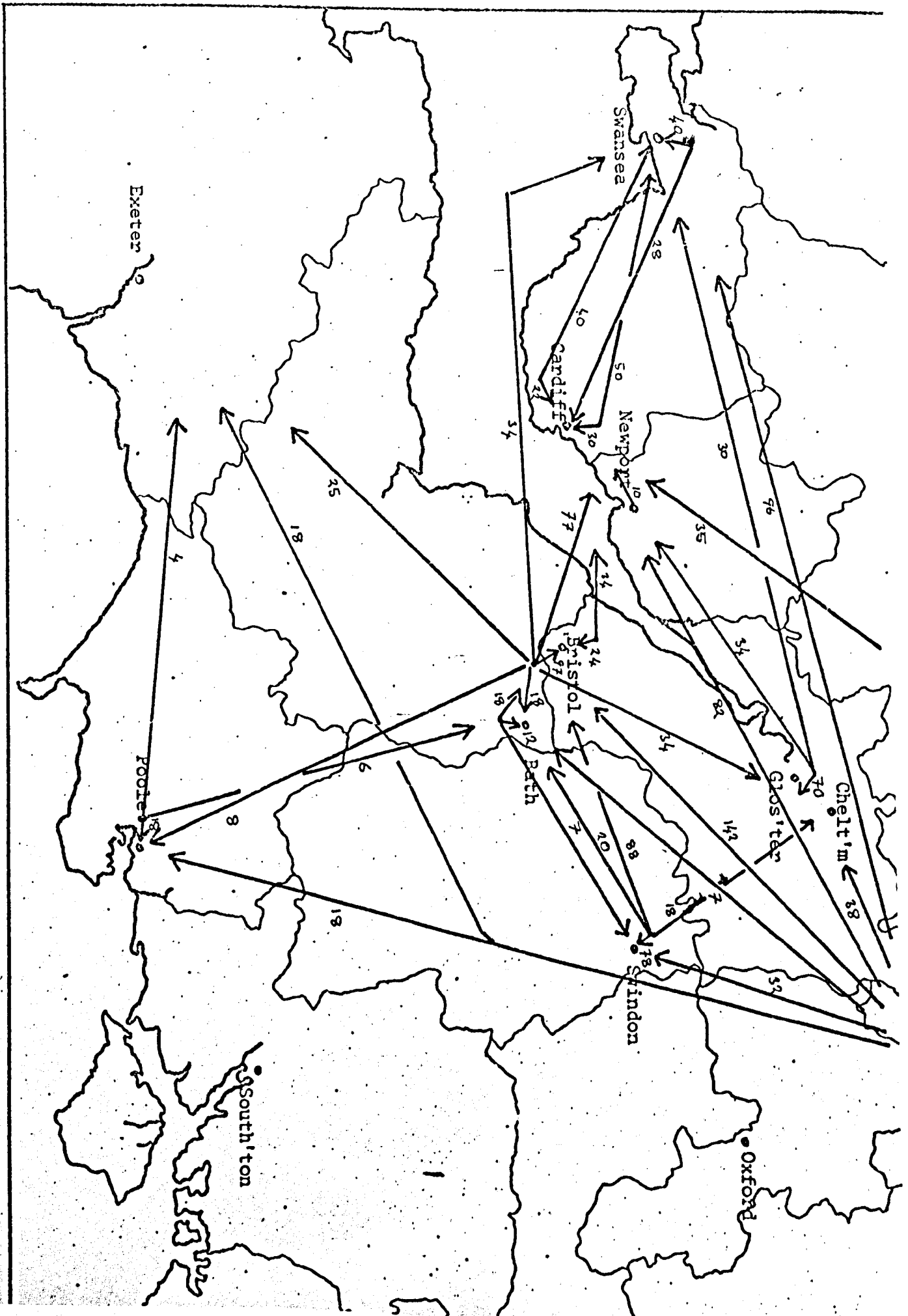
all figures in thousands

Fig C.2. Deliveries to users in the South West: Initially A, B and C product ranges only.



all figs in Kilometers

Fig.C.3 Deliveries to users in the South West; Initial Situation
 D W F product ranges only.



all figures in 1000's

Fig. C.5

Deliveries to merchants by distributor		
	Value	%
Alpha	922	36.8
Beta	940	37.5
Gamma	248	9.9
Direct	396	15.7
Total	2505	100.0

Fig. C.6

Discounts currently paid	
Swansea	25%
Cardiff 1	25%
Cardiff 2	25%
Newport	18%
Gloucester	25%
Bristol 1	27½%
Bristol 2	22½%
Bath	22½%
Poole	23½%
Swindon	27½%

The problem at that time was a request for a £50,000 loan from the merchant at Swindon. This would provide the funds to expand his premises, to finance a larger stock as well as a larger range. Also he could hire more salesmen and purchase more vehicles in order to expand his business in South Wales, Bristol and the Poole areas. He believed and could support by crude estimates that a considerable section of the markets in these areas were dissatisfied with the present service and would be willing to trade with Swindon. His own sales had about doubled in the previous five years and he had proved himself a vigorous

entrepreneur. He already had a firm control over the Swindon area market and had been making considerable inroads into Bristol. He had a reputation for keeping a wide stocked range and for prompt service. He proposed that he should deal entirely by direct deliveries from Coventry.

The sales management at Coventry had considered for some time that there was too much double handling in the South West region. The 38% of the goods which was serviced to merchants from Beta in Birmingham could equally well go from Coventry direct. The £350,000 that was sent to the Bristol 1 merchant from Alpha was clearly a waste of resources. The Alpha depot was only a few miles from the Bristol 1 merchant. Going direct to Bristol 1 was out of the question because of the strong relationship built up over several years between him and Alpha. To reduce the market served by Bristol 1 seemed to offer the only solution. This could not be done directly from Coventry because of the fragmented nature of demand in Bristol. The Bristol 2 and Bath merchants were not well managed enough organisations for Coventry to support. Coventry also had knowledge of some liaison beginning between Gloucester and one of the competitive manufacturers making expansion there risky.

Another factor which concerned Coventry was the dominant position enjoyed by Beta in South Wales, Should Beta be purchased by a competitor a large section of this market could be at risk. Alternatively if some of South Wales could be serviced from Swindon, and Coventry later themselves purchased Beta the trade could easily be transferred back, although this would have meant unnecessary costs involved in Swindon. Yet another consideration was that if Coventry were considering the purchase of Alpha or Beta, the price could be prohibitively high because of their dominant position. If Coventry had the leverage of alternative and efficient supply channels to these areas via Swindon the

price might be substantially reduced.

The risk of supporting Swindon, apart from possible low return on the loan, was the possibility of merchants and distributors reacting against this encroachment by switching some of their sales to competitors. This would make Beta an even more attractive takeover opportunity for competitors.

Alternative solutions to the South West distribution problem not involving Swindon or the purchase of distributors were of two types. One type involved the establishment of a depot in Bristol or Cardiff or Gloucester. The second was the purchase of merchants in strategic places, e.g. Bristol 1 or Cardiff 1.

The reaction of the South West region to major changes was quite unknown. Most of the channels were well established and had changed little in the last decade. The exceptions were the rapid growth of Swindon, the re-equipping by Gloucester of his warehouse with modern handling equipment and the entry of a merchant in South Wales trading solely with Japanese components. Some changes, such as the one proposed at Swindon, it was hoped could be cloaked by the traffic reorganisation caused by the recently opened Severn Bridge and by the work begun on the M.4 extension to Bristol, especially the length from near Swindon. There were clearly many courses of action open to Coventry management supported by judgements concerning competitive action but there was a lack of an economic framework in which to evaluate them. What was required immediately was an evaluation of the financial effects of, and redirection of goods implied by these alternatives. Time was short because Swindon had already received offers of smaller loans for similar arrangements with two other competitors and he was intending to act on these if no decision was made promptly by Coventry.

price might be substantially reduced.

The risk of supporting Swindon, apart from possible low return on the loan, was the possibility of merchants and distributors reacting against this encroachment by switching some of their sales to competitors. This would make Beta an even more attractive takeover opportunity for competitors.

Alternative solutions to the South West distribution problem not involving Swindon or the purchase of distributors were of two types. One type involved the establishment of a depot in Bristol or Cardiff or Gloucester. The second was the purchase of merchants in strategic places, e.g. Bristol 1 or Cardiff 1.

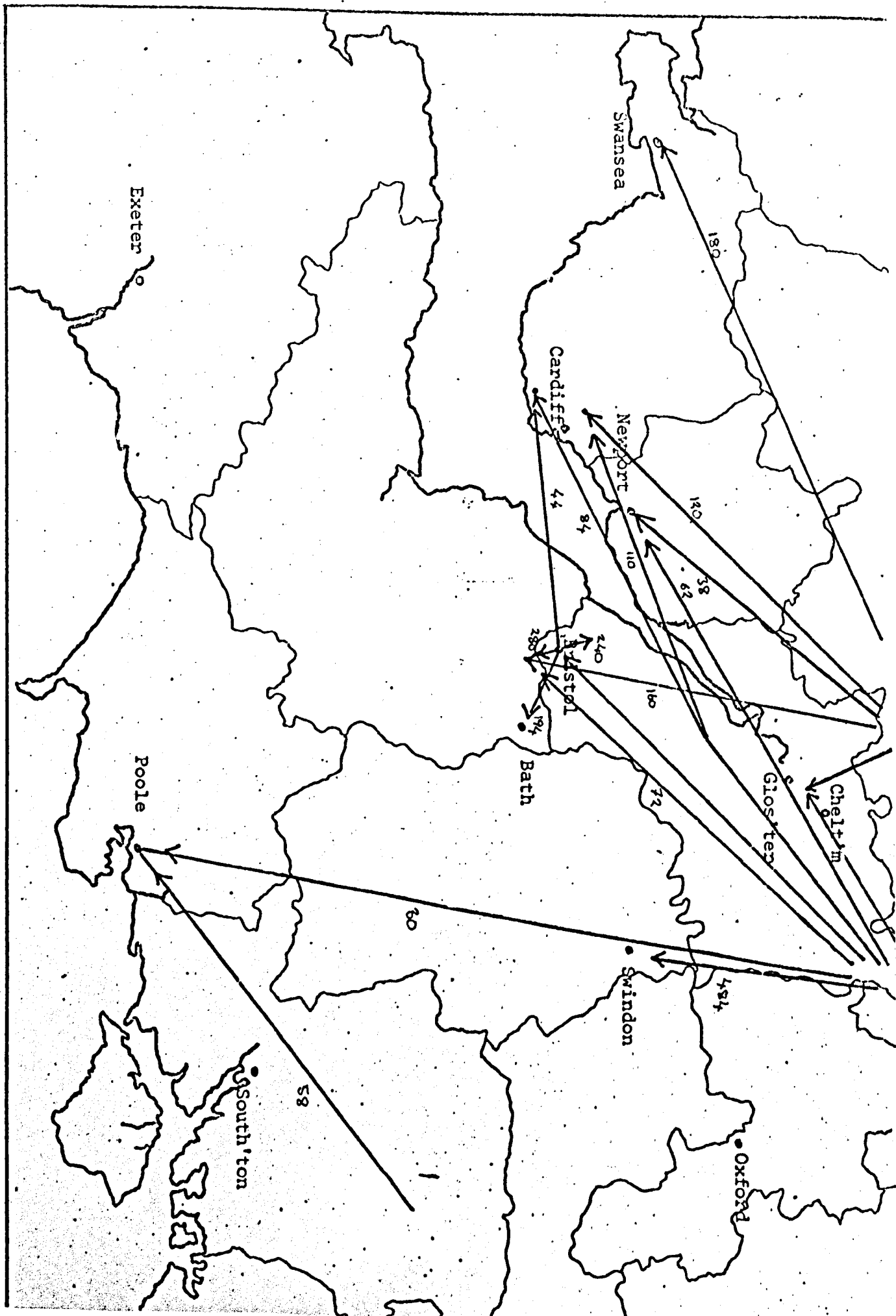
The reaction of the South West region to major changes was quite unknown. Most of the channels were well established and had changed little in the last decade. The exceptions were the rapid growth of Swindon, the re-equipping by Gloucester of his warehouse with modern handling equipment and the entry of a merchant in South Wales trading solely with Japanese components. Some changes, such as the one proposed at Swindon, it was hoped could be cloaked by the traffic reorganisation caused by the recently opened Severn Bridge and by the work begun on the M.4 extension to Bristol, especially the length from near Swindon. There were clearly many courses of action open to Coventry management supported by judgements concerning competitive action but there was a lack of an economic framework in which to evaluate them. What was required immediately was an evaluation of the financial effects of, and redirection of goods implied by these alternatives. Time was short because Swindon had already received offers of smaller loans for similar arrangements with two other competitors and he was intending to act on these if no decision was made promptly by Coventry.

The first version of the model was used with the discount structures for merchants approximated by three piece-wise linear sections. No depot possibilities were considered on the first run. Test runs were made to investigate the sensitivity of the results to changes in the linear approximation to discounts and the results reassured us that this was not a sensitive approximation. The program took less than six minutes to run and so we were able to experiment with it quite fully. Each demand area generated a submatrix of size 35 x 6 and the entire transportation block matrix was of size 280 x 73 giving a density (i.e. proportion of active cells) of 9.4%.

The first results were of the same general form as the existing system, Fig. C.7. The first change was a considerable simplification and rationalisation, avoiding much of the existing duplication. This result was expected from all programs run and was seldom treated as particularly significant. By avoiding duplication, most distributive systems can be improved. We were looking for more radical alternatives if they existed. The second change was the servicing of Swindon direct rather than via Gamma in London

Thirdly, there was some shift of trade in South Wales to be served directly from Coventry, this was marked in the larger orders rather than smaller. Fourthly, considerable South Wales trade was routed via the merchant in Gloucester, mainly in the medium order size range. In order not to raise the discount rate too high in Gloucester the program had allocated some more of the Gloucester trade to be serviced from Swindon and Bristol 1 but the discount for Bristol 1 was already high, thus this new trade for Bristol 1 was compensated by Bristol 2 increasing its share of Bristol trade and the Bristol 1 shipments to Bath ceasing. Bristol 1 and direct shipments also gained some of Swindon's trade in Bristol in order to reduce Swindon's discount now that he had increased his market in Gloucester.

Fig. C.7. Deliveries to merchants in the South West;
Results of 1st run.



all figures in £1000s

Fifthly, Cardiff 2 had gained somewhat from Bristol 2.

The sixth and last point gained from this first analysis was that Alpha was to supply much less to South Wales merchants. Overall the similarity with the results to the original configuration was surprising, this could be interpreted in two ways. Firstly, that the model had built in assumptions concerning the status quo which made other configurations impossible. It was ascertained that this was not the case by exhibiting radical alternatives as feasible. Secondly it could be interpreted as a minor verification of the model, it certainly at least increased the management's confidence. The cost of this new distribution pattern was £977,000 as against £1,026,000 previously a theoretical saving of £49,000.

The main conclusions drawn at this stage were:

1. Much of the trade now serviced by Alpha and Beta in South Wales could be more economically sent directly to merchants from Coventry. This made the purchase of Beta to serve this area, in particular, less attractive.
2. Sales that have been allocated to Bristol 2 and Bath are in the opinion of the sales management too great for those merchants to handle. Results are needed with tighter restrictions on throughput through these.
3. Swindon would be better served direct from Coventry. Not only did this appear in the final result, but it was the cell with the most negative dual variable when the existing pattern was used as an initial feasible solution, indicating that this change was a particularly valuable one. In fact £12,000 of the saving came directly from this change. Whether the Swindon merchant was 50% purchased or stayed independent this saving would be made and it was decided to implement this change immediately.

4. Because of the situation at Gloucester discussed above it was not felt to be wise to increase sales through this merchant to the required £390K from £242K previously. After some discussion it was decided to limit the sales through this merchant to £200K.
5. The advantage that was made apparent in the model of servicing much of South Wales by a one-tier distribution based on Gloucester, suggested that it would be worth investigating a depot at the merchant level servicing South Wales users from the Gloucester area.
6. The absence of any strengthening of the flow through Alpha and Beta suggested that most effort be placed towards investigating one-tier and direct distribution.
7. Some of the highest dual variables were associated with market constraints experienced by Swindon. This result was particularly interesting and would only be exaggerated by the intention of conclusion 4. to limit the Gloucester merchant. In particular the flows to Wiltshire, Bristol and Gloucester had high dual variables. A near optimal alternative solution existed which gave Swindon a zero flow to Poole instead of no flow at all^{i.e. a degenerate allocation}. Thus if Swindon tried to increase his market there, as he wished to, the result would not be too costly for the firm although it would not save money. It was decided to consider the implications of this for the next time that the Poole merchant requested an increased discount based on the evidence that he alone could supply the area.

This evidence from the dual variables that it would be in the firm's interests for Swindon to develop into more distant markets is interesting placed alongside the Swindon merchant's statement that "not only could (he)

service (them) better but it would ultimately be cheaper to the firm rather than going through Alpha and then to a merchant!"

A modified version of the model was then run using the changes requested under conclusions 2 and 4 above. These alterations only required a change of a few cards each but the opportunity was taken to adjust some of the previous data marginally as more accurate records had by then been collected. The results of the modified problem are shown for deliveries to merchants in Fig. C.10. The throughput per merchant is shown below in Fig. C.8

Fig. C.8

Merchant	Initial	1st Run	Modified 1st Run
Swansea	208	180	180
Cardiff 1	278	230	326
Cardiff 2	206	128	164
Newport	76	100	132
Gloucester	242	390	(200)
Bristol 1	622	512	526
Bristol 2	178	240	180
Bath	120	194	120
Poole	98	88	88
Swindon	477	484	548

IN £1,000's

Direct Cov.	486	480	592
Birmingham	35	-	-
Total	3026	3026	3046 (modified data)
Total Cost	£1,026 K	£977 K	£994 K

The total going through distributors and on to merchants is shown below in Fig. C.9

Fig C.10 Deliveries to merchants in the North West;
 Results of bodified run.

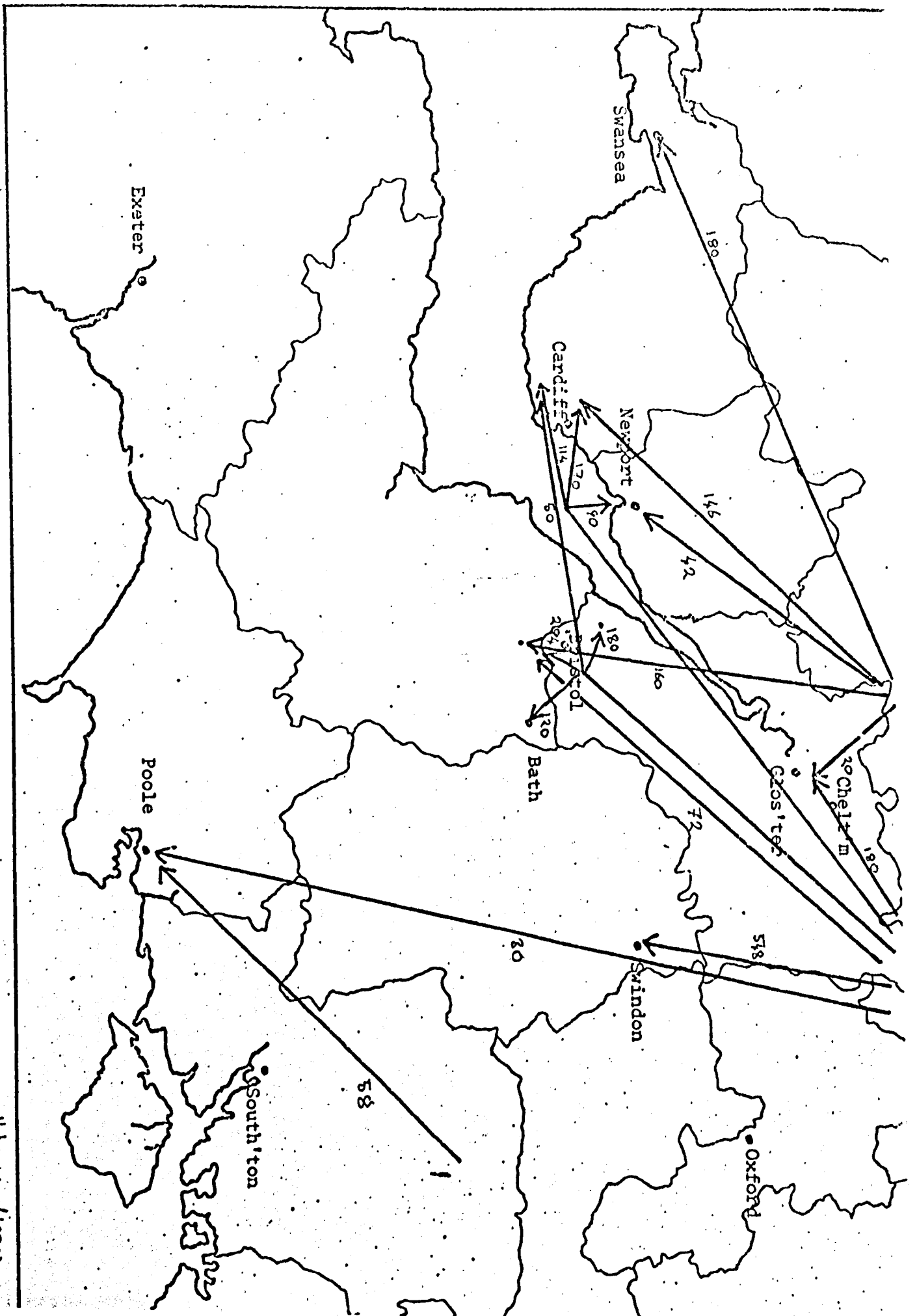


FIG. C.9

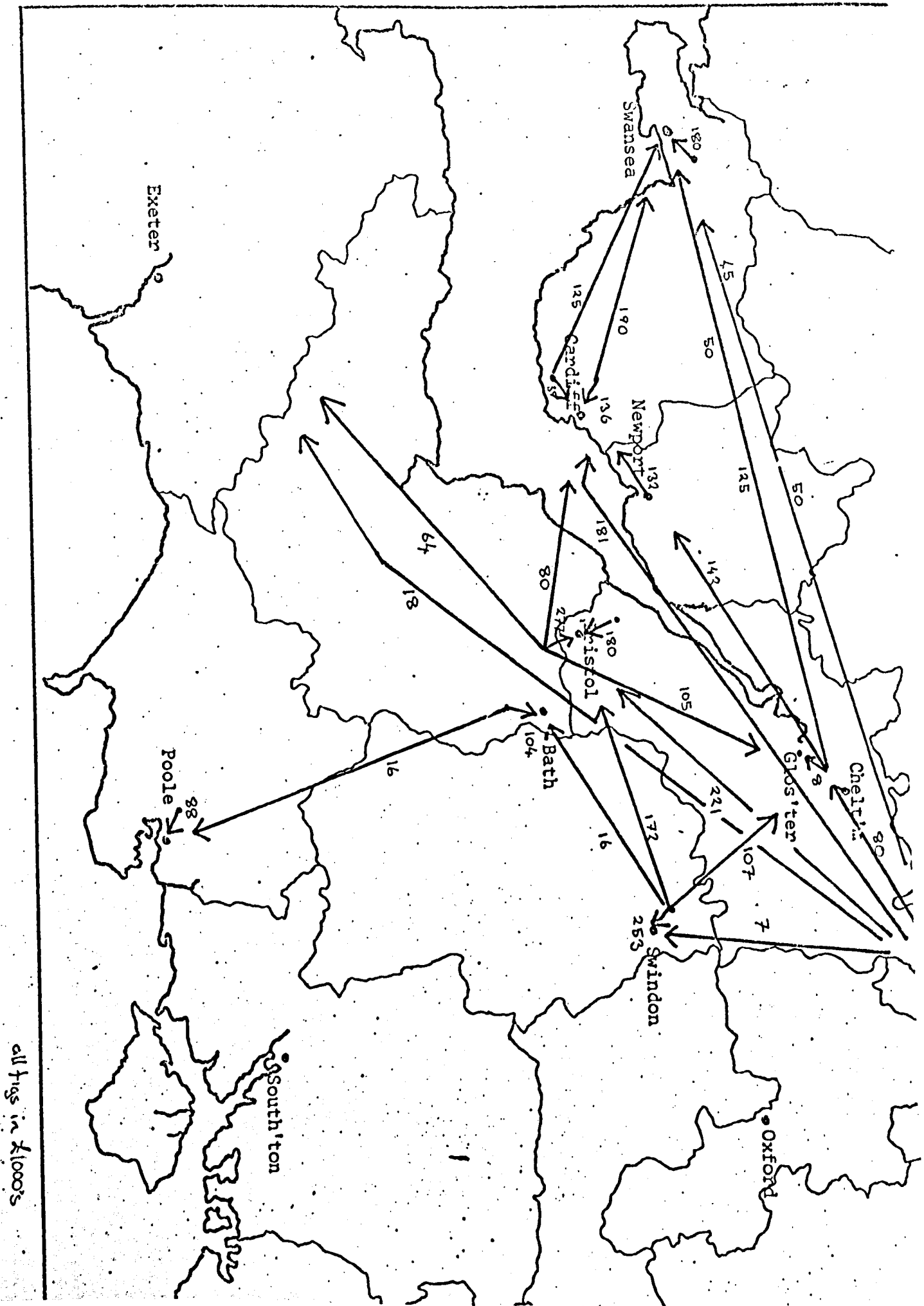
Outlet	Initial		1st Run		Modified 1st Run	
	Value	%	Value	%	Value	%
Alpha	922	36.8	758	29.8	644	26.2
Beta	940	37.5	680	26.7	548	22.3
Gamma	248	9.9	58	2.3	58	2.4
Direct	395	15.7	1050	41.2	1204	49.1
Total	2505	99.9	2546	100.0	2454	100.0

The resulting deliveries to users using the modified data is shown in Figure C.11.

During this modified run, management asked for some extra constraints that the model could not handle. These were of two forms.

- a) constraints on the amount of a product range that one merchant can handle in one region. In general this was considered too complicating a constraint to apply overall. It is quite possible to rewrite the program to allow such 'capacitated flows' but the time to do this and the extra run time needed subsequently did not make it worthwhile. Nevertheless there were one or two cells where it may have been important and the analyst was asked to consider ways of allowing for such possibilities in the future.
- b) constraints on certain spurious subsets of the variables. The analyst was requested for the effects of certain constraints such as the total of sales handled in A, B and C ranges by a particular merchant or group of merchants to be limited. These are called 'spurious' not because they were flippantly requested but to indicate that their structure was not in line with the existing model. Regret was experienced at being unable

Fig. C.11 Deliveries to users in the South West;
 modified data, all product ranges



all figs in 1000's

to cope with these but the intention was given to try and consider ways in which such spurious constraints might be handled, as long as they did not arise in any great quantity or too frequently.

The brief conclusion from the first run is a general warming towards the Swindon proposal, an increased watchfulness over events in Gloucester and a determination that direct sales to merchants generally prove more profitable than using distributors. Now the second series of runs are considered.

For the second run of the program it was intended to investigate the establishment of depots. This would also permit some conclusions about purchasing distribution channels at the merchant level. Clearly if it was shown to be economical to establish a depot in Cardiff, then perhaps purchasing a merchant there instead might do equally well. Transport cost data for depots had been included in the 1st run program but at that stage they had been suppressed by only allowing zero flow through them. The technical problems involved with handling the non-convexity introduced by the economies of scale associated with depots are considered in Appendix 1. Here just the results are investigated. To overcome the difficulties associated with local versus global optima for non-convex problems a crude grid evaluation was used on the overall capacity constraint on depot throughput. It would then be expected that when this throughput capacity is small no flow would be allocated to the depot.

At this stage it was decided to be only practical to investigate Cardiff, Bristol, Gloucester and Swindon as possible locations. By this time there was only concern with depots at the merchants level to effectively compete with merchants, not at the distributor level to serve merchants. This was management's intention originally and had been reinforced by the results of the 1st run. To start with, the one depot case was investigated, allowing each one to enter in turn while suppressing the others.

In Fig. C.12 and C.13, the distribution cost has been graphed against depot throughput for each location. The continuous line giving the optimal costs when the throughput constraints are equalities, i.e. hold exactly. The broken line indicates the optimal when constraints are upper limits only. It must be stressed that only the points are from empirical data, the joining lines are merely for visual presentation. The missing points on the Cardiff, Bristol and Gloucester graphs were caused through lack of time.

Taking first the Bristol case it is seen that no improvement on the 'no depot' position is possible by forcing any amount through a depot established in the Bristol area. The reason underlying this is that the depot, by reason of the curvature of the cost curves, would tend to try and deal with mainly local trade. But the bulk of the local trade is handled by the Bristol merchants, who in turn take mainly from Alpha. Both Alpha and Bristol I have excellent stocking policies and their combined effect results in low distribution costs to the Bristol area, which even the economies of scale associated with the depot cannot match. The Bristol case was not considered further.

Secondly, the Cardiff area was considered. Here the best position was a depot handling about £1 million sales. But even this was only slightly better than no depot at all. If warehousing costs began to rise sharply compared with discounts then it would no longer remain the global optima. Another aspect here is the sensitivity of the solution. The depot has to deal with practically all the trade in South Wales in order that it might save money. It would be most unlikely that the firm could manoeuvre its channel flows sufficiently to bring this about. Presented with these results management consider it unlikely that much more than £½ million could be channelled through a Cardiff depot. If this is the case a Cardiff depot becomes a most unattractive proposition.

Figure C.12

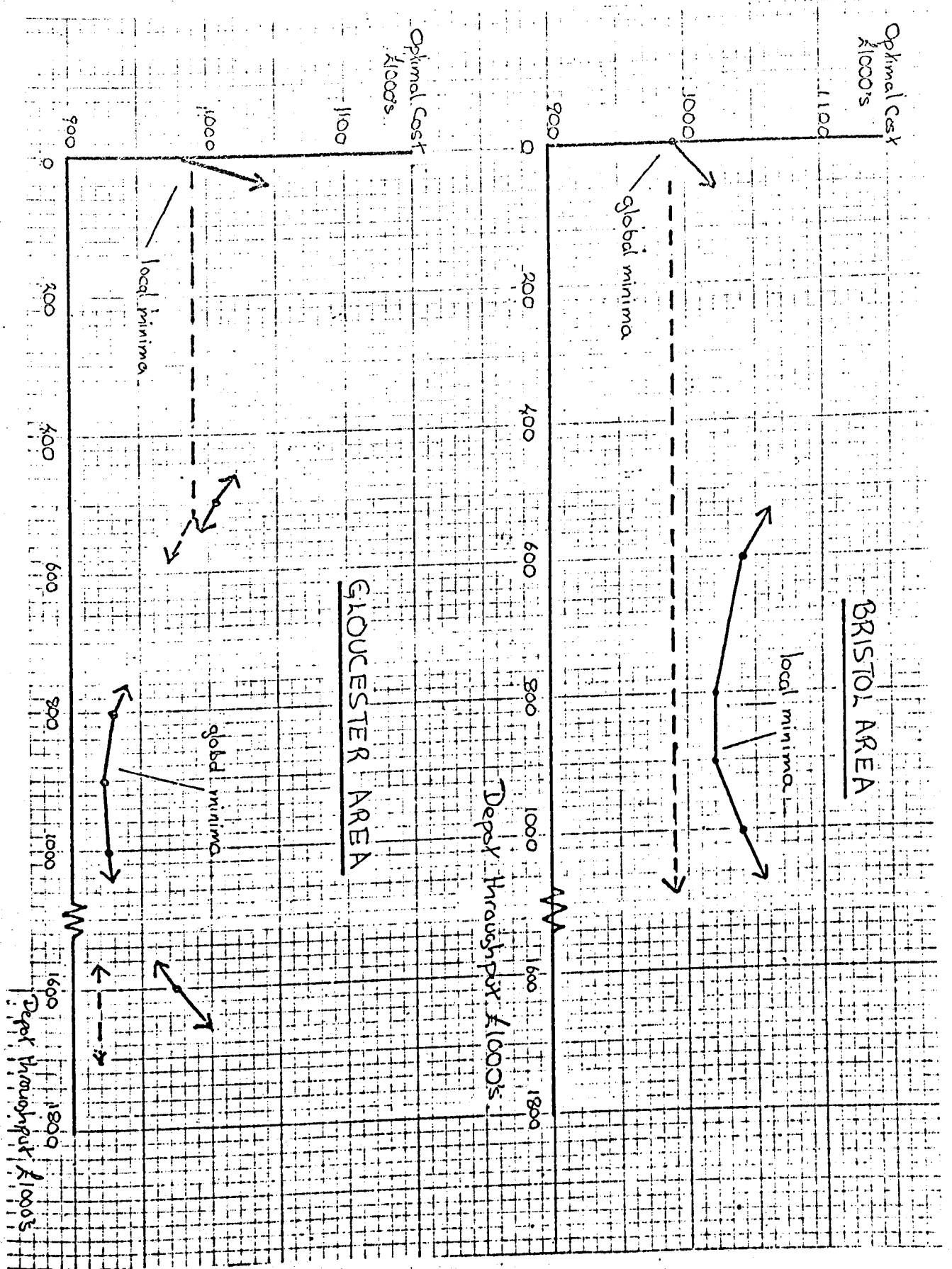
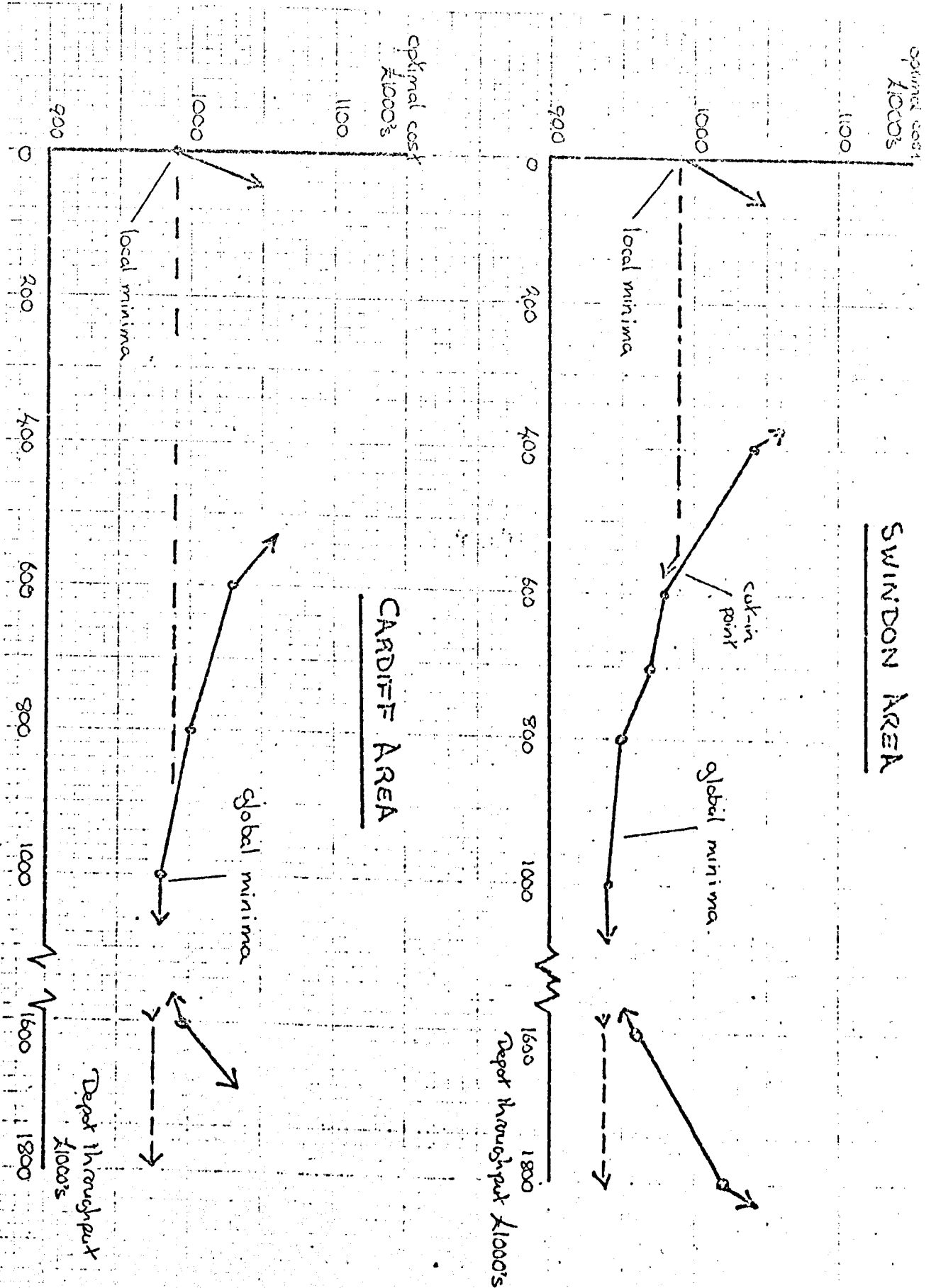


Figure C.13



Gloucester presented the financially most attractive case, becoming cheaper than the no depot case with £ $\frac{1}{2}$ million throughput and achieving a theoretical saving of £70,000 at its optimal point. Even a more modest estimate of, say, £40,000 would enable the establishment cost of the depot to be written off in four or five years. The demand pattern resulting from this location leaves no local trade for the Gloucester merchant, and also takes a fair portion of the South Wales traffic. This would mean either establishing a depot and cutting off supplies to the Gloucester merchant or purchasing him directly. The former would allow competition ample time to reorganise their distribution in that area by purchasing the merchant and there is a significant risk that a large section of the market would be irretrievably lost. Thus the only real course of action in this area would be to purchase the merchant even though the asking price might be severely inflated.

The last case was Swindon. This was almost as attractive as Gloucester apart from requiring about £.6 million sales before showing any savings. With a depot in this area practically all the merchants trade was passed through it, thus a depot here effectively closes down that merchant for the firms trade. For the same reasons as in the Gloucester case, management considered that the urgency of the situation implied not entertaining the option of a new depot in this area. The options left were the requested loan, part ownership or total ownership.

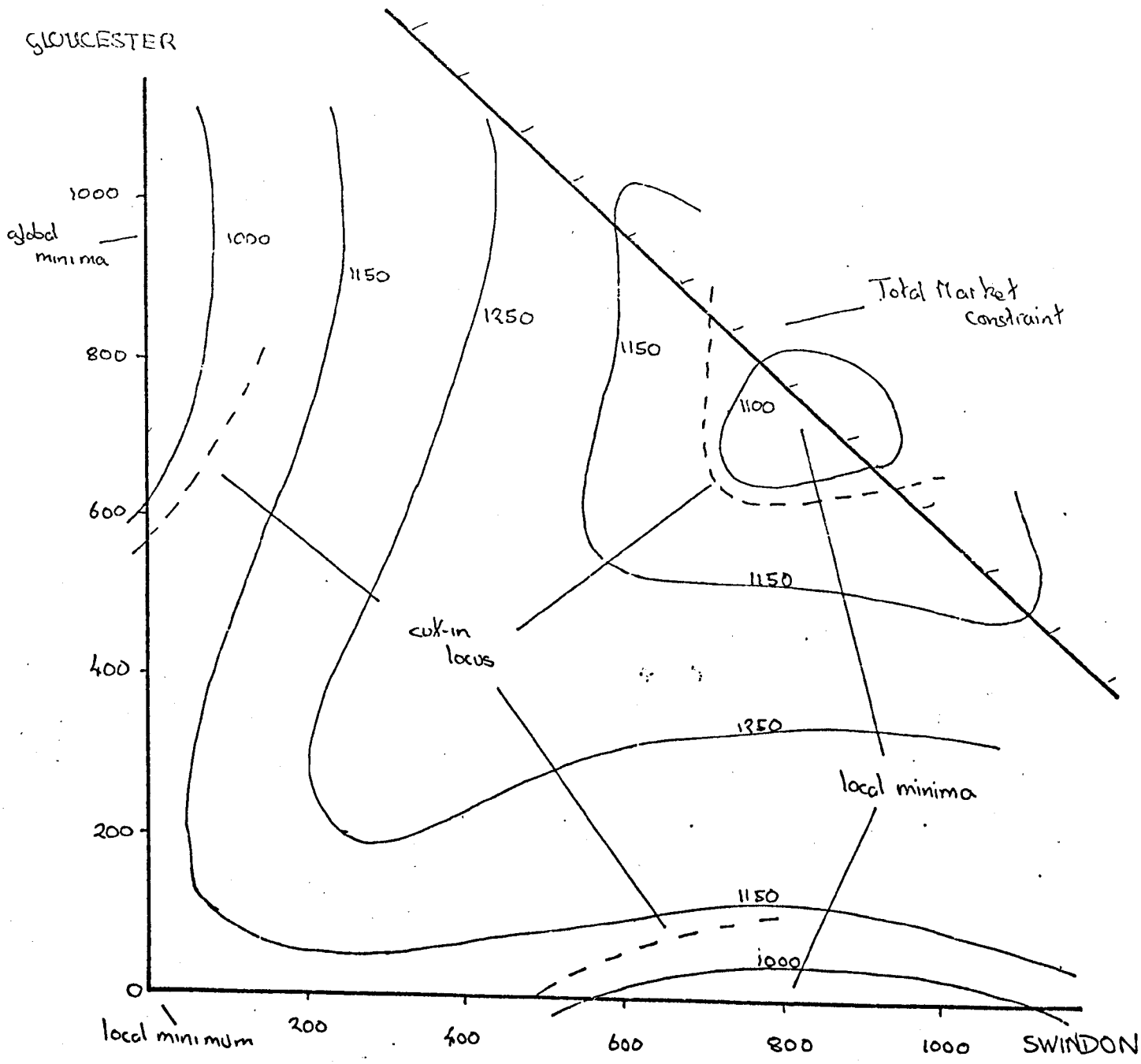
Now the two depot case is considered. In fact the three depot case was investigated, omitting Bristol from the analysis because of the previous results. As the first results were recorded it became rapidly obvious that Cardiff were never going to enter into the solution with a non-zero flow. Thus the analysis was restricted to the two depot case. Here again it soon became

clear that the only real options were when one of the depots were not used. At that stage there was no point in continuing the analysis. In preparing the research report some two years later some further work was done in evaluating the response surface for the two depot case. This is shown in Fig. C.11, where the contour lines have been guessed from a few evaluations.

The possible strategic courses of action thus remaining were as listed in the table below. Management soon reduced the list to A, E and F as possible. More information was requested from the model as to the extent of the changes in flow necessary to gain the savings. It was decided that the changes were too extensive to risk having them fail under F; Management decided that they must have controls of the outlet. No part ownership was possible under A and the total sum was too great a risk as an immediate investment. The final decision then was to attempt to purchase a 51% shareholding in the Swindon merchant. Thus approximately £80,000 was to be spent in Swindon which would gain a saving of around £25-£30,000 annually on top of the 'modified' 1st run position. The trade through Swindon of £477 thousand which was increased to £548 thousand by the modified 1st run must now be speedily increased up to at least £700 thousand. Management then requested the following information which would be required for the tactical decisions associated with the expansion of the trade through Swindon:

1. How sensitive are these results to the overall stocking policy?
2. What distribution is required and which changes should we concentrate on initially?
3. Which markets can be most profitably developed?
4. What opposition can we expect to this expansion and how should we counter it?

We investigate each of these points in turn.



all figures in £1000's.

Sketch diagram only: not plotted from experiments

ANNUAL DISTRIBUTION
COST SAVING (£1000's)

FUNDS
NEEDED

TIME SCALE

COMMENTS ON RISK

A. Purchase merchant 40-60
in Gloucester

approx 150
highly liquid

To be sure,
almost
immediate

To open negotiations is to show one's position.
High risk of merchant rejecting any offer.
Makes Beta more vulnerable to takeover, although reduces our dependence on it.
High risk that S.W. merchants would not become alienated due to competition from merchant in Gloucester
Swindon merchant goes to competition for loan.

B. Establish depot 40-60
in Gloucester
and force out
merchant

approx. 100
over 1 1/2 years

Now, or could
be done as a
defensive response
to merchant

Large portion of S.W. market put at risk giving competitors a major lead in revitalising distribution in this area

C. Build depot in 30-40
Swindon

approx. 100
over 1 1/2 years

Decision to be
made now, action
anytime.

Loss of merchant to competitors time lag while competitors make major gains in Swindon and S. W. Wales.

D. Purchase merchant 30-40
in Swindon

approx. 160
highly liquid

Near future,
before he
concludes loan
agreement
elsewhere

Unlikely that merchant accepts risk of not being able to expand his business to the size required for economy. Loss of entrepreneurial motivation by merchant

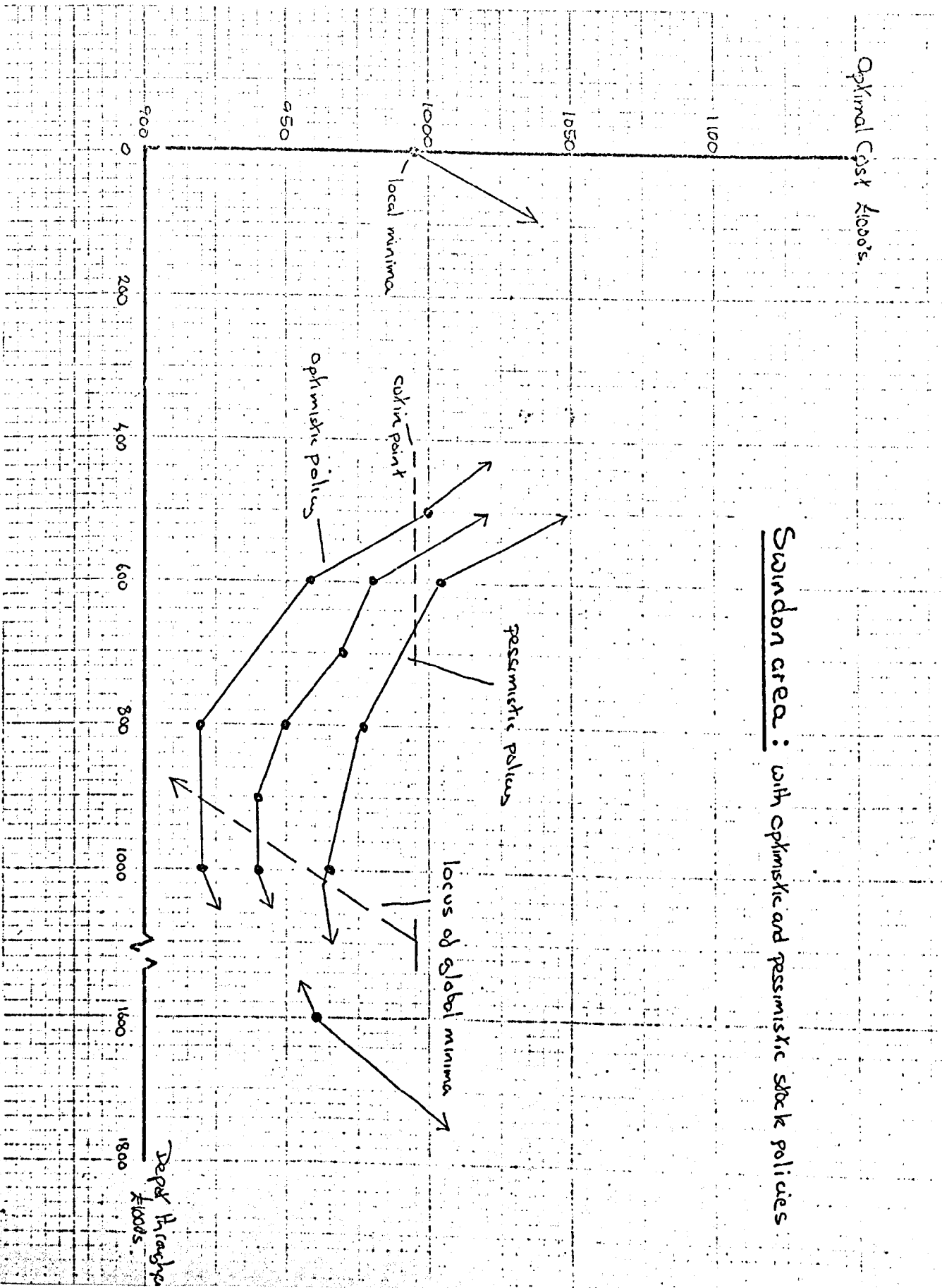
	ANNUAL DISTRIBUTION ACTION COST SAVING (£1000's)	FUNDS NEEDED	TIME SCALE	COMMENTS ON RISK
E.	Fast share in Merchants Swindon	proportion of 160 depending on share	same as D.	Merchant might well accept and there could be less loss of his entrepreneurial drive resulting. Still attendant risk of not being able to expand business fast enough to justify expenditure.
F.	Original loan requested.	50 loan presumably with 5/10 years payback period	Immediate	merchant bankruptcy causes loss of money merchant does not expand in the directions which we require. Merchant is still vulnerable for takeover competitors make share offer or give better terms on the loan.
G.	Expand direct business to merchants	modest	anytime	Swindon and Gloucester merchants at risk Alienation of distributors due to their being bypassed.
H.	Nothing	Zero	anytime	Swindon and Gloucester merchants at risk. Action of Revitalise distribution in S.W., known to be planned by competitors, would put large section of that market at risk

To consider first the question of the sensitivity of the results to changes in Swindon's stocking policy. Management realized that the representation of stocking policy was at a rather aggregate level yet they still felt a need to have an indication of the scope for changes in the policy at Swindon. The management and the analyst jointly agreed on pessimistic (i.e. low) and optimistic (i.e. high) stocking policies. The results are shown on Fig. C.15. It can be seen that the extreme policies can save or cost up to £50~~thousand~~ away from the previous results. It must be stressed that these test policies are extremes and any practical policy is likely to fall well within them. Of course if the stocking policy becomes more optimistic the total stock held rises, so that there is some analysis to be done here to achieve a balance point. This detailed analysis was clearly not the urgent concern of the firm's Board and the results in that direction were passed to Industrial Engineers.

The results in Fig. C.15 which did interest management were the following;

- (i) The shift in the cut-in point, that is where the trade through the channel is sufficient to make it cheaper overall than not using that channel. The optimistic policy lowered the cut-in point by about £50~~thousand~~. The boundary cut-in points was characteristically not symmetrical. Management now knew that by beginning operations with a comprehensive stocking policy at Swindon they could more rapidly cross the cut-in threshold. This point they exploited in order to cross the cut-in point earlier than expected by corporate Control.
- (ii) The locus of the global minima, showing that with higher stocks the cheapest distribution pattern is achieved

Fig. C.15



Sunderon area: with optimistic and pessimistic stock policies.

Depth Branches
Thousands

Optimal Cost Thousands

earlier. Particularly of interest was that the discontinuity in the global locus where it shrinks back to the origin was right outside the area investigated.

Next the second question was considered, what is the distribution pattern implied by the Swindon decision? Referring to Fig. C.16 it is seen that with Swindon at optimal strength it is mainly Bristol 1 and Gloucester that have lost trade, as well as a considerable amount of direct trade being passed through Swindon. Swindon has increased its trade to Gloucester and Bristol, and has started trading in Poole and Cardiff. Notice especially that Gloucester need no longer be constrained by the £200 thousand trade ceiling, as only £148 thousand is required to be handled there. One major change is Bristol 1 having lost its entire Gloucester trade to Swindon, and this explains a large part of the drop in Bristol 1 throughput. In order to know which flows to concentrate attention on immediately the program was run again restricting the flow to Swindon to the cut-in level, £600 thousand. Fig. C.18 shows the changes that have occurred from the modified 1st run to the 2nd run with 'cut-in' level restriction at Swindon. This shows Swindon beginning to increase its flow to Gloucester, Cardiff and Bristol. This same information can be gained by observing the dual variables associated with these cells when the modified 1st run solution is used as a feasible initial solution (which it is) to the 2nd run program. The largest dual variable associated with outlet channel in this case is clearly that associated with the Swindon depot. It might be stressed that in the 2nd run of the program the Swindon merchant has been effectively suppressed.

It is common for these results to have alternative optima which have to be inspected but we only intend to report ones with a particular interest. One such in this case is shown dotted in Fig.C.18.

Fig. C.16 Deliveries to users in the South West;
with Swindon at optimal strength.

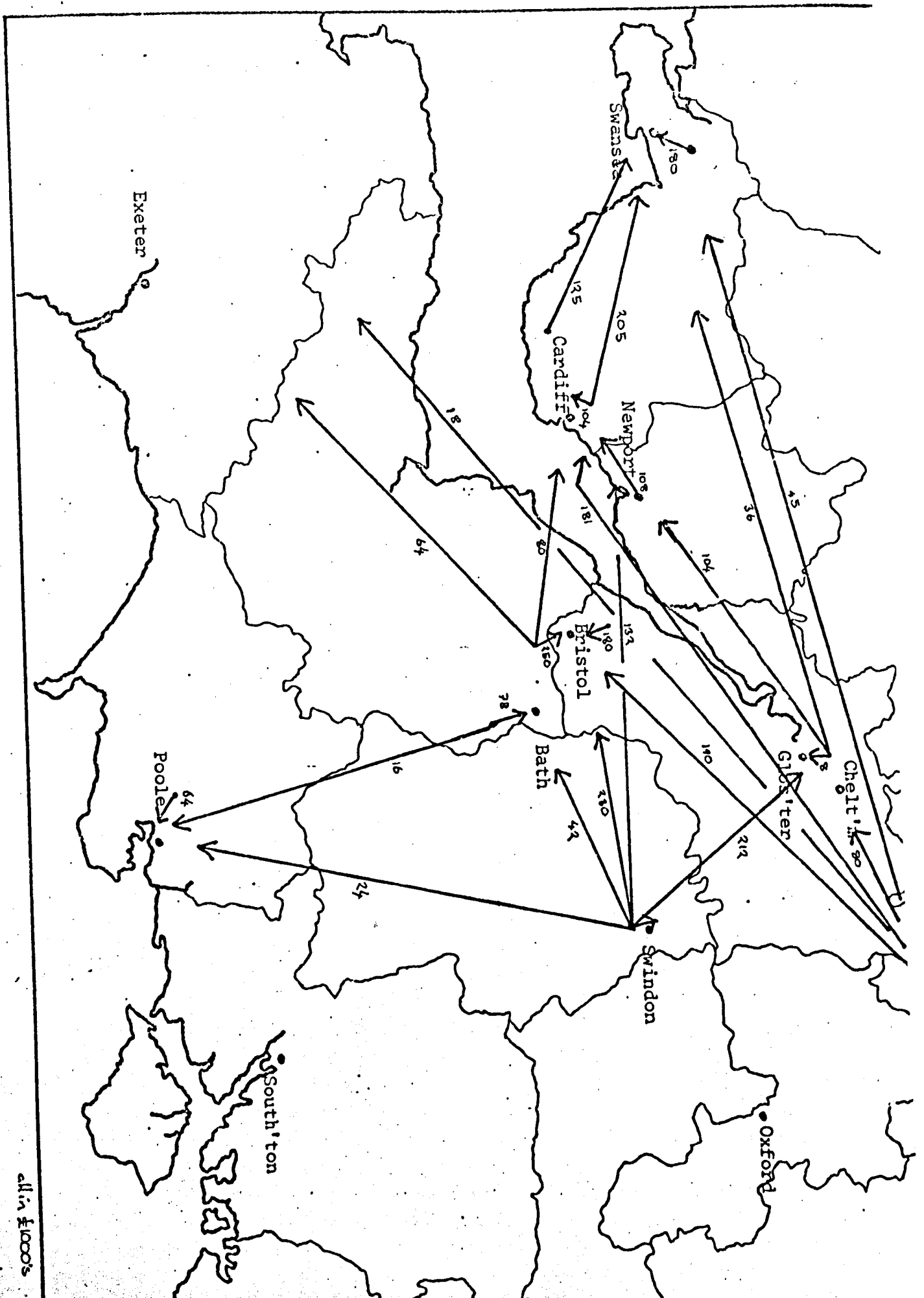
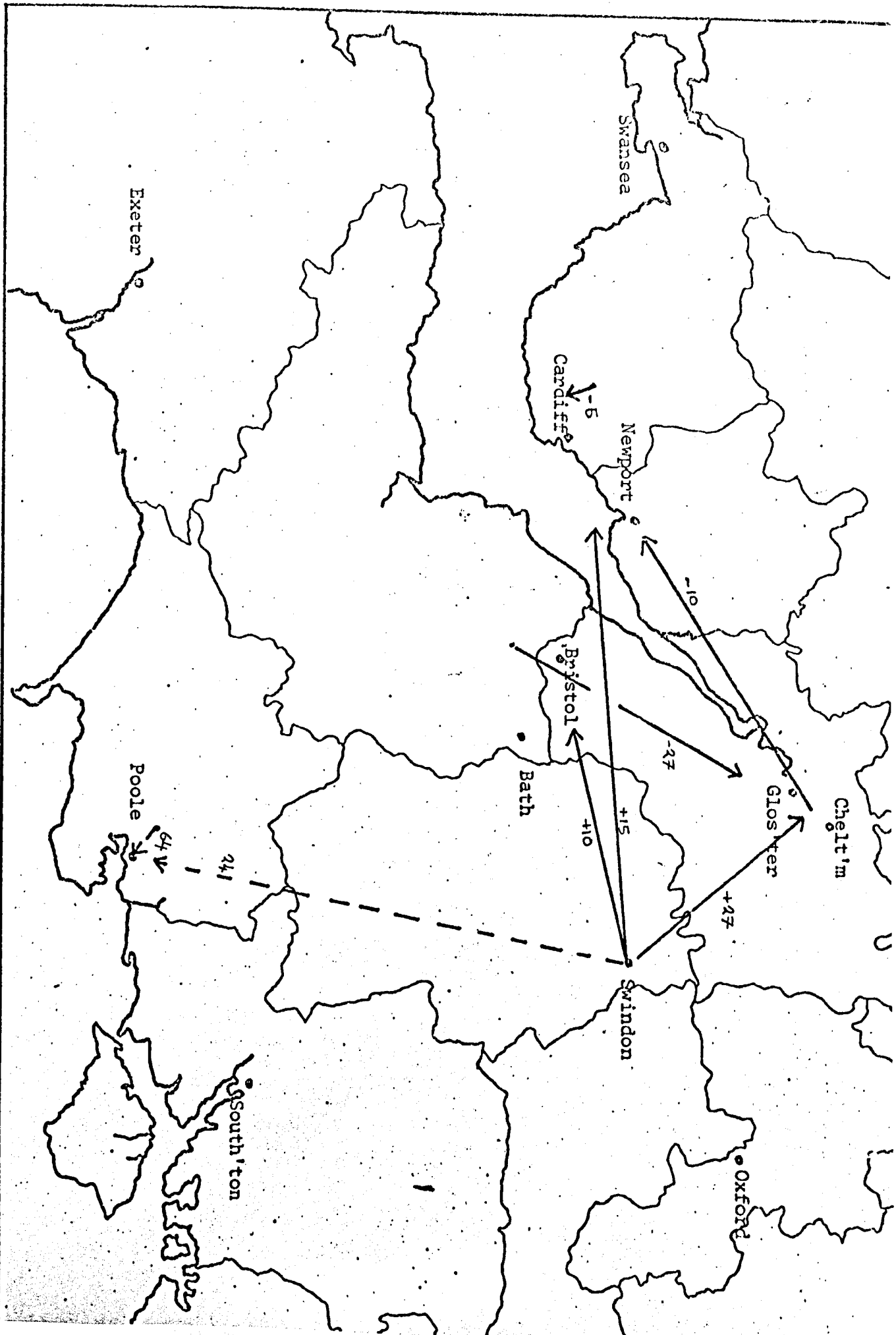


Fig.C.18 Deliveries to users in the South West;
 changes from Fig.C.11 when Swinton at 'cut-in'



all figures in £1000's

An alternative to the Poole merchant handling £58 thousand of Poole area trade and being served by £30 thousand from Coventry is for Swindon to handle £24 thousand of the trade, mainly in the larger product ranges, leaving £64 thousand left to the merchant. The Coventry deliveries would drop proportionately to £6 thousand. This means that if the Swindon merchant still wishes to enter the Poole market he can do so without damaging plans for the rest of the region.

The third question that management asked was information about increasing potential markets. This can be gained from a study of the dual variables, although little that is new in fact comes to light. It showed that the cost of servicing Swansea and Devon were somewhat high, in the Devon case higher than the profit margin after manufacturing. That is, we were subsidising purchases in Devon to a small extent rather than making a profit. Much of our smaller Swansea trade was also barely making a marginal profit. Each of Gloucester, Bristol Swindon and South Wiltshire on the other hand had considerable marginal returns. In the case of Gloucester and Bristol though the marketing staff considered that the potential market was fairly thoroughly covered. In Swindon a considerable amount of new industry was developing which the merchant was keeping under close observation. As for South Wiltshire, this seemed that some expansion was possible, and the sales staff were asked to investigate this in more detail. Management requested some guide to the marginal cost of servicing an increased market in this area in order that we might know the scale of discounts that could be used to attract new business. The dual variables on this market showed that initially one should concentrate on C, D and E product ranges rather than the very small orders, but information on how the duals changed as flows increased was really required, Before there was time to attempt this, management received information that a takeover of the Gloucester merchant by a competitor was expected soon. They requested

information on the distribution pattern with the Gloucester merchant removed. This required changing one number, maximum level of flow sent to zero, and rerunning the program. Including walking time and waiting time for an interrupt period in the computer this took 25 minutes and gave results given in Fig. C.19. This diagram only includes the paths which have changed from the optimal position. In fact the information was a false alarm and the takeover did not occur for several weeks, but the episode was critical in gaining management's confidence. They had asked a question about a major change in the distribution channels and received an answer during the same meeting 25 minutes later.

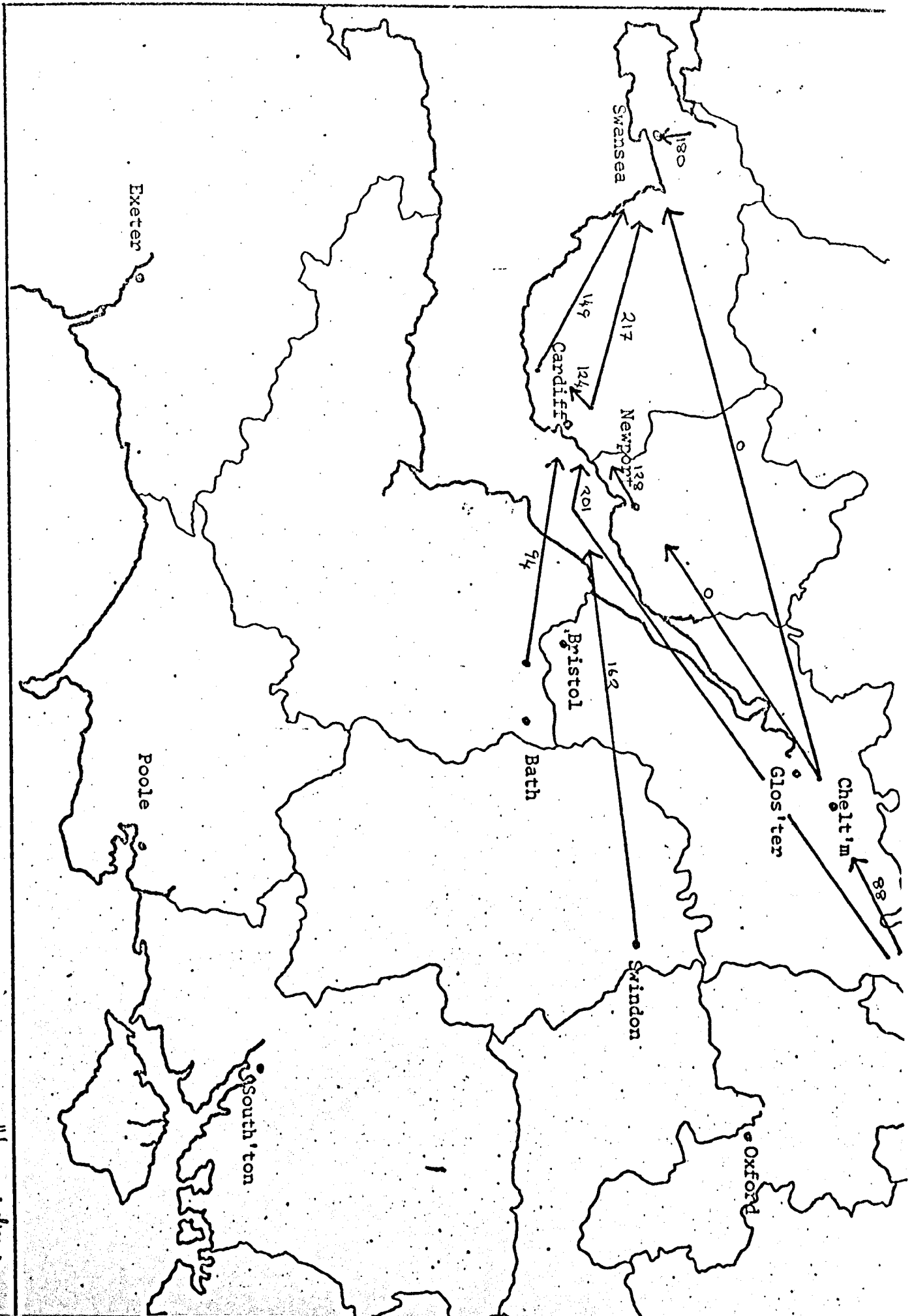
A summary of the runs is shown in Fig. C.20.

The next question asked by management was a prediction of where opposition to the reorganisation was likely to arise and how should it be countered?. This is a fundamentally different type of question to those asked above and cannot be answered in terms of the mathematical model. Questions belonging to the same category type as this had arisen continually since the beginning of the work and, of course, work had begun at an early stage to answer them. Examples of this type might be statements such as;

- i) "that might be the best thing to do but the merchants will not let you do it"
- ii) "if you try and bypass merchants, they will rise as a body against you and cut you out of the market".

Section A.4 above considered these types of questions at some length, and it was found that most of them centred around the concept of 'merchant power'. Does merchant power exist, what scope of action has it, what are its results, how can it be circumnavigated?

Fig.C. 19 Deliveries to users in the South West;
changes to Fig.C.16 if Gloucester suppressed.



All figures in thousands

Fig C. 20

MERCHANT	INITIAL	1ST RUN	MODIFIED RUN	SWINDON AT OPTIMAL	SWINDON AT CUT IN	GLOUCESTER SOUTH WALES
Swansea	208	180	180	180	180	180
Cardiff 1	278	230	326	309	321	341
Cardiff 2	206	128	164	125	164	149
Newport	76	100	132	108	132	128
Gloucester	242	390	(200)	148	190	(0)
Bristol 1	622	512	526	394	499	408
Bristol 2	178	240	180	180	180	180
Bath	120	194	120	94	120	94
Poole	98	88	88	64	88(64)	64
Swindon	477	484	548	900	600(624)	930
Direct	521	480	592	544	572	572
Total	3026	3026	3046	3046	3046	3046
Total Cost	£1026	£977	£994	£940	£980	£952

At this stage we critically needed a model of the sources, changes and consequences of merchant power. Our existing model shows our present situation, our desired optimal and some indication of how to move from the one to the other given by the dual variables. But it was also clear that, behaviourally, certain positions were inaccessible and certain changes inadmissible. Ideally such a model would predict

- i) which paths were behaviourally admissible
- ii) which paths would alienate major sections of our market and/or merchants.

We now turn to the model developed in Section A.4 and B.3.

We consider first the CH/CV values for merchants shown in figures C.21 and C.22. It is seen that Bath has close identification with his customers and suppliers although almost totally isolated from other merchants. He is acting as a classical independent channel. The Bristol and South Wales group are fairly centrally

placed with respect to users, weakly cohesive and rather closely identified with suppliers. Poole does not side with either users or suppliers and keeps isolated from other merchants, a function, if nothing else, of his geographical position. Swindon experiences moderate cohesion but has little identification with his users wants.

MERCHANT CH/CV RESULTS FOR USER-MERCHANT: INITIALLY

CV
+2
+1
0
-1
-2

	SWINDON			
POOLE	GLOUCESTER	CARDIFF 1 BRISTOL 1		
	CARDIFF 2 SWANSEA	NEWPORT BRISTOL 2		
BATH				

-2 -1 0 +1 +2 CH

C.22

MERCHANT CH/CV RESULTS FOR MERCHANT-DISTRIBUTOR/DIRECT: INITIALLY

CV
+2
+1
0
-1
-2

POOLE	SWINDON			
	Swansea GLOUCESTER	NEWPORT BRISTOL 1 CARDIFF 1		
BATH	CARDIFF 2	BRISTOL 2		

-2 -1 0 +1 +2 CH

This extra data showed that the ^{Ko} purchase Gloucester and to expand at the expense of the South Wales merchants might have caused considerable hostility from them. By gaining a major share in Swindon and then increasing trade in South Wales, Bristol, Wiltshire and Poole a weaker amount of hostility might be felt from South Wales and Bristol and perhaps very little from Bath and Poole. But at this stage this information gave no information which casted doubt as to the correctness of the decision and quite a bit which supported it.

This was the situation at the end of the initial period in the South West.

C.4.2 : December 1967 : The Second Phase

Approximately twelve weeks later this problem was returned to. The following major changes had occurred.

1. As recommended, a 51% ownership of Swindon had been negotiated in principle. the paperwork was to follow.
2. As recommended Swindon was served direct from Coventry.
3. As recommended Swindon had engaged an extra salesman who would concentrate on the S. Wiltshire area, in order to increase the market.
4. As recommended Swindon had begun to try and penetrate further the markets in Bristol, Wiltshire, Poole and South Wales.
5. As recommended an attempt was being made to try and increase the direct trade from Coventry to merchants in South Wales.
6. Swindon trade had increased ^{to} an approximate annual rate of £520K, which is 30% of the way from the initial position to the cut-in point. Much of this increase (12%) had come from trade previously lodged with Gloucester. This policy was supported

by Coventry.

7. Agreements had been made between Coventry and Swindon for a detailed study of their stockholdings procedures as recommended.

8. Gloucester was still independent, though the rumours persisted.

9. Beta had been purchased by a competitor, but had so far maintained the status quo vis-a-vis merchants.

10. Considerable antagonism to Swindon's expansion had been experienced from all merchants, salesmen consistently reported that dissent was gathering on a large scale. A few orders which would naturally have been Coventry's had been placed elsewhere by merchants.

11. Merchants in South Wales were beginning to refuse to assist in the direct deliveries rationalisation until Swindon was 'taken off their backs'. They had little doubt that Swindon's expansion was backed by Coventry even though no official announcement had occurred.

At this time a strong demand was made by a section of the management to stop the change program in this area. Their argument was basically that notwithstanding the theoretical correctness of the plan in practice it was proving impossible to undertake.

They suggested continuing the direct deliveries campaign to South Wales to counter any effects from the Beta takeover. But elsewhere they suggested retrenching and perhaps reducing Swindon's throughput to an annual rate of £500K. This would mean Swindon being unlikely to pay back its cost in the foreseeable future.

At this time another survey of merchants attitudes was undertaken. This was done under the cover of a survey to investigate some marginal changes to the standard product range. The new CH/CV values are shown in figures C.23 and C.24. The most energetic movement is shown by Poole who has moved from a self imposed isolation to being a leader in the merchant's collective front against the changes.

C.23 MERCHANT CH/CV FOR USER-MERCHANTS ; 12 WEEKS

CV
+2
+1
0
-1
-2

	BRISTOL 2			
BATH SWINDON	BRISTOL	SWANSEA		
	GLOUCESTER	COVENTRY 2	NEWPORT CARDIFF 1 POOLE	

-2 -1 0 +1 +2 CH

C.24 CH/CV RESULTS FOR MERCHANT-DIST/DIR. ; 8 WEEKS

CV
+2
+1
0
-1
-2

			POOLE	
			CARDIFF 1	
	BRISTOL 1	CARDIFF 2 SWANSEA	NEWPORT	
BATH	GLOUCESTER BRISTOL 2			
SWINDON				

-2 -1 0 +1 +2 CH

This previous isolation from users has also shifted to one of determined close co-operation and co-operation with his supplies has suffered in consequence. An example of this frenetic enthusiasm is that previously Poole had never attended a Trader's association meeting for the South West. During this 12 week period he instigated the calling of two special meetings.

Another major deduction from the CH/CV values is the increased cohesion shown by the South Wales merchants accompanied by their closer identification with users. It is impossible here to separate the two issues of Swindon's expansion supported by Coventry and Beta's takeover.

The change seemed to hardly affect Bath and the only change reflected by Gloucester was an attempt to move closer to the requirements of his customers.

Swindon, as would be expected, is experiencing isolation; but appears to be compensating by close co-operation with both Users and Suppliers, i.e. Coventry.

The two merchants in Bristol provide a particularly interesting case to the extent that they seem to have been scarcely affected by the merchant movement in South Wales, if anything, moving slightly to a more isolated position. Bristol 1 has attempted to move closer to his customers and slightly away from his suppliers. Bristol 2 has weakened his co-operation with suppliers slightly.

Overall there is clearly some tension present in this region and there has been a certain degree of 'closing of the ranks' between merchants. The South Wales situation is particularly serious with merchants being encouraged by Coventry to go direct while at the same time finding users being enticed away by Swindon who is clearly supported by Coventry also.

An interesting symptom of the merchant movement were two letters received by Coventry complaining of the expansionist plans

of Swindon and signed as 'the merchants of the South West' followed by a typed list of their names. This demonstrates a sense of group feeling not previously existing.

Using this information the Coventry management made the following decisions.

1. To stop attempts by Swindon to expand further in the Poole area. It was known that this area was not very profitable and that the decision to expand there was mainly as a concession to Swindon who was keen on the idea.
2. To slow down considerably, expansion by Swindon in South Wales and to use this as a lever to gain merchant's trade and confidence. This confidence will be especially required when, as expected, the competitors who purchased Beta will also purchase Gloucester and use it as base for direct sales to users. It will then be possible to encourage the merchant cohesion experienced now and use it as a weapon to stop the loss of trade expected when Beta has been recognised and stocked with the competitor's products.
3. Expansion in Gloucester will continue and salesmen will be instructed to 'leak' that this is because of the expected takeover.
4. Expansion in Bristol and S. Wiltshire to continue at the same strength.
5. An Organisation and Methods study will be made in Swindon to try and cut office costs.

Thus the way that the decisions made with the attitudinal data differed from that without was in the precision made possible by the use of a sharper, instrument of analysis.

The analysis isolated South Wales and Poole as the main

sources of merchant cohesion and dissent, and attacked this problem in detail rather than by a 'blanket' policy of withdrawal.

C.4.3 : November 1968 : The Third Phase

Over the next twelve months, Gloucester was purchased by the competitor as a depot in the South West to serve mainly South Wales. Bristol 1 promptly switched all his trade to Alpha. Coventry immediately stopped shipments to Gloucester and promised Gloucester's users an excellent service with an added discount from Swindon. Most of the Gloucester trade was retained. The merchant antagonism melted away in South Wales and most of the Beta trade to South Wales was encouraged to come direct. Swindon extended markets in Bristol 1, Gloucester and Wiltshire achieving an annual flow rate of £730 K. The Bath merchant was forced to diversify into an associated field of agricultural components because of his drop in trade. A third small survey showed the CH/CV positions of the merchants as in Fig.C.25 & C.26. Notice that considerable cohesion still persists but they are more integrated in their relationships with supplies. Considerable bitterness remained between Bristol 1 and Swindon, but Bristol 1 was in a difficult position. Theirs was an old established firm with a manager/owner about to retire. Their business was steadily declining in volume and the firm was not an attractive takeover proposal. This merchant and his major supplier Alpha were clearly going to be a problem in this future. This fourth phase shall be returned to, after describing other work undertaken in the meantime.

Fig. C.25

MERCHANT CH/CV FOR USER-MERCHANTS : 15 MONTHS

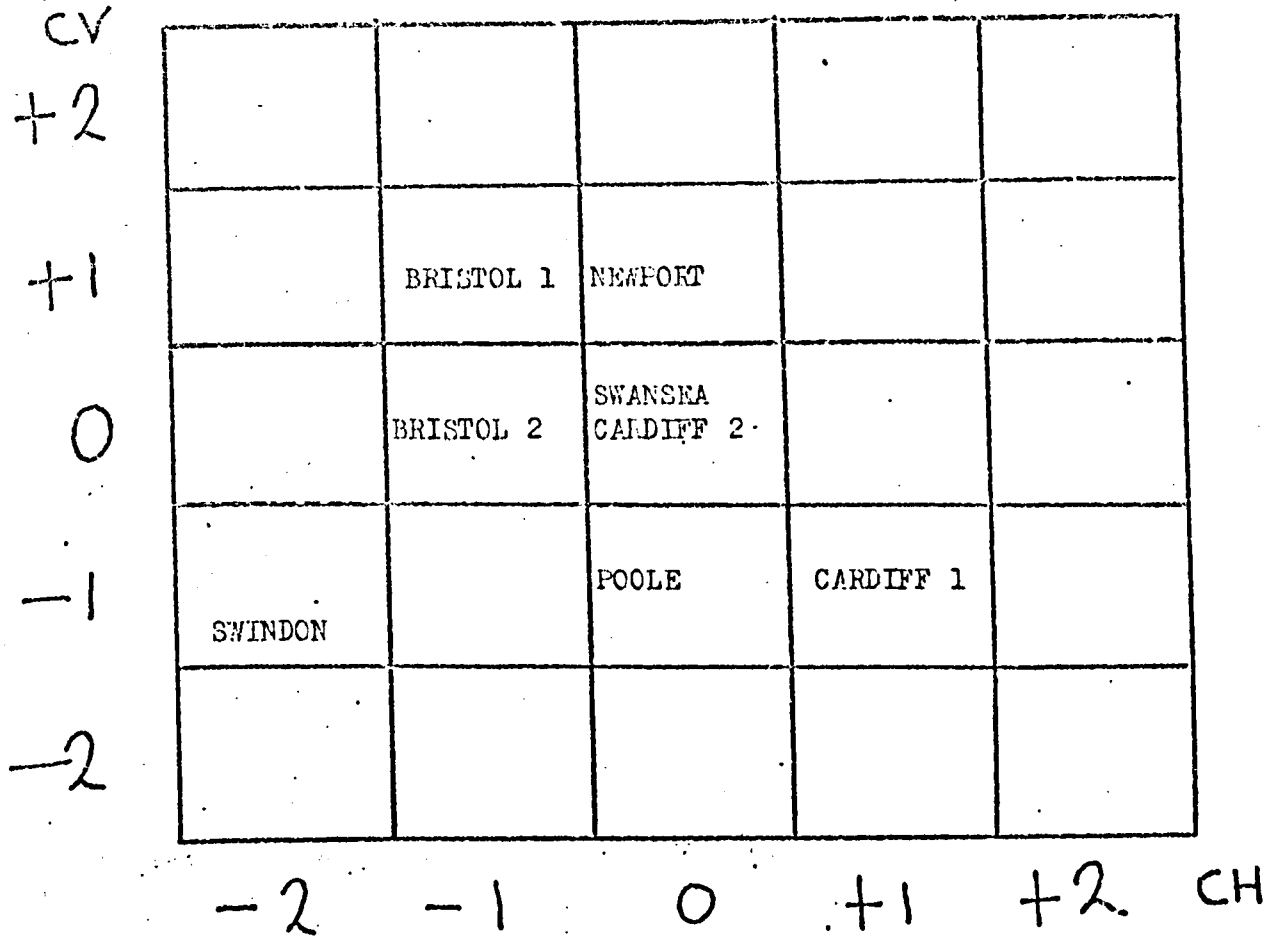
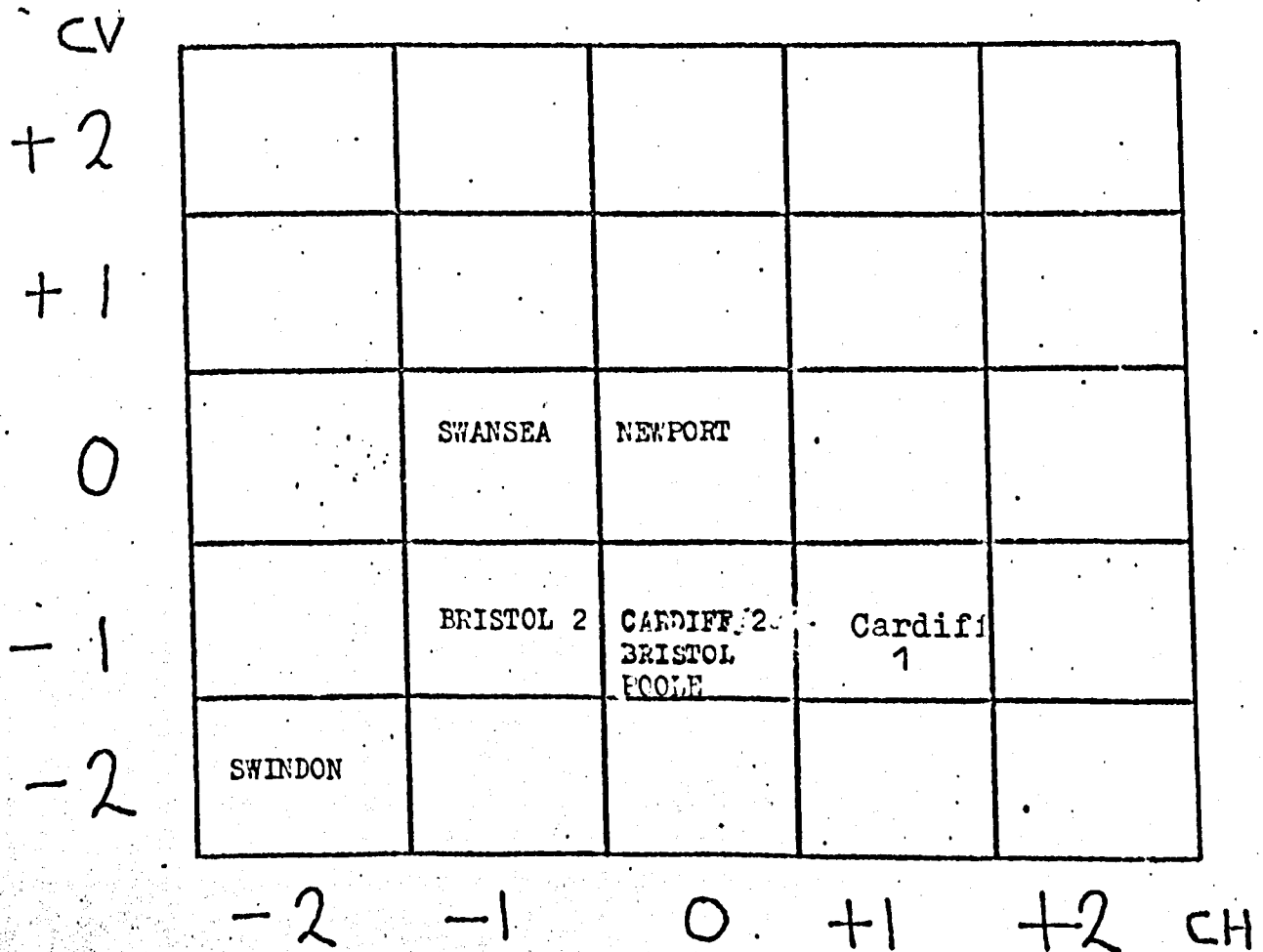


Fig. C.26

MERCHANT CH/CV FOR MERCHANT- DIST./ : 15 MONTHS



C.5 INITIAL NATIONAL STUDY

There was an immediate national problem concerned with the continued existence and ownership of the distributors. As explained there were three principal distributors Alpha, Beta and Gamma. Beta and Gamma dealt almost exclusively with the firm's components, whereas Alpha carried competitive lines, as well as another group of products which shall be referred to as α -products. Alpha had branches in Bristol, Birmingham, London, Newcastle, Glasgow, Manchester and Leeds. Beta had only one branch in Birmingham; Gamma had branches in London and Birmingham. Fig. C.27 gives the flows through these distributors as well as direct deliveries for each region of the country. It can be seen that Beta is the dominant supplier followed by Gamma. Note in particular the small contribution from direct sales.

Fig. C.27

OUTLET	ALPHA	BETA	GAMMA	DIRECT	TOTALS
REGION					
South West	922	975	248	881	3026
South East	540	1,880	2,140	470	5030
Midlands	1,104	2,470	1,406	480	5460
North	848	1,120	1,568	384	3920
Scotland	226	375	418	185	1204
TOTALS	3,640	6,820	5,780	2,400	18,640

all in £1000's

The characteristics of each distributor are briefly,

- Alpha
- 1) part of a larger concern
 - 2) has good management training etc.

- 3) deals in alternative product range of α -products to the extent of 45% of their turnover.
- 4) owns two merchant outlets and is thus in partial competition with their customers.
- 5) has experienced low growth recently and would like to enter new markets.
- 6) The distribution pattern for α -products is somewhat different in quantities purchased although almost identical in outlets used.
- 7) trade mainly with middle size merchants.
- 8) medium merchant penetration

Beta

- 1) autonomous company
- 2) Apart from one person, no valuable management; but has been run entirely profitably by him.
- 3) has maintained market share through difficult trading period.
- 4) trade especially concentrated on larger merchants.
- 5) higher merchant penetration, i.e. tends to have a large share of a merchant's business if he does any at all with him.
- 6) reputation for prompt deliveries.

Gamma

- 1) autonomous company
- 2) rather poor management
- 3) slightly declined market share recently.
- 4) trade especially with smaller merchants.
- 5) low merchant penetration but very large number of accounts.
- 6) reputation founded on goodwill towards present owners.

The Coventry management considered the existing three-tier distribution system was leading to an unnecessary waste of resources.

They believed that competitors thought this and that some changes might be imminent. It was necessary to try and evaluate the effects of alternative policies. The major policies under consideration were.

1. Purchase one or more distributors
2. Purchase strategically located merchants and by pass distributors.
3. Establish, via depots, an alternative distributive system and by pass distributors and/or merchants.

In order to investigate this problem and bearing in mind its urgency, a first model of the national distributive system was attempted. This neglected Scotland and the South West, both being rather special cases, and concentrated on the other three regions. Each one shall be investigated in turn; the analysis combined at the end. In fact all three were investigated simultaneously.

C.5.1 The South East : Initial Study

The demand areas for this region were taken as;

Oxford	Harlow	Croydon
Bedford	S.E. Essex	Brighton
Cambridge	Medway towns	Kingston
Luton	Dover	Guildford
Ipswich	Reigate	Solent
Chelmsford	Greenwich	Uxbridge
Luton	W. Ham.	Reading
St. Albans	Central London	Watford

Data was available for these 24 regions separately, but in practice they were always aggregated to never more than 12 regions.

There were 17 principal merchants with total throughputs as shown in Fig. C.28.

The flows from distributors to merchants are displayed in Fig. C.29; and the flows to users for all ranges are shown in Fig. C.30.

For clarity the actual quantities have had to be omitted.

Fig. C.28	ABC	DEF	TOTALS	DISCOUNT
Oxford	21	11	32	12½%
Solent	48	44	92	20%
Uxbridge	205	115	320	25%
Kingston	84	78	162	22½%
Watford	165	45	210	22½%
St. Albans	298	366	664	29½%
Luton	302	226	528	27½%
Harlow	312	202	514	27½%
London 1	61	21	82	15%
London 2	362	186	548	27½%
London 3	142	98	240	22½%
London 4	63	42	105	20%
Reigate	78	97	165	22½%
W.Ham 1	252	183	435	23½%
W. Ham 2	67	38	105	20%
S.E.Essex	95	42	137	21%
Rochester	52	33	85	17½%

TOTALS 2,597 1,827 4,424 all in £1000's

A detail for one merchant at St. Albans is shown in Fig. C.31 to help clarify the situation. Thus this merchant takes deliveries from;

Beta	£240 K
Gamma	£314 K
Direct	£110 K
	<hr/>
	£664 K

and deliveries as shown, the residual servicing the local area.

The first run of the program used twelve aggregate demand zones. No own depots were allowed but all distributors were present. The results of these programs are shown in Fig. C.32, which shows deliveries to merchants; Fig. C.33, showing deliveries to users for

ranges A, B, and Fig. C.34 the same for ranges E, F.

The merchant throughputs are shown in Fig. C.35.

Fig. C.35

Merchant	Initial Flow	1st run results	Changes	Modified Run	Changes
Oxford	32	12	-20	12	
Solent	92	80	-12	80	
Uxbridge	320	292	-28	240	-80
Kingston	162	92	-70*	144	
Watford	210	275	+65*	280	+70
St. Albans	664	462	-202*	512	-152
Luton	578	406	-172*	476	-102
Harlow	514	432	-82*	468	
London 1	82	170	+88*	100	
London 2	598	372	-176*	464	-134
London 3	240	152	-88*	156	-84
London 4	105	180	+75*	140	
Reigate	165	160	-5	166	
W. Ham. 1	435	390	-45	395	
W. Ham 2	105	135	+20	135	
S.E. Essex	137	122	-15	122	
Rochester	85	65	-20	65	
Direct Alpha	94	138	+44	146	+52
Direct Beta	0	244	+244*	0	
Direct Gamma	42	296	+254*	308	+266
Direct Cov.	370	560	+90*	621	+251
Merchant Total	4,524	3,797	-727	3,955	-579
TOTAL	5,030	5,030	0	5,030	

all in £1000's

Fig. C.29. S.E. England ; deliveries to merchants

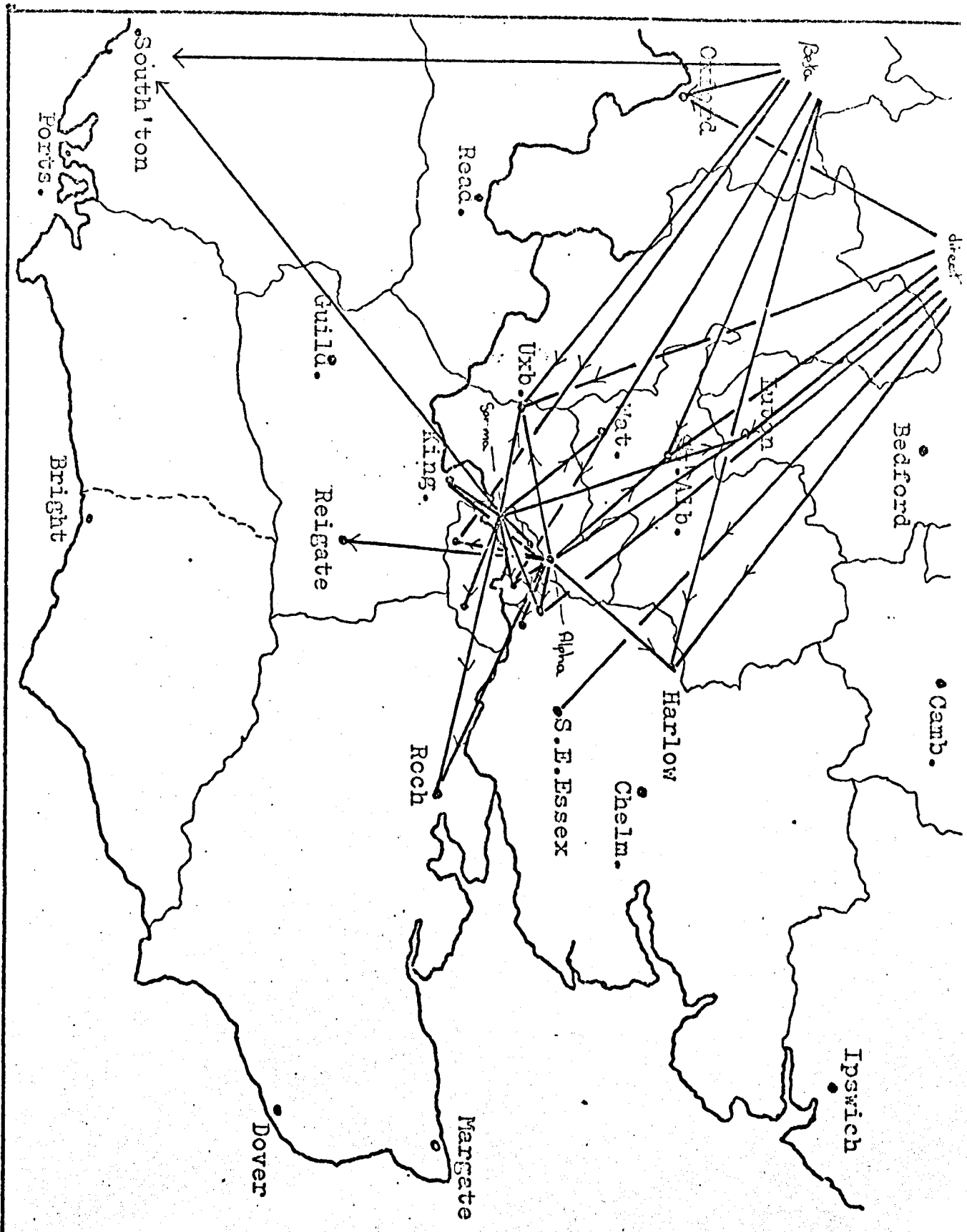


Fig. C.30. S.E. England: deliveries to users

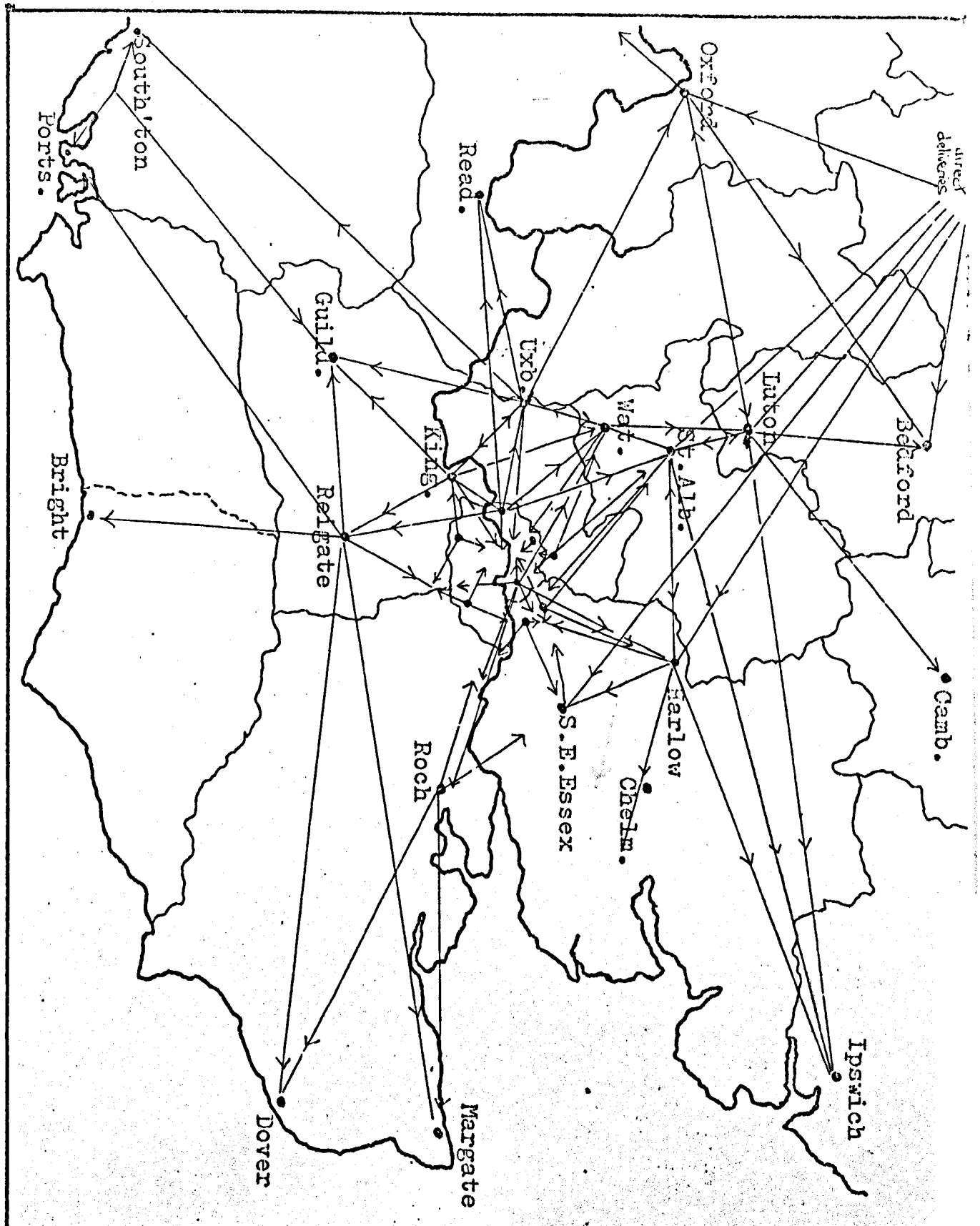


Fig. C.31. S.E. England; detail for one merchant.

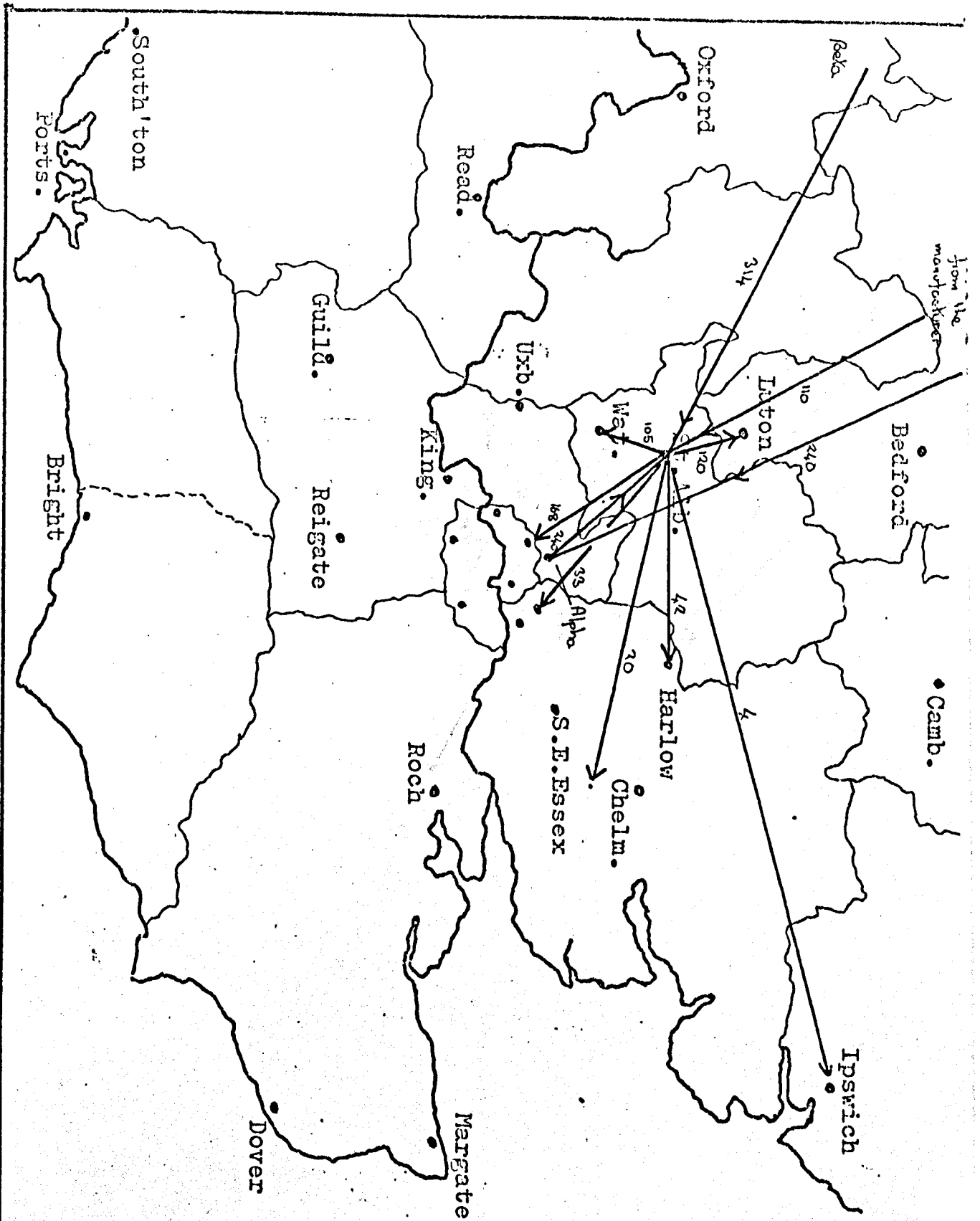


Fig. C.33. S.E. England. Principal deliveries to users for
A and B product ranges

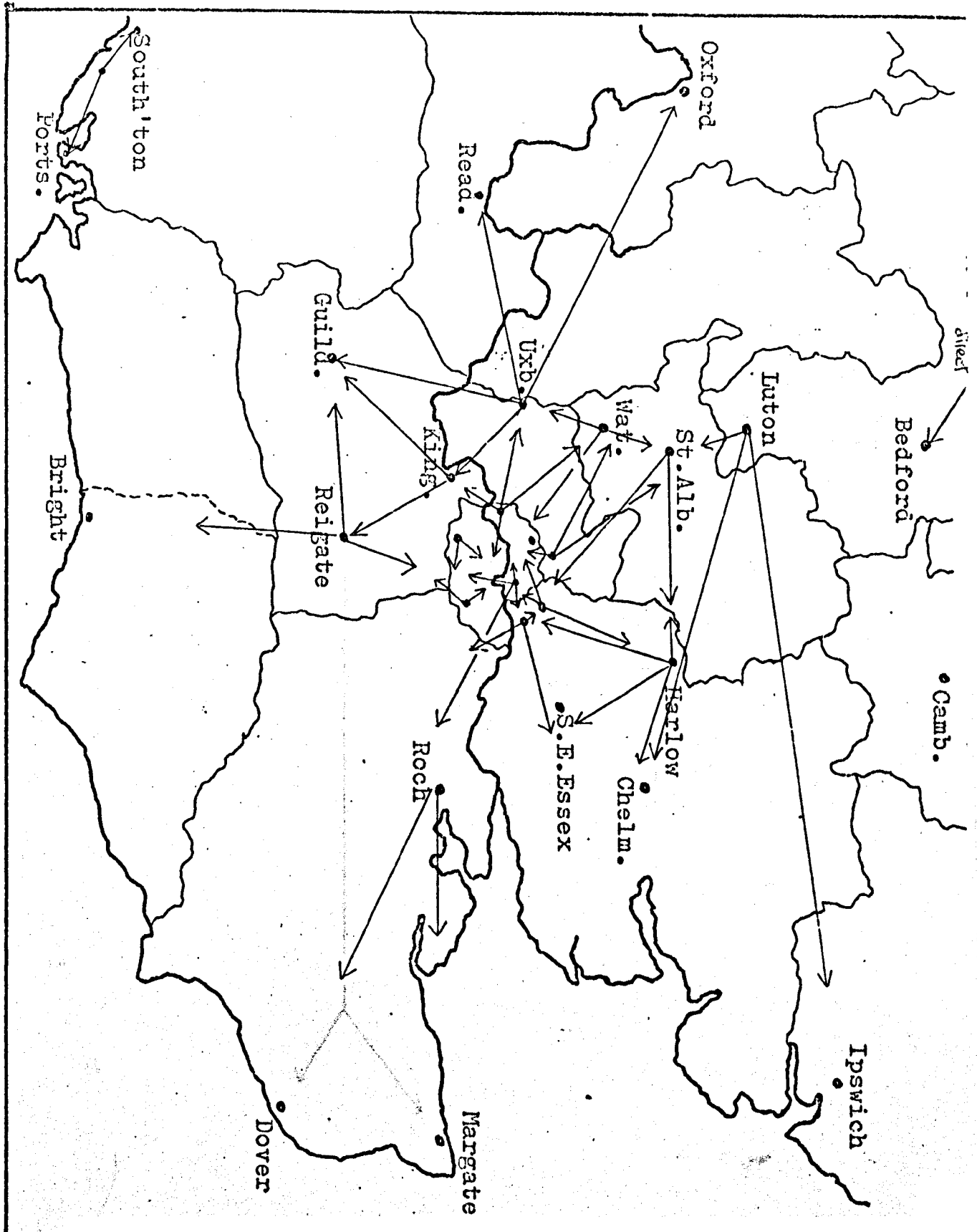
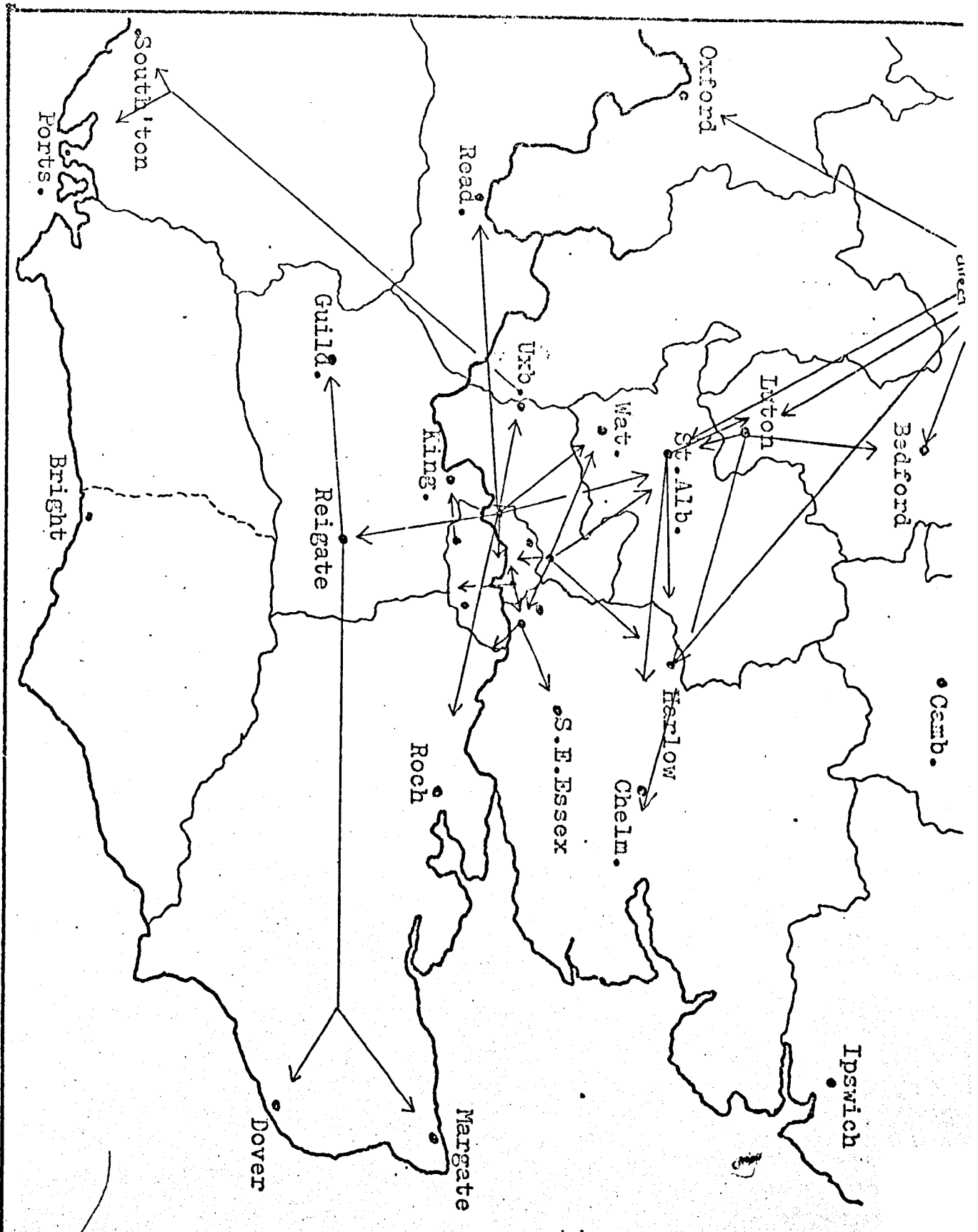


Fig. C. 34. S. E. England ; Principal deliveries to users for the E and F product ranges.



Again is seen a large measure of agreement between the program results and the actual situation. The major flow changes, those above £50,000 have been marked thus *. The most significant changes are the increased direct flows from distributors to users. These are detailed below.

	to Users	to Merchants	Total	
Alpha	138	932	1070	
Beta	244	1180	1424	
Gamma	296	1548	1844	
Direct Cov.	560	132	692	
Totals	1238	3792	5030	in £1000's

Thus for Alpha it is seen that direct flows have increased by £44K while deliveries to merchants have increased by almost £500K. Management considered that although in principle they accepted that this increase might lead to a cheaper overall policy it was far removed from being practical. In the short term, the Alpha organisation in London could not handle this quantity. Two decisions were thus made, firstly, a re-run with a limit of £800K on the total flow through Alpha, secondly an investigation of the area in which Alpha's London depot is situated for the possible establishment of a depot.

When considering Beta it is seen that although the direct shipments to users have increased, the overall flow has dropped sharply. It was Beta's policy to deal almost exclusively with merchants, and management considered the direct-user flow indicated to be an anomaly of the model, which is to be suppressed on a re-run. Of the remaining merchant deliveries a rather high proportion were of A, B, C product ranges, when Beta's policy is to try and deal solely with larger orders. It was decided not to take any action concerning this at that time.

Turning to Gamma's results it is seen that overall there has been a modest drop but the direct sales have increased substantially

by £352K. Although management thought that this would be rather a major change to contemplate they could find nothing intrinsically against it.

Considering next the merchant's results management were surprised to see the recommendation to reduce Kingston's trade as they had recently undertaken to try and assist this merchant who was trying to expand at the expense of Uxbridge. Uxbridge was partly owned by a competitor and it was management's intention to try and reduce their dependence on him. The program, though, slightly reduced Uxbridge's sales, gave some of that area's sales to Watford, but the bulk to direct shipments from Gamma. Thus Kingston sales in the Uxbridge area were cut as also were some local deliveries which were transferred to Gamma direct. Management then said that at the time they had considered the two possibilities of direct from Gamma or supporting Kingston, and had decided on the latter to show to merchants a policy of support rather than competition.

At this stage we decided on a re-run with the total sales to Uxbridge constrained to £240K.

Management agreed that a substantial reduction in the trade with St. Albans and Luton would be desirable because of their very high discounts. Also they agreed that the best way of achieving this would be as in the program results, that is to transfer some of the very large bulk production orders from that area, particularly from the motor manufacturers to direct accounts, either with Coventry or Beta. But, they argued, this is impossible for two reasons. Firstly, the orders are often call-offs. Secondly the strong relationship between the merchants and the large users in these areas. The first point it was agreed ought to be considered and it was agreed to transfer some orders in larger ranges to smaller ones consistent with the usual call-off's quantities. The second point is of the type considered below under the attitudinal data.

London was considered next and it was agreed that London 1 could not manage an increase of the order suggested. His premises and procedures were stretched at present; it was thought he was only managing his present level of activity because he kept abnormally high stocks. It was agreed to limit his total to £100K. London 4 was limited to £140K for the same reasons. It was also thought that Rochester might be purchased by a competitor so that results there were encouraging.

Taking all these considerations into account the program was re-run. The results are shown in the last two columns of Fig. C.35, the last column showing changes above £50K. The totals through distributors are now as below;

	to Users	to Merchants	Total
Alpha	146	654	800
Beta	0	1262	1262
Gamma	308	1743	2051
Direct Cov.	621	296	917
TOTALS	1075	3955	5030

The overall policy guidance decisions made from these runs were, considering the structure of the channels of status quo, that flow organisation requires changing in the following principal directions.

- 1) A reduction of about £460K in the trade through Beta for economic reasons.
- 2) An increase of about £260K in the trade through Alpha for economic reasons, although this would have been larger except for physical and organisational reasons.

- 3) An increase of about £450K in the direct trade to Coventry, £250K of this to be concerned with direct accounts and £200K with merchant accounts. This has important policy implications. An increase of this scale is effectively to serve notice that Coventry is quite prepared to distribute to all levels if discount rises make this an economic proposition.
- 4) Flows ought to be reduced to the Luton - Harlow - St. Albans merchants but a major problem arises as to how this is possible.
- 5) Some of the London merchant trade is better served direct from Gamma and Alpha.
- 6) Given a free choice and a suitable price, Gamma might constitute the best purchase. Alpha would be second but considerable extensions might be necessary.

The resultant costs of the first and modified runs are shown in the table below

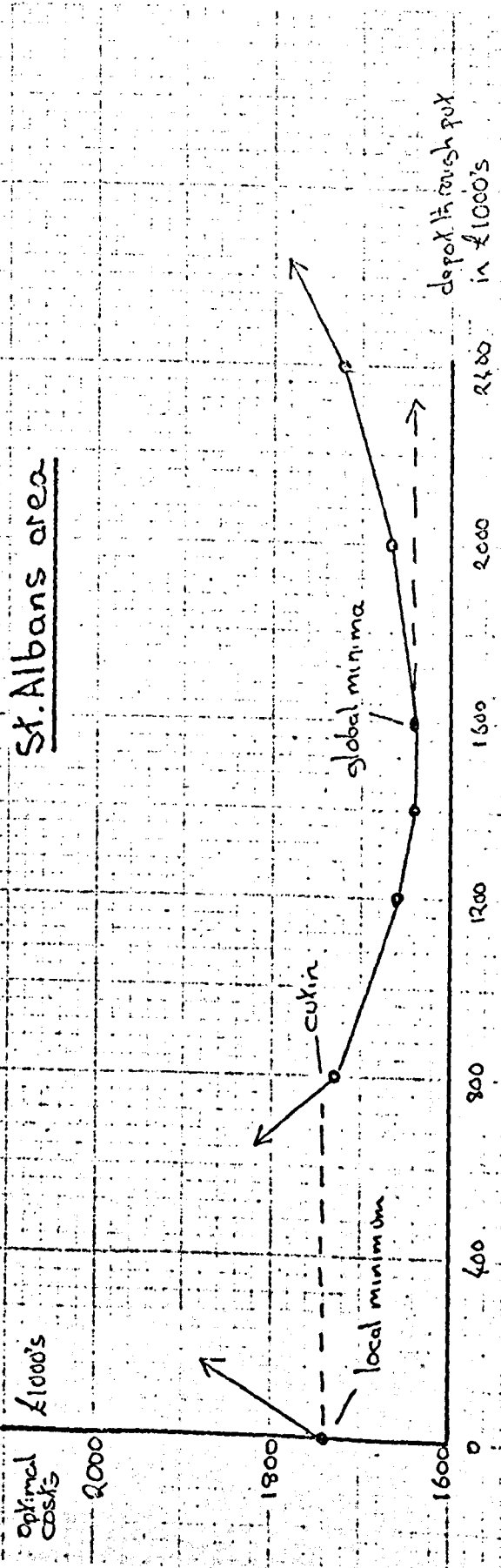
Initial position;	£1,872 ✓
1st Run;	£1,694 ✓
Modified Run;	£1,746 ✓

It was now necessary to investigate the effect of establishing depots in the region and the test areas were chosen, in consultation with management, as St. Albans, Kingston, W. Ham and London. Notice that there is little point in considering any point as a possible site, as for example in plant location problems, because the availability of local markets is a so much more sensitive aspect to the problem than transport costs. Initially one depot at a time was considered. The results will be presented in the same way as in the South West Study.

In Fig. C.36 and Fig. C.37 are graphed the results for the four areas.

**PAGE
NUMBERING
AS ORIGINAL**

St. Albans area



Kingston area

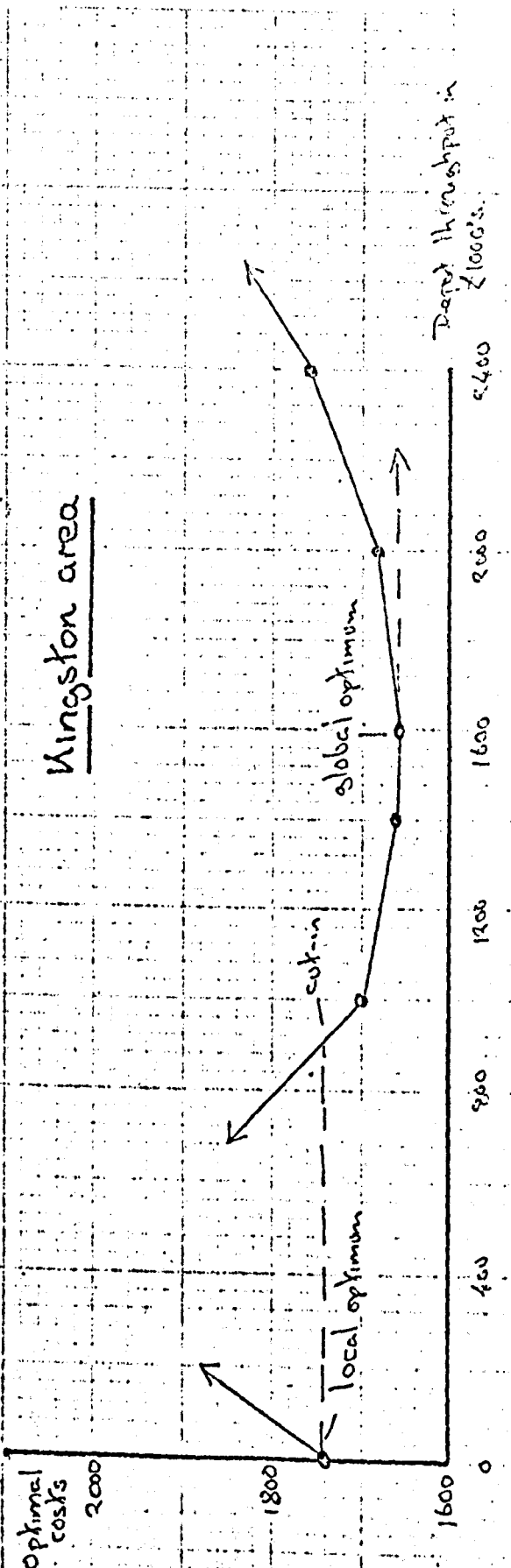
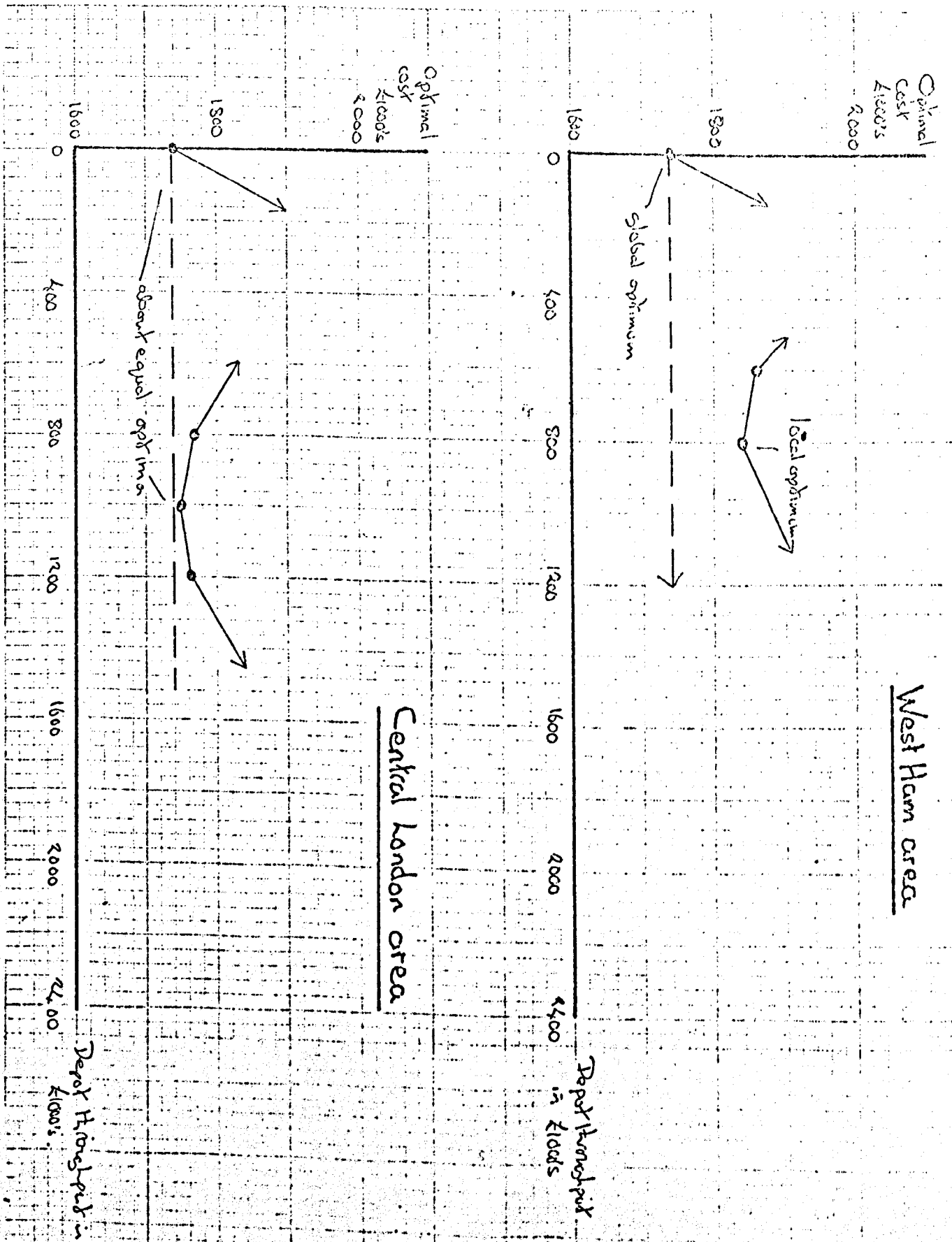


Fig. C.26



The West Ham area was rejected immediately, mainly because it never became near being an economic proposition.

All that was really happening was that the trade of the East London merchants was being transferred to float the depot. The critical areas in the North and South were barely affected.

The Central London depot was also rejected but after much more consideration. The reason it barely ever became economic was because of the substantial establishment overheads of running central London property. By the time enough trade has been switched to it to bring the unit cost per component to a economic level, it was becoming necessary to travel further afield to gain this extra trade. Consequently the contribution to unit cost from transport costs begins to move the graph upward again. Nevertheless there were business reasons for finding central London an attractive proposition, especially the possibility of extending a possible depot to also contain corporate headquarters offices. Against this, the transport manager indicated the impossible traffic conditions that would be experienced and it was really this factor along with the results for St. Albans and Kingston that secured management's judgment to reject this alternative.

St. Albans was the financially most attractive proposition, it was the cheapest, had a low cut-in point of £800K and remained the cheapest over a wide range until over £2,600K. Compared with this Kingston never became quite as economic, had a higher cut-in point of £840K and ceased to be cheaper at about £2,300K. Nevertheless the resultant costs of the two were sufficiently close to make a study of secondary criteria necessary. If these depot locations were being considered as indicators towards purchase decisions for Alpha or Gamma, then the situation is somewhat different. The flow to Alpha had already been restricted to £800K for organisational reasons. Thus using the present facilities to the limit would leave it only just at cut-in point, and major extensions to the property would have to be

undertaken before the full economic benefits would be felt. In addition, Alpha would be competing with merchants in the area where the merchant-user cohesion is the strongest, but more will be said of this below. On the other hand Alpha has already a flow of £94K direct to users which is the greatest of all three distributors.

For Kingston the last two points work in reverse, the area is more conducive to change but present user penetration is low. On the other hand the Gamma depot was used to handling trade of the magnitude required for efficient operations. The merchant flows for these two cases are shown below. These are shown for both cut-in and optimal values. The artificially constrained flows are marked thus *

Fig. C.38

Merchant	Initial Flow	Kingston Cut in	Kingston Optimal	St. Albans Cut in	St. Albans Optimal
Oxford	32	12	12	12	12
Solent	92	80	80	80	80
Uxbridge	320	215	165	240 *	205
Kingston	162	86	42	146	144
Watford	210	220	182	215	164
St. Albans	664	591	565	384	292
Luton	578	540	520	482	361
Harlow	514	514	482	493	464
London 1	82	100 *	100 *	100 *	100 *
London 2	598	421	260	562	441
London 3	240	130	105	184	162
London 4	105	130	95	140 *	130
Reigate	165	160	150	166	166
W.Ham 1	435	410	370	372	340
W.Ham 2	105	135	135	120	106
S.E. Essex	137	122	122	122	122

Table Continued..../

Rochester	85	65	65	65	65
Dir. Alpha	94	82	0	20	0
Dir. Beta	0	0 *	0 *	0*	0*
Dir. Gamma	42	0	0	22	4
Direct Coventry	370	177	20	305	92
Merchant Total	4,524	3,931	3,450	3,883	3,354
TOTAL	5,030	5,030	5,030	5,030	5,030

The evaluated outcomes of all of these alternatives were presented to management in the same form as described in the South West case. These took particular notice of the cash flows having quite a different profits in the case of the purchase of a merchant/distributor compared to that for a depot.

These options were shortlisted using roughly the following criteria.

- 1) Expected savings substantial enough to be worth making the change.
- 2) Is the liquidity position of the firm such as to make the expected cash flow feasible? This was particularly relevant because of the U.S.A. capital export restrictions operating at the time made it necessary to load as much of the cost as possible against the expense and maintenance accounts.
- 3) Is the level of risk acceptable?
- 4) Is action possible within the required time scale?
- 5) Do certain initialisation actions leave open the possibility of moving to several strategic options at a later stage?

At this point consideration was given to the attitudinal data, although at this time it did not significantly alter the attractiveness of the options shortlisted.

These are displayed in Figs C.39 and C.40 Little can be concluded from these before seeing how they change over time, but a general conclusion would be that horizontal cohesion is weak between channels and most channels see themselves fairly evenly placed between the demands of supplier and user. Of the geographical outliers Rochester and Solent identify more closely with users than suppliers. Oxford, right on the boundary of the region, has strong supplier links but is rather distant from his Users.

Using this information and supportive information of a similar type from the Midlands and North the following decisions were recommended at the initial stage.

1. Continue financial support for Kingston
2. Open negotiations with Gamma as to a purchase
3. Begin to increase Gamma flow but not substantially enough to increase Gamma's bargaining power. Make it clear to Gamma what the policy is.
4. Decrease sharply the flow through Beta, this having a high dual variable.
5. Investigate possibility of major market increases in Solent area.
6. Begin capital requisition procedures.
7. Substantial increases in the direct trade to Coventry from both merchant and user accounts, as shown in the modified run. Those in North London to remain, those in the South for possible transference to Gamma at a later date.

This concludes the detailed description of the initial study in the South East.

C.39

CV/CH FOR MERCHANT-USER : INITIAL POSITION

CV
+2

+1

0

-1

-2

LONDON 1				
OXFORD	UXBRIDGE			
LONDON 2				
KINGSTON	ST. ALBANS			
LONDON 4	REIGATE	WEST HAM		
ROCHESTER	S.E. ESSEX			
	SOLENT	WATFORD		
	LONDON 3	HARLOW		
		LUTON		

-2 -1 0 +1 +2 CH

C.40

CV/CH FOR MERCHANT-SUPPLIER : INITIAL POSITION

CV
+2

+1

0

-1

-2

LONDON 1	SOLENT			
ROCHESTER				
	ST. ALBANS	LUTON		
	UXBRIDGE			
KINGSTON	LONDON 3	HARLOW		
LONDON 2	REIGATE	WEST HAM		
LONDON 4	S.E. ESSEX			
OXFORD		WATFORD		

-2 -1 0 +1 +2 CH

C.5.2 The Midlands : Initial Study

Having reported on the South West and the South East in considerable detail, henceforth only an outline of the studies made in the other regions shall be presented.

Demand in this area was aggregated to 17 regions as below:

Birmingham (North & South)	Loughborough & Derby
Coventry	Stoke on Trent
Leicester	Tamworth
Northampton	Wolverhampton
Nottingham	Walsall
Peterborough & East Coast	West Bromwich
Leamington, Warwick & Stratford	Smethwick
Nuneaton & Bedworth	Shropshire
Wednesbury	

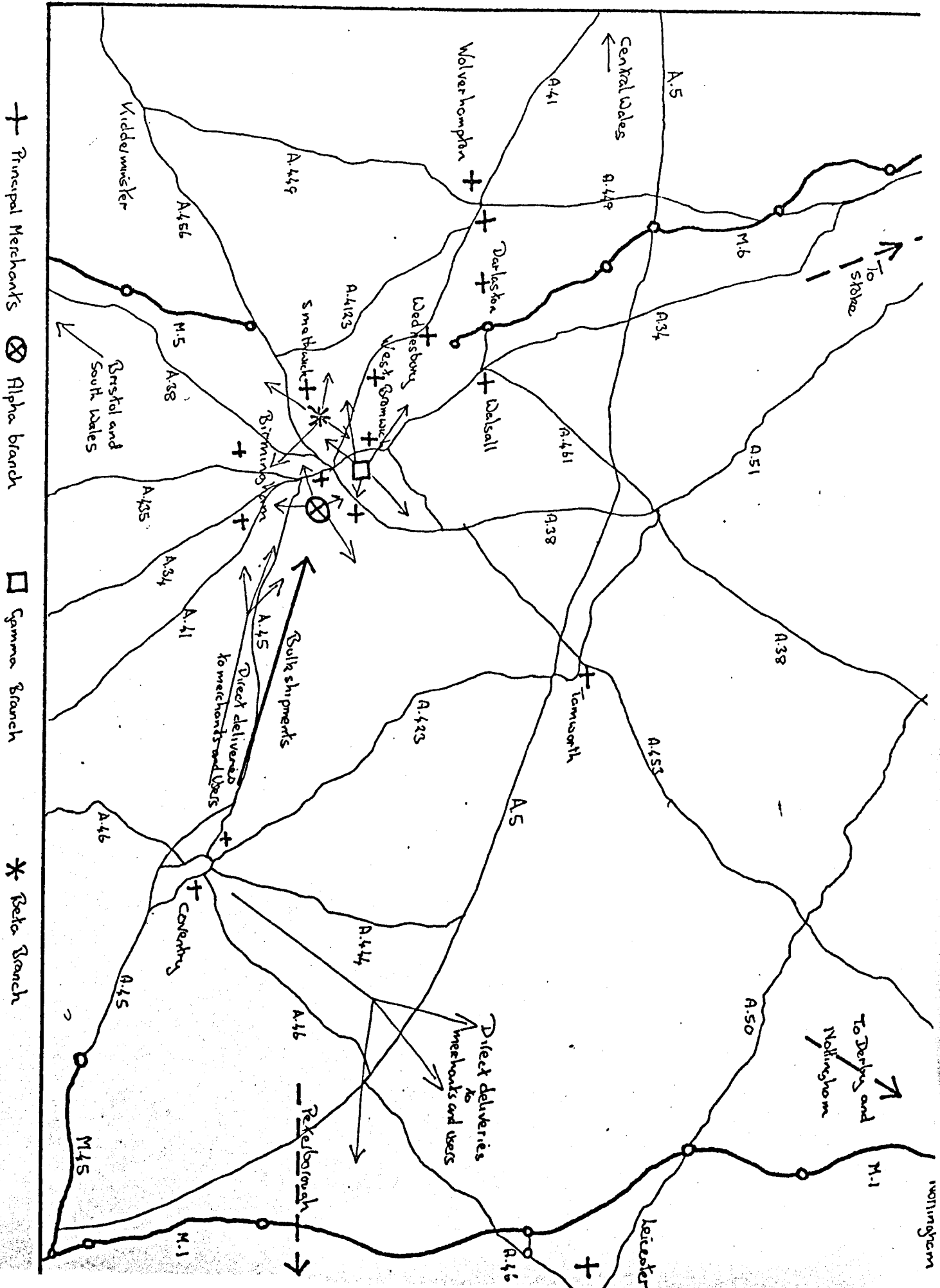
There were 21 principal merchants with annual sales as shown in Fig. C.41. A rough diagram of flows from distributors to merchants is shown in Fig. C.42.

The first program run did not include the depot case, and the results were inspected for abnormalities as in previous regions. When management had made the changes they thought fit the model was rerun with the results as shown in the last two columns of Fig. C.41.

The only depot options that were considered plausible at that time was one in either North West or South Birmingham, Initial investigations showed that the savings would not be exceptionally great. At the same time the possibility of raising enough finance, establishing the depot while still retaining most of the Merchant accounts was thought to be thin. Nevertheless the findings did show that if the purchase of a distributor or merchant was contemplated, then the best buy would be one in North

	Annual Usage	Discount	Modified program results Flow	Major Changes
Birmingham 1	624	28½%	462	-162
Birmingham 2	564	27½%	390	-174
Birmingham 3	210	22½%	230	
Birmingham 4	185	20%	105	-80
Coventry 1	364	25%	162	-202
Coventry 2	85	17½%	115	
Darlaston	62	17½%	94	
Leicester	440	25%	510	+70
Northampton	284	22½%	204	-80
Nottingham 1	164	20%	220	+56
Nottingham 2	92	17½%	146	+54
Peterborough	38	15%	44	
Smethwick	161	20%	120	
Stoke on Trent	98	17½%	90	
Tamworth	84	17½%	108	
Walsall	181	20%	210	
Wednesbury	441	25%	374	-67
West Bromwich 1	381	25%	310	-71
West Bromwich 2	272	22½%	243	
Wolverhampton 1	532	27½%	468	-64
Wolverhampton 2	148	20%	108	
Total	5410	-	4713	

Fig. C.42: The Midlands



West or South Birmingham capable of a throughput of £700K or £800K respectively with most of this originating fairly locally within Birmingham and the Black Country.

The required change in distributor flows from the modified program as shown in Fig. C.44. below.

Fig. C.44

	<u>Previous</u>	<u>Modified Run</u>	
Alpha	1104	1298	
Beta	2470	1421	
Gamma	1406	1384	
Coventry Direct User	110	437	
Coventry direct to Merchants	370	920	
TOTAL	5460	5460	all £K's

The cost of the modified program was £1,780K as against the previous cost of £1,910K; a theoretical reduction of £130K.

The cognitive variables within the merchant system did give some insight into the Midlands situation. These are displayed below in Fig. C.45 & C.46.

CV
+2

+1

0

-1

-2

DARLSTON NORTHAMPTON	NOTTINGHAM 2			
BIRM. 4 COVENTRY 2 LEICESTER	COVENTRY 1	WILTSHIRE 2	W.BROM 1	
STOKE PETERBOROUGH	TAMWORTH VOLV. 1	BIRM. 3 WALSALL WEDNESBURY	BIRM. 1 SMETHWICK	
	NOTT. 1	BIRM. 2 W.BROM 2		

-2 -1 0 +1 +2 CH

Fig. C.16

CV/CH VALUES FOR MERCHANT-SUPPLIER : INITIAL POSITION

CV
+2

+1

0

-1

-2

DARLSTON				
COVENTRY 2	COVENTRY 1	WOLV. 2		
STOKE BIRMINGHAM 4	NOTT. 2	W.BROM. 2	SMETHWICK	
PETERBOROUGH LEICESTER NORTHAMPTON	TAMWORTH	BIRM. 2 BIRM. 3 WEDNESBURY	BIRM. 1 W.BROM 1	
	WOLV. 1 NOTT. 1	WALSALL		

-2 -1 0 +1 +2 CH

It is seen that there are three merchant groupings.

Firstly the group in North Birmingham and the Black Country including Salsall, Wolverhampton, West Bromwich, Smethwick and Wednesbury. They are a tightly knit community of merchants and the best organised as a merchant body in the U.K. They are all well established traders, most with roots in the small scale foundry and engineering business. When the small concerns were no longer economic, many diversified into factoring, and thence into the merchandising business. They are in tight control of their local market and seldom make deliveries more than ten miles from base. They feel themselves well integrated with both Users and Suppliers and generally feel confident in their market position.

Secondly, the East Midlands group, including Peterborough, Leicester, Northampton and to some extent Coventry and Nottingham. Merchant cohesion is very low here and there is a considerable variance in the degree of integration felt by members. But notice that Peterborough, Leicester and Northampton form a sub-group with strong supplier affiliations. The East Midlands area is widely dispersed both geographically and by product usage, but demand is almost entirely within the replacement type. This is except for Coventry, of course, with a high demand for production quantities. Merchants are usually ex-salesmen starting their own business e.g. the one in Peterborough previously worked in Perkins, diversified ^{trucks} ~~trucks~~ ^{trucks} ^{often} after dealing in agricultural implements as well, or new entrants of the 'professional' type.

The third group are the remainder, Darlaston and Stoke with very low cohesion with other merchants and little integration with either users or suppliers. Both relied heavily on a local captured market and had entered merchandising from small scale engineering.

The principal conclusions and recommendations from this part of the study were as follows.

1. There was no justification within the region itself for the purchase of merchants or distributors. Nor ~~was~~^{would} the savings likely from a depot justify having this as a high priority in the short term. Nevertheless if considerations in other regions make the purchase of a distributor likely then it is preferably not Beta. The revised plan removed most of Beta's local trade and his distant trade is retained only by his efficiency, which ought to be able to be matched by the Coventry manufacturer. Out of the other two, Gamma is the least desirable, having exceptionally small premises in a rather inconvenient part of Birmingham, and no real managerial talent. Alpha on the other hand carries rather too much in the way of establishment. It has an overspacious warehouse with vehicle maintenance bays included, considerable, mechanical handling equipment and a large showroom for α -products. It has also a quite able managerial staff.

2. The only area where purchases of merchants would really be justified would be in the North Birmingham/Black Country area. At this stage it was felt to be much too serious a risk to possibly antagonise the strong merchant group here.

3. Direct sales from the manufacturer to the User should be encouraged. Of the increase of £327K given by the modified run £85K lies in the Black Country and ought not to be solicited. Another £170K, approximately, is spread in small parcels across the entire region and can be discounted. The remaining £170K are from Users in East Birmingham, Coventry and the East Midlands and it was recommended that attempts be made to increase this direct flow.

4. Direct Sales to merchants ought also to be encouraged. The rise of £550K recommended by the model, though, was thought to be somewhat optimistic. A breakdown showed the

key areas to be an increase of £310K to Nottingham 1 and 2 and Leicester. Note that £150K of this was recommended as new trade through these merchants anyway and practically all the rest is transferred from Beta.

Thus it was recommended that these increased flows be developed.

5. Good marginal profits are to be gained in the East Midlands if the market is there. This was deduced from the dual variables of the model. It was recommended that attention be concentrated on increasing sales in this area.

6. Although the model recommends reduction in the flows through Birmingham 1, 2, Wednesbury, West Bromwich 1 and Wolverhampton 1 amounting to a total of £538K, the cognitive data supported the marketing director's veto on any action on this front.

7. Immediate attempts can be made to effect the reductions recommended for Coventry 1, Birmingham 4 and Northampton. The cognitive data shows each of them to be fairly isolated merchants. This was another example where the cognitive data was used as a finer tool than previously available. Previously both Coventry and Birmingham would have been grouped as under (6), swelling the figure by £280K.

This ends the recommendations for the Midlands.

C.5.3 The North : Initial Study

Demand in this area was aggregated to 18 regions as below.

Manchester	Halifax/Huddersfield/Lewsbury
Bolton	Bradford/Feighley
Liverpool/Chester/	
North Wales/	Leeds
Bury/Rochdale	York
Sheffield	Humber estuary
Preston	Derlington
Blackburn	Teeside
Accrington	Tyneside
Lancaster	Barrow

There were 33 principal merchants with annual sales as shown in Fig. C.46. A rough diagram indicating flows from suppliers to merchants is shown in Fig. C.47. This region had the greatest number of merchants and demand areas even though the total demand was smaller than in either the South or the Midlands. The demand in this region was primarily for replacement goods and merchants tended to operate on rather a local level. Apart from two cases there is a marked absence of very large merchants such as are found in both the South and the Midlands. Merchants in this region are also frequently specialists in the needs of their particular industry, which is reflected in their range of stocked items.

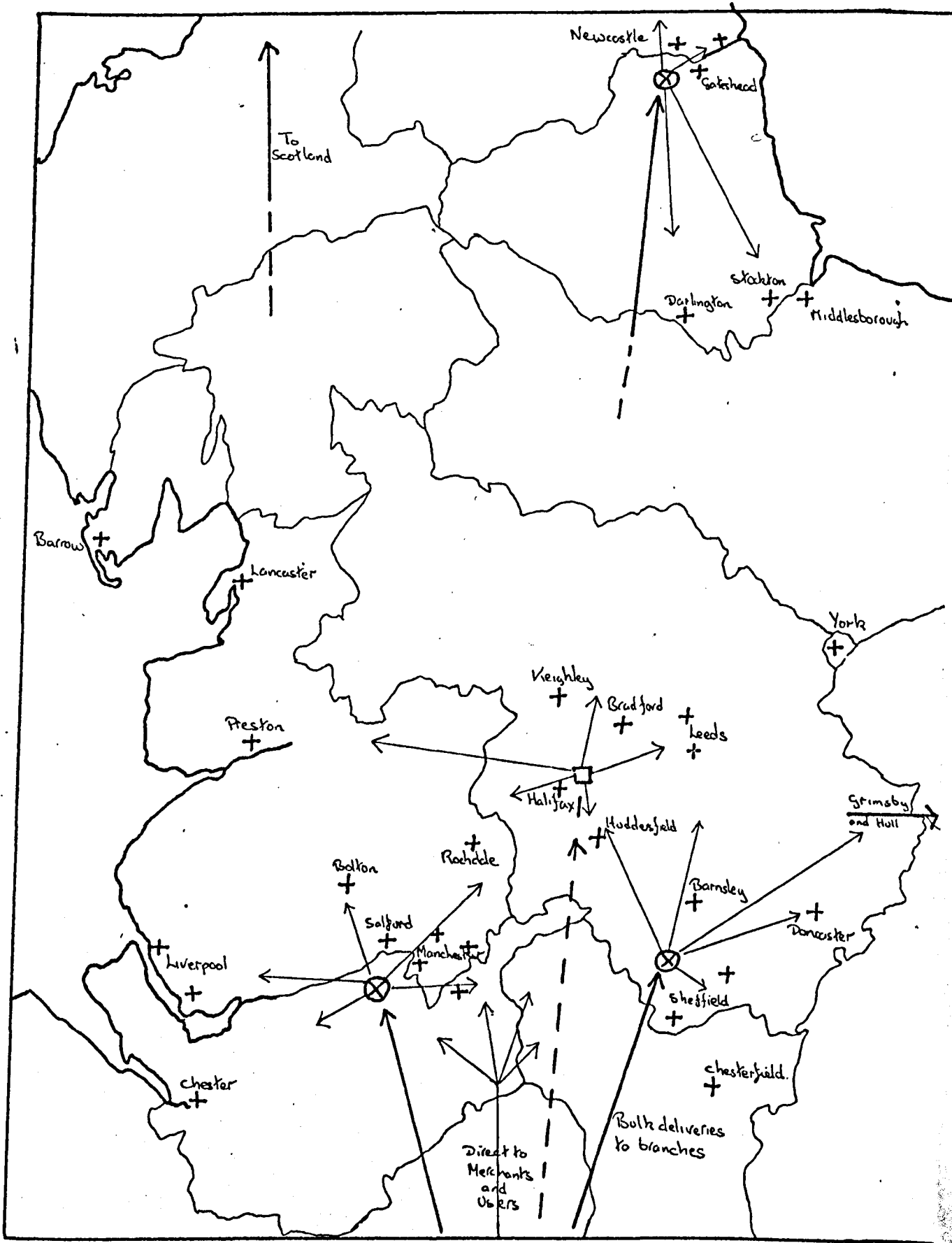
The first program results obtained for the non-depot case were discussed with management and the program suitably modified to be more realistic. The modified results are shown in the last two columns of Fig. C.47. The only depot cases that were considered worthy of attention were in Keighley, Halifax or Rochdale for the one-depot case and Leeds or Sheffield and Manchester or Liverpool for the two depot case.

Fig. C.47

	<u>Annual Usage</u>	<u>Discount</u>	<u>Modified Program Results</u> <u>Flow</u>	<u>Major Changes</u>
Lancaster	67	15%	80	
Barnsley	83	17½%	110	
Barrow in Furness	23	12½%	32	
Bolton	145	20%	189	+44
Bradford	162	20%	124	-38
Chester	31	15%	40	
Chesterfield	82	16%	84	
Darlington	74	16%	125	+51
Doncaster	104	18%	123	
Gateshead	84	17½%	62	
Grimsby	25	12½%	20	
Halifax	94	17½%	102	
Huddersfield	58	15%	83	
Hull	52	15%	84	
Keighley	52	15%	84	
Leeds 1	108	20%	150	
Leeds 2	156	20%	172	
Liverpool 1	184	20%	102	-82
Liverpool 2	161	20%	90	-71
Manchester 1	74	16½%	102	
Manchester 2	168	20%	129	-39
Manchester 3	152	20%	128	
Manchester 4	98	17½%	110	
Middleborough	110	17½%	132	
Newcastle 1	96	17½%	92	
Newcastle 2	54	15%	68	
Preston	362	25%	202	-162
Rochdale	81	17½%	124	+43

	Annual Usage	Discount	Flow	Modified program results Major Changes
Salford	124	18%	183	+39
Sheffield 1	166	20%	212	+46
Sheffield 2	414	26%	246	-168
Stockton on Tees	112	17%	138	
York	32	13%	40	
	<hr/>	<hr/>	<hr/>	
TOTAL	3810		3712	
	<hr/>	<hr/>	<hr/>	

Fig. C. 47 The North.



+ PRINCIPAL MERCHANT ⊗ Alpha Branch □ Temporary Gamma Branch.

The results of the modified run could be rather misleading and give the impression that the present situation is pretty near optimal apart from a few deviant flows. This would be a wrong conclusion, and arised because of the considerable number of qualifications and modifications that management found necessary to make after the first run. These were of mainly two types, firstly the distance effect. Because of the particularly local nature of merchandising in this region many results simply model the fact that most of the trade local to a merchant will be handled by him as at present. The exceptions to this in the results are either where more than one merchant services an area and hence the program has some room for manoeuvre, therecor the case of Sheffield 2 and Preston, the only two merchants in the regions that cover a wide territory.

The second main types of modifications were within order sizes and product ranges. We were asked to try and accomodate certain subset restrictions such as, the merchants around Leeds, say Bradford Keightley, Halifax and Huddersfield, would not handle more than a very small percentage of orders for large products in this region. It was traditional for the Leeds 1 and Leeds 2 merchant to do all the trading for there. By the time the analyst studied this Northern region decomposition methods were being applied on the model because;

- a) the model exceeded core capacity.
- b) random access storage was not easily available on the computer used.

But as is explained in Section B.2, using decomposition gives an opportunity to consider such 'spurious' constraints. In fact the time saving using decomposition seemed to be so significant as to make it a permanent feature of the model. Unfortunately in the day-to-day bustle of the change period any comparative work was out of the question. This had to be temporarily shelved.

The optimal pattern was the two depot case, with depots in Manchester and Leeds. It's nearest rival was one depot only in Keighley or Halifax. The Manchester and Leeds depots would serve both merchants and users. If restricted to merchants only then this option became much less attractive. A simple schedule of results is shown below in Fig. C.48. Management considered from these results that it was certainly worth thinking in terms of a depot rather than just a reorganisation of the existing system.

Fig. C.48

Option	Cost	£K
Manchester & Leeds serving Merchants and Users.		1,374
Halifax serving Merchants & Users		1,408
Keighley serving Merchants & Users		1,412
Keighley serving Merchants only		1,428
Manchester & Sheffield serving Merchants & Users		1,430
Halifax serving Merchants only		1,450
Liverpool & Leeds serving both Manchester & Leeds serving Merchants only		1,454
Reorganise flows in present structure		1,491
Initial position		1,532
		1,612

Now consider the cognitive data below.

CV
+2
+1
0
-1
-2

NEWCASTLE 2				
LANCASTER	CHESTER NEWCASTLE 1 LIVERPOOL 2	CHESTERFIELD SALFORD		
GRIMSBY YORK	BARNSELY GATESHEAD STOCKTON HULL	MANCHESTER 2 BOLTON SHEFFIELD 1 KEIGHLEY ROCHDALE	BRADFORD DONCASTER HUDDERSFIELD MANCHESTER 3	
BARROW	MANCHESTER 4 MIDDLESBOROUGH	LEEDS 2 DARLINGTON LIVERPOOL 1 MANCHESTER 1	HALIFAX LEEDS 1 PRESTON SHEFFIELD 2	

-2 -1 0 +1 +2 CH

Fig. C.50

CV/CH MERCHANT - SUPPLIER : INITIAL

CV
+2
+1
0
-1
-2

BARROW NEWCASTLE 2	CHESTER GATESHEAD MIDDLEBOROUGH	SHEFFIELD 1 LIVERPOOL 1 KEIGHLEY		
LANC. GRIMSBY YORK	BARNSELY STOCKTON HULL MANCHESTER 4	SALFORD BOLTON CHESTERFIELD DARLINGTON	MANCHESTER 3 DONCASTER PRESTON HALIFAX SHEFFIELD 2	
	NEWCASTLE 2 LIVERPOOL 1	ROCHDALE LEEDS 2 MANCHESTER 3 MANCHESTER 1	BRADFORD HUDDERSFIELD LEEDS 1	

-2 -1 0 +1 +2 CH

The characteristic groupings of merchants here are firstly the Leeds groups including Keighley, Halifax, Bradford and Huddersfield. This group of six merchants plus four smaller merchants not considered here, isolated by industry type and geography, have developed into a close knit community with well established norms of behaviour. With one exception they were founded by ex-workers in the woollen industry mainly between 1830 and 1890, although they were not necessarily founded to trade in the engineered component market. They are close to users but remain on co-operative terms with suppliers.

The second group is the nine principal merchants in Manchester, Liverpool, Salford, Rochdale and Bolton serving the SELNEC conurbation. Here industry is more fractionated with many new manufacturing plants, e.g. I.C.I, Shell and Vauxhall. Cohesion is still substantial but weaker than in the previous region. The vertical integrations and identifications are also more varied and less consistent. One gains the impression that cohesion could collapse under the right pressure. Further North there is the Ribble valley towns of Preston, Blackburn, Burnley and Accrington. Although there are major merchants in all of these towns the whole area is dominated by the Preston merchant. He was until recently a manufacturer but ^{has} now turned to factoring; only about 10% of his trade is in goods he had made, and another 35% is in factored goods which, under licence, he buys in bulk and packages under his own label.

Next is the North East, a region of diverse industrial activity and local loyalties. Cohesion is low and vertical integration varied. It could never be said that the merchants of the region constituted an informal association. If one was looking for signs of cohesion the natural place would be within the Tyne side and Teeside but this does not appear to be the case. The only indication of cohesion was Darlington who attempted to identify himself with Leeds, although he was not really accepted by them, and

a certain degree of 'within industry' co-operation. As an example, Gateshead who mainly serviced the Durham mining area had more to do with Darlington, who also had considerable mining business, than with either of Newcastle 1 or 2 who primarily serviced the shipyards and the newly located industries.

The Sheffield area including Doncaster, Rotherham and Chesterfield, but excluding Barnsley, were another tight group around the steel industry but without the intense local feeling of the Leeds group.

Lastley, there are the outliers, Lancaster, Barrow, York, Grimsby, Hull and Chester all mostly isolated and each really a separate case in themselves.

Given this new information the following recommendations were made for this region.

1) That establishing depots or purchasing merchants in order to service users directly should not be contemplated in any of SELNEC, Leeds or Sheffield areas, at least in the short term. This is because of the strong merchant cohesion in these regions and of their integration with users posing too great a risk of loss of business.

2) That it would be worthwhile though to consider an establishment to service merchants. Beta has no depots in the region, Alpha has one at Manchester and Newcastle, Gamma's salesman in the region has begun to keep small stocks of locally needed items in a couple of garages he has rented. Thus Alpha seemed to be the most attractive and Beta the least. By this time the S.E. region had begun to effectively force the final decision away from Alpha and towards Gamma, mainly because of the time scale involved and because of κ -products. Another problem in this region was Alpha owning merchants outlets in both Manchester and Sheffield and there would be problems regarding these, all

of which would take time to solve.

Perhaps the most crucial reason for preferring Gamma in this region is that at present it controls about 40% of the trade in the region. Whereas Alpha even with two depots has only 22%. Over 70% of the trade through Alpha's depots in this region being α -products.

Thus given Gamma as the most likely choice now but wishing to keep open the option of also purchasing Alpha a later stage management considered that the establishment of a depot at Keighley or Halifax serving merchants only was the best option.

3) Of these two Keighley was a cheaper solution and also land prices were considerably less than Halifax. Against this was the small enterprise of Gamma salesmen, which was at Halifax. Also bad weather access to Halifax from the M1 and across the Pennines to Selneby by the A.58 at present and the Transpennine motorway, then under construction, passing near to Halifax made this the final choice. Thus, as negotiations proceeded with Gamma, soundings were to be made in the Halifax region for suitable warehouse premises.

4) Informal approaches should be made in the North East to see which of the merchants there would be most attractive either to purchase or give franchises to. This was prompted by a belief that considerable extra trade was possible from this region and that it would be profitable to service it. The latter information being given by the dual variables.

These investigations must bear in mind the possible future purchase of Alpha and his depot in Newcastle. Of the existing merchants Darlington would seem to be the most attractive, and it was intended in this situation to exploit the lack of strong merchant cohesion in the area.

5) Attempts must be made to reduce the influence and trade of Preston, who with a 25% discount is making distribution in that

area very expensive. Just how this is done is uncertain especially because of his strong involvement with users. It was recommended that the analyst, the sales manager and two salesmen responsible for that area consider the problem at some length over the next few months.

6) Much of the trade in the Selnece region ought to be delivered direct from the manufacturer. This applies particularly to large production orders, which should be removed from the care of the Liverpool merchants and Manchester two and three.

7) Although the program recommends a major reduction in the trade handled by Sheffield 2, no attempt must be made to implement this until the disturbance caused by the possible takeover of Gamma has settled.

8) Trade passing through Beta should be bypassed and goods sent direct to merchants wherever possible.

This ends the recommendations for the North and is also the end of the initial period. There was now a gap of 3 or 4 months while these recommendations were implemented.

C.6 JANUARY 1968 : SECOND PHASE

Introduction

This time has been chosen as the second phase, because it was now that the decision was balanced on a knife edge. Also, another survey using the indirect instrument had recently been carried out, and all the information that was likely ever to be available was assembled.

The actual situation, of course, had developed and matured over the previous months and several actors had got themselves totally committed to one view. There was no longer a desire to explore all alternatives and jointly decide on the best available, now all the decision makers felt themselves on the defensive and identified with certain courses of action. It was now that the interplay of information from both economic and attitudinal data became of prime importance.

C.6.1 The South East

The results of the initial decisions were;

1. Kingston in fact requested very little financial support, appeared to raise capital by lowering stocking position.
2. Price of approximately £0.5 million agreed for Gamma.

Accounting details now being settled, plus complicating issues of assets owned by Gamma which are not really wanted. Although nothing official had been announced most of the market and Gamma's general staff were aware of the situation.

3. Start made on increasing Gamma's trade with merchants mainly with those discouraged to deal with Beta. The policy of increasing Gamma's direct user trade having to be stopped because of other merchant pressure.

4. A start made on decreasing flow to Beta. After one month Beta purchased by competitor. Immediately, there was a campaign to save this trade by offering good terms through any of the channels, direct, Alpha or Gamma.

Initially Beta had a £1,880 thousand trade with merchants. It was estimated that 4 months later i.e. 3 months after Beta takeover the annual rate of trade had split as below.

	<u>£K</u>
Retained by Beta	1,470
Direct - Coventry	90
Gained by Gamma	180
Gained by Alpha	140
Total	1,880

Of that retained by Beta, it was crudely estimated that £120K was committed to Coventry's products for reasons of technological incompatibility. Another £250K were also so committed in the short run, although redesigning was possible. And between £200K - £500K further could be retained by Coventry from product loyalty. Thus ^{an}immediate action of Marketing was to visit as many large users as possible to ensure them of continued support and technical service; and, in difficult cases, to drop hints of discount rises.

To retain merchants' trade, Coventry increased all AA merchants discount rates to 25% if they were not above this already. This decision was against the advice of the analyst study who considered that 'blanket' moves of any sort in this situation were inappropriate and certain to encourage merchant solidarity. With Beta's takeover this solidarity might help Coventry marginally, but Coventry's own changes were likely to be rather more drastic. At that stage every tool that could be used against an individual merchant would be needed. Merchants who had received an increase soon forget that they had, others, who had already had a 25% discount or more, remained bitter for a long time remembering that they worked hard to reach 25%.

5. No start was made before Beta's takeover and no manpower was available to do it afterwards.

6. These were begun with little success, until corporate H.Q. heard of Beta's takeover and recognised the seriousness of the position. The procedures then ran smoothly.

7. This action was submerged within the need to retain Beta's trade, which thus fulfilled this extra function.

Other actions during this period were;

1. The Solent merchant was purchased by a competitor. Although he gave assurances that he would continue to stock all brands within the foreseeable future it was clearly going to be unsatisfactory in the long run to try and service the expanding market there through a competitor's distribution channel.

2. St. Albans had begun to stock alternative brands to Coventry's, when previously it carried only the one brand. The quantities involved are minimal and is presumably to be interpreted as a threat, but with St. Albans having over £½ million of Coventry's trade and being a leader in the merchant community, the situation had to be carefully watched.

3. Severe merchant response to the takeover of Beta, as demonstrated by Beta already having lost over 20% of his merchant trade, with almost another 25% committed to leaving. Merchant response mainly focused by geographical area, especially North (London, St. Albans and Watford) and the East (S.E. Essex, the Hams and Harlow).

4. The Marketing and Finance directors on Coventry board coming under direct criticism for continuing with the policy, which could affect them the same as it did Beta. Marketing's own salesmen and sales clerks were the mainspring of this criticism but supported by engineering and production personnel.

The principal decision at this time in this region was whether or not to proceed with the purchase of Gamma. The model was rerun suitably modified by Beta's absence, the relevant discount changes

and with the knowledge that the purchase of Alpha was impossible in the short term, the clear favourite in economic terms was to purchase Gamma. But in the light of the fierce reaction experienced from merchants because of Beta's takeover opposition was growing to any attempt at vertical integration. The new cognitive data is shown below in Figures C.51 and C.52.

This data shows that the core of merchant dissent is focused on the two areas around St. Albans, the dissent leader, and Harlow. The two groups had begun to meet regularly and were developing plans for joint action in the case of any further incursion on their territory. These two groups were essentially separate but had had one joint meeting and had now institutionalised a habit of sending a representative of one to the other. Although collective action had arisen within the neutral territory of the merchant traders association, meetings were now held in members houses.

It would appear that little collective identity was felt by Oxford, Kingston, Rochester, Reigate, London 1 and Solent. The position of London in general was quite a surprise. Although from the outside one might consider London to be a natural focus for dissent in fact because of the lack of any common industrial purpose this is not the case. London 3 is in the East End and identifies with that group, London 1 is in the Croydon district and relatively isolated, London 2 and 4 both keep to themselves serving their own local districts.

Using this data management felt that the purchase of Gamma with its depot in the west of London could be undertaken with the following provisos.

- 1) It must service the merchant not the user level primarily.
- 2) The St. Albans and Harlow territories must be supported and respected.

Fig. C.51

CV/CH FOR MERCHANT-USER - 3/4 MONTHS

CV
+2
+1
0
-1
-2

LONDON 1 OXFORD	LONDON 2.			
	SOLENT REIGATE LONDON 4	UXBRIDGE	WEST HAM S.E. ESSEX	ST. ALBANS
ROCHESTER KINGSTON			LUTON WEST HAM3	HARLOW

-2 -1 0 +1 +2 CH

Fig. C.52

CV/CH FOR MERCHANT-SUPPLIER - 3/4 MONTHS

CV
+2
+1
0
-1
-2

LONDON 1 ROCHESTER			LUTON	ST. ALBANS
	LONDON 2 LONDON 4	UXBRIDGE	WEST HAM	HARLOW
KINGSTON OXFORD	SOLENT REIGATE		WATFORD LONDON 3 S.E. ESSEX	

-2 -1 0 +1 +2 CH

With these provisos acting as new constraints the model was rerun. The results showed us that to keep the purchase of Gamma an economic proposition trade would have to be taken from merchants in the South and West of the region. Thus the following decisions were made.

- 1) Finalise the purchase of Gamma.
- 2) Step up erosion of Beta's merchant trade.
- 3) Arrange visits to the Harlow and St. Albans group to explain the situation.
- 4) Remove support from Kingston.
- 5) Begin to erode the trade of Rochester, Reigate, London 1 and 4, Oxford, Kingston and Uxbridge.
- 6) Respect the position of Solent until alternative arrangements are possible.

C.6.2 The Midlands

The following actions had been taken during these months and since the final decision to purchase Gamma had been made.

- 1) Direct trade had been expanded in the East Midlands to Users.
- 2) Direct flows to the Leicester and Nottingham merchants had been encouraged and had increased by 25% of the annual flow.
- 3) A fierce campaign had been waged to secure as much as possible of Beta's trade after the takeover. This had not been so successful as in the South due primarily to this being Beta's home ground, but considerable gains had been made in the Black Country and manufacturers-merchant relations there were consequently extremely good.
- 4) and so on

- 4) The bargaining with Birmingham 4, Coventry 1 and Northampton had been made much tougher and many direct orders to Users solicited had been gained. Perhaps, 15% of the required decrease in the annual flow rate had been achieved.

The model was now run again using the new discount rates, and the principal effects of Beta's takeover. This time the purchase of Gamma was assured and no option on other purchases were included. The results again showed that as much of the Black Country trade as possible ought to go direct to users. The East Midlands pressure ought to be continued and as much of South Birmingham's trade as possible ought to go direct from users either through the small Gamma depot or straight to the factory. The dual variable on the Gamma depot size was particularly large showing that considerable savings could be made if bigger premises were available. The cognitive data is shown in Fig. C.53 and C.54 below.

In this case little was learnt that was new. The North Birmingham and Black Country group was strongly cohesive but still well integrated with both suppliers and users. An expected backlash had occurred from the East Midlands especially Northampton and Peterborough, but the cohesion was still rather weak.

The only way that this data affected the decisions recommended by the model was to confirm management's decision not to try and expand direct users trade in the Black Country. There was considerable opposition to continuing expansion in the East Midlands and in this case the cognitive data was used by both sides. One to demonstrate how far Solidarity had changed, the other to demonstrate that even so it was still weak. The final decision was made to continue expansion in this area but to increase the frequency of reviews of this policy.

Fig. C.53

CV/CH MERCHANTS - USERS - 4 MONTHS

CV
+2
+1
0
-1
-2

DARLASTON	NOTT. 2			
	COVENTRY 1 LEICESTER BIRMING.4	PETERBOROUGH TAMWORTH .		
COVENTRY 2 STOKE		BIRMING. 2 WOLVERH. 1 NORTHAMPTON	WOLVERH.2 SMETHWICK	WEST.BROM 1
	NOTT. 1	BIRMIN. 3 WEST.BROM2	WEDNESFIELD	BIRMINGH.1

-2 -1 0 +1 +2 CH

Fig. C.54

CV/CH MERCHANTS-SUPPLIERS - 4 MONTHS

CV
+2
+1
0
-1
-2

COVENTRY 2	COVENTRY 1	NORTHAMPTON		
DARLASTON 1				
STOKE	NORTHAMPTON LEICESTER	PETERBO.	WOLV. 2	
	BIRMING. 4	W.BROM 2 TAMWORTH BIRMIN. 3	SMETHWICK BIRMING. 2	W.BROM 1 BIRMING. 1
	NOTTINGHAM1	WOLV. 1	WALSALL WED.	

-2 -1 0 +1 +2 CH

C.6.3 THE NORTH

The following actions had occurred during the intervening months during which Beta's takeover had occurred.

- 1) A major campaign to capture as much as possible of Beta's trade had been undertaken since the takeover. In terms of the annual rate it was estimated that the situation was as below.

	<u>£K</u>
Retained by Beta	792
Direct - Coventry	194
Gained by Gamma	94
Gained by Alpha	40
	<hr/>
TOTAL	1,120

Of that retained by Beta it was estimated that £70K was committed to Coventry's products for technological reasons and another £50K so committed in the short run. Loyalty was more difficult to estimate but it was unlikely to exceed an annual rate of £50K.

Sales staff visited all the big users and all the merchants in the area assuring them of continued support from Coventry. The same increase to 25% for all AA merchants' discounts were given for those not at this figure. Again this was against the advice of the analyst as discussed previously.

- 2) Considerable increases in direct shipments had been gained in the South of the Selne region as recommend. Much of this was with the support of the Liverpool and Manchester merchants who were beginning to find that user discount erosion had so diminished their margins as to make some of the accounts of doubtful profitability to be serviced at a local level.

- 3) Some warehouse space within reasonable access of a major

road had been based near Halifax and orders had been placed for shelving and other equipment. One of the salesmen responsible for the area was effectively organising this on the spot.

4) Shortly after negotiations had opened with Darlington as to the possibility of a Franchise with him, he was purchased by a competitor. This left Coventry extremely vulnerable in the area and increased the urgency for the depot in Halifax. It was also another weight in favour of the purchase of Alpha, but by now the evidence had come down so strongly on the side of Gamma that it made little difference. Very little of Darlington's trade could be persuaded to either go direct, understandably as the line of communication was too long, or to deal with other merchants.

5) There had been strong merchant reaction to Beta's takeover generally but one merchant Sheffield 2 had strongly supported the move. He had switched some more of his trade to Beta and was beginning to try and persuade users to change to the alternative products. Other than him being a close friend of Beta's owner, no reason could be found for this. The consequence of his loyalty was that he caused significant antagonism against himself from other merchants and consequently suffered from considerable isolation.

6) Manchester 4 was purchased by another competitor, but up until this time little change had become apparent in the flows. He never had been tightly integrated with other merchants and little change was apparent here also.

7) Preston led a campaign of merchant protest against the establishment of the Halifax depot which he claimed was threatening him directly. Upon investigation it seemed doubtful how much the other merchants, Bolton Keighley, Rochdale and Salford really supported him. At this time the only actions had been in the

form of threats to withdraw business etc., no actual moves had occurred.

8) Because of the apparent threat to the Leeds area merchants, by the Halifax depot, a special Public Relations exercise had been mounted there which culminated in the signing of an agreement with the local Traders Association which offered financial support for the establishment of a local trades magazine. The cost to the firm was minimal, just a few hundred pounds.

Considering all these changes the program was rerun. The results were mainly a repetition of the previous results, but this time some experiments were done with suppressing either or both of Preston or Sheffield. The results were quite interesting and showed that most of Sheffield's trade could be serviced direct and via other local merchants at very little extra cost. Also that Preston's business could also be shared between other merchants and the Halifax depot. With Darlington now gone, the most likely merchant to support in the area was Stockton-on-Tees. The cognitive data was now as in Figures C.55 and C.56.

Using both the economic and attitudinal data the following recommendations were made.

1) To continue pressure on gaining direct orders in the Selne region, especially the South of that region.

2) To speed up the equipping of the Halifax depot and begin servicing merchants from there as soon as possible.

3) To encourage the growth of strong merchant feeling in the Sheffield area against Sheffield 2. Also when the time is considered right to begin to try and make users transfer their trade in that area to other merchants. This is likely to be a sensitive move and it was not agreed to among the Coventry Board without some reluctance.

4) Efforts must be made to recapture some of the Darlington business, and effort must also be given to ensure that the same

Fig. C.55 CV/CH merchants-users: four months.

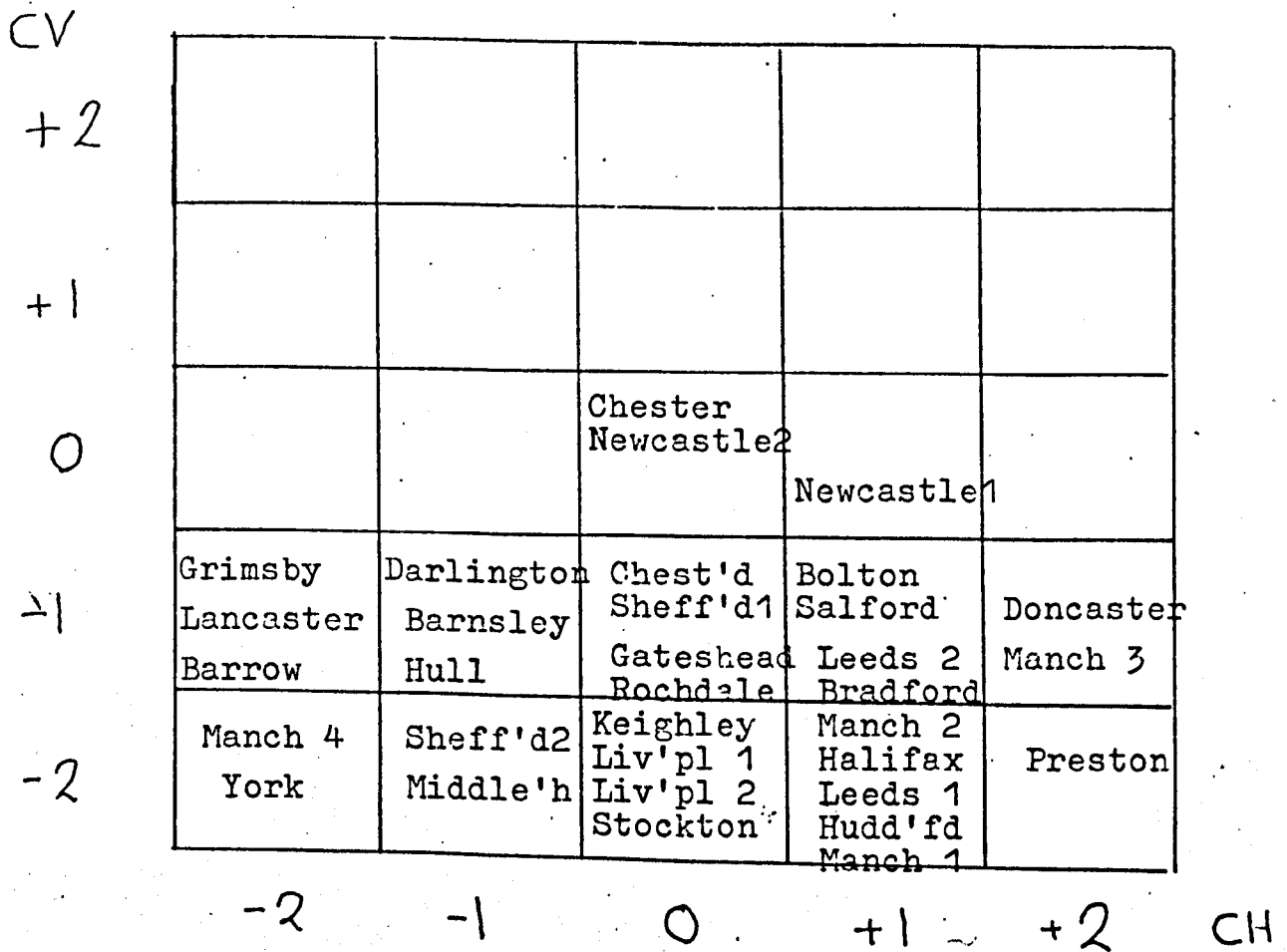
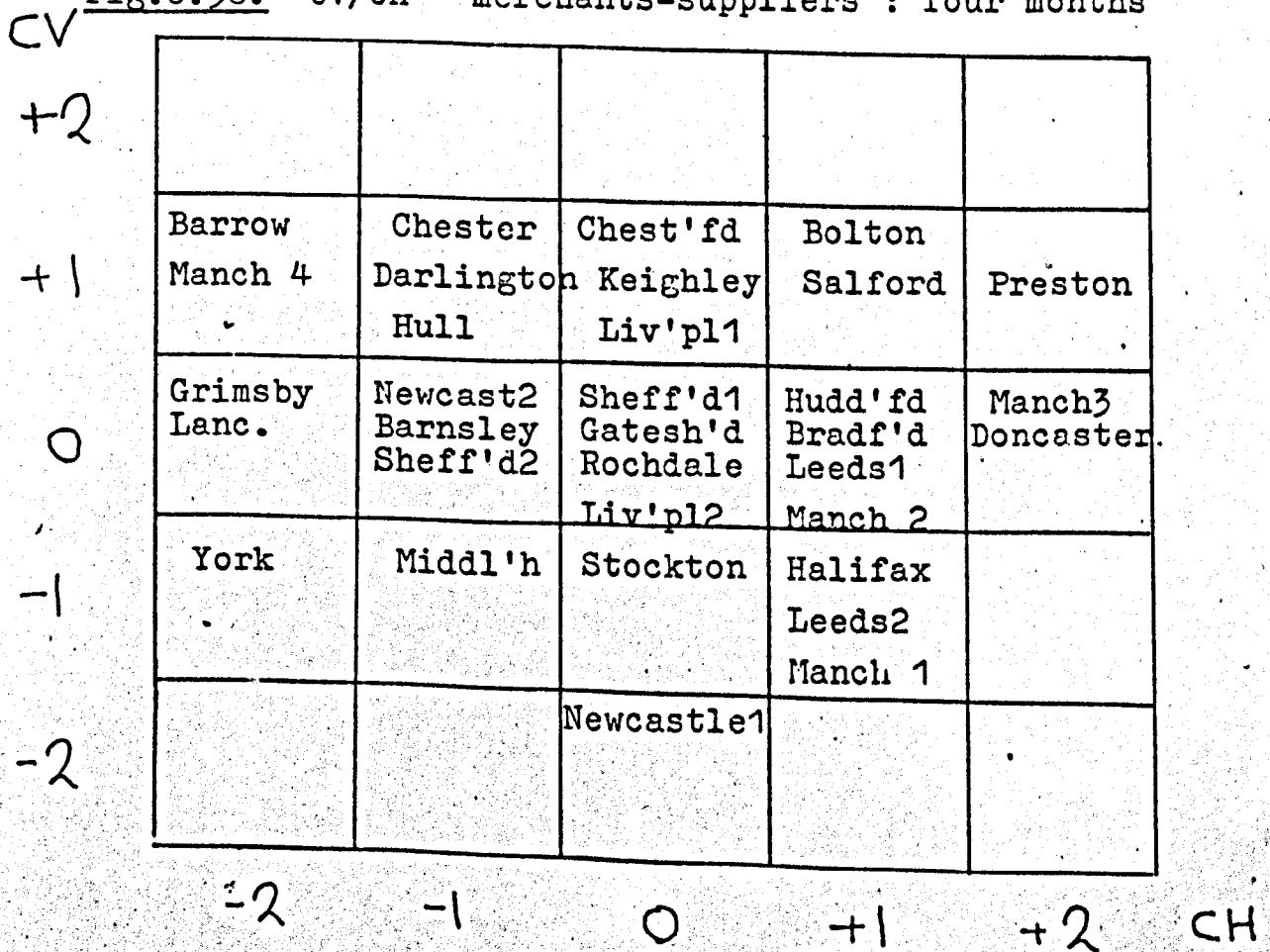


Fig.C.56. CV/CH merchants-suppliers : four months



does not happen with Manchester 4.

5) Talks must begin in the North East about where a dealership or franchise might be located now that Darlington had been lost.

6) Also in the North East the dual variables showed that it would be profitable to try and increase sales there if possible. The marketing personnel were asked to investigate this.

7) The analyst recommended that some tests ought to be devised to test the strength of support given to Preston by other merchants. Some ideas were put forward, but the Board finally decided that the risk was too great. Instead, Preston was advised that the Halifax depot was there to serve him and other merchants and would not be selling directly to users, other than to a few selected major accounts.

This ended the second phase of the national study. Although frequent minor decisions occurred, it was not until about eighteen months later that a whole cluster of major decisions arose. These will be treated as the third phase of the study.

C.7 JULY 1969 : THE THIRD PHASEC.7.1. The Changes So far

In the previous eighteen months the following principal changes had occurred throughout the United Kingdom.

1. The whole of Beta's distribution system had been absorbed into that of the competitor's which purchased it. A considerable amount of the business had been lost en route as shown below in Fig. C.57.

Fig. C.57

	<u>Initial Beta</u>	<u>Lost to Direct</u>	<u>Lost to Alpha</u>	<u>lost to Gamma</u>	<u>July 1969 Beta</u>
South West	975	442 *	47	0	486
South East	1880	240	268	461	971
Midlands	2470	218	330	132	1790
North	1120	115	82	212 **	711
Scotland	375	25	88	15	247
Totals	6820	1040	755	790	4205

(£1000's)

* including sales through Swindon

** including sales through Halifax

It was further estimated that between £100,000 and £400,000 of the trade remaining to Beta could be still secured on grounds of technological incompatibility.

2. Gamma had been purchased and integrated into the firms distribution system. This included the following.

- a) Dismissal of several excess employees in the London distribution depot, especially among the clerical staff.
- b) Rationalisation of sales staff, including reallocation of salesmen and sales clerks to customers and demand regions.

- c) Inclusion of Gamma employees on the firms payroll computer programs.
- d) Rationalisation of lorry routes and centralisation of lorry maintenance facilities. Sales of two excess vans.
- e) Integration of the Gamma administrative system to match the firms standardised procedures.
- f) O & M study of Gamma's office procedures, followed by considerable office reorganisation.
- g) Consolidation of stock, scrapping of obsolete lines. Integration of Gammas stockholding with the firm's computer controlled system. Datel 600, data transmission line installed.
- h) Reorganisation of management structure at Gamma to fit the firms management profile.
- i) A programme of consolidation of customer accounts embarked upon and partially completed.

3. The Halifax depot has been operating for over a year, an operation, that had included, amongst others, the following actions.

- a) Hire and training of personnel. Purchase of suitable lorries and equipment.
- b) Installation of administrative procedures for customer servicing and stockholding, both integrated via a Datel terminal to the firm's system.
- c) The reallocation of salesmen and sales clerks within the region.
- d) The consolidation of customer's accounts in the region.
- 4) The significantly enlarged Marketing and Distribution

functions within the firm made it necessary to reorganised the internal organisation of the firm.

Previously Distribution had been controlled by the Production

Manager, who also controlled the stocks of finished goods and raw materials. Now an enlarged Marketing function was established responsible for:

- 1) Salesmen and Sales clerks nationally
- 2) Overseas Marketing Operations
- 3) The Coventry Sales Office and Publicity departments.
- 4) Coventry's Finished Goods and Raw Materials stocks.
- 5) Maintenance of the lorry fleets.
- 6) Halifax depot.
- 7) London depot (from Gamma)
- 8) Birmingham depot (from Gamma)
- 9) Swindon Liaison and stockholding
- 10) Merchant and distributor liaison.

With this considerably expanded function, the marketing director increased his influence on the Board.

5) Several merchants had been purchased by competitors including in particular both Kingston and Sheffield 2. Preston had to some extent learnt to live with the Halifax depot. Gloucester had been purchased in the South West, Bath had diversified into an alternate product market and Reigate seemed to be doing the same.

6) In Scotland the key merchant had been purchased and a collateral agreement between the firm and Alpha had been made about sharing warehouse and office facilities.

7) Alpha had been suffering a business crisis, from the economic recession affecting α -products and the parent was considering some form of reorganisation.

8) Due to the economic recession the firm had been forced to cut indirect workers by 120 and direct workers by 80.

9) Not counting the capital expenditure of about £0.5 million on the purchase of Gamma, the firm had made a modest loss in the last financial year, compared with a substantial loss in the previous two years.

10) All the reorganisations had involved rerunning the model at various times as the situation had changed, and also another indirect application of the instrument had been carried out over Easter 1969. During this time the analyst had been partially involved with this work and partially involved with solving other problems arising within the Corporation.

C.7.2 Problems Outstanding

As it stood at that time there were several shortcomings in the distribution system. The principal ones are detailed below.

1) Notwithstanding the integration and rationalisation of Beta's captured customers with the distributive systems of both the firm and Gamma; the total duplication of a nationwide distribution system still existed with Alpha.

2) No satisfactory solution to the problem in the North East had been found. No merchants having been found satisfactory enough to be offered a franchise agreement.

3) The shared facilities in Scotland could only be considered temporary.

4) Competitors were making considerable strides in the Selner region, mainly at the expense of Alpha's Manchester depot. It was clear that better servicing of the area would be needed to maintain trade there at a satisfactory level.

5) The small Gamma depot in Birmingham was proving to be a bad compromise. Either a proper depot with adequate facilities was needed in the area, or the Birmingham trade ought to be serviced directly from Coventry. This was particularly true because of Beta's strong hold on this local market.

Considering all these problems, management requested that the analysis be resumed with the object of deciding whether to purchase or bypass Alpha. Both economic and attitudinal models

were used in the subsequent analysis that took until November 1969. The principal recommendations are given below.

C.7.3 Principal Recommendations for the Third Phase

- 1) That Alpha be purchased as long as the price is not much in excess of £900,000.
- 2) That the two wholly owned merchants of Alpha are not to be included in the above package in order not to alienate the merchant level in the particular regions where they were situated, viz. Leeds and Manchester. These two merchants had most of their trade with other products produced by the parent company owning Alpha.
- 3) That α -products be added as a factoring service to the whole of the firm's enlarged distribution system.
- 4) That in the short term rationalisation will occur between the two London depots. In the longer term more suitable premises may be needed.
- 5) That complete consolidation occur at the premises in Scotland.
- 6) The Manchester and Newcastle depots are developed as centres for all the trade in their respective regions.
- 7) That all the Birmingham regional trade be serviced from the Alpha depot and the small Gamma depot closed.
- 8) That the sales force, stockholding functions and administrative procedures of the two networks be totally integrated. This would mean that a proportion of the Alpha workforce would have to be made redundant.

Most of these recommendations were implemented during the subsequent months.

C.8 August 1970 : THE FINAL PHASE

By this time most of the recommendations made in the third phase had been implemented. The one major exception was the using of the Birmingham Alpha depot. The parent company intended to dispose of these premises completely and the part-used for warehouse and distribution would consequently not be available. The decision was taken to service all the Birmingham area trade by a consolidation of the Alpha Birmingham depot with Coventry's facilities. This caused even more redundancies than was initially envisaged. Some public reaction to these changes are shown in the press cuttings taken from the front page of local newspapers in Fig. C.58. All routes and customer accounts were then standardised over a period of months and the stockholding procedures centralised. With this major new addition to the firm's Distribution system the Marketing management was again reorganised and strengthened.

Over the previous year and currently the firm was making a steady profit and rapidly recovering some of its lost market share, despite the continuing economic recession. At this point the research project, which had already only been continuing in an advisory capacity for the previous year, was terminated.

C.9 CONCLUSION

During the two and a half years of the study the following major changes occurred either directly or as a consequence of recommendations made using the mathematical and attitudinal models.

- 1) The complete physical revamping of the distribution system involving the removal of all three distributors and many merchants.
- 2) The re-establishment of the firm, at least temporarily, from making a considerable annual loss to a reasonable profit.
- 3) The consequent internal reorganisation of the firm due to the increased emphasis on Marketing and Distribution.

Industrial Staff

~~Continental~~, in Coventry announced today that it is to make 140 workers redundant by the end of the month.

The redundancies, caused by a reorganisation of services, cover 110 indirect workers and about 30 production men.

The company's director and general manager, ~~Robert~~ said today that talks had taken place with the unions involved and were continuing.

In an agreement with the unions the company had said they would, in the case of any cut backs, reduce the amount of sub-contract work and overtime, and consider natural wastage, voluntary redundancy and re-training.

The redundancies are being made among the 1,200 labour force at the ~~Continental~~ works.

In a statement today, the company said that the recent acquisition of the distribution business of ~~Continental~~ Ltd. had provided a further opportunity for the company to broaden its field of distribution and stock-holding services through which the standard range of ~~Continental~~ and engineers' ~~Continental~~ were marketed in the United Kingdom.

~~Continental~~ is at present rationalising its newly-acquired warehouses and depots throughout the U.K. and adding the benefit of a large, centralised and computerised organisation for improved service.

"In addition to expanding its distribution business the company is also re-aligning its manufacturing capabilities to prepare for the expected increase in competition from Continental manufacturers," added the statement.

4) A complete shift in the attitude of management towards the objectives of the firm.

On arrival at the firm in 1967, a possible strategic option was to give a sole agency and withdraw from distribution.

On leaving the firm in 1970 a seriously considered possibility was to close the manufacturing facilities and use them for distribution of components imported from other members of the parent company.

PART TWO

SECTION D

SECTION D

THE APPLICATION OF O.R. TO DECISION MAKING IN
UNSTABLE ENVIRONMENTS

D.1	INTRODUCTION	341
D.2	CONSEQUENCES OF INSTABILITY	343
D.3	A GENERAL DISCUSSION	347
D.4	NINE POSSIBLE PITFALLS OF REASONING IN DECISION MAKING UNDER ACUTE TIME PRESSURE.	356
D.5	CHANGE AGENT RESEARCH	362
D.6	A DISCUSSION ON THE SOURCES OF INFORMATION	375
D.7	GENERAL CONCLUSIONS	378

D. THE APPLICATION OF O.R. TO DECISION MAKING IN UNSTABLE ENVIRONMENTS

D.1 INTRODUCTION

An unstable system is here taken to mean a system which it is anticipated is about to sustain a shock or change of sufficiently major proportions to force action to be taken at a strategic level urgently. Decision making in such systems differs in degree to decision making in more stable systems. These differences are principally;

- 1) A change in the quantity and type of information available.
- 2) A tendency of decision makers to choose between available alternatives rather than search for new ones.
- 3) A move towards decisions based on the individual decision makers power and influence and away from rational instruments such as the consensus.
- 4) The abandonment of longer term thinking in the pursuit of immediately objectives.
- 5) Finally a tendency of decision makers to become too committed to entrenched positions before the situation is really clear.

As the case study of section C proceeded it became clear that these differences of degree between the two types of decision making was forcing the O.R. analyst to adapt his behaviour towards the decision makers. This was not surprising because the classical O.R. approach to organisational design of letting a fairly detailed model of the system operate in a rather crude model of the environment is one which relies heavily on the assumption of reasonable environmental stability. It was the intention during the study to record the changes in behaviour forced on the analyst and to attempt afterwards to draw some generalisations on this material.

Discussions with colleagues and other practitioners beforehand tended to give the impression that the only practical help that O.R. could give in these situations, was a 'quick and dirty' study. This presumably meant that the analyst must be prepared to weaken his criteria as to what constitutes valid information for inclusion in the study and as to what conclusions can be taken as well-proven.

The results of the study tended not to support this view, identifying rather the principal changes in the analysts behaviour as being concerned with the relationship he maintains with the client decision maker.

The next section gives the framework for the discussion by giving more details about how instability changes the decision makers behaviour.

Then section D.3 passes to a general discussion before focusing on three areas in particular in sections D.4. to D.6 inclusively.

The statements made throughout this section are to be considered rather differently from those in the rest of the thesis. In section C the question under consideration was 'technological', a problem basically of design. Sections A and B were concerned with scientific description and explanation. Here the focus is on general 'methodological' conjectures, or guides to further research. No claims are made at this level of generalisation, other than our results provide supporting evidence for the conjectures.

D.2 CONSEQUENCE OF INSTABILITY

There ~~are~~^{is} a wealth of possible consequences of instability but we shall concentrate on those that arose most frequently during the empirical study.

1) Environmental instability.

This involves instability in what is recognised to be the environment, and in the shifting nature of the key variables defining it, making it necessary for model testing to be carried out in a wide range of possible environmental futures. Especially important are 'structural' changes, where the formation or dispersion of other formal organisations either of a competitive or co-operative kind become increasingly major components in decision making. A convenient description of this is a 'turbulent field', Terreberry (68) and concern L_{22} processes in the notation of Emery and Trist (65). Terreberry reports that both Drucker and Gardner;

"assert that the kind and extent of present day change precludes prediction of the future. Increasingly the rational strategies of planned innovation and long range planning are being undermined by unpredictable changes"

In this context we remember the dour prophesy of Cyert and March (63).

"As long as the environment of the firm is unstable - the heart of the theory (of the firm) must be the process of short run adaptive reactions".

In our study it was not found to be sufficient to deal with organisations within the environment as formally defined or to treat them as static phenomena. It was found necessary to consider relationships between organisations, and to treat the formation, weakening, strengthening or destruction of these relationships over time as critical factors in prediction.

The organisation behind 'merchant solidarity', however loose or informal, was nonetheless the key variable in determining actions and reactions within the distributive system. This same looseness and informality can result in the complete texture of the distributive environment changing without the firm's management being properly aware of it.

2) Instability of the actors perceptions and attitudes.

In a rapidly changing situation each actor's perception of his goals and the alternative options open to him are liable to frequent changes. Without a suitable period of time the actors fail to interact and influence each other, to gain an insight into each others' perceptions, to isolate conflicting goals and there is generally no time for a consensus to emerge. As information is often scarce, the importance of what is available is often exaggerated. Bizarre interpretations are often given to quite harmless information or actions, and as possible conflict is seen to approach polarisation occurs and the selective weighting of evidence begins.

In distribution, as change appears likely, business confidence and trust disappears, attitudes are realigned, and every action or piece of information becomes a source of speculation and debate usually aimed at reinforcing their new attitudes.

As circumstances change opportunities for personal goals change, and these can affect the actors preference for and perception of organisational objectives. But it is doubtful whether this is any stronger here than in any situation of organisational change.

3) Uncertainty concerning the availability and accessibility of information.

When considering unstable systems the following become increasingly causes of concern.

- a) The actual time available for information gathering is unusually limited.
 - b) Information concerning when the decision is to be made becomes particularly important.
 - c) Many sources of information are too slow to respond to changes.
 - d) External sources of information cease to be cooperative and many situations are so sensitive that merely the act of requesting information could severely change the position. Internally, sectional interests, fear, often justified, and claims of territoriality or 'empire building' causes information to be withheld or falsified deliberately. Thus when estimating the reliability of a source, we are forced to begin to consider the motives, for distorting the evidence, of that source.
 - e) Much information can no longer be obtained by direct measurement either because it is inaccessible or because its only manifestation is as actor's judgements. Here indirect methods of information gathering is necessary with all its attendant epistemological problems.
 - f) In the early stages of most O.R. studies it is quite common to be ignorant of what it is that information is needed about. But in unstable situations this seems to permeate the whole course of the work. This problem diagnosis aspect, of determining whether one phenomenon is a core problem or merely a symptom of a problem, is particularly difficult to make prescriptive comments about; being, as it is, so tied up with abilities and experience of the particular analyst.
- 4.) Most prescriptive models for strategic decision-making

move from strategic plans in general to tactical actions in particular. The assumption of a certain stability implies that tactical deviations caused by unexpected environmental influences can be accommodated within existing strategic plans. A stream of such deviations would feed back to a realignment of the strategic position over a period of time. Being in an unstable situation seems to force a different pattern of behaviour though. It is typical that a series of tactical changes are the first significant warning that the organisation received concerning the approach of a sudden change. Organisations will typically ignore the need for a strategic overhaul and entrench their position with a series of piecemeal provisions. Thus a situation can occur where a decision is needed which is not catered for within existing strategic plans but there is no time to restructure these plans. In such a case it cannot be assumed that the sensitivity of future strategic positions to this decision is low. This one tactical decision can determine to a considerable extent what strategic options remain open. In section C, a competitor made a bid for one of the firm's distribution outlets. The immediate response to the decision, although by itself scarcely a strategic decision, significantly affected which long term options remain open. The result of that decision was a major factor in whether or not it successfully moved into the distribution business or concentrate on remaining primarily a manufacturing concern.

Thus a summary of this point would be; that the relationship between strategic and tactical decisions becomes more complex in unstable situations and the direction of cause and effect influence less a predominately one way affair.

This concludes the list, but two points must be borne in mind when considering it. Firstly it is not meant to be exhaustive, but rather reflects the factors that arose most frequently in practice. Secondly, none are unique to decision making in unstable environments, they just appear more urgent and important then.

D.3 A GENERAL DISCUSSION

A client decision maker may request help from an O.R. analyst for many reasons, but two in particular are usually present. The first is his skills and experience, and the second is that he is anticipated to make a scientific attack on the problem. It is the second that we shall concentrate on here. The request for scientific procedures is really a request for more confidence in the criteria used in decision making, for what is to be accepted as valid information or deductions concerning the situation.

The core problem here is what, if anything, happens to the use of concepts such as information, verification, hypothesis, production, proof, facts and judgement, all of which are accepted terminology when discussing decision making; when the time in which the decision is to be made becomes a dominant factor. There would be no point in discussing this matter unless we suspect, as we do, that pitfalls of reasoning await the decision maker. Pitfalls that is, where potential danger would have been lessened had there been time to reflect on the implications involved.

D.3.1 Facts

On entering a situation an analyst is confronted with several actors intent on telling him the 'facts', usually different versions, and he is then expected in return to 'get at the real facts'. Thus the analyst's task is seen as attempting to approach what is 'really there already' although we are not quite sure yet what it is. This causes no trouble when calibrating some existing model. It is not intended to underestimate the statistical problems involved here but the point is that there are few sources of confusion about what the problems are. If time pressure forces a smaller sample to be taken, then problems do arise with statistical

estimation and inference, but they are of a type which a statistician would be used to handling.

Quite a different situation is met with in the theory of distribution channels when we talk of merchant power. This attribute is seen in the minds of actors to transcend the limits of an individual merchant or retailer and is a property of the collectivity of merchants. Before it makes sense to design and instrument to calibrate this power some thought must be given to its existence. It might well be a shared delusion on the actors part which has developed as a defence mechanism to protect themselves against attacks on their own lack of retailing competence. It is maintained either consciously or unconsciously by a fear of retaliatory action in the market place if they 'step out of line'. Retaliatory action which is pushed forward on a wave of 'merchant power' in itself merely a mental construct of their own. The analyst can refuse to share the delusion and find it impossible to follow the rationality of their future actions. Or he can remember that a certain group of people among the actors suffer from this delusion, if that is what it is. By moving firmly into retailing and finding no reaction from merchants comparable to what would be expected from merchant power, he might attempt to explode the myth. But the actor's conviction is likely to have been rather weak in order to agree to such a move. Thus a case could be made that the very act of being allowed to test the myth went a long way towards destroying it. Thus a 'fact' becomes an opinion that we feel no need at present to question.

The point here is that it is difficult, or maybe impossible, to give a reference to the term fact which will be independent of the language used to think, speak or write about facts. The serious problem with the 'merchant power' concept is that given a reasonable span of time then doubts would arise, questions might be asked and a

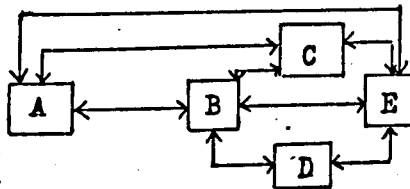
spirit of investigation or enquiry might grow in order to gain empirical evidence of the phenomenon. But under acute time pressure actors mentally recoiled from the idea of questioning a basic belief. As the ground starts shifting, he relies on supports found safe by experience and about which there was a consensus of opinion among actors of its correctness. Here we are suggesting that not only did actors require something immobile to rely on but that this psychological need for support produced three derivative states of mind. Firstly it provided a means of simplifying the situation, an opportunity eagerly grasped. Secondly it made actors develop motives for distortion of the evidence that was available and potentially damaging to the belief. Thirdly it imposed a petrification on critical questioning. Probing and searching for truth and illumination in that area was stopped. Rather, it did not have to be stopped because there was no perception of the need ever to have begun it. Why search for truth when truth is obvious. This attitude spills over onto the analyst. Firstly he is unlikely every to doubt, ^{seeing} how firmly actors believe and remembering his own motives for accepting simplifications to make his job easier.

Secondly, if he does question he will be accused of wasting time, confidence in his judgement will drop, he will be increasingly isolated as a deviant who cannot see the obvious, and his working relationship will gradually deteriorate. Thirdly by scoring 'successes' by pointing up flaws in their belief, the analyst will put actors on the defensive, will alienate himself from the group with which actors are willing to share opinions and might well entrench actor's position even further.

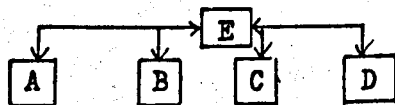
A final result of the formation of shared delusions, is their self-fulfilling tendency, Spencer (65). The emphasis by actors within the organisation, of the extent of merchant power could convince merchants that this was indeed the case. Merchants would then combine into informal local trade associations

in order to institutionalise and direct application of this power and henceforward power there would be.

An example where the roles of analyst and actor have been reversed was found in the same context. The analyst quite freely discussed the distribution channel. He had read books discussing the distribution channel, was quite clear on what he meant by it and was willing to share his definition and perception of it. Simply this concept referred to goods passing from manufacturer E to a distributor C or a wholesaler D and then to a broker or to a retail merchant B for sale to a user A. Any person in this chain might bypass any other at a particular time. Thus the channel was perceived as a chain of events, of goods passing down and orders passing up the chain with a transference of ownership at each link. He visualised something like this example below:



Yet the analyst found that actors in client organisation E were basically irrational in their discussion of possible changes to be made to the system. After considerable investigation the analyst realised that the actors perception of a distribution channel was based on which organisation they send to directly. For example:



Of course if this were merely a semantic confusion regarding the meaning of channel it would be a trivial example. But it is rather more. By using a conceptual framework which was not 'rich' enough to adequately describe the system under study, what was recorded as facts were at some variance with what the analyst recorded. Again this situation resulted in a petrification of critical questioning and was

maintained by the desire not to overcomplicate the urgent matter in hand. This is certainly understandable, but it leads in this instance to ignoring certain changes occurring two stages away in the distribution channel which was soon to remove most of the choice in the so-called urgent matter. Interestingly exactly the same example with distribution channels has been reported elsewhere (). e.g. McVey (60).

From the above then we become aware that treating the facts as existing 'out there' already for us to try our best to make statements about, is an unacceptable position, and it would also be wrong to suggest that a little clearer thinking by all those involved would clear up the problem. The point is that new ways of talking, writing and thinking, when tested and established, initiate new facts. Thus what we call factual statements are hypotheses which we feel we have no need at the present time to question. When we lose confidence in their validity we either drop them altogether, keep them with a changed semantic value, or modify their form or scope, e.g. by adding conditional clauses. We must next turn to discussing in what way these hypotheses can be used in research and particularly in operational research. As the present research was intended both as an individual piece of Operational Research and as a foundation to begin to make generalisations about applying O.R. to unstable situations, it is necessary to consider first how the classical orientations of O.R. and scientific research conflict in any individual situation.

D.3.2 Operational Research and Scientific Research

It is meaningless to discuss what these terms 'really' mean and how they differ, the important matter is for us to state our interpretation of them. As long as these interpretations do not diverge

too radically from accepted usage a comprehensible discussion can follow.

Both O.R. and scientific research use the scientific method to approach their own type of questions. A scientific question takes the form; given a system S under study at time T we wish to understand and describe the behaviour of the system in order to predict what state the system will be in at time $T + K$ and with what probability?

Contrasted with this is a technological question; given that we wish a system S to be in a certain state at time $T + K$ with a certain probability, what must we do to it how?

Of course involved in the technological question will be an iteration of scientific questions concerning predictions with trial system configurations. But this does not detract from the view that the driving force behind each question is distinct. I propose that the primary purpose of scientific research is to answer scientific questions and that of O.R. to address itself to technological questions, that is questions of design, several corollaries follow from this proposition. Firstly that even in this most general formulation of a technological question the concern with when decisions are made to change the system is manifest. Secondly that it would be expected that design questions are framed more on the particular and less on the general. Thirdly that the problem of validation with the technological question is somewhat different to the problem of validation with the scientific question. We do not in essence require that the whole operation be repeatable with similar results by other analysts. The scientific question of validity though must be continually concerned with repeatability and with deciding which of several alternative theories is the best, even though each of them fit the empirical evidence adequately.

Two rival theories in science is a cause of concern and

a focus of research effort. Two alternative designs which fulfill clients specifications equally well are a source of indifference.

D.3.3 Hypothesis and Interpretations

Having argued for a distinctly different pragmatic orientation between scientific and technological questions it is time to redress the balance. This is especially needed in organisational research because so many of the phenomena under study have been man made. Co-operation between men for certain ends requires the solution of a set of problems involving co-ordination, control, planning etc. A solution is usually what we mean by an organisation and the study of alternative solutions and their efficiency, what we mean by organisational science, one trouble is that it is likely that existing organisations form only a small percentage of possibly solutions to the set of organisational problems. As such it seems unjustifiable to make too clear a distinction between design and research. As an example let us consider the term 'diagnosis' An outstanding diagnosis of an organisational problem could be a major step forward in research as well as also solving a particular client's problem. On the other hand a failure to solve a particular problem might also constitute a significant theoretical insight. The cause of failure may be quite irrelevant. The relationship here is quite complex. An analyst while attempting to unravel a clients problem may proffer an interpretation of a situation. This could serve as a research hypothesis, that is, an explanation, or it might be an intervention, changing the situation under study by the client recognising its value as a diagnosis.

Thus although design and scientific quotations are logically distinct they can often result in the same activity. Nevertheless successful solutions to a design problem cannot be taken as a criterion of the validity of organisational theories. We may well solve particular problems while adhering to false theories We may be right about the cause of the organisational problem and our

series of recommended actions might be efficacious, but our theory for explaining its efficiency be quite false. We may be wrong about the problem and the solution but a side effect of our intervention might be to remove the problem. Or, finally, success might be a chance coincidence between our presence and the problem being solved naturally.

We can thus see that interpretations can play one of these three roles

- (i) A hypothesis
- (ii) A diagnosis or identifications of a organisations problem.
- (iii) An intervention which changes the situation. The changes induced by interventions must not be considered necessarily accidental.

We are specifically arguing here for the use of hypotheses as 'mechanisms of change', statements made by the analyst, often knowing them to be false, in order to change a situation or to observe the client's response. An important special case of this type of hypothesis would be speculation, particularly making statements as a low risk testing of reality.

D.3.4 Practical Problems

Thus, in summary, we have argued that a mode of behaviour is possible which allows Operational Research to contribute to the solution of problems arising in unstable situations and concurrently to draw generalised conclusions about decision making in these situations. This behaviour is similar to the type now known as 'change agent research' and relies on the use of interpretations and statements as mechanisms of change rather than as just diagnoses. This behaviour changes the relationship between the analyst and the client, making the analyst an indispensable part of the decision making process.

The adoption of this form of behaviour weakens many of the safeguards normally attending the analyst. The more critical among these which are weakened are the analyst's objectivity and the actor's ability to 'chat over' his side of an argument with the analyst in an open manner. When the loss of these 'safeguards' were compounded with many new errors arising as a result of having to make decisions under acute time pressure, the possibility of an error of judgement became serious.

Below we have attempted to look in more detail at three areas which were continuous sources of concern during the change period in order to isolate the major hazards. The first concerns errors of reasoning caused by hasty decisions. The second a review of other people's experience in change agent research. Thirdly the changes found necessary in the epistemological foundations of the information used.

D.4 Nine Possible Pitfalls of Reasoning in Decision Making Under Acute time pressure

As discussed above, during the empirical work of section C it was frequently the case that errors in reasoning were being made by the client decision maker and the analyst. When considered afterwards it was usually the case that these lapses could be attributed to either 'political' sectional interest or to inadequacy of the available information. When they could not be so explained the cause was usually thought to be because of the lack of normal safeguards of having to rethink, 'chew over points', or 'let ideas shake down': The errors in this category tended to fall under several natural headings and are considered here so that by beginning to recognise these pitfalls, we might defend ourselves against their worst implications.

When organising the material under these headings frequent recourse was made to those developed by Seaborn Jones (68) in another context.

D.4.1 Rationalisation

'The invention of specious reasons to explain irrational behaviour, or the invention of acceptable reasons to conceal unacceptable ones' S.J. p.214. For example two actors might be involved in a bargaining relationship and one has received what was taken as an insult from the other. He cannot say to himself that here is a sufficient reason to break the bargaining relationship; after all, he might say 'I ought not to let my personal feelings influence my business judgement in that way'. However, he is now ever watchful of the others' business behaviour and should the other cause some provocation, he will raise the standard of behaviour normally required in order to justify to himself that there is sufficient reason to discontinue the relationship, purely on the grounds of the standards of business behaviour.

D.4.2 Overextending An Argument

The sales management of the firm had a quite legitimate argument for not challenging the merchant's status quo in certain areas of the country because of their belief in the merchant's ability to retaliate severely. But because of the difficulty encountered with proving this to their colleagues on the Firm's Board, they were forced into a defensive position and began extending their argument as a dogma to cover the ease of any change proposed at the merchant level. 'Overextension is the use of a single principle or theory to explain a range of phenomena too wide to be adequately explained, without distortion, by that principle alone' S.J. p.208.

The method used in section C to overcome this overextension, attacked the problem in two ways. Firstly it developed a sharper means of analysis so that overextension was not necessary. Secondly by studying the problem of how to measure 'merchant power' the sales management felt enough support to be able to move away from the defensive position and begin to investigate where their arguments fell down.

D.4.3 All-or-Nothing Answers

Here a single answer is required to a question which correctly involves several related questions or an unqualified answer involves making an implicit assumption. An example, that frequently occurred when the analyst was giving his opinion on a matter to the Board, was the question 'Do you or do you now think X?' ; where X could be interpreted in several situations. This technique is extremely dangerous, when it is used to make some decision about an urgent matter. It was frequently used by actors for whom the early polarisation of views was advantageous. An answer beginning 'well, if we consider X just in the context....', would meet a response of, 'don't start' if's and but's, give a straight answer to a straight question'.

D.4.4 Pseudo-Scientific

The use of scientific jargon and terminology to cloud the tentative nature of results. A statement in the study was spoken by a senior executive to the analyst, 'the corporate chief is visiting next week will you develop some mathematics to show our decision about thewas correct'.

D.4.5 Moveable Criterion of Acceptance

This is 'the technique of raising the standard of evidence, confirmation or proof required before accepting or acting upon an unwelcome decision'. S.J. p.201.

This is 'a convenient technique and one which is used universally, it is difficult to detect and even more difficult to confute, because standards of evidence are seldom explicitly formulated' S.J. p.201

Model building in unstable systems requires so many wide and generalised assumptions, that an actor intent on wielding this technique of varying the criteria of acceptance can easily bring the whole process to a stop. Two methods of overcoming this were tried and to some extent succeeded. The first was to present as a topic for general discussion amongst decision makers the havoc that this behaviour can cause. The second was to personalise the problem by either the analyst himself, or him encouraging another actor to question, during a meeting, a particular decision maker about why he feels it necessary to use this technique. It is quite likely that he was unaware of his own continual use of the technique and care must be exercised in case this attack caused resentment or over reaction.

It is well to note at this point that the recognised use of this technique can often be an extremely valuable key to an otherwise intractable problem, and is potentially a very rich source of information.

An example concerned a decision to try and bypass a large merchant in Preston, serving users instead from the depot in Halifax. The local salesman produced one by one a stream of rather spurious reasons why this should not be done, such as his trade is predominantly in 'call-off' accounts making bypassing almost impossible. These reasons had all to be checked and found not really to be case. After some time it became evident that his continued protection of the merchant was going beyond the bounds of normal business caution. After some background investigation, the analyst discovered that the salesman and the merchant had been close friends for years and on being challenged the salesman agreed that this was the case. With this new information, new options were generated. The trust that existed in the relationship between the salesman and the merchant made it possible to negotiate on open terms about what to do about the conflict between the roles of Halifax and Preston. Such negotiations had been quite impossible before because of the merchant's defensive attitude.

D.4.5 Selective Evidence

Here instead of attacking a theory directly, a particular aspect of a theory is attacked and shown to be untenable. This is taken as refuting the whole theory without making it clear that only a part is being criticised. For example in this study when computer inventory control for a regional warehouse was mooted, this was 'decisively proved untenable', by a detailed cost analysis of the number of stock transactions dealt with per week. The frequent method in inventory control of only controlling the fast-selling and/or high-value items automatically was conveniently not considered, although it had been suggested by the analyst earlier.

D.4.7 The Mechanistic Pitfall

This is to assume that the springs of a person's action can always be traced to external stimuli received by him, rather than by

his interpretation of those stimuli. Attitudes can often apparently run counter or quite independent of these stimuli, as is vividly shown through the analysis of 'merchant power' in section A.4

D.4.8 Overenthusiastic Entrenchment

When pressure was on the decision makers, it was common for individuals to rush into forming a definite opinion before all the evidence was really available. Pressure was put on people, who felt that they had not got assembled enough information to 'come down off the fence'. People who admitted to 'not really being sure' were made to look 'weakminded', and were not considered 'men of action'. Those that had committed themselves to certain positions often found to their acute embarrassment that, when new information was brought to light; they were defending an untenable position or perhaps one which they would now not normally have chosen. This rather ridiculous position was only aggravated by the charges of 'traitor' or 'fickleness' levied on those who had then attempted to change their position.

D.4.9 Closure

This is the technique of concentrating only on the options perceived available and of 'closing the doors' to any new considerations. This is a difficult error to guard against. There must always come a time for choosing among alternatives rather than searching for new. In this work though, it was found that when decision makers were under acute time pressure the activity that suffered first was the searching. Frequently several days would be spent choosing between the options that were immediately obvious. It would have been considered a sheer waste of time to spend the first day searching for new options, even though when this was done it often made the choosing much easier subsequently.

Bound up with this technique of closure is the psychological need for simplification which is felt by both decision maker and analyst alike.

Conclusion of Discussion of Pitfalls

Risking the accusation of repeating ourselves we will stress again that all the above pitfalls are present in some form in any thinking process, certainly any concerned with the solution of organisational problems. The point is that there has been no necessity to train analysts to recognise and hence dilute the effects of these pitfalls because the normal process of intelligent inquiry carried out with a degree of intellectual honesty will do this naturally. But, when dealing with decisions taken under acute time pressure these normal safeguards cannot be assumed to be thoroughly active. A summary of our position would be the following.

In rapidly changing decision situations, analysts need to be specifically trained to recognise and deal with the pitfalls of reasoning occurring in groups, as time does not allow the natural control of informed scepticism, reflection and discussion to develop to a sufficient degree. In these situations analysts will tend to use hypotheses as much for diagnosis purposes as for explanation or prediction.

D.5CHANGE AGENT RESEARCH

Undertaking either empirical research into strategic decision making in unstable situations or more simply applying Operational Research to a particular example of this activity, both involve the problem of access to the real decision making process. Characteristic of this type of decision making is its informality, without the casual reliance on working documents and minutes found with more formal long range planning

One solution to the problem of access and hence a way to undertake either of the above activities is to ensure that the analyst is an indispensable part of the decision making process. Several practical problems though follow in the wake of this solution.

Common to both is the availability of such an opportunity. Mainly of concern to the research side is the problem of divided loyalties, of whether not to pursue topics not central to the clients interest, and there is also the problem of objectivity and of disturbing the situation in the very act of measuring or observing it. Principally of concern to the Operational Research project is the changed role it forces on the analyst, weakening the distinction between staff and line roles and putting him into the position of having to defend certain proposals rather than being an unbiased evaluator. Section D.3 argued that this changed role was primarily manifest in making the analyst use hypotheses for diagnostic purposes as much as for explanation or prediction. Also interaction with clients tended to become more speculative and interpretative rather than just informative.

Relationships with clients become more of a dialogue or combined effort of formulation or clarification, rather than a technical service.

Similar problems and the same sort of approach to solutions has been made independently by other researchers and it is necessary here to briefly review their work. Their areas of research are quite

broad and do not have much in common with that undertaken in this thesis, but the problems they have identified in client relations are very similar.

This review is intended to be brief and is not comprehensive, the aim is to gain advice on how we might have tackled the problems of the analyst-client relationship more satisfactorily. Change agent research is the generic title given to research in which the researcher plays an active role in the decision making process.

Sofer's Therapeutic and Research Work

Sofer (61) indicates that his work had two foci. 'One was the provision of help to the organisation - the therapeutic component; the other was the scientific use of the material to which access was gained - the research component'. The work was aimed at the analysis of problems within organisations and to providing assistance in making the necessary changes. Concerning the therapeutic component he makes many comments relevant here. Concerning the eternal problem of data collections he says, 'The importance of fact-finding in this work can, however, be overstated. For one thing the facts I collected were often new only to me - the organisation knew about them already.' He then makes the point that the mere collection of facts may give little help and mentions experiments whereby decision making about complex issues may even be impaired by providing a mass of data. The relevance of this latter point is doubtful because of the uncertainty concerning data, its aggregation and contextual development into usable information. He continues; 'Often it was the process of analysis, the redefinition of the problem, the character of the material mustered, the weights which different items were given, which provided the most help for administrators.....(these contributed) to the clarification and explication of the logical basis for conclusions already suspected.

He found himself 'accepting feelings and attitudes as social facts which had to be included in any overall appreciation'.

Concerning his participation he notes that it 'helped the groups to be more objective' and 'to see themselves as I saw them'.

When discussing the research component he considered advantages and difficulties. One advantage concerned the granting of access. 'To understand the behaviour of organisations it is usually helpful and sometimes essential to undertake field studies, i.e. the firsthand observation of social events in the milieu and at the times when these actually occur. This necessity derives from the complexity of organisational behaviour (and) from the limitations of uninformed reflection', (my emphasis). Having indicated the necessity he describes some reasons why industrial firms in particular seldom grant access to this form of observation; these include confidentiality, observers 'getting in the way', 'observation implies the possibility of comparisons that can challenge the rightness and inevitability of existing practices' and discomfort caused by the actors 'personal conflicts, setbacks and defeats' being publically witnessed. Discussing possible strategies for the investigator he notes a limitation on the mode of approach whereby the investigator is a passive observer, having been granted access.

'.....the observer tends to be excluded from the inner councils of the leaders of the organisation because they see little overlap between his interests and objectives and their own, and do not expect a return from him. He must confine most of his observations to matters of more peripheral concern to them.' This is a limitation that cuts right at the heart of the methodological difficulties in our own subject field. While listing some of the difficulties he says 'In work of this type the investigator finds it difficult to study any problem except the one pre-occupying his respondents. His choice of problem is restricted, and this makes it difficult for him to execute a sustained

programme of research on one topic or to pursue a research interest through to a logical conclusion.' And later, 'Once the work is in motion he foregoes much of his freedom of choice in regard to the order, the timing and the conditions under which his data will appear'. 'It is moreover, easy for him to be diverted even from those research interests with which he started by the urgencies of problems within the organisation'. He concludes by adding an extra warning that a '....loss of objectivity occurs through.... a high degree of emotional identification with the (clients),' and in summary says he doubts if this type of research will make much contribution to our theoretical understanding of organisations unless ' a separate exercise is undertaken with each major field study in order to relate it as specifically as possible to a formal body of knowledge'.

Bennis' Approach to Planned Organisational Change

W.G. Bennis' very important contribution to this area has been worked out and developed over many years, and disseminated through many publications. We can give nothing except a cursory inspection of his work, selecting only those parts essential for our immediate purposes. The major sources will be Bennis (63, 66a, 66b). Most important for us to discuss what he sees as possible programmes for implementing planned organisational change. He focuses on the three broad types most frequently used.

1) Training

Here he includes laboratory training and T-group training as developed for example by Argyris (62) and Blake and Mouton (64). The emphasis of this work is on management to experience through group laboratory work the process of problem formulation and solution. In this 'safe' environment participants can observe group processes in action and can evaluate the effect of, for example, leadership, distortion, the roles and maturations of other participants and, in short

'to analyse and become more sensitive to the processes of human interaction and acquire concepts to order and control these phenomena'. Observation of these groups provides researchers with valuable insights into the processes of decision making. But the work is focused on helping the individual decision maker to perform better over a series of training sessions. Little relevant research information concerning decision making in rapidly changing environments could be gained in our opinion from such observations and neither is the technology of this type of planned change really suitable to our needs.

ii) Consulting;

He bases this type mainly on Sofer's above, and we will not repeat ourselves. One point is worth making, referring to Argyris (62), he describes the way clients continually expect 'answers' or 'solutions' from consultants, something he is usually not in a position to give, and are often disappointed or resentful when none are forthcoming. In our own work we found this abdication of decision making frequently. An analyst will sift out unlikely courses of action, generate a few more perhaps and compare and evaluate these. If the analyst begins to say 'this is what you must do' the decision maker ceases to make decision and the point of the analysts role is lost.

iii) Applied research

Here research results are used as an intervention in the system, and because of this intervention 'involvement and participation in the planning, collection, analysis and interpretation of more data is activated.'

Applied research, as defined by Bennis, seems to us such a wide definition as to apply to almost any type of analytic work within organisations. It certainly applies to our own work, but we gain no benefit from knowing this.

He does stress that these types are not disjoint, that,

on the contrary, most cases involve change agents using all three. He does point out that 'some change agents report, however, that they work in collaboration with others and that they divide their functions'. We must return to this point later.

As criticism of the above he particularly cites that

- (i) 'all the approaches... tend to emphasise interpersonal and group factors as casual variables in blocking problem solving activities, and tend to de-emphasise the cognitive processes of problem-solving'.
 - (ii) change agents typically lack explicitness concerning what criteria of organisational effectiveness they are trying to optimize.
 - (iii) the lack of any real 'theory of change' having been distilled from the existing work is disappointing.
- This criticism does not really apply though to Blake (64).

A final comment from Bennis is, 'Too often, rational elements are denied or rendered impotent because they conflict with a strongly ingrained belief, consciously or unconsciously held'.

Jones' Study

Jones (68) undertook a content analysis of 190 published accounts of organisational change. His taxonomic scheme for the study included the type of role adopted by the change agent, environmental classification, classification of the client system, a delineation of the client/agent relationship and some measure of the success of the change. We will review briefly his work only in as far as it impinges on our own work. He perceives two change agents role distinct from our usage so far, these are the pacemaker,

'His usefulness to an organisational system is his capacity to energise or carry out a vital organisational function with an external supply of power'.

and the change catalyst, which is,

'an agent that causes or speeds up or slow down change (catalysis) in an organisational system' 'a small input of catalytic influence has significant and widespread affect in an organisational system' (p.16)

His conclusion concerning change agents was that the most successful were internal to the client system and indigenous to the client systems socio-cultural environment. It would also function as an 'economic organisational system', that is have distinct organisational and fiscal responsibilities.

Concerning client/agent relationships he concluded.

'The most critical dimension in change is the receptivity of the client system to change. If the receptivity is high, then successful change usually results', and vice versa (p.109). He also found that 'the greater the magnitude of the change alteration resulted in an even greater increase in the overall organisational effectiveness. A major change alteration should not be a serious deterring factor.....' (p.109) And again, 'mutually set goals usually resulted in successful change, whereas the opposite was the situation where either party dominated the change relationship'. (p.109) Summarising 'what we gained from Jones' study for our own work, remembering that it was published while this project was in progress;

a) A thorough discussion of the change agent rate b) the broad strategic variables likely to assist success. But we still felt we lacked a discussion of the role of the change agent qua researcher. We felt that the strategic variables of a study were still more a matter of opportunity rather than choice, especially in our own research area. We also felt that more tactical or operational behavioural characteristics of the agent/client relationship would be valuable. e.g. we felt 'client receptivity' to be difficult to define or assess in any particular situation. We were also sceptical about Jones' methodology, see the criticism in Clark & Ford (70), although we

acknowledges his significant research contribution in an otherwise uncharted ocean.

H.S. Leavitt

In Cooper (64) and March (64), Leavitt makes a couple of points especially worth recording here. Firstly, noting the innumerable cases where operations research techniques have fallen short because they ignored the human side of the enterprise, he continues;

'Operations research people can be incredibly naive in their insensitivity to human feelings. But in another, more gracious sense, one can say that the technological approaches have simply taken a more macroscopic, longer view of the world than the people' (meaning T-group training etc.) 'approaches. Better solutions do get accepted in the long run, because deeper forces in the economy press them upon the individual organisation-competitive forces, mainly'. Cooper (64) p.62.

Of course, here, Leavitt in his turn is being 'incredibly naive' about 'deeper' and 'competitive forces' finding 'better solutions' and the quotation reads more like a creed than a work of scholarship, but he makes his point well enough for our present purposes.

Secondly, when discussing decision-making he sees sensitivity training as aiming at 'achieving committed agreement'. On the other hand he describes structural organisational theorists as 'locating precise decision points and assigning decision making responsibility always to individuals' Cooper (64) page.69.

The research implications of this dichotomy are profound, but they are also severely practical. Should the researcher with limited time resources record individuals' action or group's consensual processes.

Bengt Stymne

This is work that has of late come to my attention, after the research project was over some months. I base this brief review on Stymne (70a, 70b).

He defines 'client-orientated' or "clinical" Organisational Research' as referring,

'to projects where a researcher ... works in an organisation with the intention of contributing to the solution of some of the organisation's problems. In addition, during the course of the project, the researchers should observe the course of events, especially with respect to their own measures and the effects of these measures. They should try to link their analysis to existing theories and aim towards making their results public in written reports. (70b, p.4)

He gives two main arguments for this type of research.

Firstly the access problem.

'Sometimes there is ... apprehension that the results (of the project) will directly damage the interests of the prevailing power group. As a result, researchers are barred from studying the most important problem areas and from access to the most sensitive type of data. In a client-orientated project, the researchers and client try to work out a joint formulation of the problem, ... the researcher will gain access to data that are otherwise concealed. He might even have an opportunity to observe the decision making of the top group in the organisation' (my emphasis) (70b, p.5)

Secondly the dynamic affect;

'..... projects provide an opportunity to follow the organisation for along period of time. The researchers can test the validity of their explanations by proposing changes.... The

schematisations used by the researcher (or someone else) are in fact one of the means of bringing about organisational change' (70b, p5) As arguments against this type of research he mentions firstly that 'researchers can be bought' and counters this with the ability to maintain the integrity of research....

The second argument

'has to do with the difficulty in establishing experimental control and the difficulty in making generalisations.'

He counters this by two proposals one of which we consider to be somewhat spurious. His first is that 'the control aspect is irrelevant to some extent because organisations are unique'.

Of course organisations are unique, and we must use care in comparative studies, but this merely encourages us to search for generalisations and to employ experimental control. If organisations could be identical, the experimental control problem would be trivial. He continues, 'Another reason is that the result of a particular change is not determined by a number of experimental situation variables but by peoples' ways of thinking and reasoning at a certain time'(70b,p6). He closes with: 'The ability to make generalisations can seldom be of the type 'of A and B, then C'. Instead they have to be expressed in an increasingly developed and coherent language in order to talk about how organisations with different combinations of properties functions'(70b,p.6)

We are not entirely clear about the point being made here, but we consider he is confusing the difficulty of casting generalisations about complex phenomena into the 'modus ponens' form, with the possibility of doing so.

There are much less grandiose reasons for supporting this type of research, and these have been discussed above. Our most compelling reason at the time was the lack of a viable alternative research method which would yield as much, in as short a time.

The last point that we wish to discuss from his work is a practical one. His research was concluded in pairs, one acting in the advisor role the other as observer. The advantages, of resources allow it, are obvious but it is interesting to note some of the difficulties experienced:-

- 1) 'The client feels uncertain when is is treated differently by representatives of the research group'
- 2) 'The members of the research group run into different types of problems and therefore find it difficult to understand one another'.

and 3) the moral dilemma.

'Is it in fact right for me to collect data that I know are not the most urgent when it comes to solving the clients problems' (70b p.9)

We have quoted at some length from his work firstly because of the closeness to our methodological conclusions and secondly as (70b) is not published at the time of writing.

Clark and Ford

Another recent paper in this area is by Clark and Ford (70) again brought to my attention some months after the completion of the project. Firstly they competently survey the field using as a framework, for considering existing accounts of planned organisational research, a typology distinguishing the source as self-reporting, or external research and timing as concurrent or past facto. The present research is thus self-reporting and concurrent. They consider the major methodological difficulties concerning planned organisational change at the present are:

- 1) the antecedents to planned organisational change.

Very little is reported concerning organisational or technological antecedents prior to entry by the researcher 'Thus we can say very little with certainty as to how antecedent conditions have influenced particular examples.....' (p.40)

- 2) 'The handling of conflict'

'Jones is very typical of researchers in this area who start by stating that the change agents' service the organisational needs' and blandly dismiss any conflict as 'resistance' (to change') (p.41)

- 3) 'The analytical frameworks which consultants use to examine particular situations; though we do learn about the frameworks they present to their clients and to the general public' (p.41)

They then present an alternative approach, utilising two research strategies. Firstly researchers are attached to existing consultancies. This is termed a tandem relationship, and may involve one member taking on a dual role of researcher and consultant. Secondly project descriptions are juxtaposed to existing published reports and this has led to 'the formulation of a limited number of hypotheses and is being used to

develop a more formalised research design' (p.45). They report that this 'tandem relationship', although thwart with initial difficulties, which have now largely been solved by two years experience, is proving a suitable vehicle to solve the joint problems of access and concurrent analysis.

Conclusions

The reasons why we adopted the research method under discussion have already been outlined. Our conclusion can now be compared alongside other accounts. We found we experienced the same problems by and large and although the methods and hints recorded as solutions have been varied, we believe one major factor stands out above all the rest. This is, that if it is required to study strategic decision making in rapidly changing situations empirically in the field then the problem of access can be solved satisfactorily by the change agent or the dual consultant/researcher method. We do not say, can only be solved because we do not believe this and welcome alternative suggestions.

Two further points need to be made finally. The first is that the present clarity on the research problem and the attendant attempts to surmount them is very much a post facto recognition and interpretation of the thinking pursued in the hectic days at the beginning of the study. Events were beginning to occur and we had to decide not only what to do but how and what to record. The second point is the impossibility of separating our insights from those gained by reading the above. Perhaps this is always the case with research but we note with interest that the accounts by Stymne, Clark and Ford and Jones were all published towards the end of the project and Sofer was not brought to our attention until late also. We are optimistic, then, that a convergence of ideas is occurring and look forward to the development of a sounder and more robust methodology in the future.

D.6 A DISCUSSION ON THE SOURCES OF INFORMATION

During the study of section C, when decisions had to be made urgently it was anticipated that we would have to weaken our criteria of what was acceptable data and evidence. It was also anticipated that this would most frequently occur in the form of taking smaller samples. Although this was true, it was only part of the truth. More often it was found necessary to change the very source from which information was obtained. This was the case for several reasons which shall be described by examples. Firstly if knowledge of the total market for a product in a certain area was required and time and resources made a thorough study impossible we might ask a group of informed people for their estimates. Such people would include salesmen, salesclerks, sales management or friendly merchants. We could have taken a very small research sample of the market, but frequently it was found preferable to shift our source to these actors' estimates.

Secondly, when estimating the strength of merchant cohesion it would have been impossible to apply the direct measurement instrument that had been developed, while a change period was actually in progress. The very act of applying the instrument could have seriously affected the level of merchant cohesion. There was no question here of being forced to take smaller samples, the source of the information itself had to change.

Thirdly when estimating the merchants stockholding matrix, considerable data would have been necessary to obtain a confident estimate. It was found in practice that quite reasonable estimates of the matrix could be given by salesmen and others who dealt with that merchant. These results could then be checked for consistency afterwards by predicted reorder distributions with those actually received.

Fourthly, a rather different case. We have argued elsewhere that in unstable systems actors tend to behave in accordance with their perception of the situation, which is often considerably volatile,

rather than as a direct result of economic variables. To understand such behaviour these perceptions or attitudes must be measured, and this implies that these sources of information are likely to be more relevant here than in more stable situations.

On the other hand there were many instances where the time pressure did nothing except force a smaller sample to be taken. An example is the crude grid search on depot throughput. Only a few points were estimated and we assumed the curve was reasonably well behaved between these points.

Having established via examples the way that our study was forced to change its sources of information, the question arises as to how to assess the reliability of the information. In most of the cases this meant in practice, asking questions about the reliability of the source. If a salesman has accurately estimated markets in the past we would be prepared to accept his judgement, in this case. But supposing he has never been asked to estimate before, but he has been successful on the football pools, what are we to think?

What is needed is a series of criteria for deciding on the acceptability of a source. But what form are these criteria going to take, and presumably these criteria may change depending on the type of information required, the use for which it is intended and also with the source in question. There are no a priori grounds for assuming these criteria will be consistent across all these categories of requirements. For example if we wished to know where the major competitive activity in the component field will be in 1990 we will ask a different person from whom we required to know how many X we sold in 1959.

Because we were intending to rely on information from diverse sources, it was important to develop some practical way of assessing sources. Turning to the published literature we discovered little to help.

The writers in the field of social research such as Sjoberg & Nett (68), Becker (58), Hyman (54), Merton (56) and Miller (64), all

contributed careful thought and analysis to the problem. But they left us in practice with not much more than a feeling that we must;

1. Try and consider any possible motives for distortion that the source may have
2. Try and cross-check information when received, checking particularly for consistency.
3. Prepare the instruments, e.g. interviews or questionnaires, very carefully beforehand.
4. Maintain research integrity at all times.

Although this is very sound advice it could scarcely be termed a significant insight. Another possible attack on the problem was via the research done on the 'delphi' method of assessing reliability. The writings of Helmer and Rescher (59), Brown and Helmer () and Dalkey () although each a most sensible piece of writing in their own field, leave a feeling of profundity in intent and trivia in actual content. Any version of the 'delphi' approach we found quite impossible to use in this context.

Thus, as far as we are concerned, the question of how to assess sources remains very much an open one, requiring considerably more research effort. Our only conclusion would be along the following lines;

We would expect to find it necessary to have frequent recourse to alternative sources of data, especially where that means obtaining judgements from actors involved. This makes us more concerned about the reliability of the source. Criteria to judge this are not consistent and need to be varied with the source, and type of information, and for the purposes for which it is required.

D.7 GENERAL CONCLUSIONS

The general conclusions consisted of the following five conjectures.

- 1) In rapidly changing decision situations, analysts need to be specifically trained to recognise and deal with the pitfalls of reasoning occurring in groups, as time does not allow the natural control of informed scepticism reflection and discussion to develop to a sufficient degree.
- 2) The problem of access in these situations can be solved satisfactorily by the change agent or the dual consultant/researcher method.
- 3) The situation forced the analyst to use hypotheses for diagnostic purposes and interpretations as mechanisms of change, as much for explanation and prediction. Interaction with clients tended to become more speculative rather than just informative. Relationships with clients became more of a dialogue or combined effort at formulation or clarification rather than a technical service.

- 4) It becomes necessary to have more frequent recourse to alternative sources of data, especially where that means obtaining personal judgements of the situations from actors involved. This tends to shift the concern to the reliability of the source rather than the data itself. Criteria to judge this reliability are not consistent and need to be varied with the source and type of the information, and with the purposes for which it is required.

- 5) The relationship between strategic and tactical decisions becomes more complex in unstable situations, with the direction of cause and effect influence less a predominately one way affair.

REFERENCES

Artle R. and Berglund S.

A Note on Manufacturer's Choice of Distribution
Channels.

Man. Sci. (July '59) pp 460 - 471.

Aspinwall L.

The Characteristics of Goods and Parallel Systems.
Theories

in Kelly E.J. and Lazer E. (Eds.)

Managerial Marketing (Irwin) 1958 pp 434 - 450

Assael H.

The Political Role of Trade Associations in
Distributive Conflict Resolution.

Jour. of Marketing (1968) pp 21 - 28

Balderston F.

Communication Networks in Intermediate Markets.

Man. Sci. (Jan '58) pp 154 - 171.

Balderston F. and Hoggatt A.

Simulation of Market Processes

Berkeley Institute of Business and Economic Research

Univ. of California 1962.

Balderston F.

Design in Marketing Channels

in Cox, Alderson and Shapiro (Eds.)

Theory in Marketing (Irwin) 1964 pp 163 - 175.

Baligh H.H.

A Theoretical Framework for Channel Choice

in P.D. Bennett

Economic Growth, Competition and World Markets.

Amer. Marketing Ass. 1965 pp 631 - 654.

Baligh H.H. and Richartz I.

Vertical Market Structures.

Allyn and Bacon 1967.

Becker Howard S.

Problems of Inference and Proof in Participant
Observation.

Amer. Social Review 23 (Dec.'58) pp 652 - 660

Bennis W.G.

A New Role for the Behaviour Sciences : Effecting
Organisational Change.

Admin. Sci. Quart. 8 (1963) pp 125 - 165

Bennis W.G.

Changing Organisations.

New York.

McGraw Hill 1966.

Bennis W.G.

Theory and Method in Applying Behavioural Science
to Planned Organisational Change

in Operational Research and the Social Sciences

Ed. by J.R. Lawrence.

Tavistock 1966.

Bucklin L.P.

Postponement, Speculation and the Structure of
Distribution Channels.

Jour. Marketing Research Vol.2 (1965) pp 26 - 31.

Bucklin L.P.

The Theory of Distribution Channel Structure

Univ. of California. Institute of Business and

Economic Research 1966. IBER Special publication.

Clark P.A. and Ford J.R.

Methodological Problems in the Investigation of
Planned Organisational Change.

Soc. Review 18 (1970) pp 29 - 52.

Cyert R.M. and March J.G.

A Behavioural Theory of the Firm
Prentice Hall 1963 p.100.

Emery F.E. and Trist E.L.

The Causal Texture of Organisational Environments.
Human Relations 18 (1965) pp 21 - 31.

Geoffrion A.M.

Primal Resource-directive Approaches for Optimising
Non-linear Systems.

Working Paper 141. The Rand Corporation 1968.

Geoffrion A.M.

Duality in Non-linear Programming.

Working Paper 150

Western Management Science Institute 1969.

Grigoriadis M.D. and Ritter K.

A Decomposition Method for Structured Linear and
Non-linear Programs.

Comp. Sci. Tech. Report No. 10

Comp. Sci. Dept. Univ. of Wisconsin 1968

reprinted in

Jour. Comp. and Systems Science Vol.3 pp 335 - 360
1969

Helmer O. and Rescher N.

On the Epistemology of the Inexact Sciences.

Man. Sci. (June '59) p. 47.

Hyman H.H.

Interviewing in Social Research.

Univ. of Chicago Press 1954.

Jones G.

Planned Organisational Change : A Study in Change
Dynamics.

RKP London 1968.

Lasdon L.S.

Optimisation Theory for Large-scale Systems.

Macmillan 1970.

Lawrence P.R. and Lorsch J.W.

Differentiation and Integration in Complex
Organisations.

Admin. Sci. Quart. Vol. 12 (1967) pp 1 - 47.

Leavitt H.J.

Contributions to :

New Perspectives in Organisational Research

Cooper, Leavitt and Shelley (Eds.) Wiley 1964

and to

Handbook of Organisations

March J.G. (Ed.)

Chicago Rand. McNally 1964.

Merton R.K. et al.

The Focused Interview.

New York : Free Press 1956.

Miller S.M.

The Participant Observer and 'Over-rapport'.

Amer. Social Review 17. Feb. '52 pp 97 - 99.

Roy D.

Efficiency and "The Fix" : Informal Intergroup
Relations in a Piece-work Machine Shop.

Amer. Jour. of Social Vol. 60 (1955) pp 255 -266.

Seaborn-Jones G.

Treatment or Torture.

Tavistock 1968.

Sjorberg G. and Nett R.

A Methodology for Social Research.

Harper and Row 1968.

Sofer C.

The Organisation from Within.

Tavistock 1961.

Spencer P.

The Self-fulfilling Prophecy and the Self-Defeating
Prophecy in Local Planning.

Institute for O.R. Internal Paper.

Stymne B.

Values and Processes

SiAR Student Litteratur.

Lund, Sweden 1970.

Stymne B.

Clinical Organisational Research

Paper presented at XVII International Conference

of T.I.M.S. 1970.

Takahashi I.

Variable Separation Principle for Mathematical
Programming.

J. Opns. Res. Soc. (Japan) Vol.6 1964 pp 82 - 105

Terrebery S.

The Evolution of Organisational Environments.

Admin. Sci. Quart. Vol. 12 1968 pp 590 - 631.

Zoutendijk G.

Methods of Feasible Directions.

Amsterdam : Elsevier 1960.

Brown B. and Helmer O.

Improving the reliability of Estimates obtained from
a consensus of experts. Rand publication P 2986

Dalkey N.C. The Delphi method; an experimental study of
group opinion. Rand publication RM 5888 PR.

McVey P.

Are the channels of Distribution what the textbooks
say?

Jour. of Marketing 24 Jan '60 pp.61-65

APPENDICES

Appendix 1Extensions to Deal With The Option to Establish Depots

Initially when this option looked as though it might be relevant some theory was developed based on Zoutendijk's (60) method of feasible directions. On actually using the model it was found that only once was it necessary to consider as many as three depots and even in this case it was soon apparent that no more than two would be needed. Most of the time the only concern was the one depot case. The theory was then somewhat redundant, as a crude grid search on the channel flow through that depot was quite adequate. Nevertheless the theory will be described here because of an interesting simplification that was found to be possible.

Representing the cost for depot j as $f_j(S_j)$ where S_j is the flow through that depot, and letting $t(S_1, \dots, S_m)$ to be the optimal value of the transportation procedure given that the depot flows are restricted to be exactly S_1, \dots, S_m .

Then the 2-stage/single geographical region problem is;

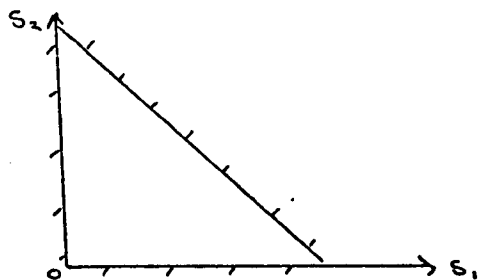
$$\text{Min } G(\underline{S}) = \text{Min} \sum_{j=1}^M f_j(S_j) + t(S_1, \dots, S_m)$$

$$\text{such that } \sum_j S_j \leq T \text{ and } S_j \geq 0 \quad \forall_j$$

where T is the total market.

This case can be extended to the 3-stage, multi-market case straightforwardly. Thus the task is to choose a vector \underline{S} to satisfy this minimisation. The feasible region has a particularly simple structure. The f_j costs are characteristically associated with economies of scale and we can expect the familiar local-global problems of non-convex programming.

For $M=2$ the search surface is;



We can always find an initial feasible point thus:-

$s_j = 0 \quad \forall_j$ that is all goods go direct or through merchants.

Let a feasible point be \underline{s}^0 then the direction of steepest descent is $-\nabla G(\underline{s})|_{\underline{s} = \underline{s}^0}$.

There are two cases either we can move in this direction or we cannot, let us call these cases 1 and 2.

Case 1

We are free to move in the downward gradient method to

$$\underline{s}^1 = \underline{s}^0 - \lambda \nabla G(\underline{s})$$

one of three things can happen;

- The one dimensional optimum is reached while still feasible.
- Some variables become negative.
- The diagonal constraint is broken.

For b),

We only approach axis $s_j = 0$ if

$$\frac{\delta G(\underline{s})}{\delta s_j} > 0$$

i.e. $\frac{\delta f_j(s_j) + v_j - \phi}{\delta s_j} > 0$ which is reached after, where v_j is the

shadow price on the flow through the j -th depot, a distance $s_j^0 / \frac{\delta G(\underline{s})}{\delta s_j}$

Thus case b) occurs after travelling a distance

$$\theta = \min_j \left\{ \frac{s_j^0}{\frac{\delta G(\underline{s})}{\delta s_j}} \right\} \quad \text{overall } j \text{ where } \frac{\delta G(\underline{s})}{\delta s_j} > 0$$

For c);

We can only approach the diagonal constraint if the negative gradient makes an acute angle with the normal to the constraint, which is (1, 1, 1)

$$\text{Thus } (1, 1, \dots, 1) \cdot \nabla G(\underline{s}) < 0$$

$$\text{i.e. } \sum_j \frac{\delta f_j(\underline{s}_j)}{\delta S_j} + \sum_j V_j < M\phi$$

The distance to the constraint is $T - \sum_j S_j^0$ and thus it is met after a distance.

$$\epsilon = \frac{T - \sum_j S_j^0}{\left\{ M\phi - \sum_j V_j - \sum_j \frac{\delta f_j(\underline{s}_j)}{\delta S_j} \right\}}$$

We can simplify this a little, for we know that

$$\phi \neq 0 \text{ only when } T - \sum_j S_j^0 = 0$$

$$\text{Thus we have: } \epsilon = \frac{\sum_j S_j^0 - T}{\sum_j V_j + \sum_j \frac{\delta f_j(\underline{s}_j)}{\delta S_j}}$$

choosing the least of these $\lambda = \min(\epsilon, \theta)$ we are then interested whether $G(\underline{s})$ achieves a minimum on the closed interval $[\underline{s}_0, \underline{s}_0 - \lambda \nabla G(\underline{s}_0)]$

To determine this any of the simple one dimensional search methods is appropriate.

Case 2

If we cannot move in the direction $-\nabla G(\underline{s})$ then we are lying on one of several constraints, and the negative gradient vector is crossing it into the infeasible region. Let us denote the active variables by A . Then if we let \underline{r} be a vector in whose direction we can move we know that $r_i > 0$ for all $i \notin A$.

also if the diagonal constraint is active then any point in the \underline{r} direction must also satisfy it thus,

$$(1, 1, \dots, 1) (S_{\underline{r}} + \lambda \underline{r}) = \sum_j S_{j0} + \lambda \sum_j r_j \leq T$$

$$\text{thus } \sum_j r_j \leq 0$$

We also need to normalise \underline{r} thus $\sum_j r_j^2 = 1$ and also to minimise

the angle between \underline{r} and the downward pointing gradient vector, or equivalently to maximise the cosine of the angle between them; thus we must find $\min \nabla G(S) \cdot \underline{r}$

Writing $\nabla G(S) = \underline{a}$ the problem is $\min \underline{a} \cdot \underline{r}$ such that $\sum_j r_j \leq 0$ if

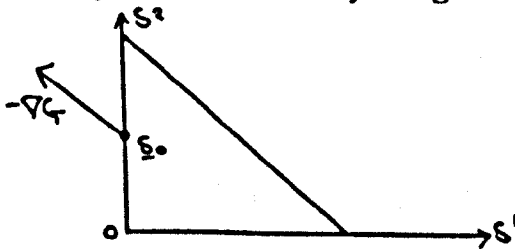
diagonal constraint active

and $r_i \geq 0$ for all $i \notin A$

$$\text{and also } \sum_j r_j^2 = 1$$

There are three cases to consider;

Case A) only axes \bar{A} active, diagonal not active see diagram below;



Here, $A = \{2\}$. In this case we must always have $r_1 = 0 \forall i \notin A$ and such that $a_1 > 0$. Our problem thus becomes

$$\min \sum_{i \in B} a_i r_i \quad \text{such that } \sum_{i \in B} r_i^2 = 1$$

$$r_i \geq 0 \quad i \in C.$$

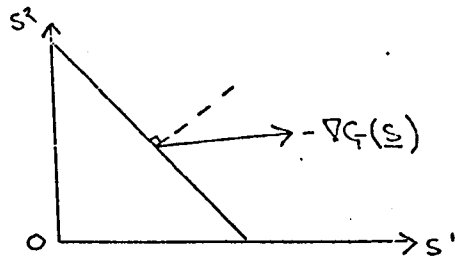
where $B = A \cup \{i \notin A \text{ and } a_i < 0\} = A \cup C$

These equations have the solution

$$\begin{aligned} r_i &= \alpha a_i & i \in B \\ &= 0 & i \notin B \end{aligned}$$

where α is a normaliser $\alpha = \frac{1}{\left(\sum_{i \in B} a_i^2 \right)^{1/2}}$

Case B) where only the diagonal constraint is active as in the diagram below.

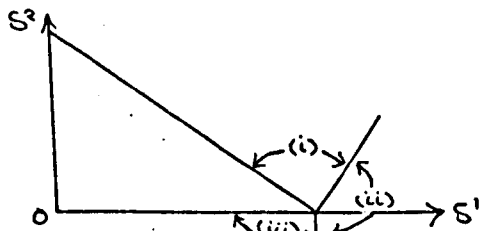


As the downward gradient points into the infeasible region,

$\sum_i a_i < 0$, and that a feasible direction \underline{r} must satisfy $\sum_i r_i = 0$, $\sum_i r_i^2 = 1$ and $\min \sum_i a_i r_i$. This has the solution $r_i = \alpha (a_i - \bar{a}) / \sqrt{\sum_i (a_i - \bar{a})^2}$

where $\bar{a} = \frac{\sum_i a_i}{M}$ and α was the normaliser $\alpha = -1 / (\sum_i (a_i - \bar{a})^2)^{1/2}$

Case C) This was when we lie in a corner, as below;



Here we distinguish three sub-cases.

- (i) This we treat as case B and move up the diagonal.
- (ii) Here we are at a local optimum
- (iii) This we treat as case A and move long the axis.

Thus in summary, it is seen that the principle difficulty in the use of Zoutendijk's method, that of having to solve the quadratic programming problem in order to find feasible directions in case (2) has been overcome. In this case the equations have been sufficiently simple to permit an analytic solution. In addition to this the function evaluation at each stage gives the gradient direction and gives all the information necessary to calculate the feasible directions.

APPENDIX TWO

A P P E N D I X 2DOCUMENT 1COMPROMISE PROCEDURES USED IN THE BARGAINING
RELATIONSHIP.General Instructions.

1. The researcher is advised to try and keep to the topics of conversation as listed here. If the client is getting impatient and has other appointments it may be necessary to jump some of the early topics but topic 4 must be included, otherwise the results are useless. The researcher should then try and fill in from context what he can of the others. Similar remarks apply if the client is becoming bored or losing interest to a degree that might cause the interview to terminate prematurely. But in this case an attempt should first be made to regain the clients interest by introducing other neutral topics. Suggestions are against S.E.T., against decimalising, neutral on metrification until the client states his position, sadness about the economic recession, be informed about the growth or decline of local industries, the raising of the price of the Road Fund Licence is ridiculous, and the new laws for lorry driver's hours are going to 'put a lot of small men out of business'.

If the client wishes to 'go off on a tangent' in the discussion, then follow him some of the way but beware of

those who do this intentionally rather than answer your questions. A firm, 'now I shall have to get on with my questions, otherwise I shall be wasting too much of your time', has been found useful in the past. Make sure you return to the correct place.

2. Personalise this document as much as is necessary. If the client is clearly interested and thinks the questions are sensible, make it appear that you were really the key figure in developing it. If the questions are falling rather flat, or are inappropriate, or just sound rather silly, be the first to mention this. If necessary dissociate yourself from the document, but make sure you stay with the client. Good comments are, 'this is just the sort of thing those backroom boys are always dreaming up', 'goodness knows who could have thought this question up' or 'I think that the person who wrote this was trying to get at'.

A good technique is to try and create an anticlimax. Thus on one question say, 'I bet you won't be able to keep a straight face when you answer this daft question'. If you do manage to generate some laughter, at an appropriate time go to the next point with 'now to some more serious questions'.

If you do personalise or depersonalise the document record this under 'other notes', for future applications.

3. Try to estimate the time the client has available before starting, and plan the interview to fit this.

4. Know the document thoroughly beforehand. It should be totally unnecessary for you to refer to the document other than to read results. DON'T SHUFFLE PAPERS OR CONTINUALLY SCRIBBLE RESULTS DURING THE CONTACT PERIOD. This has been found to be most important, to maintain a working relationship.

5. DO NOT FORGET TO RECORD THE DATE.

TOPIC 3.

INTRODUCTION TO BARGAINING.

This must be led into carefully, most clients not being prepared to admit beforehand that most of their day is spent in reaching agreements on individual orders.

Firstly for each group of contacts what factors are of principal interest.

Prime = 3, average = 2, little = 1, not relevant = 0.

Group						
Quantity						
Discount						
Credit						
Price						
G.M.						
Delivery						
Quality						
Availability						
Min.Order Size						

TOPIC 4REACHING AN AGREEMENT.

If at all possible this topic should move from the particular to the general. Suggestions are to encourage him to take recent examples of orders, perhaps the day before's, and discuss each one in particular to them to try and lead into the general framework. If this isn't possible he may be able to recall recent orders from memory and discussing these might give a lead-in. If neither of these are possible it will be necessary to prompt him on the particular. Start by getting some estimate of the three categories below.

	% Freq.
No disagreement	
Compromise found	
No order placed because agreement impossible	

This is likely to be very crude in practice, i.e. 50%, 25%, or 33½% for each; but it is most important in beginning to get an idea of 'scale of seriousness' in the clients mind. Having established this, it is possible to begin to subdivide each of these categories. If the client wishes to extend the list to more categories do not discourage this but invent whatever notes are required to record this. If the client wishes to 'bracket together' some categories attempt to persuade him against this. Have ready sensible examples to

show how different the categories can be. Do not push this persuading as far as to reduce general co-operation. It is more important to get some results, however crude rather than risk antagonism and get nothing. At all times use the typical comments listed below. Do not use the 'type' name, unless the client becomes particularly interested in it, and only then mention it in passing.

1. No disagreement.

2. Splitting the difference; both sides are prepared to give a little; meet each other half-way; this is reaching an agreement on one factor.

example: One proposes a price of £2 each, the other £1.5 and they agree on £1.8. No other product characteristics entering the bargain.

3. Straight compromise; this is trading-off one product characteristic against another.

examples: I will let you have that discount for double the quantity.

I can't meet those terms unless you can reduce your credit balance.

I can let you have half that quantity now and the rest later.

4. Parallel trade off; this is trading-off one order against another; sometimes on the same invoice.

examples: If you are prepared to wait for your other order we will be able to get this one for you.

As I am buying all these things from you
I would like a discount, otherwise certain
items I would prefer to purchase elsewhere.
We can do that if you are prepared to wait
until we can deliver both orders at once.

5. Sequential trade-off; this is trading-off over a period of time.

examples: If you place a regular order for these, we can give you an extra 2½%.

I will give a bit on this order as a favour, but I'll ask you to remember that for next time.

Unless you can begin to reduce your credit balance, we will have to reduce your discount. We can meet those terms if you are prepared to contact a call-off agreement.

6. Stonewalling; one side refusing to give way, other than a very minor amount. Otherside finally to give in:

7. Repeating; cannot reach agreement, let us both think it over for a while before talking again.

8. Mediator; a mediator is sought in order that agreement might be reached. Often this means each client passing the disagreement to his immediate senior.

9. Failure to agree on this order. The account is presumed to be still secured.

TOPIC 5

Record any other comments or gossip that you think may be relevant. Also include any advice for future visits, e.g. enquire about his family, or his health.

End of document.

DOCUMENT 2MEASUREMENT OF THE MERCHANTS COGNITIVE
POSITION.General Instructions.

The discussion can be fairly unstructured. There is no need to follow the topics in the correct sequence if it seems easier to do otherwise. Give an overall view of the sort of cognitive positions possible. Illustrations are often best done initially by using extremes to make the point. Try and have prepared examples of merchants whose position is well known and who is likely to be known to the client. Many clients find it necessary to adjust their answers after comparison with other's estimates.

TOPIC 1

Thorough description of client.

Name of researcher.

Date of contact.

TOPIC 2VERTICAL TOWARDS USERS.

- +2 I don't identify at all with the user. The user's problems are his own, I have no interest in them. Users can come from where they like, I have no particular segment of the market or industry that I specialise in. If the user doesn't like my terms he can go elsewhere. In my dealings with the user I act as the manufacturers selling agent.
- +1 I still consider myself primarily the manufacturer's agent, but I try and fit in with some of the users requirements, for example, I persuaded the manufacturer to keep a certain item in the standard product list for a certain big user.
- 0 It's my job to try and balance out the needs of the user and the supplier. Neither gets priority treatment from me, I try and stay fair to both. I represent the needs and problems of each side to the other.
- 1 I find myself frequently representing the users against the manufacturer. I know more about the users problem and know them better personally than I do the supplier. The user trades with me so that I can protect his supplies and do any chasing or progressing necessary.

-2 I am effectively the user's agent. I protect his supplies and prices. I stay in business by making the users needs and views, my own needs and views. I have frequent contact with the user and we have made many contractual agreements on supply, including several made informally. He helps me out where he can with lorry maintenance and in return I look after his interests.

TOPIC 3HORIZONTAL TOWARDS OTHER MERCHANTS.

- 2 The other merchants are my worst enemies. Competition is cut-throat between us. You have to be continually on your toes to stop them grabbing business.
- 1 I have some interests in common with other merchants. We get together to talk over general business problems such as the trades description act, or lorry drivers hours. We have made a joint contract to have all our adding m/c's changed over for decimalisation. But underneath this we realise that we each grow at the others expense, we are competitors and often bitter ones.
- 0 We know each other socially and met at various trade association meetings. We help each other out in times of emergency. Often I will drop off the odd parcel for another merchant if I have a van going that way. If I don't have a part in stock, I might ask another merchant to loan me one temporarily. Persistent and deliberate poaching will cause severe retaliation, but general competition is considered fair game.

+1 We know each other's specialities and try to keep to them. We co-operate quite extensively, helping each other out where possible. Poaching is not looked upon kindly and severe pressure could be applied if indulged in persistently. New entrants to the field are not encouraged. We all have our own accounts and tend to stick to them. New users are fair game to anyone; but the word usually goes round beforehand not to touch anything above a certain %. If free competition was allowed, we would all go out of business, and the cost to the customer would rise in the long term.

+2 We act as one voice. We carve-up the custom, agree on servicing and discounts. We act together against new entrants and deviants.

Note: It is important to remember on this topic that we need to measure what people feel the situation is, not necessarily what it actually is. These comments must be used as cues or levers to focus the comments of the client.

TOPIC 4VERTICAL TOWARDS SUPPLIERS.

+2 +1 0 -1 -2

Each are to be interpreted in the same way as in Topic 2, but the role of the users and suppliers must be reversed. It will be common for aberrant results to occur, and this should not worry you. Many clients will claim to be +2 or both, or -2 or both. To isolate this it is better to separate the application of Topic 2 and 4 which have been purposely separated by the discursive Topic 3.

TOPIC 5

Record any other comments or observations that you consider relevant. Also recording hints or advice for future visits to this merchant.

TOPIC 6

Try to arrange a visit to the storeroom and make a crude estimate of the stockholding in the following manner :-

- 1) Are shelves 3, 4 or 5 high.
- 2) Walk at a steady pace.
- 3) Record paces for each colour code for our goods.
- 4) Try and make estimates for other goods.
- 5) Count number of stockmen.
- 6) Count number of salesclerks.
- 7) Remember and record any stockhandling equipment.
- 8) Ask or estimate type and number of vans.

Before or after the visit try to arrange to observe the merchant's premises for a period. Notice and record the registration number of any customers or suppliers vehicle. Also record any firm's vans with identification names.

End of document.