COMMISSION OF THE EUROPEAN COMMUNITIES

A STUDY OF THE EVOLUTION OF CONCENTRATION IN THE MECHANICAL ENGINEERING SECTOR FOR THE UNITED KINGDOM

October 1975

Through an empirical study of concentration the Commission can base its competition policy on detailed knowledge of industrial structures.

The following report will help to establish the basic features of the concentration process in the mechanical engineering industry in the United Kingdom.

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A STUDY OF THE EVOLUTION OF CONCENTRATION IN THE MECHANICAL ENGINEERING SECTOR FOR THE UNITED KINGDOM

by
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October 1975

P R E F A C E

The present volume is part of a series of sectoral studies on the evolution of concentration in the member states of the European Community.

These reports were compiled by the different national Institutes and experts, engaged by the Commission to effect the study programme in question.

Regarding the specific and general interest of these reports and the responsibility taken by the Commission with regard to the European Parliament, they are published wholly in the original version.

The Commission refrains from commenting, only stating that the responsibility for the data and opinions appearing in the reports, rests solely with the Institute or the expert who is the author.

Other reports on the sectoral programme will be published by the Commission as soon as they are received.

The Commission will also publish a series of documents and tables of syntheses, allowing for international comparisons on the evolution of concentration in the different member states of the Community.

CONTENTS

CHAPTER 1 - INTRODUCTION AND CONCLUSIONS

The London Graduate School of Business Studies (London Business School) was contracted by the E.E.C. Commission to examine concentration in three industrial sectors: mechanical engineering; pharmaceuticals; and photographic film. This report relates to mechanical engineering.

The study team consisted of Professor J.B. Heath, Dr. J. McGee, Mr. N. Owen, Miss A. Dove and (pharmaceuticals only) Mr. S. Slatter.

The team would like to thank the E.E.C. Commission, Dr. Linda and Mr. Schwartz in particular, for having initiated a set of studies that have been found most interesting and worthwhile. We hope that our work, especially the accompanying details in the agricultural machinery and cranes sectors in this report, and in pharmaceuticals, will play an important part in setting the bare statistical details in a wider business environment that will illuminate their meaning.

Some General Conclusions

Before embarking on the details of mechanical engineering we would like to record some general conclusions from having undertaken these studies. We hope they will be read in the spirit in which they are written, as positive responses intended to be helpful in the further extension of this work.

First, we sense a danger in the over-elaboration of statistical measures of concentration. Not only are the more complex measures more difficult to understand, especially for the non-economic specialist who may have to use them, but it is questionable how much they add to the stock of knowledge gained from a less sophisticated approach.

Having acquired a deep appreciation of the competitive situation in some sectors of industry by conducting many interviews with senior executives in a large number of companies, and then having compared this understanding with what the statistics appeared to show, we have come to appreciate that standard statistical techniques of concentration analysis all have their limitations and that a fairly simple measure of concentration which acts

as a trigger for more penetrating studies conducted by a variety of research techniques may well be more fruitful in the long run.

Secondly, some basic statistical home truths seemed entirely valid in the context in which we were working. For example, that it is better to make an approximate measure of the right variable than to achieve a very precise measure of the wrong variable; that the measure should be appropriate to the purpose for which it is being undertaken and there may be many purposes in measuring concentration and its change over the years; that the way in which the data are collected is itself influenced to an important degree by the type of measure to which one is working - a different measure of concentration would lead one to collect and to interpret primary source material in a different way so that data are not readily transferable from one measure to another; that it is often best to undertake trial or pilot studies before attempting to complete the final measure, since the preliminary results and further thought and work can often improve the quality of the final product.

Thirdly, it seems to us of great importance to be able to take proper account of international competition in studies of concentration. In a community without tariff barriers, and in which non-tariff barriers are becoming less important also, economic dominance must surely be market based not production based. The share of output, sales, employment, profits, or any other indicator of domestic producers may be grossly misleading in a free trade environment, with at least a possibility of competition from companies based in other Member States or from outside the Community. To have a set of measures which does not require this approach would seem a fundamental weakness.

Likewise it is very important to take proper account of diversification of enterprises. While this was attempted in the "units of economic activity" analysis, our experience showed that such results were probably unreliable, and we felt a low degree of confidence in attributing any great significance to the numbers that resulted. Companies' accounts in the United Kingdom do not often provide financial results by Divisional Activity, and where separate activities are undertaken by subsidiary companies the published operating results may be affected by corporate pricing and other policies that make them difficult to interpret.

Moreover, in the 'enterprises' analyses the arbitrary way of including or exluding divisionalised companies produced some clear statistical nonsenses that disturbed us considerably (some of these are mentioned in detail later).

The fact that a firm is diversified can also mean that the share of its different products in its total sales could be changing significantly without its value of total sales showing any significant change. Indeed, a firm may have developed a product and marketing strategy designed specifically to minimise fluctuations in cash flow through the achievement of a product range which has contra-cyclical characteristics. In such a case the fact that its total sales value showed a degree of stability would not necessarily indicate anything about the intensity of competition under which it was operating.

Competition is seen to be active if over a period firms change their ranking in their industry sector, and if - in particular - the more efficient firms are seen to be increasing their market share at the expense of the less efficient firms. A technique of measurement which depends solely upon the size relationships between firms, irrespective of whether the firms concerned are all the same firms at different times, may miss an important indicator of competitive effectiveness. Thus if in one period firms A and B have a market share of 40% and 30% respectively, and if in a later period firm B has 40% of the market and firm A 30%, very different conclusions may be drawn about the reality of competition in such an industry than if firms A and B had maintained their previous market shares.

Furthermore, significant changes in market share generally do not occur rapidly. A period of 4 to 5 years is probably too short to show other than marginal changes, but they may be part of a longer term fundamental movement that clearly would reveal the presence of intense competitive pressures if one waited longer. In our pharmaceuticals report, for example, we found it desirable to consider product competition and market share analysis over a nine year period (1964-73). Firms that are locked in an intense competitive embrace, like two wrestlers, may not quickly reveal on the outside what forces they are experiencing inside.

Likewise a measure which does not take account of the role of innovation in achieving concentration change or ranking change again may overlook an important guide to the efficiency of competition. A stable market share (in the example in the above paragraph, firms A and B maintaining their relative positions over time) may well be consistent with both firms engaging in a substantial degree of innovation within the several sectors in which they are engaged in mutual competition (as clearly demonstrated in our pharmaceuticals report).

Finally, some increases in concentration are to be welcomed (and indeed are actively encouraged by the Governments of Member States, and in some cases by the Commission itself), while others are to be deplored. No set of concentration indices in themselves can distinguish one from the other; this can only come from a detailed analysis and appraisal of the situation. To find potential candidates for this more detailed scrutiny, simple measures of concentration may well suffice.

Conclusions on Mechanical Engineering

The Mechanical Engineering industry in the U.K. is entering a period of deep recession that will create unprecedented difficulties for the majority of its constituent companies (see Chapter 3). Fixed investment in plant and machinery in the U.K. is declining significantly during 1975, and will continue to fall (at a less rapid rate) in 1976 and perhaps during part of 1977 also. As the principal supplier of this equipment, the U.K. mechanical engineering industry will suffer considerably. Imports continue to take a larger share of domestic consumption (especially from other Member States). Moreover rapid inflation is causing major difficulties in financing both stocks and work in progress (which are more important in this industry than in most other sectors of manufacturing) and fixed investment (long term finance is both very expensive and in short supply).

The part of the mechanical engineering industry that is the subject of the present study has been divided into five principal sectors: agricultural machinery, textile machinery, construction and earth-moving machinery, mechanical handling, and office machinery. However, these sectors in total account for only about 25% (by value added) of

the industry as a whole (see Chapter 2), and cannot therefore be said to be wholly representative of the U.K. mechanical engineering industry. Nevertheless, the diversity of activity, of forms of industrial organisation, and of degrees of competition that have been identified within these five sectors may well represent the range of circumstances that would be found in the rest of the industry.

The agricultural machinery sector (Chapter 4 and, in a very detailed case study, Chapters 9 to 15) divides itself quite naturally into two distinct parts: tractors and agricultural equipment (and within agricultural equipment there are ten principal product categories). The global figures on concentration are meaningless and wholly misleading except by reference to the details of these two principal sub-sectors. The tractor part of the industry is highly concentrated and dominated by large multinational enterprises; the equipment part of the industry is much more fragmented, in general is more traditional in its style of management, and economies of scale are less important. In all product lines dealers are important intermediaries in the selling process, and the organisation of production is perhaps less important in understanding competition than is the organisation of dealers.

The principal feature of the textile machinery sector (Chapter 5) is the importance of international trade. In 1972 the sector exported 73% of its production, and imports accounted for 52% of domestic consumption, and in general the larger companies concerned think and operate on a world wide scale. In some principal product lines technical progress is the key to international competition. In these circumstances the relevance of concentration measures based purely upon domestic production is hard to discern, and as in the case of agricultural machinery, the figures are devoid of any significance as indicators of the intensity of competition.

About 75% of sales in the construction and earth-moving sector (Chapter 6) come from 'earth-moving equipment', and this product category is involved in the production of ever larger individual pieces of equipment, which only the largest companies make. However, domestic consumption in this sector of mechanical engineering has been static or declining for some years, and the present recession in the U.K. economy as a whole can only

make matters worse. Nevertheless, some of the largest firms are multinationals, and the large export business of the sector has been a sustaining factor. As in agricultural machinery, dealers are an important part of the competitive system: indeed, some makers of agricultural tractors, faced with little growth in demand for their products, are moving into the construction machinery sector, to some extent on an international scale.

The mechanical handling sector (Chapter 7) consists of five principal product lines, with the most dominant product - industrial trucks - occupying about one third of total sales. Companies appeared to be fairly specialised within their own product line, so that from the point of view of concentration and competition the sector is in reality five distinct sub-sectors. Moreover the sector is more than usually dominated by a long tail of small enterprises (over 60% of enterprises recorded in the U.K. Census of Production on Mechanical Handling employed less than 25 persons).

The special study of the cranes sub-sector within mechanical handling (Chapters 16 to 18) shows that the principal products serve quite distinct and separate markets and are in general not competitive with each other, but that over the whole sub-sector imports are taking an increasing share of domestic consumption (from 11% in 1966 to 23% in 1973). A distinctive feature of this sub-sector, which has some parallels in construction and earth-moving equipment, is the dominance of hiring rather than purchasing.

Concentration in the land crane market increased dramatically in 1968-69 - one firm acquiring a 70% share in production through state-assisted mergers within one year of first entering this product area. Certain benefits appear to have resulted from this increase in concentration, and the original companies are still run as profit centres within the main enterprise.

Finally, in the office machinery sector (Chapter 8) the most important product area - document copying - is in a state of unprecedented change, due to the rapidity of technical progress and the expiry of key patents.

However, measures of concentration at the sector level show a remarkable stability that conceals the considerable tensions that actually exist. Multinational enterprises - predominantly owned in the United States - are important in the whole of this sector, and their competition is on a world wide basis.

Having now summarised briefly the conclusions relating to each of the five principal sectors within the mechanical engineering industry, it must be said that in every sector there were considerable statistical problems that rendered much of our company account concentration data of very uncertain significance (see Chapter 2). Through our attempts to reconcile the company account data with the U.K. Census of Production we came to realise that measures of concentration based on the Census, which historically has been the usual statistical source for studies of this kind, are also subject to certain fundamental weaknesses. There is no way in which these difficulties can be overcome until U.K. companies are required to publish their financial and operating accounts on a product by product basis that is not only more detailed than is current practice but that is aligned in product classification with the official statistical categories that are widely used for other purposes. To do this, however, will involve many companies in making somewhat arbitrary divisions that in themselves could be misleading. We do not see any easy solution to these difficulties.

It is for all these reasons that we have come to the conclusion that concentration measures <u>at best</u> can give only a very general indication of the state of competition, and that more usually the measures will have no real meaning at all. Concentration measures are a crude signpost that will often point in the wrong direction; but whether in any specific instance the signpost is being reliable cannot be discerned from the measures themselves, however sophisticated they may be made; further and more detached work on the individual circumstances is necessary for that purpose.

Finally, it became apparent as a result of the very detailed study of the agricultural machinery sector (the work of Mr. N. Owen on our Research Team) that not only were the concentration measures devoid of meaning but that (as described in Chapter 15) the whole of this branch of economics was unsound.

The subject of 'industrial organisation', as developed most elaborately by J.S. Bain[1], requires very substantial modification, to such an extent indeed as to undermine totally the now traditional framework of 'structure-behaviour-performance' (in North America often referred to as 'structure-conduct-performance'). The emphasis in that Chapter is on the role of the experience curve in determining costs and profits, on the practice of marketing as the key to understanding competition, and on the size of company as conferring certain benefits that have significance for competition.

Even if one could in practice overcome all of the statistical weaknesses of measuring concentration referred to earlier (e.g. to obtain reliable data on diversified companies, and to measure concentration in the supply of markets rather than in terms of production), it would still be misleading. The reason is this. Large company size is often associated with high concentration, because total output is limited by the size of the market. But large company size brings with it the resources of professional management, including a marketing capability that intensifies the awareness of competitive behaviour by rivals, and it offers the opportunity for powerful analysis and advanced skills in planning and executing responses.

Thus, while it may be correct to conclude that, for example, parallel pricing is likely to be a consequence of a high degree of concentration, one cannot draw any conclusions from this about the intensity of competition since that will be determined also by the consequences of large company size, especially in relation to a professional approach to marketing, that may accompany high concentration. Measures that rely solely on the size distribution of firms miss this entirely. The crucial point is that there is no way of telling from concentration data alone (even if all of the statistical defects were overcome) whether or not they are conveying correct information about the intensity of competition.

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(1) "Industrial Organisation", John Wiley & Sons, 1959.

PART 1: DATA BASE AND INDUSTRY SURVEY

CHAPTER 2 - COVERAGE AND DATA

1. COVERAGE

The sectors included in our study were as follows:

S.I.C. No.		N.I.C.E. No.
331 + 380	Agricultural Machinery & Tractors	361
335	Textile Machinery & Accessories	364.1
336	Construction Equipment	366.3
337	Mechanical Handling:	
.1	Conveyors & Aerial Ropeways	366.5
.2-4	Cranes & Hoists	366.5
.3	Lifts & Escalators	366.5
.5	Industrial Trucks	366.5
338	Office Machinery	362

Data was collected at the company level to include the following variables as specified by the Commission:

Enterprise Data

i) Turnover (total sales including exports).
ii) Number employed.
iii) Total wages + salaries.
iv) Net profit before tax.
v) Cash flow (net profit + depreciation).
vi) Net investment - no reliable figures for the U.K.
vii) Own means (shareholders capital - i.e. equity + reserves).
viii) Exports.

In line with parallel studies being conducted on behalf of the E.E.C. Commission, individual companies were classified as 'enterprises' producing within the specific industrial sector if 50% or more of their turnover was accounted for by the sale of products classified to that sector.

Units of Economic Activity Data

'Units of economic activity' analysis included also companies in each sector where less than 50% of their turnover was accounted for by the sales of products classified to that sector. In some cases these were very large firms which predominated in the sectors concerned, but which were excluded from the 'enterprise' data because less than 50% of their turnover was in the relevant products. But lack of reliable information usually meant that an element of judgement was necessary in deriving data.

Even so, it was possible to produce data only in relation to category (i) above, on 'turnover' (much of it estimated), and to have produced data on the other seven categories would have resulted in an unacceptable degree of guesswork.

In both sets of analysis companies employing less than 200 persons were excluded(1), where employment number could be identified. Likewise imports were not explicitly taken into account since the data required referred only to companies which manufactured within the U.K. (the relevance of this exclusion is discussed in more detail in the sectors principally affected).

The Sub-Sectors in this Study

The sub-sectors of the U.K. mechanical engineering industry that have been the subject of this Report are listed in Table 2.1, together with an assessment of their importance within the total mechanical engineering industry. It can be seen that this Report covers only about 25% of value added in the U.K. industry, and about 23% of employment. The situations described later cannot, therefore, be taken as in any way representative of the industry as a whole. But the range of circumstances is so wide that it is difficult to believe that the rest of the industry is in any way fundamentally different.

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(1) As will be seen later, in practice a very small number of such companies were included in the analysis. This was because they were at first thought to be larger, but subsequent study (after the data sheets were prepared) showed them probably to be smaller. The overall effect of this was insignificant.

TABLE 2.1:

MECHANICAL ENGINEERING INDUSTRY

	Value Added		Employment	
	£ mill	% Total	'000	% Total
Agricultural Machinery	113.7	5.5	48	5
Textile Machinery	95.1	4.6	49	5
Construction Machinery	100.5	4.9	40	4
Mechanical Handling	133.2	6.6	62	6
Office Machinery	60.0	2.9	31	3
Total Study Sectors	502.5	24.5	230	23
Other Sectors	1530.6	75.5	774	77
TOTAL MECHANICAL ENGINEERING	2033.1	100	1004	100

Source: U.K. Census of Production, 1968.

2. METHODOLOGY AND MAJOR DATA PROBLEMS

(a) The study is based on data collected from the annual audited accounts of companies classified to the appropriate industry sectors.

The advantage of using 'primary' sources is that the data are being collected with a specific purpose in mind. Any research worker would be quickly aware of their varying degrees of reliability (using secondary sources, such as Government statistics, one tends to ignore this problem, real though it is). Information at company level, however, raises its own problems. This is clear from the difficulties in dealing with large diversified companies, such as I.B.M. and Ford Motor Company, whose activities cover a wide range of sectors besides those which we are studying. These cannot be included as whole companies, nor can they be ignored, because in both cases a very false impression of market concentration would result. Companies do not have to break down their activities by product type and are only required by law to submit one set of consolidated accounts.

It was for this reason that data was collected for both 'enterprises' and 'units of economic activity'. The 'enterprise' data uses the

50% cut-off point. This excludes I.B.M. from the office machinery sector, although it is a major manufacturer of typewriters. But its estimated contribution to the sales of the office machinery sector is included with the 'units of economic activity' data.

Where a large company published separate accounts for subsidiary companies engaged in different activities, the subsidiary itself would be included as an enterprise. For example, using the 50% rule, George Cohen 600 is excluded from the crane sector, but its two subsidiaries, manufacturing cranes exclusively, are included as enterprises. It is not always possible to do this satisfactorily, because of the divisional structure of the parent company.

(b) Another problem with the consolidated accounts of large companies is that they include returns from foreign subsidiaries. This does not affect employment and remuneration data, which are usually given for the U.K. only. But turnover, cash flow and profit figures will exaggerate a company's position in relation to the U.K. market. In some cases allowances can be made for this in relation to turnover, although there is no reliable way of allowing for the contribution of foreign subsidiaries to profit.

In fact the profit figure in all cases should be treated with considerable caution. Since companies are taxed in relation to profits, it may pay them to show accounting profits lower than those which they actually made. Larger companies have a major interest in maintaining a steady growth path of profits because of possible effects on their share price. Moreover, 'own means' does not necessarily give a good indication of capital employed since it excludes loan capital. The latter is often an important source of financing for the larger companies, and many small subsidiaries rely on loans from parent companies. Turnover and employment, therefore, appear as the two most reliable indicators.

(c) Using company data leads to problems in calculating the residual - the size of the 'tail'. Business Monitor figures (published by the Government) cover all goods manufactured within the U.K. by companies employing 25 or more persons assigned to each industry

on the basis of their principal products. But a summation of turnover for the top 20 firms in a sector from their accounts (supplemented by personal enquiry) is invariably larger than the Business Monitor total for the industry. This is because:

i) turnover figures may include sales by foreign subsidiaries;

ii) turnover will cover sales of the company made outside the particular industry - since we are using 50% as the cut-off point this could be a major source of the error;

iii) turnover includes returns from leasing of machines - (especially relevant to Rank-Xerox in office machines).

(d) Another problem arises from using Standard Industrial Classification to indicate the industry boundaries. For example, the S.I.C. classification of 'office machines' includes duplicating machinery but excludes copying machinery. These two products are direct substitutes for each other. The major manufacturer of the latter, Gestetner, is at present being sued by Rank Xerox for infringement of patent rights. Therefore it was thought unrealistic to exclude Rank Xerox from that sector, which was extended to include manufacturers of photocopying machines. There are various other market boundary problems, which are discussed in the context of the industries concerned.

CONCLUSIONS

We have done the best we can with the information available. But it must be recorded that those who have worked most closely with the figures feel a deep sense of unease about their general validity and reliability. We believe that they represent correct orders of magnitude, but they should not be taken too literally.

CHAPTER 3 - THE MECHANICAL ENGINEERING INDUSTRY TODAY

1. BACKGROUND

From the time when it was the spearhead of the Industrial Revolution until today, when it remains the largest of all manufacturing industries in the United Kingdom, and also the largest exporter, the Mechanical Engineering industry has been of great importance to the economy. The industry as a whole accounts for approximately 13% of the output of all manufacturing industry in the U.K., and a slightly higher percentage of those employed in manufacturing. Furthermore, currently it accounts for about 31% of all U.K. manufactured exports.

The industry is very diverse in terms of its product range and, in spite of a high degree of concentration in some sectors, it is still dominated by a very large number of small firms. Concentration in distinct markets, involving specialisation in economic or geographical space, does not generally match at all closely with the conventional statistical divisions of the industry; hence the reality of competition cannot be identified reliably from the statistics.

Although some sectors match the most advanced technology currently applied anywhere in the world, in many respects traditional ways of organising and managing companies prevail. In the last decade, however, some large groups have emerged as predominant enterprises within the industry which have been able to introduce more professional management and to spread risks through diversification. Studies indicate that for many years the industry has on balance been exporting products that are less sophisticated, technologically, than it has been importing.

In common with other capital goods industries, mechanical engineering has always suffered from the cyclical effects of demand, the national business cycles being amplified by the time they reach the engineering sector. The lags behind national turning points in economic activity are considerable. At the present time, for example, the industry is still achieving a high rate of activity and some managers are complaining about labour shortages; but it is quite evident from the performance of the national economy and of economies overseas, and from medium term forecasts, that activity will decline substantially until the bottom of the recession is reached, probably not before 1977.

Short Term Prospects

Indeed, the econometric model of the national economy of the London Business School, managed by Professor Jim Ball and Terry Burns, expects there to be a substantial decline in fixed investment in plant and machinery of about 11% in 1975 as compared with 1974, and a further fall of about 6% in volume terms in 1976 over 1975, and it is not expected that any substantial recovery in fixed interest will occur until the latter part of 1977. For the mechanical engineering industry, which is by far the largest supplier of plant and machinery for fixed investment, these prospects are gloomy indeed.

TABLE 3.1:
SHORT-TERM FORECASTS

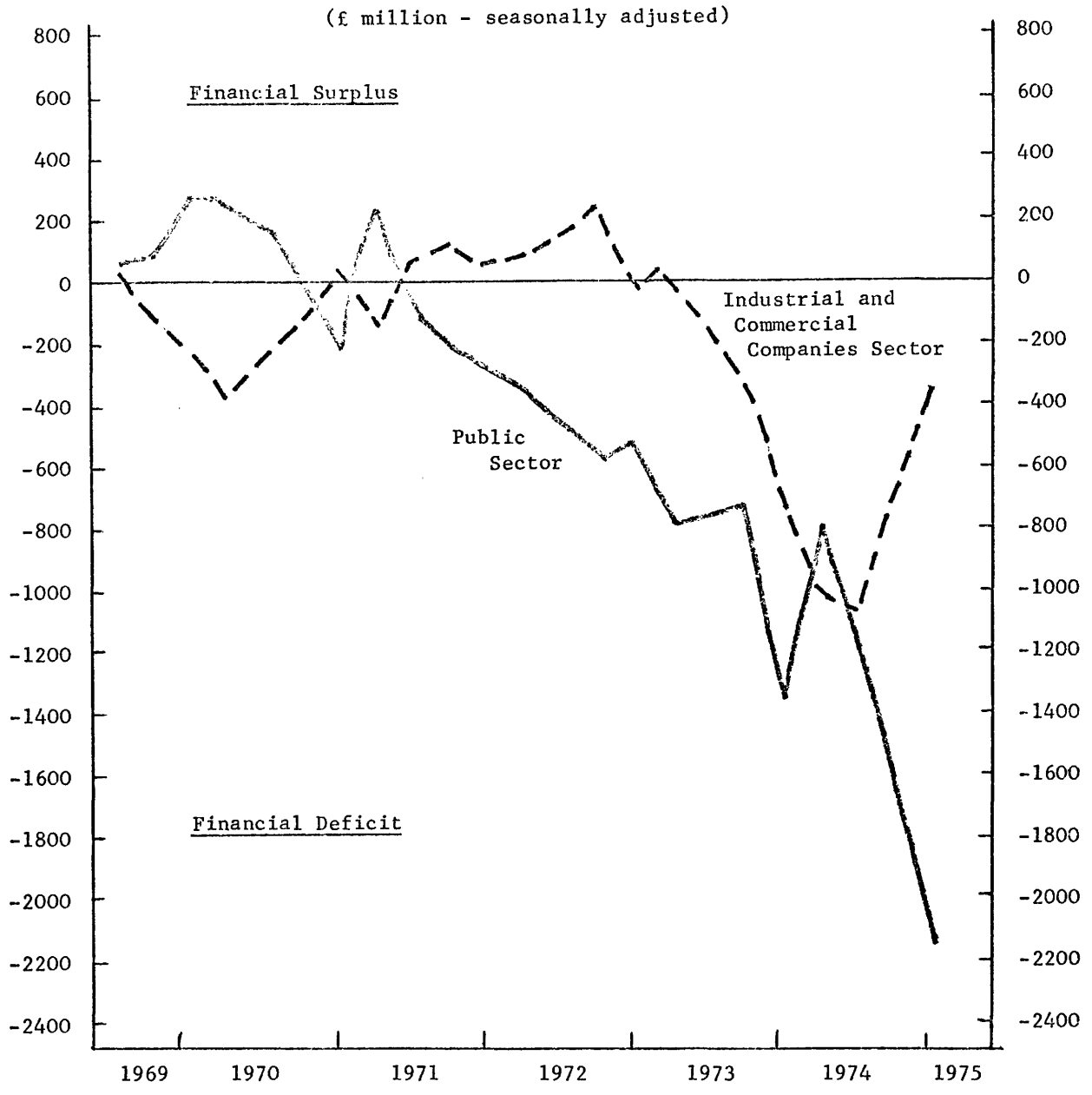
	(% change over previous year) 1975	1976	1977
Real GDP	-1	+1½	+4
Volume of Investment in Plant and Machinery	-11	-6	+6

Source: London Business School

These estimates are supported by a consideration of the net acquisition of financial assets in the industrial and commercial company sector within the U.K. (this is defined as the sum of corporate savings and capital transfers into the corporate sector, less growth of fixed capital formation and less the increase in the value of stocks and work in progress). Chart 3.1 shows that in these terms the industrial and commercial company sector as a whole went into substantial financial deficit during the latter part of 1973 and in 1974, with some recovery towards a more normal relationship in 1975. But, as Chart 3.2 brings out, the closing of this gap is being brought about much more by the decline in domestic fixed capital formation rather than any substantial increase in corporate savings and net capital transfers. While there is no doubt that investment demand will increase substantially in the future, the timing of this seems likely to create cash flow difficulties for a number of companies in the mechanical engineering sector.

CHART 3.1:

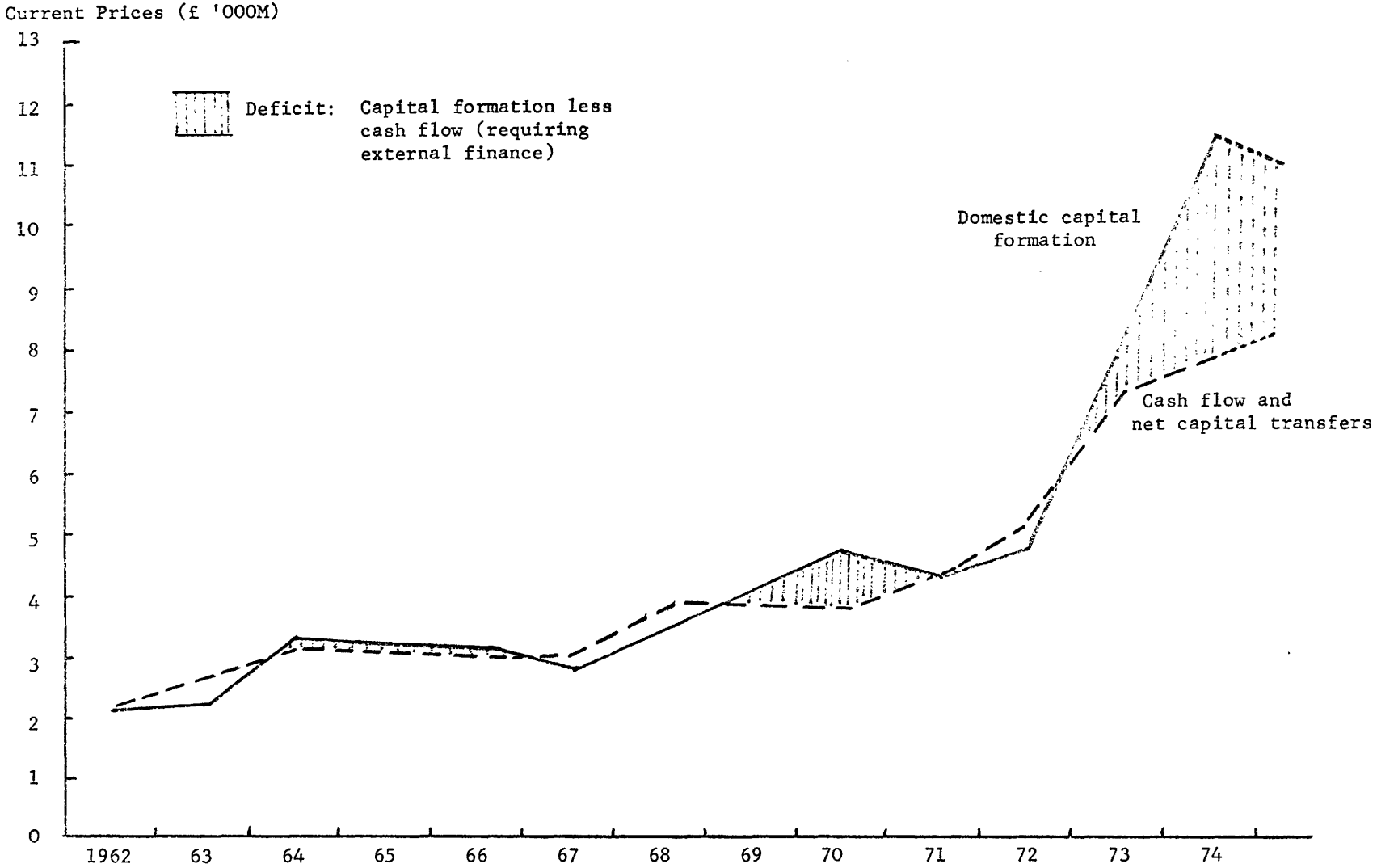
NET ACQUISITION OF FINANCIAL ASSETS



Source: "Economic Trends", August 1975.

CHART 3.2:

FLOW OF FUNDS - INDUSTRIAL AND COMMERCIAL COMPANIES



Source: N.E.D.O. "Finance for Investment".

These difficulties are compounded by the continuing rapid rate of inflation in the U.K. Most companies do not yet adjust their accounts to take proper and full account of this high rate of inflation, and as a result most companies have not made adequate financial provisions both for refinancing their working capital in stocks and for the replacement of obsolete plant and equipment at the much higher price levels that are now prevailing.

There are two basic methods of adjusting company accounts to make proper provision for inflation: the 'Constant Purchasing Power' method, advocated until recently by the Insitute of Chartered Accountants, and the 'Current Cost Accounting' method recently advocated by the Sandilands Committee on Inflation Accounting(1). Table 3.2 shows that adjusting the published accounts of industrial and commercial enterprises on the basis of CPP accounting would result in only a small percentage reduction on the pre-tax profits exhibited in the published statements, but that on a CCA basis there would be something like a 65% reduction in the published accounts for pre-tax profits if full account were taken of inflation on that basis. The Table also shows some estimates of the effects of inflation adjustments on the rate of return in the engineering sector. A Phillips & Drew research publication (4th September 1975) estimated that for general engineering the reduction on a CPP basis would be about 12%, and estimates by the National Economic Development Office (a Government agency, as described below) calculated that the decline in profits after taking account of inflation on that basis would be about 10%. But for general engineering on a CCA basis, Phillips & Drew estimate that the reduction in profits would be of the order of 88%. In other words, in an industry that exhibited book profits of the order of £195 million in 1973/74 on a CPP inflation adjusted basis the true profit level would be about £174 million, and on a CCA inflation adjusted basis the true profit would be only £23 million. Whether these figures are precisely right or not is difficult to judge, but what is clear is that the real level of profitability in the mechanical engineering sector is far too low to support a programme of capital replacement and expansion at the price levels currently prevailing. Clearly this is a most serious situation for the industry.

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(1) "Inflation Accounting: Report of the Inflation Accounting Committee", Chairman: F.E.P. Sandilands CBE, HMSO 1975.

TABLE 3.2:

ESTIMATED EFFECTS OF INFLATION ACCOUNTING ON PRE-TAX PROFITS : LATEST ACCOUN

	% Change	
	CPP	CAA
(1) Total Industrial and Commercial	-1	-65
(1) (of which General Engineering)	-12	-88
(2) Mechanical Engineering	-10	

Sources: (1) Phillips & Drew Research, 4th September 1975.

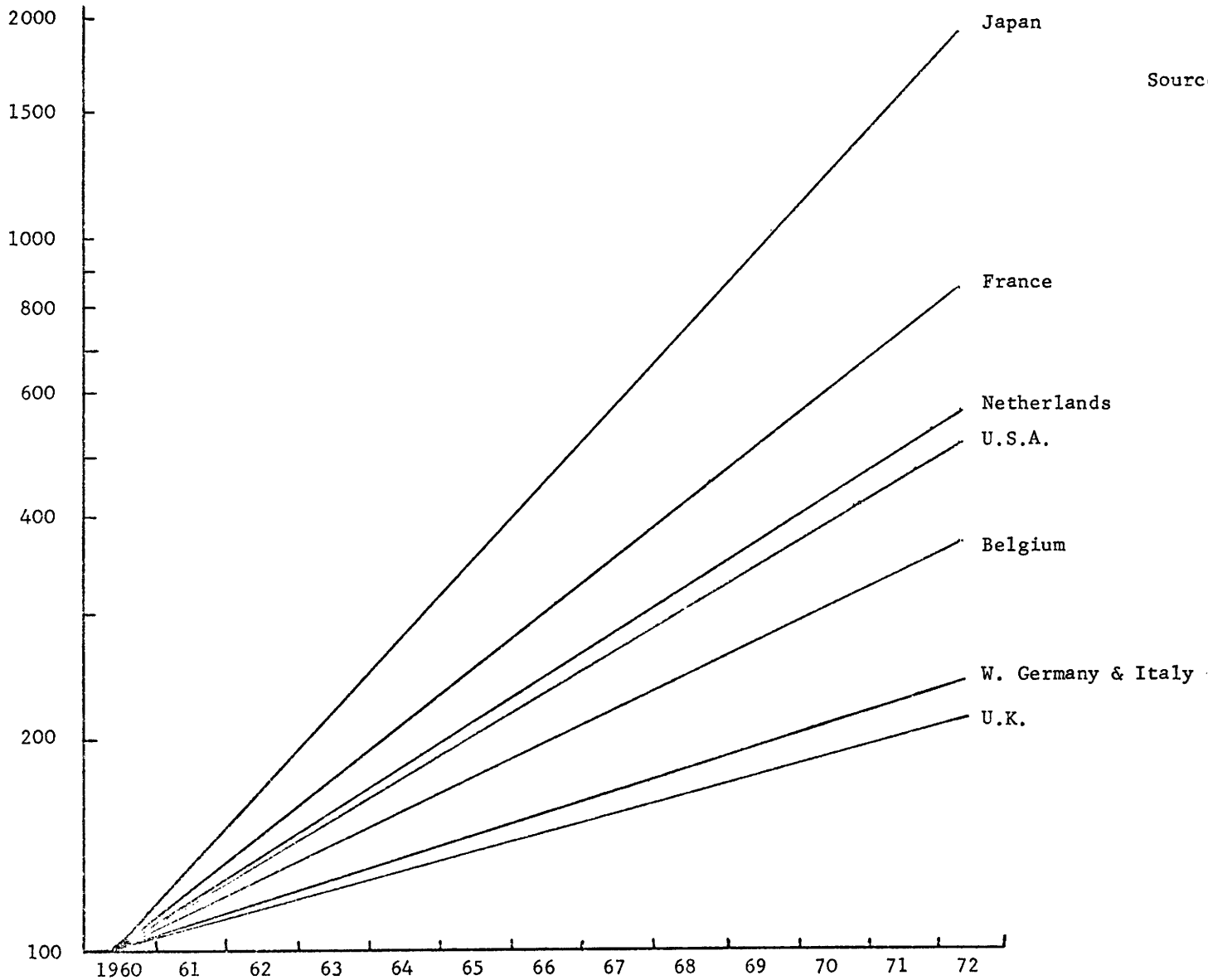
(2) N.E.D.O. 1973/74 estimates based on "Inflation and Company Accounts".

The long term position of the mechanical engineering sector in the U.K. has also been most unsatisfactory. While the growth of fixed investment has not been significantly below the level of Western Germany, as against other Member States the growth in the volume of gross fixed capital formation in manufacturing industry has been substantially less, as shown in Chart 3.3 (which shows also the U.S.A. and Japan). This Chart is derived from the figures in Table 3.3 below.

CHART 3.3:

TREND LINES OF MANUFACTURING INVESTMENT

(Index: 1960 = 100 Constant Prices)



Source: N.E.D.O. "Finance for Investment"

TABLE 3.3:

INDEX NUMBERS OF GROSS DOMESTIC FIXED CAPITAL FORMATION (MANUFACTURING) IN CONSTANT PRICES FOR SELECTED ECONOMIES 1960-72

(1960 = 100)

Year	U.K.	W. Germany	(1) France	(2,4) U.S.A.	(2,4) Japan	(3) Italy	Belgium	(3) Netherlands
1960	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1961	118.7	109.7	120.0	93.9	124.2	118.9	122.4	114.5
1962	109.6	109.6	134.1	99.3	104.2	133.3	137.2	125.6
1963	96.8	101.0	143.7	104.7	116.9	145.0	136.5	129.3
1964	109.2	106.4	154.5	121.6	127.7	115.8	135.8	155.8
1965	120.5	117.8	159.4	144.1	104.4	91.8	149.8	159.5
1966	123.8	114.9	172.5	168.4	121.4	101.2	172.6	178.4
1967	120.8	102.7	178.5	171.0	183.9	114.9	168.4	184.2
1968	124.9	100.5	182.4	166.6	229.3	127.3	152.2	192.8
1969	141.1	133.6	209.8	175.7	287.0	141.3	171.9	190.7
1970	148.2	154.0	242.8	169.9	313.3	160.0	198.0	221.9
1971	138.9	148.7	257.5	162.9	283.2	162.4	194.7	215.1
1972	125.4	137.2	n/a	174.6	284.4	158.0	183.1	196.9

(1) Includes fishing, quarrying for building materials and construction.

(2) Derived by deflating a current price series of GDFCR in manufacturing by an implicit price index for private non-residential GDFCF.

(3) Includes mining and quarrying, construction, gas, electricity and water.

(4) Private sector only.

Sources: OECD National Accounts (except West Germany).
Deutsches Institut für Wirtschaftsforschung: West Germany.

But over the same period productivity in manufacturing industry has been growing much more slowly in the U.K. than in other Member States, and in North America, as shown in Table 3.4. This Table also shows that in the period since 1970 the growth of productivity in manufacturing has been nearer that of other countries, although this is deceptive because productivity grew rapidly during the period of rapid growth in output during 1972, and subsequently declined thereafter.

The truth is that the rate of growth of productivity in manufacturing industry in the U.K. has been slower than that in Western Germany and France for a great many years, going back before the Second World War, and has as much to do with the attitudes of people in industry towards work as it has to do with the rate of growth of investment. Attitudes towards work, the lack of a sense of unity of purpose within industry that is now a prominent feature of our industrial society, are difficult to overcome in the short term.

TABLE 3.4:

OUTPUT PER MAN-HOUR IN MANUFACTURING

	(1963 = 100) 1969	(1970 = 100) 1975 (1st Qtr.)
U.K.	98	117
Germany	144	120
France	148	116
Italy	152	145
Netherlands	160	122
U.S.A.	124	114
Canada	127	118

Source: NIESR

International Trade

The declining competitiveness of the U.K. mechanical engineering industry is illustrated in its trade performance with E.E.C. Member States and with North America. The major reversal of the industry's positive trade balance with other E.E.C. countries that had existed for many years is a symptom of the problems that the industry faces. Table 3.5 below summarises the trend. As mentioned earlier, the unit value of U.K. imports in this industry tends to be significantly higher than the unit value of its exports: this suggests that the degree of sophistication of imported machinery is rather higher than the degree of sophistication of machinery that it exports, although a comparison of unit value of unit value indices is a very crude indication of this. Nevertheless, this declining competitiveness as shown in the trade balance is a cause for considerable concern.

TABLE 3.5:

U.K. MECHANICAL ENGINEERING : TRADE WITH E.E.C.*

	U.K. Imports (c.i.f.)	U.K. Exports (f.o.b.)	U.K. Trade Balance
1963	102	165	+64
1970	333	340	+7
1971	365	385	+20
1972	447	429	-18
1973	694	529	-165
1974	877	686	-191

* the original siz Member States.

Source: U.K. Trade Accounts.

Relations with Government

The National Economic Development Office, which is an agency of the Government, since its formation in 1962, has had a number of industry committees (called 'Little Neddys') on which sit representatives from large companies in the industry (generally company Chairmen or Chief Executives), senior trade union leaders concerned with that industry, Government officials concerned with that industry, and some independent members; the Chairmen are generally senior executives from another industry so as to maintain independence. From the early days of the N.E.D.O. the mechanical engineering industry has had its own industry committee.

Originally these separate industry committees were seen as part of the Government's planning process, but in recent years their role has changed somewhat to become a forum for discussion of problems in specific industries, a channel of communication for special studies and reports, and a centre of advice to the Director General of the N.E.D.O. in his discussions with the heads of Government and trade unions. The current performance of the U.K. mechanical engineering industry is at present subject to considerable discussion in this forum.

With a few minor exceptions, all of this industry is in the private sector. It is, however, the policy of the present Government to set up a National Enterprise Board that will assume responsibility for managing the Government's existing financial interest in companies, and will acquire a stake in other companies in important sectors - including the mechanical engineering industry. This is expected to occur during 1975 or early in 1976.

Earlier Government interventions in this industry occurred with the activities of the Industrial Re-organisation Corporation, set up in 1965 and closed down in 1970. This Corporation was established in order to promote and assist with the restructuring of British industry through merger in order to improve efficiency. The mechanical engineering sector was involved to only a minor degree, however, and affected the cranes sub-sector of Mechanical Handling Equipment most of all.

Government interventions affecting the industry have also centred round schemes to promote investment in manufacturing industry. These have included investment grants, being effectively a means of subsidising investment at the time when the expenditures are incurred, investment allowances under which expenditures can be written off against profits before incurring corporation tax, and free depreciation which allows companies to choose the rate of depreciation that they will apply to newly installed fixed assets, again with provision for writing this off against profits before the application of corporate taxation. However, studies that have been undertaken of the effects of these investment incentives generally fail to find that they have had any marked or significant effects on the rate of investment above what would otherwise have been incurred. This does not mean that in no cases have investment incentives had any effects, but it does suggest that this is not an appropriate way of increasing the rate of investment in any economy that appears to have been investing at a lower rate than many of its competitors. The main effects have probably arisen because of regional differentiation in the way in which investment incentives have been applied, so that while the geographical distribution of investment probably has been significantly affected by the various incentive schemes, it is difficult to identify that they have had much effect on the aggregate level of investment within the country as a whole.

Perhaps the most significant intervention of Government in this industry in recent years has been through the attempt to control inflation by holding down prices. The last five years in particular have seen a regime of price restraint and control of increasing severity and complexity. This has not, of course, been confined to the mechanical engineering sector: it has been nationwide, and has been applied with particular severity in state enterprises.

The long run effect of this has been very damaging to British industry. In particular we believe that it has been damaging to growth of investment, because it has squeezed cash flow and profitability, and in more usual circumstances this is the major source of funds for investment. Thus the operation of the price code, albeit relaxed to some degree in 1975, has had a fundamentally undermining effect not only on the firms in the mechanical engineering sector directly, but also indirectly through the difficulties that the rest of manufacturing industry have had in financing their expenditures on the products of this industry.

In the circumstances described in this chapter it is little wonder that the real crisis is one of confidence in the future. Even when demand does recover, will the operations of the price code permit a sufficiently high level of profitability and of expected returns from new investment that full recovery of the mechanical engineering industry will occur? This is a most serious question for all of the firms concerned.

CONCLUSION

The mechanical engineering industry today is in a state of declining activity that may last through to 1977. Confidence is lacking throughout much of British industry that will affect seriously the likely rate of this recovery, and in this context the operations of the Price Code - as one of the Government's ways of overcoming the present rapid rate of inflation - is a key factor.

PART 2: SECTOR STUDIES

CHAPTER 4 - AGRICULTURAL MACHINERY

Since later we devote seven chapters to a detailed and comprehensive study of the Agricultural Machinery sector, at this stage only a brief - mainly statistical - presentation is necessary.

1. DEFINITION OF THE SECTOR

Basically the industry is divided into two parts: tractors and agricultural equipment. In 1974 tractors accounted for 53% of industry sales, and equipment for the remainder.

'Equipment' included the following ten principal product categories: Combine Harvesters (about 80% of the domestic market being supplied by imports); Balers; Forage Harvesters (about 70% imported); Milling Equipment; Rotary Cultivators; Manure Spreaders; Grain Drying and Handling Equipment; Haymaking Equipment and Root Harvesters. The range of products is clearly very wide; and in six product categories (out of ten), imports account for one third of more of domestic consumption. Indeed, in tractors, imports accounted for 81% of domestic consumption in 1974, and on average imports accounted for 69% in the equipment market.

Basic data collected from Company Accounts, used as the basis of the concentration measures in this chapter, are given in Table 4.1, below. They show that in 1971 'enterprise' turnover was £274 million, and employment was 39,000 persons . Turnover in 'U.E.A.' companies was, however, of the order of £299 million.

TABLE 4.1:
SUMMARY OF DATA FROM PRIMARY SOURCES

		1968	1969	1970	1971	1972
Enterprises:	Turnover	229	254	265	274	322
	Employment	38	40	42	39	37
	Wages & Salaries	47	53	60	61	68
	Net profit	14.3	12.3	1.7	0.7	11.4
	Cash flow	76.7	72.4	72.6	76.8	82.2
	Exports	130	144	145	151	175
	U.K. Home sales	99	104	110	112	131
U.E.A.:	Turnover	254	278	291	299	348

Source: Company Accounts and L.B.S. Study.

No precise comparison is possible with the 1971 Census of Production, because (partly in order to conceal individual company information) 'wheeled tractors' overlaps with 'construction equipment, and the Census definition of 'agricultural machinery' includes a number of agricultural engineers which were not producers of equipment. For what they are worth, however, the comparison is given in Table 4.2 below.

TABLE 4.2:

AGRICULTURAL MACHINERY INDUSTRY COMPARISON

	£ million Turnover	'000 Employment
L.B.S. Study 1971		
Enterprises	274	39
U.E.A.	299	-
1971 Census of Production (gross output)		
Agricultural Machinery	191	27
Wheeled Tractors	138	24

Source: 1971 Census of Production and L.B.S. Study.

Table 4.1 also shows that demand has fluctuated over the study period, with a major recession (shown most clearly in the cash flow profit figures) in 1970-71.

2. CONCENTRATION

Concentration data based on the turnover of 'enterprises' are given in Table 4.3 below. They show some slight variability over the period - not, one might gather from this data, of any great significance.

Slightly lower concentration ratios for the same 'enterprises' appear on the basis of employment statistics, as shown in Table 4.4.

TABLE 4.3:

SUMMARY OF CONCENTRATION MEASURES BASED ON TURNOVER DATA FROM 'ENTERPRISES'

	1968	1969	1970	1971	1972
4-firm concentration ratio	80.9	81.3	80.4	81.2	79.0
8-firm concentration ratio	91.4	91.8	91.7	90.6	90.1
Coefficient of variation	2.6	.26	.25	2.5	2.4
Gini coefficient	0.77	0.78	0.77	0.77	0.75
Herfindel Hirschmann	333.4	33.73	318.8	322.0	288.5
Entropy	-75.6	-75.1	-77.4	-77.3	-81.6
Linda Indices - $\frac{Ln^*m}{n^*m}$	.826 / 22	.878 / 22	.832 / 22	.790 / 22	.720 / 22
Linda Indices - $\frac{Ln\ h}{n\ h}$	1.91 / 3	2.20 / 2	2.20 / 2	2.08 / 2	1.79 / 2

Source: L.B.S. Study.

TABLE 4.4:

SUMMARY OF CONCENTRATION MEASURES BASED ON EMPLOYMENT DATA FROM 'ENTERPRISES'

	1968	1969	1970	1971	1972
4-firm concentration ratio	79.6	79.5	79.8	78.5	77.1
8-firm concentration ratio	90.5	90.3	90.9	89.8	89.5
Coefficient of variation	2.3	2.3	2.4	2.4	2.3
Gini coefficient	0.75	0.75	0.76	0.75	0.74
Herfindel Hirschmann	268.3	280.9	292.9	285.4	268.8
Entropy	-82.8	-81.8	-79.9	-81.7	-84.1
Linda Indices - $\frac{Ln^*m}{n^*m}$	.719 / 22	.730 / 22	.778 / 22	.724 / 22	.686 / 22
Linda Indices - $\frac{Ln\ h}{n\ h}$	1.501 / 2	1.648 / 2	1.622 / 2	1.668 / 2	1.624 / 2

Source: L.B.S. Study.

Based on 'U.E.A.' data, concentration appears to be somewhat lower, with a more pronounced tendency towards decline than was apparent from the 'enterprise' results, as shown in Table 4.5 below.

TABLE 4.5:

SUMMARY OF CONCENTRATION MEASURES BASED ON 'U.E.A.' TURNOVER DATA

	1968	1969	1970	1971	1972
4-firm concentration ratio	72.4	72.9	70.6	71.1	69.5
8-firm concentration ratio	86.4	86.6	86.1	85.8	84.9
Coefficient of variation	2.15	2.14	2.07	2.05	1.93
Gini coefficient	-736	.739	.730	.723	.709
Herfindel Hirschmann	194.5	192.9	182.7	186.3	169.4
Entropy	-95.4	-95.5	-97.5	-96.6	-99.9
Linda Indices - Ln*m / n*m	.519 / 28	.541 / 28	.511 / 28	.508 / 27	.470 / 27
Linda Indices - Ln h / n h	.986 / 3	.994 / 3	.984 / 3	1.04 / 3	.907 / 3

Source: L.B.S. Study.

The significance of these figures for competition is explained in great detail in Chapters 9 to 15 below. In summary, there is great variability between product categories. The tractor market is, for example, dominated by only a few U.K. producers - mostly multinationals (the five major producers accounting for 90% of employment in that sector) - and the majority of these employees worked in large plants (90% of employees were in establishments of over 500 persons); in the equipment market, however, the five largest producers employed about 30% of that sector's labour force, and only 40% of employees were in large establishments of over 500 persons.

Furthermore, the characteristics of companies in the two sectors are typically quite different, their management styles and cultures being also dissimilar would result in different responses to market pressures and competition. Economies of large scale operations are evident in tractor production but not generally in equipment supply, where the chosen production method and where market characteristics appear to be the more significant factors. And there appears to be a considerable degree of mobility in market share within equipment product categories that become submerged in the aggregate concentration data presented in the earlier tables.

What can be concluded from the detailed study later is that these earlier concentration tables provide no meaningful appreciation of the degree of monopoly or competition in the agricultural machinery sector. They are simply numbers.

CHAPTER 5 : TEXTILE MACHINERY

1. DEFINITION AND DESCRIPTION OF THE SECTOR

The Textile Machinery sector of mechanical engineering includes all those companies which manufacture a range of textile machines and their accessories. Final products cover a wide variety of machines, used for a diversity of textile processes, ranging from the extrusion of man-made fibres to the more traditional spinning, weaving, knitting, dyeing and finishing machines.

The Textile Machinery industry covered by this study employed about 28,500 persons in 1971 (in 'enterprises'), with 'enterprise' turnover of £159 million. The turnover of companies in the 'units of economic activity' analysis was, however, £198 million (since this analysis included companies whose output in this sector was less than 50% of their total output), while the 1971 Census of Production showed a turnover of £212 million - with 43,600 employees. As explained later, this large difference in the number of employees arises mainly because of the inclusion in the Census of firms of less than 200 employees.

TABLE 5.1:

TEXTILE MACHINERY : INDUSTRY COMPARISON (1971 Data)

	Turnover (£ mill)	Employees ('000)
This Study		
'Enterprises'	159	28.5
'UEA'	198	...
1971 Census (Gross Output)	212	43.6

Sources: L.B.S. Study, and 1971 Census of Production.

In volume terms, production in the U.K. has fluctuated about an almost horizontal trend, as shown in Table 5.2.

TABLE 5.2:

TEXTILE MACHINERY : U.K. PRODUCTION

£ million

	Volume* (£ 1970)	Volume* (1968=100)	Current Year Values
1968	161	(100)	143
1969	173	(107)	158
1970	163	(101)	163
1971	154	(96)	172
1972	162	(101)	197
1973	173	(107)	234

* at 1970 prices

Source: Annual Abstract of Statistics

Major Product Groups

As Table 5.3 below illustrates, the two largest sectors in this industry are first, looms, weaving machines, knitting machines and auxiliaries (a sub-sector of this industry that has recently experienced a severe contraction in output), and secondly, spinning and twisting machinery (which, in contrast, has grown rapidly).

TABLE 5.3:

TEXTILE MACHINERY : U.K. PRODUCTION BY SUB-SECTOR

	£ million* 1972	1973
Machines for processes preparatory to spinning & twisting	19.2	22.7
Spinning & twisting machinery	26.8	46.0
Looms, weaving machines, knitting machines & auxiliaries	56.7	48.7
Tufting machines, carpet machines, etc	8.8	14.8
Dyeing & finishing machines	12.1	12.1
Parts & accessories	30.2	35.1
Other **	53.0	55.0
TOTAL	197.0	234.0

* Current Year Values.
** Production by establishments classified to other sectors.

Source: Business Monitor

Comparison with Census of Production Data

The Textile Machinery industry identified for the purposes of this enquiry covered 20 companies for the 'enterprise' analysis and 28 companies for the 'units of economic activity' analysis. But it can be seen from Table 5.4 that the 1971 Census of Production records 491 enterprises in the Textile Machinery sector - the vast majority employing less than 200 persons (and 88% of them employing under 100 persons). Most of these smaller firms are engaged in the manufacture of accessories, such as bobbins, needles and shuttles, and they also undertake machinery repair work in this industry. As such they are important suppliers to the industry and a necessary part of it, as organised at present.

TABLE 5.4:

TEXTILE MACHINERY : INDUSTRY COMPARISON : EMPLOYMENT

	Number of 'Enterprises', 1971	
Size Class by Employment	This Study: Number of 'Enterprises'	1971 Census of Production
0 - 199	1	491
200 - 299	4	11
300 - 499	8	13
500 - 1,499	4	8
1,500 & over	3	4
	20	527*

* Since some enterprises control establishments in more than one sector, after allowing for double counting the number of companies is 491.

Source: L.B.S. Study, and 1971 Census of Production.

The 1971 Census of Production also records a larger number of enterprises in each of the size categories of 200 employees and above than in our own study of 'enterprises', but this is to be expected because of the exclusions under the specification of 'enterprise' for our purposes. (Unfortunately it is not possible to categorise companies according to 'units of economic activity', by size distribution of employment, since this information is not available).

Categorised by turnover, the number of enterprises in the 'enterprise' and 'units of economic activity' analysis are shown in Table 5.5 by

size distribution of turnover (unfortunately the 1971 Census of Production does not show a comparable distribution). As to be expected, there are rather more companies in the latter category than in the former, although the 28 companies in our 'units of economic activity' analysis are fewer than the 36 companies with 200 or more employees shown in the 1971 Census of Production (Table 5.4 above).

TABLE 5.5:

TEXTILE MACHINERY : INDUSTRY COMPARISON : TURNOVER

Size Class by Turnover (£ mill)	Number of Companies, 1971 'Enterprises'	'UEA'
0 - .49	1	4
.5 - .9	5	5
1.0 - 1.9	3	5
2.0 - 4.9	5	5
5.0 - 9.9	1	2
10.0 - 19.9	2	3
20.0 & over	3	4
	20	28

Source: L.B.S. Study

International Trade and its Implications

Historically the machinery industry depended on the cotton manufacturing industry in Lancashire. However, in the 1930s, when the U.K. demand for new machinery slumped, textile machinery companies became dependent on the growth of textile industries in the developing Commonwealth nations. The industry was able to expand by meeting a need for fairly unsophisticated equipment in countries which owed their competitive edge in cotton textiles to cheap labour and labour intensive operations.

During and immediately after the Second World War, U.K. manufacturers had to concentrate first on armaments and then supplying goods to the depleted home market. Loss of some traditional exports markets and a falling behind in research and development resulted. Competition overseas

grew with the development of major industries in Switzerland, Germany and later in India and Pakistan. In particular, the Swiss developed the 'Sultzer' shuttleless loom. Traditional sectors of the U.K. industry suffered; the number of loom makers fell from about fifteen in 1945 to approximately four today, and all the latter are minor companies. The world-wide textile recession of 1952 accentuated the trend.

But this recession coincided with the development of synthetic yarns. The U.K. industry had to turn to new markets to come to terms with these developments. Radically new processes were required, such as texturing - designed to give the desirable properties of natural fibres to yarn. Knitting also was developed. There were improvements across the entire range of machinery, raising machine speeds, combining processes, automating transfers between processes. The textile industry became a more capital intensive operation and the textile machinery industry a high technology engineering sector. Readiness to develop and exploit improvements, such as electronic patterning in knitting operations and open-end spinning, has determined the ability of the various sectors of the industry to compete internationally. Thus, sectors in which British companies have made significant developments show a strong positive trade balance, whereas sectors such as weaving are weak internationally.

The international nature of this industry accentuates the problem of estimating concentration ratios based on domestic output. Because of the high level of exports (71% of domestic production exported in 1973) and of imports (56% of domestic consumption supplied by imports in 1973), concentration indices based on U.K. manufacturing companies alone will seriously distort the significance of concentration indices for the industry.

Moreover, the trend of sales of U.K. manufacturers is different from the trend of production (shown in Table 5.2), because some U.K. manufacturers were also selling imported machinery. While the index of sales (Table 5.6 below) also shows a marked recession in 1971, as did production, the trend is clearly rising (1973 was 24% up on 1968, whereas production was only 7% up).

TABLE 5.6:

TEXTILE MACHINERY SALES, EXPORTS AND IMPORTS 1968-73 (£ mill) *

	1968	1969	1970	1971	1972	1973
Total sales[1]	130	142	147	149	200	233
Total sales: 1968 prices[2]	130	137	128	118	148	161
Index (1968=100)	100	105	98	91	114	124
Exports[3]	100	106	116	134	147	166
Imports[3]	42	46	49	50	58	88
Trade Balance [(3)-(4)]	+58	+60	+67	+84	+89	+78
% sales exported	76	74	78	89	73	71
% home market supplied by industry	44	44	39	26	48	44
U.K. market [(1)-(3)+(4)]	72	82	80	65	110	155
U.K. market: 1968 prices[2]	72	78	7L	51	81	107

* All values rounded to the nearest £ million and expressed in current prices unless otherwise stated.

Sources: (1) Business Monitor Series, Department of Industry.

(2) Based on index of wholesale prices in mechanical engineering, Monthly Digest of Statistics.

(3) Overseas Trade Statistics, Department of Industry.

Profitability

Profitability varies considerably, both over the period of study and between different sectors of the industry. The average profit ratio for 1968 was 14%. and it had fallen to 2% in 1972. Companies making consistently low or negative profits are those engaged in the manufacture of looms, and some of the jute machinery manufacturers. Companies consistently earning high returns on capital over the period could be classified as the technical leaders in their specific areas; this implies there are considerable returns to investment in R & D available in this industry. For example, Scragg's technological leadership in the design of yarn texturing machines earned a record 71% on capital employed in 1969/70. Edgar Pickering, the carpet tufting machinery manufacturer, also have a good earnings record.

Analysis was undertaken to investigate the relationship between profits and size of companies (in terms of employment). The industry is fairly concentrated and one may expect larger companies to be making about average profits. The hypothesis was that size, because of the level of concentration, may explain the variation in profit levels. Therefore profit levels were regressed against numbers employed over a sample of twenty companies, for both 1968 and 1972. Neither equation showed significant values for the coefficients and the R^2 was approximately zero. Therefore we cannot find a statistical relationship between size and profitability in this sector.

2. CONCENTRATION

The principal information for our analysis of concentration is contained in Table 5.7 below (regretably, 1973 data were not fully available, and so had to be omitted). It shows that 'enterprise' turnover increased by 59% over the period 1968-72, while the net profit of those companies increased by 27% in total. 'UEA' turnover increased by only 30%, however.

TABLE 5.7:

SUMMARY OF PRIMARY SOURCE DATA, 1968-72

Unit	Variable		1968	1969	1970	1971	1972	Indices 1972 (1968=100)
'Enterprise':	Turnover	(£ m)	104	135	135	159	165	159
	Number employed	('000)	27	27	27	28	28	104
	Wages & Salaries	(£ m)	27	31	33	41	46	178
	Net profit	"	15	18	11	16	19	127
	Cash flow	"	17	21	14	19	23	135
	Own capital	"	50	44	45	55	58	115
	Exports	"	57	168	70	81	97	170
'UEA':	Turnover	"	158	185	187	198	205	130

Source: Company Accounts (L.B.S. Study).

Tables 5.8a and 5.8b summarise the main concentration ratio results. They show that overall 'enterprise' concentration in turnover in those

companies measured increased during the period, as also in employment; each exhibited a small decline in 1970.

TABLE 5.8a:

SUMMARY OF CONCENTRATION INDICES : 'ENTERPRISES' : TURNOVER

	1968	1969	1970	1971	1972
4-firm concentration ratio	64.6	71.8	69.2	73.3	74.0
8-firm concentration ratio	85.1	88.3	86.9	89.3	88.7
Coefficient of variation	1.38	1.38	1.41	1.53	1.73
Gini coefficient	.605	.637	.634	.669	.682
Herfindel-Hirschman Index	145.3	145.5	150.1	167.5	199.9
Entropy	-101.4	-97.9	-98.5	-93.8	-90.0
Linda Indices $-\left(\frac{Ln^{*}m}{n^{*}m}\right)_{L}$	.409	.362	.441	.492	.561
	10	4	6	5	2
$-\left(\frac{Ln\ h}{n\ h}\right)_{L}$	1.0	.76	.77	.58	.56
	2	2	2	3	2

Source: L.B.S. Study

TABLE 5.8b:

SUMMARY OF CONCENTRATION MEASURES : 'ENTERPRISES' : EMPLOYMENT

	1968	1969	1970	1971	1972
4-firm concentration ratio	71.4	73.6	72.5	76.3	77.8
8-firm concentration ratio	85.3	85.6	84.4	86.2	87.1
Coefficient of variation	1.62	1.65	1.64	1.83	1.91
Gini coefficient	.635	.643	.631	.666	.680
Herfindel Index	181.8	186.8	184.0	217.9	231.5
Entropy	-95.1	-93.7	-94.9	-88.7	-86.2
Linda Indices $-\left(\frac{Ln^{*}m}{n^{*}m}\right)_{L}$	.436	.440	.415	.490	.529
	19	19	19	19	19
$-\left(\frac{Ln\ h}{n\ h}\right)_{L}$	.853	.787	.835	1.05	1.27
	4	3	3	5	3

Source: L.B.S. Study

Table 5.9 below gives the results for turnover on a 'units of economic activity' basis. It shows, as would be expected, a lower overall

concentration ratio, but also a much slower increase in the ratio over the period 1968-72.

TABLE 5.9:

SUMMARY OF CONCENTRATION MEASURES : 'UEA' : TURNOVER

	1968	1969	1970	1971	1972
4-firm concentration ratio	62	57	58	60	65
8-firm concentration ratio	82	82	81	83	84
Coefficient of variation	1.48	1.40	1.41	1.47	1.61
Gini coefficient	.655	.649	.648	.664	.682
Herfindel index	113.9	105.2	107.0	113.0	128.2
Entropy	-110.4	-111.5	-111.8	-109.8	-106.7
Linda Indices $-\left(\frac{Ln^{*}m}{n^{*}m}\right)$	.343	.281	.279	.302	.380
	9	5	9	8	7
$-\left(\frac{Ln\ h}{n\ h}\right)$	.589	.654	.714	.809	.958
	2	2	2	2	2

Source: L.B.S. Study.

The U.K. industry is dominated by four major companies, Bentley Engineering, Stone-Platt Industries, James Mackie Ltd. and Ernest Scragg[1], which accounted for over 60% of total sales by U.K. manufacturers in 1973. There are a further seventeen companies which had total sales in excess of £1 million in 1973. But few of these companies compete directly with each other. The number of different machines manufactured is so large that there is room for many small companies to survive alongside the giants of the industry. There are a large number of even smaller companies, but they supply mainly spares and accessories to local markets.

Our data does not extend to 1973, but in that year Stone-Platt acquired Saco-Lowell for approximately £9.5 million. This increased their textile machinery sales from £26½ million in 1972-73 to £43 million in 1973-74; in spite of this large increase in turnover, they are still second in size to Bentley. Since Saco-Lowell is an American manufacturing company, operating in the United States, the merger may have little effect on the U.K. industry.

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(1) It was announced in the summer of 1975 that E. Scragg and Stone-Platt Industries are planning a merger.

Concentration varies in the individual sub-sectors. For example, there are only two U.K. manufacturers of carpet tufting machinery, whereas in the textile dyeing and finishing machinery sector there are approximately sixteen manufacturing companies. Knitting machinery manufacture is another concentrated sub-sector, dominated by Bentley Engineering and its subsidiaries; with the liquidation of G. Stibbe & Company in 1974, concentration in this sector is increasing.

Nature of Competition

Competition in the textile machinery industry is at the international level; there appears to be little direct competition between U.K. manufacturers in the U.K. market.

Technology is an important feature of competition in the industry - technical innovators often appear as market leaders. The "Sultzer" loom manufactured in Switzerland dominates the world-wide market for looms; Scragg are universally acknowledged for their crimping machines, which use electronic methods and operate at much higher speeds than conventional machinery in this field; Bentley produce high speed large diameter circular knitting machines. Each of these machines would be considered world leaders in their specific areas.

Other Structural Features

Entry Barriers: The advanced level of technology in the industry makes barriers to entry high for the new firm. The established engineering company wishing to diversify might be attracted by the high rates of return made by some of the innovators in the industry (Scragg earned a record 71% on capital employed in 1969-70); but in fact there are few diversified engineering firms in the industry (see below). Preparatory machines for synthetics, such as those made by Scragg, are very advanced. Three out of the four largest companies, Scragg, Platt and Mackie, operate in the preparatory and spinning machinery sub-sectors, making entry less attractive.

But the level of technology varies considerably between sub-sectors. The U.K. loom manufacturers have not advanced as rapidly as their European

competitors, and so technical barriers are not so high; but companies in this sector earn a below average rate of return so entry appears unattractive. Nevertheless, there are still new firms moving into this sector since the initial capital commitment is not excessive. The great variety of types of machines required by the textile industry allows small specialised operators to exist alongside the powerful manufacturers.

Vertical Integration: There is little significant vertical integration in the industry. G. Stibbe manufactured knitting machines, in competition with Bentley, and had a textile manufacturing division which they sold in 1972. They have subsequently gone into liquidation. Courtaulds have their own subsidiary engineering company which manufactures machines, mainly for their own use, so it does not compete directly with other companies in the industry. Some of the larger companies are vertically integrated within the industry. Sears Holdings, who own Bentley Engineering, the major U.K. knitting machinery manufacturer, also controls a company manufacturing knitting machine needles and one manufacturing knitting machine components. Sears Holdings made a step towards further vertical integration in their £45 million bid for Nottingham Manufacturers (the major carpet and knitwear manufacturers) in 1974. Since Sears had acquired Edgar Pickering in 1973 (one of the two major U.K. manufacturers of carpet tufting machines) they would have had a major customer for both Bentley's and Pickering's machines under their common control. But the bid was referred to the Monopolies Commission and subsequently withdrawn before the enquiry began.

Diversification: Diversification in some of the sub-sectors seemed to occur as a result of necessity than as a positive move towards more profitable areas of production. For example, when the Pakistan jute market collapsed in 1968, jute machinery manufacturers such as Keay were forced to diversify to survive (they now make machinery for paper sacks). Dronsfield Bros. also make machines for the paper industry. Some of the companies in the dyeing, finishing and bleaching sector of the industry are diversified into other sectors of engineering. Mather & Platt make centrifugal pumps and fire-fighting equipment.

Ownership Patterns

A significant proportion of the companies are privately owned, including one of the 'top four', James Mackie (Holdings) Ltd. The percentage of foreign control is low with only four firms (Leesona, Singer (U.K.) Ltd., Crostol and Proctor Dalgleish) under foreign ownership. There has been little change in the ownership structure of the industry over the period.

3. CONCLUSIONS

Concentration ratios in the Textile Machinery sector show some increase over the period 1968-72, the increase being larger on an 'enterprise' than on a 'UEA' basis. Some sub-sectors were dominated by only one or a few firms: other sectors were more atomistic in structure. The industry has a long tail of small firms about which published information is very fragmentary.

But as indicators relating to competition such information is difficult to interpret. In 1972 the industry exported 73% of its production, and imports were 52% of domestic consumption (some imports were sold by U.K. manufacturers, others were imported directly by users). In some sectors advanced technology holds the key to success, and here competition is world-wide.

We conclude, therefore, that concentration ratios based on U.K. producers in Textile Machinery are rather meaningless statistics. Much detailed information about individual companies is necessary for a full understanding of the nature of competition in this sector.

CHAPTER 6 - CONSTRUCTION AND EARTH-MOVING EQUIPMENT

1. DEFINITION AND DESCRIPTION OF THE SECTOR

This sub-sector of the mechanical engineering industry includes those companies making certain kinds of equipment for civil engineering contracting companies. Final products include the following:

- Digging machinery, including excavators, trenchers and ditchers.
- Other earth-moving equipment, including graders, levellers, crow-bar tractors, dumpers and powered
- Concrete mixing and placing machinery.
- Road making and maintenance plant, including asphalt, tarmac and bitumen processing and laying equipment, and road rollers.
- Crushing, pulverising and screening plant, both fixed and mobile machines.
- Well-drilling, piledriving and earth-moving equipment.

The name 'construction equipment' is rather misleading, because the official S.I.C. definition excludes mobile cranes, cable hoists and drag lines, which are part of materials handling, crawler and tower cranes and forklift trucks.

The construction and earth-moving equipment covered by this study employed about 26,400 persons in 1972 (in 'enterprises') with a corresponding turnover of £245 million. The turnover of companies included in the 'units of economic activity' analysis was, however, about £293 million while the 1972 Census of Production showed a gross output of £340 million with 38,400 employees. This is due largely to the inclusion in the Census of companies with less than 200 employees, compared with the criterion for inclusion in our study of a minimum of 100 employees.

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TABLE 6.1:

INDUSTRY COMPARISON : 1972

	Turnover (£ mill)	Employees ('000)
This Study		
'Enterprises'	245	26.4
'Units of Economic Activity'	293	....
1972 Census		
Gross output	340	38.4

Source: L.B.S. Study and Census of Production 1972.

TABLE 6.2:

U.K. PRODUCTION

	1967	1968	1969	1970	1971
(£ mill)	157.6	190.6	207.6	232.1	222.0

Source: Annual Abstact of Statistics.

As Tables 6.3 and 6.4 below illustrate, the product group labelled 'other earth-moving equipment' (graders, levellers, crowbar tractors, dumpers, etc.) is the largest and most dynamic force in this sector. It comprises more than 50% of the sector and has shown the largest growth rate since 1963.

TABLE 6.3:

U.K. DELIVERIES BY PRODUCT GROUP

Product Group	1963 (£ mill)	1971 (£ mill)	Per Cent Change
Digging	35.9	52.1	45.1
Other earth-moving	67.5	146.2	116.6
Concrete mixing and placing	10.4	12.4	19.2
Crushers, pulverisers, etc.	8.2	14.7	79.3
Road making and maintenance	10.9	20.6	89.0
TOTAL	132.9	246.0	85.1

Source: Business Monitor

TABLE 6.4:

U.K. SALES BY PRODUCT GROUP

Product Group	1972	1973
	(£ mill)	
Digging	72.5	93.7
Other earth-moving	155.8	187.6
Concrete mixing and placing	16.5	21.8
Road making and maintenance	25.3	32.4
Crushers, pulverisers, etc.	17.9	19.5
Well-drilling, etc.	12.2	19.1
Other	7.8	9.2
TOTAL	308.0	383.3

Source: Business Monitor.

(Note - a reorganisation of official statistics accounts for the difference in presentation between Tables 6.3 and 6.4).

Nearly 75% of total sales comes from the manufacture of earth-moving equipment (the first two items in Table 6.4). About 11% comes from integrated differ tractor combinations, 17% from sales of parts for earth-movers, and 17% from sales of tractor shovels and crawler tractors.

The manufacture of construction and earth-moving equipment is one of the oldest sectors of the mechanical engineering industry, with natural and traditional associations with the mining and engineering industries. The industry is intimately linked with the performance of the economy, cyclical movements being amplified backwards along the chain of supply so that construction equipment, allowing for underlying trends, is subject to large fluctuations in activity.

Many of the larger units of construction equipment have experienced relatively infrequent design changes, although there has always been a trend to build larger and more powerful earth-movers. Competition tends to be greatest and size of enterprise smaller among suppliers of smaller equipment.

The construction and earth-moving equipment identified for the purpose

of this study covered 23 companies for the 'enterprise' analysis and 29 companies for the 'units of economic activity' analysis. From Table 6.5 it can be seen that the Census of Production records 170 enterprises in this sector, the great majority employing less than 200 persons - in fact 74% of enterprises employ less than 100 persons.

TABLE 6.5

INDUSTRY COMPARISON : EMPLOYMENT

	Number of Enterprises : 1972	
Size Class by Employment	L.B.S. Study	1972 Census of Production
0 - 199	1	149
200 - 299	3	10
300 - 399	4	4
400 - 749	4	10
750 - 1,499	6	10
1,500 and over	5	5
	23	188*

Sourc: L.B.S. Study and Census of Production 1972.

* Some enterprises control establishments in more than one size grouping. After allowing for this double counting the number of companies is 170.

The Census records 39 enterprises employing more than 200 persons, compared to the 22 in our study. This is to be expected due to the exclusions made under our definition of 'enterprises' and, in smaller part, due to common ownership of some enterprises recorded by the Census.

2. MAJOR CHARACTERISTICS

The basic data on our sample of enterprises, in contrast to some other sectors, makes rather depressing reading (shown in Annexe 6.B)[1]. From 1968 to 1972 turnover increased by 34%, employment fell by 6%, profits fell by 8%, cash flow dipped and then reverted to its 1968 position, own capital increased by 20% and exports by 47%.

First of all this means a fairly stagnant home market declining gradually from £119 million in 1969. Secondly, profit margins have declined, the

(1) All Annexes are collected together at the end of this Chapter.

margin on turnover dropping from nearly 11% to 7½%.

A detailed analysis of the data (Annexe 6.C reveals that only 5 out of 23 enterprises have profit margins over 10%, and none over 20%. No less than 7 enterprises export more than half of their turnover. There is no clear correlation between export performance and profit margins.

Table 6.6 displays the turnover size distribution of enterprises in our study under both the 'enterprises' and 'units of economic activity' headings. The significant point here is the relatively large number of medium size companies, turnover £5 million to £10 million, and the lack of complete dominance by the largest companies.

TABLE 6.6:

INDUSTRY COMPARISON TURNOVER : 1972

	Number of Companies	
Size Class by Turnover (£ mill)	'Enterprises'	'U.E.A.'
0 - .49	0	0
.5 - .99	1	3
1.0 - 1.99	3	1
2.0 - 4.99	5	9
5.0 - 9.99	7	7
10.0 - 19.99	5	6
20.0 and over	2	3
	23	29

Source: L.B.S. Study.

Table 6.7 indicates the extent to which the largest U.K. manufacturers are committed to overseas markets - about 54% of production is exported. Moreover, in these seven companies 56% of sales are from wholly owned foreign (i.e. American) subsidiaries. The export share of sales is 71%, 78% and 42% for the U.S. subsidiaries, compared with 55%, 54% and 18% from wholly owned U.K. subsidiaries.

TABLE 6.7:

LARGEST U.K. MANUFACTURERS

	1972		
Company	Sales	Exports	Ownership
Caterpillar Tractor Co.	61,104	43,156	Foreign subsidiary
J.C. Bamford Excavators	32,000	17,600	U.K. private
General Motors (Scotland)	19,882	15,500	Foreign subsidiary
Aveling Barford	19,323	10,426	U.K. subsidiary
Clark Equipment*	16,253	6,899	Foreign subsidiary
Ruston Bucyrus	14,470	4,986	50% U.K., 50% foreign subsidiary
Hy-Mac	10,089	1,860	U.K. subsidiary
	173,121	94,217	

Source: L.B.S. Study.

* 13 months.

Ownership

The ownership and size distribution of firms in our 'enterprise' sample is shown in Table 6.8[(1)]. Of the 23 companies only six are quoted companies in the U.K., and only nine have an ownership untrammelled by other interests - that is, quoted and private companies. In other words, 14 companies are subsidiaries. Five in the sample are owned abroad and two more have joint U.K. and foreign ownership. The foreign ownership in this sector is always American. Of the seven largest companies with turnover more than £10 million, four are U.K. controlled.

(1) Annexe 6.A contains a full listing of 'enterprises' and 'units of economic activity' in this sector, together with brief notes on parent companies, associated subsidiaries, major products and merger and takeover activity.

TABLE 6.8:

TURNOVER DISTRIBUTION AND OWNERSHIP

Size Class by Turnover	Total	'Enterprises' UKQ	UKP	UKS	FS	UKS/FS
0 - .49	0					
.5 - .99	1			1		
1.0 - 1.99	3	2		1		
2.0 - 4.99	5	2	1		2	
5.0 - 9.99	7	2	1	2	1	1
10.0 - 19.99	5			2	2	1
20.0 and over	2		1	1		
	23	6	3	7	5	2

Legend: UKQ = U.K. quoted company
UKP = U.K. private company
UKS = U.K. subsidiary
FS = foreign subsidiary
UKS/FS = jointly owned subsidiary

Source: L.B.S. Study.

In general terms, this is an industry with a stagnant U.K. market, poor and declining profitability, and dominated by the biggest firms but nevertheless subject to significant foreign, multinational ownership.

3. MARKET STRUCTURE

Concentration

The basic information for our analysis of concentration is contained in Annexe 6.D, where for each variable the various concentration indices are tabulated for the period 1968-72. Some of this is summarised in Table 6.9 below, where the concentration measures for turnover are collected together. A similar tabulation for 'units of economic activity' is shown in Table 6.10.

TABLE 6.9:

SUMMARY OF CONCENTRATION MEASURES FOR TURNOVER OF 'ENTERPRISES'

	1968	1969	1970	1971	1972
4-firm concentration ratio	49.7	52.2	55.1	55.1	54.0
8-firm concentration ratio	72.4	74.9	76.4	75.8	74.2
Coefficient of variation	1.09	1.19	1.25	1.28	1.23
Gini coefficient	.50	.53	.56	.55	.54
Herfindel-Hirschmann	95.0	104.9	111.7	114.5	108.9
Entropy	-116.9	-114.3	-111.9	-112.1	-113.6
Linda: L_{n^*m}	.212	.234	.204	.259	.244
n^*	16	16	14	16	18
$L_{n^*\ 1}$	1.05	1.22	.96	1.12	.95
$n^*\ 1$	2	2	2	2	2
n	23	23	23	23	23

Source: L.B.S. Study and E.E.C. Computer Programme.

TABLE 6.10:

SUMMARY OF CONCENTRATION MEASURES FOR TURNOVER OF 'UNITS OF ECONOMIC ACTIVITY'

	1968	1969	1970	1971	1972
4-firm concentration ratio	39.1	41.7	44.5	44.9	43.9
8-firm concentration ratio	63.0	65.9	68.7	68.6	67.2
Coefficient of variation	.95	1.04	1.11	1.11	1.08
Gini coefficient	.48	.50	.53	.53	.52
Herfindel-Hirschmann	65.9	71.8	77.0	77.0	74.4
Entropy	-129.7	-127.6	-125.1	-125.5	-126.2
Linda: L_{n^*m}	.155	.173	.193	.191	.187
n^*m	20	21	16	20	25
$L_{n^*\ h}$	.842	.975	.769	.899	.764
$n^*\ h$	2	2	2	2	2
n	29	29	29	29	29

Source: L.B.S. Study and E.E.C. Computer Programme.

The overall picture from these statistics is one of stability. Turnover, net profits, and exports show signs of increased concentration; own means shows decreasing concentration; employment and wages and salaries show no trends; and cash flow is a little ambiguous. Some variables show a tendency for concentration to rise in the first half of the sample period, only to fall back in the second half. None of these trends are particularly strong. The concentration of turnover on a 'units of economic activity' basis has a similar pattern to 'enterprises'.

Concentration measures do not reveal movements of individual companies within a market - although there are likely to be more when using 4-firm ratios. Annexe 6.E shows rankings of enterprises by size of turnover and profits. The stability of concentration measures is reinforced by the great stability of turnover rankings. The rank correlation coefficient between each pair of successive years is .987, .987, .982 and .985. In fact, the same coefficient for 1968 and 1972 is over .95. The only remarkable point is the Linda definitions of 'superpowers': Caterpillar Tractor Co. (No. 1) is always ranked first, but the second superpower is General Motors (Scotland) Ltd. (No. 2) for 3 years and Ruston Bucyrus Ltd. (No. 6) and J.C. Bamford Excavators Ltd. for 1968 and 1972 respectively.

The ranking by profits shows much more variability as one would expect. The year to year rank correlations are .56, .66, .91, .81 and .58 for 1968 to 1972. However, the critical value for the Spearman Rank Correlation Coefficient at a significance level of .01 is .497, so there is still a statistically significant correlation from year to year, albeit a weakened one compared with turnover. Much of this weaker correlation is due to the lapse of J.C. Bamford Excavators into losses in 1969, followed by a return to large profits in 1970.

Other companies have moved into losses and then back into profits: British-Jeffrey Diamond (No. 22), Hy-Mac (No. 7). Clark Equipment (No. 5) has dropped into the uncomfortable position of three successive years with increasing losses. J.I. Case (No. 17) and Thomas Green (No. 21) show persistent losses.

The rankings by profit correlate significantly with those by turnover (coefficient is .58) - generally this is what one would expect. The largest enterprises by turnover to show losses are Clark Equipment (No. 5) and Hy-Mac (No. 7). The five or six higher ranked companies all make profits.

Entry Barriers

There appear to be two important characteristics in the industry - economies of scale in production and the value of a strong dealer organisation. These are most visible in the earth-moving equipment sector where large multinational, usually American, companies predominate. The President of Caterpillar says, "economies of scale are very important in our business and we like to supply from a single source wherever possible"(1). Thus, Caterpillar's entry into the hydraulic excavator market (hitherto a European preserve) involves a sole manufacturing plant at Gosselies in Belgium for the light end of the range for distribution throughout the world, and two manufacturing points, Belgium and the U.S.A., for the heavy part of the range. Similarly, with its Japanese partner, Mitsubishi, Caterpillar will manufacture in Japan a range of small tracked and wheeled loaders for distribution to the world market. Newcastle is its worldwide source for tractor-drawn scrapers. Clark Equipment, with its main plants at Camberley and Strasburg, are moving in the same direction.

The industry has traditionally been split into two parts. At the 'small' end it has always been easy for entrepreneurs to set up in business by buying in standard components, assembling them, and selling the finished product in local markets at a highly competitive price. This has always been less feasible with bigger items where component costs are greater and the technology more advanced. However, there are signs that those companies which can manufacture in greater volume, and thus achieve economies of scale in production and purchasing, and offer a wide range of products through a strong dealer network are attracting more and more

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(1) Financial Times, 30th November, 1972.

business. Some commentators observe that the right strategy in the earth-moving equipment market is to compete over a sufficiently broad front to provide dealers with a viable business. Examples of such companies are Poclain (France) - the European leader in hydraulic excavators - and Orenstein & Keppel (Germany) who have an even broader line. J.C. Bamford have followed this strategy in the U.K. by extending from simple digger-loaders based on tractors to hydraulic excavators, wheeled tractors and crawler tractors. Their turnover increased by 130% in four years, 1968-72.

Another important potential force in the market is the makers of farm tractors who, faced with little growth in their traditional business, are pushing into construction machinery. (Caterpillar, many years ago, exitted from the farm machinery business). Massey Ferguson have a new construction equipment factory in Italy. Ford have acquired Richier, one of the larger and more diversified French construction machinery manufacturers. British Leyland own Aveling Barford in the U.K. and General Motors have a subsidiary in Scotland.

Overseas Markets

In 1972, the world construction equipment market was believed to be worth over £2,500 million a year[1] and growing healthily. The U.S.A. has always been by far the largest exporter, followed by the U.K., Germany and France. In 1971, of the £244 million deliveries by the U.K., £136 million was exported. The leading American companies have organised their European production facilities to take full advantage of economies of scale. The Japanese industry shows signs of becoming more active, partly because of a strong home market (a similar situation has enabled the German industry to organise to achieve economies of scale). Present indications are that on a European scale the industry is rather fragmented both in manufacturing and distribution. The traditional concentration of producers on limited product ranges may well be ending, together with the traditional links between manufacturer and purchaser.

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(1) Financial Times, 30th November, 1972.

Diversification

Fourteen of the enterprises in this sector are subsidiaries of other companies which usually have a broadly diversified engineering base. The U.K. quoted and private companies tend to be highly specialised and non-diversified. The merger activity (as noted in Annexe 6.A) has generally been across industry boundaries.

4. CONCLUSIONS

(1) The sector has been in a state of stagnation relieved only by the strength of export markets.

(2) The industry shows structural stability without unduly high levels of concentration of turnover or employment.

(3) On a world scale the nature of competition seems to favour larger, multinational companies able to win economies of scale in production and marketing. Concentration in profits is quite significantly higher than in turnover.

(4) It will probably require a major expansion in both the European and U.K. market to trigger off increases in size of enterprise through internal expansion probably, together with vertical integration forward into dealer and wholesale networks).

ANNEXE 6:A: CONSTRUCTION & EARTH-MOVING EQUIPMENT : ENTERPRISE & U.E.A. LISTING

Identification Number	Name of Company	Type of Company	Parent Company	Major (or Assoc.) Subsidiaries	Subsidiaries in other Countries	Major Products	Mergers/ Takeovers
1	Caterpillar Tractor Co.	Foreign subsid.	Caterpillar Tractor Co., U.S.A.	-	-	Track-type tractors, bull-dozers, traxcavators, (also forklift trucks)	-
2	General Motors (Scotland) Ltd.	Foreign subsid.	General Motors Corp., U.S.A.	-	-	Highway earth-moving equipment, rear dumps, crawler tractors, front end loaders	-
3	Aveling Barford Ltd.	U.K. subsid.	British Leyland	Barfords of Belton John Cocksworth Invicta Bridge & Engineering A. Bowns (+ 7 more)	Australia Canada	Road rollers, dumpers, motor graders & shovels, contractors' plant, small dumpers, agricultural drainage implements	Subsidiary of British Leyland since 1967
4	J.C. Bamford	U.K. private company		J.C.B. Research J.C.B. Earth-movers J.C.B. Sales J.C.B. Service	Canada France U.S.A.	Earthmovers, excavators	Acquired Chaeside in 1968
5	Clark Equipment Ltd.	Foreign subsid.	Clark Equipment Co., U.S.A.	-	-	Earthmoving equipment, cargo van bodies, refrigeration units, (also forklift trucks)	In 1967/8 acquired Stracatruc Ltd. for £2 million
6	Ruston-Bucyrus	Assoc. company	G.E.C. Ltd. & Bucyrus Erie Co., U.S.A.	-	-	Excavators, mobile cranes	
7	Hy-Mac Ltd.	U.K. subsid.	Powell-Duffryn Ltd.	-	-	Hydraulic excavators, earth-moving equipment	In 1968/69 acquired Peter Haulto Equipment Ltd & Hydraulic Machinery Co £650 thou.
8	Priestman Bros.	U.K. subsid.	Acrow (Engineers) Ltd.	Coles Cranes Ltd.	-		

Identification Number	Name of Company	Type of Company	Parent Company	Major (or Assoc.) Subsidiaries	Subsidiaries in other Countries	Major Products	Mergers/ Takeovers
9	Frederick Parker Ltd.	U.K. private company	-	-	-	Builders & contractors plant, road making plant.	
10	Brehan Muller Group Ltd.	U.K. quoted	-	Titan Vacuum Engineering Bristowes Machinery Co.	-	Mechanised handling plant for quarries, asphalt machinery, macadam plant, contractors plant, concrete mixers	Was known as Brehan Patterson & Benham until acquired Miller's Machinery in 1971
11	Benford Concrete Machinery Ltd.	U.K. quoted	-	-	-	Concrete machinery & galvanizers	
12	Barber Greene England Ltd.	Foreign subsid.	Barber Greene, U.S.A.				Vickers own 49% of cap'l
13	Liner Concrete Machinery	U.K. quoted	-	Three gravel companies	-	Concrete block & mixing machinery	
14	Marshall-Fowler Ltd.	U.K. subsid.	Thos. W. Ward	-	-	Industrial & agricultural crawler tractors, road rollers, boilers	
15	Allis-Chalmer (G.B.) Ltd. (Fiat-Allis (U.K.) Ltd. on 4.1.74 when acquired by Fiat SpA of Italy)	Foreign subsid.	Allis-Chalmers Corp., U.S.A.	-	-	Earth-moving equipment (1971 - manufacture of agricultural equipment discontinued)	
16	Thwaites Engineering Co. Ltd.	U.K. private	-	-	-	Excavator equipment	
17	J.I. Case & Co. Ltd.	Foreign subsid.	Tenneco Inc., U.S.A.	David Brown Tractors	-	Crawler & wheeled tractors	
18	B.S.P. International Foundations Ltd.	U.K. subsid.	Edward Le Bas Ltd. (controlled by Le Bas Investment Trust)	-	India Parkistan	Pile driving & extracting plant equipment, public works contractors	Was known as British Pile Steeling Co. until became part of Le Bas 1969/70

Identification Number	Name of Company	Type of Company	Parent Company	Major (or Assoc.) Subsidiaries	Subsidiaries in other Countries	Major Products	Mergers/ Takeovers
19	Johnson Construction Equipment Group	U.K. quoted	-	Plant hire companies in group	-	Construction equipment, dumpers, pumps, rammers (also mechanical systems)	
20	A.C.E. Machinery (Holdings) Ltd.	U.K. quoted	-	-	South Africa	Contractors' plant specialists, building & construction equipment, mechanical handling equipment, plant for disposal of sludge & slurry	
21	Thomas Green & Sons Ltd.	U.K. subsid.	Hawker-Siddeley Group & then I.C.F.C.	-	-	Deadweight, rubber tyred & vibratory rollers & other road construction equipment	Changed from Hawker Siddeley to I.C.F.C. in 1972/73
22	British Jeffrey Diamond Ltd.	U.K. quoted	-	-	-	Road rollers (also mining machinery & conveyors, crane distributor, refuse pulverising plant)	
23	Bray Construction Equipment Ltd.	U.K. subsid.	Sheepbridge Engineering Ltd.	-	-	Earth-moving equipment, agricultural & 'off the road' heavy duty tractors	
24	Ransomes-Rapier	U.K. subsid.	Central & Sherwood Trust (immediate parent is Newton Chambers & Co. Ltd.)	N.C.K. Rapier N.C.K. Excavators	-	50% Excavators (also 50% mobile cranes)	
25	International Harvester	Foreign subsid.	International Harvester, U.S.A.	-	-	Industrial & earth-moving tractors - wheeled/crawler, other agricultural & construction equipment	
26	Massey Ferguson	U.K. subsid.	-	-	-	Tractors	

Identification Number	Name of Company	Type of Company	Parent Company	Major (or Assoc.) Subsidiaries	Subsidiaries in other Countries	Major Products	Mergers/ Takeovers
27	Ford Motor Co.	Foreign subsid.	Ford, U.S.A.	-	-	Tractors	
28*	(Blaw Knox Ltd. -(Muir Hill Ltd. (Winget Ltd.	U.K. subsid.	Babcock & Wilcox	Plant hire companies associated	-	Construction machinery	
29	Eaton Yale	Foreign subsid.	Eaton Corp., U.S.A.	Eaton Ltd.		(also forklift trucks)	
30	Stothert & Pitt Ltd.	U.K. quoted	-	-	-	Concrete mixers, road rollers	

* These subsidiaries of Babcock & Wilcox are treated collectively in the data, except as regards Major Products which applies solely to Blaw Knox Ltd.

ANNEXE 6.B: CONSTRUCTION AND EARTH-MOVING EQUIPMENT : SUMMARY STATISTICS

Year	Turnover (£ mill)	Employees ('000)	Wages & Salaries (£ mill)	Net Profits* (£ mill)	Cash Flow* (£ mill)	Own Means* (£ mill)	Exports (£ mill)	Exports/ Turnover (%)	Profits/ Turnover (%)	Profits/ Own Means (%)	Wages & Salaries/ Employees (£/person)
1968	182.6	28.2	32.7	19.8	29.4	83.8	88.3	48.4	10.8	23.6	1,160
1969	208.4	29.5	38.3	16.6	21.2	89.7	89.3	42.9	8.0	18.5	1,298
1970	231.1	29.5	40.1	19.1	23.5	91.1	125.6	54.3	8.3	21.0	1,359
1971	232.6	28.1	43.0	19.6	24.0	95.8	122.0	52.5	8.4	20.4	1,530
1972	244.9	26.4	46.7	18.2	30.9	100.4	129.7	53.0	7.4	18.1	1,769

* Including losses and other negative flows.

Source: L.B.S. Study.

ANNEXE 6.C: CONSTRUCTION & EARTH-MOVING EQUIPMENT : PROFITABILITY BY ENTERPRISE 1968-72

Enterprise	Turnover (%)	Exports/ Turnover (%)
1	16.3	59.4
2	11.1	68.2
3	4.8	59.2
4	8.3	42.0
5	-5.3	53.8
6	17.5	39.7
7	-7.0	26.3
8	8.3	35.7
9	5.4	52.0
10	8.7	17.6
11	14.3	33.7
12	6.2	90.1
13	5.4	19.4
14	0.6	20.6
15	5.2	71.7
16	13.6	25.4
17	-7.8	32.1
18	4.3	36.5
19	6.3	18.9
20	7.8	32.8
21	-4.8	32.8
22	2.9	22.5
23	4.2	42.2

NOTE: Ratios are unweighted averages of five years, 1968-72.

Source: L.B.S. Study.

ANNEXE 6.D: CONSTRUCTION & EARTH-MOVING EQUIPMENT : CONCENTRATION MEASURES 1968-72

VARIABLE	1968	1969	1970	1971	1972
4-firm Concentration Ratio					
Turnover	49.7	52.2	55.1	55.1	54.0
Employment	51.3	49.9	50.0	49.8	50.3
Wages and Salaries	51.8	54.4	57.8	53.8	51.6
Net Profits	77.0	82.2	81.0	74.9	80.4
Cash Flow	72.5	79.1	78.8	73.3	80.3
Own Means	64.0	63.4	64.8	61.5	61.8
Exports	59.0	53.3	64.8	65.1	66.8
8-firm Concentration Ratio					
Turnover	72.4	74.9	76.4	75.8	74.2
Employment	71.8	71.6	72.1	71.5	71.2
Wages and Salaries	72.7	74.7	74.8	73.5	73.7
Net Profits	87.6	92.6	94.9	92.2	91.4
Cash Flow	87.6	90.1	93.2	89.3	92.2
Own Means	81.4	81.8	84.6	80.2	80.2
Exports	80.0	79.9	86.3	83.7	84.9
Linda Index : Core Ln*m / n*m					
Turnover	.212/16	.234/16	.264/14	.259/16	.244/18
Employment	.226/20	.212/14	.217/15	.212/16	.219/15
Wages and Salaries	.230/12	.252/13	.262/16	.239/15	.244/14
Net Profits	.540/17	.848/16	.647/5	.531/5	.701/16
Cash Flow	.454/5	.660/17	.486/5	.536/5	.516/3
Own Means	.381/19	.379/10	.403/9	.326/15	.327/14
Exports	.301/13	.263/10	.375/8	.385/15	.420/16
Linda Index : Superpowers Ln* h / n*					
Turnover	1.05/2	1.22/2	.96/2	1.12/2	.95/2
Employment	.59/2	.61/2	.61/2	.55/2	.52/2
Wages and Salaries	.69/2	.56/3	.53/3	.55/3	.60/2
Net Profits	.94/2	1.41/2	1.02/2	1.45/2	1.00/4
Cash Flow	.65/2	1.36/2	1.06/2	1.45/2	.81/2
Own Means	.82/2	.79/2	.76/2	.75/2	.72/2
Exports	1.34/2	.64/2	.90/2	1.03/2	1.23/2
Coefficient of Variation					
Turnover	1.09	1.19	1.25	1.28	1.23
Employment	1.01	.99	1.02	1.03	1.02
Wages and Salaries	1.05	1.14	1.19	1.14	1.09
Net Profits	1.76	2.07	1.74	1.81	1.77
Cash Flow	1.65	2.05	1.72	1.73	1.58
Own Means	1.55	1.47	1.41	1.34	1.33
Exports	1.47	1.14	1.50	1.63	1.64
Gini Coefficient					
Turnover	.50	.53	.56	.55	.54
Employment	.50	.49	.50	.50	.49
Wages and Salaries	.51	.53	.54	.53	.52
Net Profits	.69	.74	.72	.72	.69
Cash Flow	.70	.73	.71	.68	.68
Own Means	.63	.62	.62	.59	.60
Exports	.61	.58	.66	.65	.66

...../cont.

ANNEXE 6.D: CONSTRUCTION & EARTH-MOVING EQUIPMENT : CONCENTRATION MEASURES 1968-72 (cont.)

VARIABLE	1968	1969	1970	1971	1972
Herfindel-Hirschmann Index					
Turnover	95.0	104.9	111.7	114.5	108.9
Employment	87.9	86.1	88.4	89.7	88.7
Wages and Salaries	91.2	100.0	105.4	100.3	95.1
Net Profits	194.3	279.1	223.0	214.0	243.8
Cash Flow	162.5	247.8	208.3	199.8	193.8
Own Means	147.9	137.4	141.7	127.4	125.9
Exports	136.8	100.1	141.9	159.0	160.7
Entropy					
Turnover	-116.9	-114.3	-111.9	-112.1	-113.6
Employment	-118.0	-118.6	-117.8	-117.9	-118.1
Wages and Salaries	-116.9	-114.6	-113.2	-114.9	-116.2
Net Profits	-91.3	-77.9	-81.8	-86.3	-81.6
Cash Flow	-95.6	-83.6	-85.6	-90.8	-86.9
Own Means	-103.5	-105.0	-101.9	-106.5	-106.6
Exports	-105.6	-111.5	-101-5	-100.9	-99.9

Source: L.B.S. Study and E.E.C. Computer Programme.

ANNEXE 6.E: CONSTRUCTION & EARTH-MOVING EQUIPMENT : ENTERPRISE RANKINGS

E1 : Ranking by Turnover*

	1968	1969	1970	1971	1972
Superpowers:	1	1	1	1	1
	6	2	2	2	4
Core:	2	6	3	3	2
	3	4	6	4	3
	4	3	4	5	5
	5	5	5	6	6
	7	7	15	14	7
	14	14	14	7	15
	18	15	7	18	18
	9	18	9	15	14
	8	9	18	9	9
	11	8	12	11	11
	15	11	11	8	12
	12	12	8	12	8
	22	17	17	22	22
	17	22	22	17	17
	16	16	16	16	13
	23	23	13	10	16
	13	13	23	13	10
	10	10	10	23	23
	19	19	19	19	20
	20	20	20	20	19
	21	21	21	21	21

Superpower entries:	1	-	-	1
" exits:	1	-	-	1
Core entries:	-	-	2	2
" exits:	-	2	-	-

ANNEXE 6.E: CONSTRUCTION & EARTH-MOVING EQUIPMENT : ENTERPRISE RANKINGS (cont.)

E2 : Ranking by Profits

	1968	1969	1970	1971	1972
Superpowers:	1	1	1	1	1
	6	6	2	2	4
Core:	2	2	6	6	6
	4	11	4	4	11
	11	3	3	3	15
	12	16	11	11	9
	22	12	15	9	2
	7	18	12	15	16
	9	8	18	16	3
	16	14	16	18	18
	18	9	9	12	13
	5	5	14	8	7
	14	10	10	10	10
	13	15	23	22	23
	3	13	20	20	22
	8	19	13	14	20
	10	22	19	13	19
	19	20	21	19	-21
	23	23	-8	23	-12
	20	-21	-22	7	-17
	15	-17	-17	-21	-8
	-17	-7	-5	-17	-14
	-21	-4	-7	-5	-5

Superpower entries:	-	1	-	3
" exits:	-	1	-	1
Core entries:	2	1	-	11
" exits:	3	12	-	-

CHAPTER 7 : MECHANICAL HANDLING

1. DEFINITION AND DESCRIPTION OF THE SECTOR

The Mechanical Handling sector of engineering covers companies producing a wide range of products, which fall naturally into four major sub-sectors:

A. Conveyors and aerial ropeways; elevators (excluding underground conveyors); pneumatic and hydraulic handling plants.

B. (a) Cranes and transporters; includes mobile cranes, electric overhead travelling cranes, dockside cranes and tower cranes.

(b) Hoists; lifting and winding devices.

C. Lifts and escalators; including equipment for both passengers and goods.

D. Powered industrial trucks.

Total employment of the 'enterprise' companies covered by this study was of the order of 35,000 in 1971, with a turnover of £207 million. Turnover in the industry in 'UEA' companies was estimated at £260 million. These compared with a Census of Production figure of £367 million gross output (which included an undisclosed amount of double counting where the output of one firm was the input of another firm in the industry). The figures are given in Table 7.1 below:

TABLE 7.1:

MECHANICAL HANDLING : INDUSTRY COMPARISON (1971 Data)

	Turnover (£ mill)	Employees ('000)
This Study		
'Enterprises'	207	35
'UEA'	260	...
1971 Census	(Gross Output) 367	64

Sources: L.B.S. Study, and 1971 Census of Production.

Production in the industry sector as a whole has increased by about 23% in volume terms over the period 1968-72, as shown in Table 7.2.

TABLE 7.2:

MECHANICAL HANDLING : U.K. PRODUCTION

£ million

	Volume		
	(£ 1968)	Index (1968=100)	Current Year Values
1968	169	100	169
1969	185	109	193
1970	196	116	230
1971	184	109	251
1972	202	120	311
1973	208	123	373

(Note: figures pre- and post-1971 are not exactly comparable)

Source: Business Monitor and Annual Abstract of Statistics.

Major Product Groups

Production in the five major sectors of the industry are show in Table 7.3. Industrial trucks occupy almost one third of the whole industry.

TABLE 7.3:

MECHANICAL HANDLING : U.K. PRODUCTION BY SUB-SECTOR

£ million

	1968	1969	1970	1971	1972	1973
Conveyors & aerial ropeways	42	44	51	59	72	84
Lifting & winding devices	10	11	12	13	34	38
Lifts & escalators	31	34	36	40	38	41
Cranes	47	55	68	77	79	86
Industrial trucks	39	49	63	62	84	113
TOTAL	169	193	230	251	311	373

(Note: Figures for 1971 and 1972 do not add to the total because the total figure is adjusted upwards for sales of these goods made by firms outside the sector).

Source: Business Monitor.

Because of the low cross elasticity of demand between these sub-sectors, companies identified as producers of mechanical handling goods could be classified meaningfully to one of the sub-sectors. This was straightforward because there was very little overlap of products: nearly all the major companies produce exclusively for one of the sub-sectors. One notable exception are the overhead crane manufacturers, who are also major manufacturers of hoists and hoist blocks (they are included in the crane sector).

Comparison with the Census of Production Data

The Census of Production (1971) identifies 548 enterprises in the sector. Of this total 479 employed less than 100 persons (and over 60% of these Census enterprises employed less than 25 persons).

TABLE 7.4:

MECHANICAL HANDLING : INDUSTRY COMPARISON : SIZE DISTRIBUTION BY EMPLOYMENT

	Number of Companies, 1971	
Size Class by Employment	This Study: Number of 'Enterprises'	1971 Census of Production
0 - 99	1	479
100 - 399	13	89
400 - 499	1	6
500 - 749	6	16
750 - 1,499	9	6
1,500 - 1,999	3	...
2,000 & over	3	4
	36	600*

* Some 'Census Enterprises' were companies in more than one size group. Net of duplication the number of Census companies was 548.

Sources: L.B.S. Study, and 1971 Census of Production.

As in several other sectors, the large number of firms employing less than 100 persons partly explains the difference in employment (noted in Table 7.1) between the L.B.S. figures and those in the Census. And the usual statistical difficulties with the Census of Production are present that make the strict interpretation of Table 7.4 difficult.

International Trade

The industry as a whole exports about one third of its output - a share that has been varying considerably over time. Imports account for about one fifth of domestic consumption; and the sector has a balance of trade surplus. But this trade surplus has been declining since the peak year 1971, as shown below in Table 7.5.

TABLE 7.5:

MECHANICAL HANDLING : TRADE AND CONSUMPTION

(£ million : Current Values)

	1968	1969	1970	1971	1972	1973
Total Exports	47	70	84	108	92	108
Total Imports	24	23	30	36	47	66
Trade Balance	+23	+47	+54	+72	+45	+42
U.K. Domestic Consumption	146	146	176	179	266	331
% of Production Exported	28%	36%	37%	43%	30%	29%
Imports as % of Consumption	16%	16%	17%	20%	18%	20%
U.K. Consumption at constant prices (1968=100)	100	96	103	97	118	126

Sources: Overseas Trade Statistics, and Business Monitor.

The share of output that is exported varies considerably also between sub-sectors, from 5% of lifts and escalators to 41% of forklift trucks. The former sub-sector is dominated by one manufacturer, a single multinational; the latter is a more oligopolistic sector with several large manufacturers. Since the degree of engineering expertise in the industry is generally low, competition tends to be very intense. In some sub-sectors transport costs have become a significant percentage of final selling price and have made exported goods of this type less competitive abroad. Manufacturing by license is therefore quite usual. But with some of the larger machines, such as the heavy cranes, only the moving

parts are exported, the construction steel work being done in the importing country. Firms also export their engineering expertise, for example by sending out engineers to supervise the building of structures on site.

In recent years a world-wide market for handling equipment has come from containerisation: sales in Taiwan, Singapore and Australia have followed the development of container facilities. Containerisation has also led to revolutionary changes in handling methods with gantry crane side loaders and modified forklift trucks. And of course a good market has developed in the Middle East, for obvious reasons.

2. CONCENTRATION

The principal information for our analysis of concentration is contained in Table 7.6 below. It shows that while the turnover of 'enterprises' included in our study increased by 47% in 1968-72, net profits increased by only 20%. Wages and salaries increased by 56%.

TABLE 7.6:

SUMMARY OF PRIMARY SOURCES DATA : 1968-72

Unit	Variable		1968	1969	1970	1971	1972	Indices 1972 (1968=100)
'Enterprises':	Turnover	(£ m)	135	156	190	207	198	147
	Employment	('000)	32	33	35	35	34	106
	Wages & Salaries	(£ m)	36	41	50	55	56	156
	Net profit	"	10	11	10	13	12	120
	Gross cash flow	"	13	13	13	16	16	123
	Own capital	"	52	52	53	54	57	110
	Exports	"	26	35	52	65	51	196
	U.K. market	"	110	121	132	142	147	137
'UEA':	Turnover	"		209	243	260	255	(122)*

* 1969=100

Source: Company Accounts (L.B.S. Study).

The principal concentration ratios for the 'enterprises' included in this study are given in Tables 7.7a and 7.7b. They show that turnover concentration has been very static over the years 1968-72, while employment concentration has been rising.

TABLE 7.7a:

SUMMARY OF CONCENTRATION INDICES : 'ENTERPRISES' : TURNOVER

	1968	1969	1970	1971	1972
4-firm concentration ratio	37	42	38	40	37
8-firm concentration ratio	56	60	56	57	55
Coefficient of variation	.99	1.10	1.03	1.07	1.03
Gini Coefficient	.478	.500	.485	.492	.480
Herfindel index	65.7	65.3	57.3	59.7	57.5
Entropy	-137.6	-134.1	-138.1	-137.2	-138.2
Linda Indices $-\left(\frac{L}{n^*m}(Ln^*m)\right)$	.134	.149	.135	.136	.133
	32	31	35	34	32
$-\left(\frac{L}{n\ h}(Ln\ h)\right)$	.66	.76	.64	.58	.66
	2	2	2	2	2

Source: L.B.S. Study.

TABLE 7.7b:

SUMMARY OF CONCENTRATION INDICES : 'ENTERPRISES' : EMPLOYMENT

	1968	1969	1970	1971	1972
4-firm concentration ratio	34	37	38	39	39
8-firm concentration ratio	54	50	57	57	57
Coefficient of variation	.90	.96	1.02	1.03	1.02
Gini coefficient	.45	.46	.49	.49	.49
Herfindel index	51.6	56.7	56.8	57.2	56.8
Entropy	-139.9	137.4	-137.9	-137.9	-138.1
$\left(\frac{L}{n^*m}(Ln^*m)\right)$	.120	.130	.136	.138	.137
	29	28	28	23	33
$\left(\frac{L}{n\ h}(Ln\ h)\right)$	.672	.678	.648	.586	.528
	2	2	2	2	2

Source: L.B.S. Study.

Likewise Table 7.8 shows the only concentration data available on the basis of 'units of economic activity' companies. Concentration ratios have varied over the period, but about a broadly horizontal trend (as did the ratios for turnover concentration in 'enterprises').

TABLE 7.8:

SUMMARY OF CONCENTRATION INDICES : 'UEA' : TURNOVER

		1968*	1969	1970	1971	1972
4-firm concentration ratio		-	32	30	32	30
8-firm concentration ratio		-	47	46	47	44
Coefficient of variation		-	1.20	1.02	1.07	1.02
Gini coefficient		-	0.52	0.47	0.48	0.47
Herfindel index		-	42.2	40.1	42.2	39.8
Entropy		-	-155.0	-153.9	-153.0	-154.4
Linda Indices	$\left(\frac{L_{n*m}}{n*m}\right)$	.000	.099	.091	.092	.089
		47	48	48	47	44
	$\left(\frac{L_{n\ h}}{n\ h}\right)$	.66	.76	.64	.58	.66
		2	2	2	2	2

* 'UEA' figures for 1968 not available.

Source: L.B.S. Study

It is, however, difficult to conclude anything meaningful about industry concentration at the sector level. There is surprisingly little overlap between sub-sectors in that nearly all the major companies produce exclusively in only one of them. A notable exception is Acrow, a diversified engineering company which manufactures handling systems and overhead travelling cranes, and has moved into the mobile cranes sector with its takeover of the Steel Group in June 1972 (in 1973 the company had 30% of its turnover from mechanical handling sales compared with 19% in 1969).

It is noticeable that amongst a large number of companies operating in this sector there are relatively few foreign subsidiaries, and no major multinationals. Eaton Ltd., Hyster and Clarke Equipment, the three American truck manufacturers, all manufacture forklift trucks in the U.K.; but they have nothing like the same dominance in this market than in the United States.

The only other notable foreign subsidiary is the Otis Elevator Company, which has a large share of the lift market. But a large number of the major U.K. engineering companies have subsidiaries manufacturing in this sector; for example, Tube Investments, George Cohen 600 Group, Thomas Ward & Son and G.E.C.

The three largest companies in order of 1973/74 turnover are Coles Cranes Ltd. (part of the Acrow Group), Lansing Bagnall (now The Kaye Organisation Ltd.), and the Otis Elevator Company. All three operate in separate sectors: cranes, industrial trucks, and lifts and escalators respectively. There is virtually no cross elasticity of demand between, for example, conveyors and cranes. Also, companies do not necessarily provide a threat of potential competition; the technology needed to manufacture, for example, a crane or forklift truck is more akin to the technology in manufacturing of construction and earth-moving equipment rather than the other sectors of mechanical handling. It is almost meaningless, therefore, to discuss the concentration of the mechanical handling industry as a whole, but some remarks may be appropriate concerning concentration at the sub-sector level. Each of the four principal product groups is discussed separately.

Sub-Sector Concentration

(a) Conveyors and Aerial Ropeways

Most of the major producers in this sector are subsidiaries of large engineering groups. Doughty Meco (part of the Doughty Group), with a turnover of £7.2 million in 1973/74, and G.E.C. - Elliott Mechanical Handling, with a turnover of £8.1 million in that year, are the two major companies. Lamson Industries, Powell-Duffryn, Tube Investments, Babcock & Wilcox and Acrow all have subsidiaries manufacturing these products. In the 1950s many companies entered the sector as a ready means of diversification.

The Tube Investments subsidiary, George W. King Ltd., ceased production in November 1973. At the time it was the largest company of its kind, producing a complete unit handling system for the motor industry, supplying heavy conveyor systems. Its closure came as a result of both internal management problems and a new approach to

ordering equipment by the motor manufacturers, which subjected King Ltd. to direct and intense competition from American companies.

Except for the closure of George W. King, there has been little structural change in the industry since 1968. The manufacture of conveyors is an easy process so there are many small manufacturers producing conveyors of specific specialist types, many being members of large groups. Entry and exit at the tail end of the market is fairly frequent. However, the two major companies account for just under 20% of total sales in the industry, and the four-firm concentration is approximately 30%.

There exists a threat of potential competition in the sector because of the ease of entry. Almost any engineering company can produce its own conveyor. Therefore a conveyor manufacturer will have to keep price (and profit) levels fairly low, otherwise some of their customers will produce their own conveyors. But the introduction of fully automated handling systems require a degree of technical expertise, and manufacturers can hope for better returns in the future, if they follow the trend towards automated systems.

(b) Cranes and Hoists

Concentration and competition in this sector is discussed in much greater detail in Chapters 16-18. Some remarks in parallel with those from the other three sub-sectors, nevertheless may be helpful here.

The crane market is interesting since it has undergone considerable structural change since 1968. Significant mergers were promoted by the Government sponsored 'Industrial Reorganisation Corporation' at both the heavy and the mobile ends of the market. Intent on putting together the fragmented land crane market, the IRC helped Clarke Chapman Ltd. to raise its share of the heavy crane market to 80% in little over a year after first taking an interest in the field.

In the middle of 1968 Clarke Chapman acquired Clyde Crane & Booth Co. Ltd. and then bought Sir William Arrol, one of the country's largest crane manufacturers, making heavy cranes for steelwork,

shipbuilding and docks with up to 650 tons lifting capacity. In 1969 the crane interests of Wellman Engineering were taken over by Clarke Chapman. The new Clarke Chapman now had the largest share of the crane market with the help of a £2 million government loan.

At the mobile end of the market the Steel Group subsidiary, the British Crane and Excavator Corporation (now known as Coles Cranes Ltd.) had approximately 70% of total U.K. production of the ranges it manufactured. In September 1969 the Steel Group, encouraged by a £1 million loan from the IRC, took over Priestman Brothers, manufacturers of excavators and mobile cranes. Following this the Steel Group had a very successful year in 1970/71 with profits up by 100%: the Steel Group was then taken over by Acrow in 1972.

Mobile cranes account for over half of total U.K. deliveries of cranes. The trend is towards heavier units. For example, Coles Cranes introduced a new Colossus range in 1971 capable of handling loads of up to 170 tons but which can still be driven on the road.

In the U.K. the majority of cranes are not bought but are hired from one of the many plant hire companies, of which the largest is the British Crane Hire Corporation. Turnover of such companies has risen from £15 million per annum in 1962 to £125 million per annum in 1972.

But some European countries appear to have erected effective technical barriers to protect their own industry. France is reported to require cranes to have ropes different from those fitted in any other country, and in Italy the technical requirements (covering how ropes are slung from booms) are different from other European countries. (At present the main export markets for cranes appear to be outside Europe).

(c) Lifts and Escalators

In terms of value of output, this is one of the two least important sectors in mechanical handling. In constant prices, output has in fact fallen from £30.9 million in 1968 to £22.7 million in 1973. Future growth prospects are poor because of the sharp decline in the U.K. construction activity.

Concentration is higher than in the other three sub-sectors. The market is dominated by the American multinational, the Otis Elevator Company, which has nearly 50% of the market. Their major competitors are the Express Lift Company (another G.E.C. subsidiary) and the Marryot Group Ltd., and approximately 30 other companies. Again, many of the manufacturers are subsidiaries of other larger manufacturers in the sub-sector, and so treated as one large enterprise with them. Several manufacturers are subsidiaries of other engineering companies. The Herbert Morris Group (crane manufacturers) have their own lift manufacturing division.

Because of these complexities of company structure, the problem of identifying the small independent firms is made very difficult. The four firm concentration ratio of well over 80% may exaggerate the actual level of concentration, and the data collected does show that inter-relationships exist between the major companies in this industry, as is summarised in Table 7.9 below.

TABLE 7.9:

MAJOR LIFT & ESCALATOR MANUFACTURERS

Company Accounts	(£ million) 1972 sales
Otis Elevator Group	20.8
Marryot Group	8.9
Express Lift Company	8.0
United Lift & Escalator Company	2.6
Evans Lifts	2.8
William Wadsworth & Sons Limited	1.7
Hammond & Champness	3.8
	48.6
Total deliveries by U.K. manufacturers of lifts and escalators (Business Monitor series)	38.0

Sources: Business Monitor, and L.B.S. Study.

The table emphasises the difficulties involved in reconciling company data with total sector data. From our company data it appears

we have identified all the manufacturers, but we know there is a tail of small companies, and there is no way of estimating the latter's contribution to the industry's sales. The problem arises as a result of including companies as a whole (if 50% or more of their sales are of lifts and escalators). In fact, with the above manufacturers the percentage of sales of the industry's products is a great deal higher than 50%. But, because none of the companies break down their activities, there is no way of telling where the £10 million discrepancy occurs.

The structure of the industry has been very stable over the period. There was only one major ownership change, when Hammond & Champness Ltd. were sold by Elevators & Engineering Ltd to the Dover Corporation in the U.S.A.

(d) Industrial Trucks

This section of the industry is highly competitive, and has expanded rapidly since 1968. The forklift truck is the basic unit of mechanical handling and is a very flextible machine. Technical developments have not been in relation to power, but to expanding the versatility of the machine to side loading, containerisation and so on. The worker environment was found to inhibit performance of faster trucks (trucks with performance specifications differing by as much as 65% were found to vary by less than 1½ times overall in working conditions where the power can never be fully utilised). Innovation has been the hallmark of the sector, and forklift trucks can be found to undertake the most awkward stacking and storage problems.

The forklift truck manufacturers, together with the mobile crane manufacturers, were those most prepared for the European market. Lansing Bagnall has approximately 20% or more of the European market, and, like Lancer Boss, has operations in Germany. The European market is still fragmented so there is a tendency for manufacturers to switch from Commonwealth to Europe. The prerequisite for obtaining large European contracts is an efficient distribution system. European distribution is fragmented and British manufacturers have begun establishing their own marketing operations in Europe.

As shown in Table 7.10, the forklift truck industry has a four firm concentration ratio of about 60%. There is one major company, The Kaye Organisation (previously known as Lansing Bagnall), with a turnover in ecess of £20 million, followed by a block of four companies with turnovers of approximately £10 million each.

TABLE 7.10

CONCENTRATION IN THE INDUSTRIAL TRUCKS MARKET

	1968	1972
4-firm concentration ratio	58	59
8-firm concentration ratio	86	86
(Ln*m L	.272	.307
(n*m	7	11
(		
(Ln h L	.701	1.501
(n h	2	2

Based on 'Units of Economic Activity - Turnover

Source: Company Accounts, L.B.S. Study.

Entry into the sector has occured over the past ten years. In June 1966 the Henley Forklift Truck Company was registered, and by 1972 had achieved a turnover in excess of £4 million. Montgomerie Reid rose from relative obscurity to take over Wessex Industries, another manufacturer of forklift trucks, in 1972.

Several large engineering companies, especially those manufacturing construction equipment, have found forklift truck manufacture a convenient area of diversification. Both Clark Equipment and the Caterpillar Tractor Company make forklift trucks, as do Eaton Yale Limited. It is noticeable that all the latter are American companies; none of the English construction equipment manufacturers have made this move yet, but they exist as a threat of potential competition to existing manufacturing. (Ransomes & Jeffries, the agricultural machinery manufacturers, do however manufacture fork-lift trucks).

3. CONCLUSIONS

The mechanical handling sector consists of five industries, or major product lines. Each of these five is dominated by a few firms, but there is little diversification between them. Thus concentration ratios based on grouping the five sub-sectors together into a single mechanical handling industry is bound to be misleading, and to understate the true concentration levels that exist.

However, difficulties with the data, especially where small firms are subsidiaries of larger firms in each sub-sector, mean that the data we have provided is not completely reliable.

The cranes industry had been subject to considerable structural change, inspired and promoted by the Government's Industrial Reorganisation Corporation, and supported by Government money, for this reason we thought it appropriate to conduct a special inquiry into this area, supported by a large number of interviews. This is reported in Chapters 16 to 18 below.

CHAPTER 8 - OFFICE MACHINERY

1. DEFINITION OF SECTOR

Principal Product Categories

The office machinery sector divides into five sub-sectors:

- Typewriters.
- Accounting machinery, including adding, calculating and punched card machines, and cash registers.
- Document copying equipment, including photocopying machines and stencil, spirit and offset litho duplicators.
- Other office equipment includes addressing machines, coin counting and sorting machinery, cheque encoders and paper shredding equipment.
- Miscellaneous, including spare parts.

The Standard Industrial Classification for this sector includes photocopying machines. However, the fastest growing development in recent years has been the process of xerographic and photographic document copying. Here, we include it under the heading of office machinery rather than instrument engineering as the S.I.C. classifies it.

The enterprises covered by this study employed about 51,400 persons in 1972 with a corresponding turnover of £353.6 million. Two of the largest companies, Rank-Xerox and Gestetner, have overseas subsidiaries whose earnings and profits are consolidated into the U.K. accounts. In this study we have generally tried to exclude the overseas portion of their activities amounting to about £213 million. However, the concentration measures reported in Annexe 8.D[1] are based on published accounts for all enterprises.

The Census of Production for 1972 shows a turnover of only £124.9 million employment of 26,900 persons. This very large discrepancy arises from the difficulty of separating office machinery only from other related activities. About £80 million of the difference is due to photocopying

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(1) All lettered Annexes are collected together at the end of the chapter.

equipment. The remainder is due to activities of the enterprises in S.I.C. categories, electronic computers, metal furniture, shop and office fittings and general painting and publishing.

TABLE 8.1:

INDUSTRY COMPARISON : 1972 TURNOVER, EMPLOYEES

	Turnover (£ mill)	Employees ('000)
This Study*		
'Enterprises'	353.6	51.5
'Units of Economic Activity	422.6	....
1972 Census		
Gross Output	124.9	26.9

Source: L.B.S. Study and Business Monitor.

* excluding overseas earnings of Gestetner and Rank-Xerox.

According to the Census, the largest of the five sub-sectors was document copying equipment which, in 1971, accounted for nearly 44% of total deliveries (see Tables 8.2 and 8.3 below).

TABLE 8.2:

DELIVERIES

	(£ million)		
	1963*	1971	% Change 1963-71
Typewriters	8.3	11.8	42.2
Accounting machinery	41.6	59.4	42.8
Document copying**	13.3	81.0	509.0
Other office equipment	5.3	10.4	96.2
Miscellaneous	10.9	22.8	109.2
TOTAL	79.4	185.4	133.5

Source: Business Monitor.

* Including cash registers, ticket machines, calculators.
** Includes photocopying.

TABLE 8.3:

SALES

	1972	1973	(£ million) Exports 1973	Imports 1973
Data processing and handling	33.0	21.1	14.3	5.1
Duplicators	23.9	26.7	14.8	2.1
Typewriters	22.1	29.7	19.4	26.0
Accounting Machinery*	34.3	37.2	16.6	51.5
Other (addressing, document handling, parts, etc.)	14.7	17.6	6.2	9.8
TOTAL	128.0	132.3	71.3	94.5

* Including cash registers, ticket machines, calculators.

Source: Business Monitor.

Deliveries of photocopying equipment alone were valued in 1971 at an estimated £63 million. Since 1963 the major growth point in the industry has been the development of document copying equipment, their deliveries alone have increased from an estimated £6 million in 1963 to £63 million in 1971, a 950% increase.

A reclassification and re-organisation of statistics makes it difficult to compare Tables 8.2 and 8.3 - in particular photocopying is excluded from Table 8.3. Rough estimates place the photocopying market in 1972 at £70 to £75 million.

Two points arise from this table. First is the extensive import/export trade reflecting increasing specialisation of production. The second is the very large import figure of £51.5 million for accounting machinery. Fully 50% of this is due to electronic calculators where sales have more than doubled in 1972-73.

The physical dimensions of this sector are difficult to define with turnover for 1972 estimates ranging from £125 million to £566 million.

A rough guide to the composition of the larger estimate is:

	Turnover (£ million)
Census/Business Monitor estimates	125
Document copying equipment	85
Overseas earnings of Gestetner and Rank-Xerox	210
Unidentified, comprising other sectors, other overseas earnings, double counting	140
TOTAL	560

Annexe 8.A lists all the enterprises and units covered by this study with notes on ownership, subsidiaries, major products and merger/takeover history.

Table 8.4 compares our coverage of enterprises with that of the Census. The latter record 79 enterprises to our 20, the difference being principally in the 49 companies recorded in the Census employing less than 100 persons. In the larger size categories of 1000 employees and over, this study counts 14 enterprises to the Census' 9. The turnover from the 5 extra enterprises must amount to at least £25 million in 1972, perhaps even as high as £200 million. Our data on companies does not permit the drawing of very tight market boundaries. We chose to collect together those companies who had substantial interests in office machinery but were unable to separate out their other activities. For example, if Rank-Xerox document copying activities are their largest single activity, then the Census would exclude it from the enumeration whereas we would include it. Rank Xerox alone would then explain £100 million of the £225 million discrepancy (document copying plus unidentified).

TABLE 8.4:

INDUSTRY COMPARISON : ENTERPRISES AND EMPLOYMENT

Size Class by Employment	Number of Enterpriseses : 1972 L.B.S. Study	1972 Census of Production
0 - 99	0	49
100 - 299	3	11
300 - 999	3	10
1,000 - 4,999	12	}
5,000 and over	2	} - 9
	20	79

Source: L.B.S. Study and Business Monitor.

Table 8.5 displays the turnover size distribution of enterprises and units in the study.

TABLE 8.5:

INDUSTRY COMPARISON : TURNOVER : 1972

Size Class by Turnover	Number of Companies 'Enterprises' (a)	(b)	'U.E.A.' (a)
less than 1.0	1	1	1
0 - 1.99	2	2	2
2.0 - 4.99	4	4	6
5.0 - 9.99	5	5	5
10.0 - 19.99	2	2	3
20.0 - 39.99	3	2	3
40.0 - 99.99	2	3	3
100.0 - 199.99	1	0	1
200.0 and over	0	1	0
	20	20	24

(a) excludes overseas activities of Gestetner and Rank Xerox by estimation,

(b) includes all activities of Gestetner and Rank Xerox consolidated into U.K. accounts.

Source: L.B.S. Study.

2. MAJOR CHARACTERISTICS

In general terms this sector has a high growth rate and a wide diversity of products ; from 1968-72 turnover has grown 91%, profits and cash flow by more than 150%, and own means by 86%. Annexe 8.B contains summary statistics.

Sales are sensitive to the general level of economic activity showing distinct pauses during times of economic difficulty. The mainspring of growth lies in the fact that expansion in the economy has involved a large increase in clerical and administrative work, often of a highly complicated nature. With labour increasingly scarce and costly, the

tendency has been, and is likely to continue to be, the substitution of labour by capital. These trends are world-wide, consequently leading to the establishment of multinational enterprises with specialised production facilities and diverse markets. This means, for example, that it is possible to sell certain types of office equipment to the U.S.A., the largest market and the strongest suppliers in the world.

The 1960s saw two features in the marketing of office machinery. First was the establishment of large and vigorous sales forces with more than a hint of the hard selling approach. Second, in order to increase sales, frequent model changes were announced producing a kind of planned obsolescence for existing equipment. Perhaps more important than this obsolescence was the need to maintain competitive product advantages in the market. However, it was the 1970s which produced major changes - these were based on technical innovations, and are discussed in section 3 below.

Office machinery has long been dominated by overseas manufacturers, principally American. Table 8.6 itemises the 9 largest manufacturers in the U.K. in 1972, 7 of whom are foreign subsidiaries.

TABLE 8.6:
LARGEST U.K. MANUFACTURERS : 1972

Company	Turnover	Exports	Ownership
Rank Xerox*	107,000	15,000	U.K./Foreign subsidiary (U.S.A.)
National Cash Register	46,000	7,700	Foreign subsidiary (U.S.A.)
Burroughs Machines	45,000	7,400	" " (")
British Olivetti	28,000	900	" " (Italy)
Gestetner Holdings*	23,000	11,000	U.K. quoted
Addressograph-Multigraph	20,000	1,800	Foreign subsidiary (U.S.A.)
Roneo Ltd. (Vickers)	18,000	1,800	U.K. subsidiary
Imperial Typewriters	11,000	1,200	Foreign subsidiary (U.S.A.)
G.A.F. (U.K.) Ltd.	10,000	700	" " (U.S.A.)
	308,000	47,500	

Source: L.B.S. Study.

* Overseas activities of Gestetner and Rank Xerox have been excluded by estimation.

Table 8.7 analyses enterprises by turnover size and ownership. Twelve out of twenty are foreign subsidiaries, and sixteen are subsidiaries of larger companies. Ownership patterns are very stable - see Annex A because the major companies are already subsidiaries of large foreign companies. No mergers have been found during 1968-72.

TABLE 8.7:

TURNOVER AND OWNERSHIP : 1972

Size Class by Turnover* (£ mill)	Ownership				
	UKQ	UKP	UKS	FS	UKS/FS
less than 1.0	1				
0 - 4.99			2	4	
5.0 - 9.99	2		1	2	
10.0 - 39.99	1		1	3	
40.0 and over				2	1
	4		4	11	1

Legend: UKQ = U.K. quoted company
UKP = U.K. private company
UKS = U.K. subsidiary
FS = Foreign subsidiary
UKS/FS = jointly owned subsidiary

Source: L.B.S. Study.

* Overseas earnings of Gestetner and Rank-Xerox are included.

3. MARKET STRUCTURE

Concentration

The basic information for analysis of concentration is contained in Annexe 8.D, where, for each variable, the various concentration indices are tabulated for 1968-72. Some of this is summarised in Table 8.8 (below) where measures of turnover concentration are collected together. A similar tabulation for 'units of economic activity' is shown in Table 8.9.

TABLE 8.8:

SUMMARY OF CONCENTRATION MEASURES OF TURNOVER OF 'ENTERPRISES'

	1968	1969	1970	1971	1972
4-firm concentration ratio	72.3	73.6	77.7	76.9	76.8
8-firm concentration ratio	88.1	79.2	79.4	79.7	79.5
Coefficient of variation	1.54	1.57	1.86	1.86	2.05
Gini coefficient	.65	.66	.71	.70	.72
Herfindel-Hirschmann	169.0	173.0	223.0	222.0	261.0
Entropy	-95.0	-95.0	-87.0	-87.0	-84.0
Linda: L_{n^*m}	.49	.49	.65	.63	.67
n^*	15	15	14	14	14
$L_{n^*\ h}$	.97	1.06	1.45	1.53	1.77
$n^*\ h$	2	2	2	2	2
n	20	20	20	20	20

Source: L.B.S. Study and E.E.C. Computer Programme.

TABLE 8.9:

SUMMARY OF CONCENTRATION MEASURES FOR TURNOVER OF 'U.E.A.'

	1968	1969	1970	1971	1972
4-firm concentration ratio	56.0	56.0	61.7	59.1	58.0
8-firm concentration ratio	77.7	77.6	80.9	79.2	79.1
Coefficient of variation	1.17	1.16	1.34	1.78	1.33
Gini coefficient	.56	.56	.61	.59	.59
Herfindel-Hirschmann	99.0	97.0	117.0	110.0	115.0
Entropy	-114.0	-114.0	-109.0	-111.0	-111.0
Linda: L_{n^*m}	.28	.27	.34	.31	.31
n^*m	20	17	16	13	12
$L_{n^*\ h}$	.54	.55	.58	.65	1.15
$n^*\ h$	2	2	2	2	2
n	24	24	24	24	24

Source: L.B.S. Study and E.E.C. Computer Programme.

Over such a short period one does not expect great changes in structure, particularly where the competing units are large and internationally

owned. The picture is one of stability of concentration at a fairly high level - over 75% 4-firm concentration ratio in 1972. However, dropping the overseas earnings of Rank-Xerox and Gestetner reduces this to around 32%. Insofar as trends can be identified, the concentration of turnover has been stable with a small peak in 1970, those for employment and wages and salaries has been stable if not declining slightly, those for profits, cash flow and own means show definite increases over the period, and exports showing a smaller increase. Profits are very heavily concentrated among the top four. Looking at Annexe 8.C, 11 of the 20 enterprises have profit sales ratios of less than 10%.

This stability at a high level of concentration is further illustrated by enterprise rankings from year to year. Annexe 8.E shows rankings by turnover and profit in each year. The Linda indices show very few movements in and out of the 'core' of oligopolistic enterprises or of the 'superpowers'. The rankings of turnover are remarkably stable from year to year as evidenced by the rank correlation coefficients all over .96. Profits rankings show less stability, as usual, but nevertheless are remarkably stable. The 'core', as calculated for profits, consists only of four or six companies, compared with fourteen or fifteen for turnover.

Introducing 'units' into the analysis means considering I.B.M. Their activities in this sector are less than 50% of their total turnover, but are exceeded only by Rank Xerox. On a units basis in 1972 N.C.R. dropped out of the superpower classification to be replaced by I.B.M. This is probably a quirk of the calculation procedure which requires a minimum of two to be in a category. From the data listing for 1972 it is clear that Rank Xerox stands on its own in terms of size (£107 million turnover) with I.B.M., N.C.R. and Burroughs grouped together with about £45 million turnover. From 1968-71 N.C.R. was the second superpower, but these four have always led the field.

Nature of Competition

The office document copying sector in the U.K. is in a state of unparalleled flux. For several years the barriers between market sectors have been eroded gradually as technical innovation has improved

the versatility of a wide range of products, bringing them into competition with each other for the first time. The centre of the market is the plain paper copier business in which few of the participants are likely to emerge in the same condition as they entered. This was all partly caused by the expiry of several Xerox patents around 1970. Since late 1973 a number of new names have appeared in the market alongside Rank-Xerox, Gestetner, Agfa-Gevaert, I.B.M. and Nashua. A recent report[1] puts the number of new entrants at 13, with Kalle Infotec (subsidiary of Hoechst), Reprographic and Roneo Vickers notable among them. There is a strong possibility that there will be an inundation of new products from the major Japanese electronics manufacturers. Rank-Xerox, with its 95% share of the U.K. market, is under investigation by the Monopolies Commission.

The second major technical advance has been in production of transistorised circuits for electronic calculators. Competition is perhaps at its most intense in this area with further technical changes expected to bring prices down even more by 1980. The extent of price-cutting does seem to worry the industry and there are suggestions that by late 1975 there will be only half a dozen major producers - all of whom will have extensive interests in related fields. This might not be expected to reduce the number of brand names.

The third and potentially most significant technical change has been the advent of 'word processing machines'. The concept is the use of sophisticated electronic typewriters to increase the speed of transcribing oral words into type. The idea originated with I.B.M.'s German subsidiary and I.B.M. generally dominate the market with 85% of U.S. sales and about the same in the U.K. However, most of the world's major typewriter manufacturers are in the word processing market now. I.B.M.'s main contenders in the U.K. are Ultronic Data Systems (U.D.S.), Kalle Infotec, Olympia, Olivetti Dataflex (the only assembler in the U.K.) and Business Data Products, which markets the Redactron machine made in the U.S.A. Sperry Remington has recently announced its entry and, even more recently, its exit[2], and companies like Rank-Xerox, 3M and Triumph-Adler, the

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(1) Financial Times, 10th June, 1974.

(2) Entry in 1973, exit in 1975.

German subsidiary of Litton Industries, were thought likely to introduce their own models, but the present recession appears to have at least delayed matters.

Other Structural Features

The principal entry barriers are technology in the document copying and word processing sections, probable economies of scale in manufacturing throughout the sector, although there is little evidence about this. The dominance of the leading five companies and their acquisition of profits makes entry a dubious proposition. No information could be collected on pricing behaviour.

There has been little evident change in vertical integration or diversification over the sample period. Most enterprises historically have specialised in one or other product group, with only the large multinationals having a widely diversified base within the sector as we have defined it.

Ownership is predominantly American, including six of the nine largest enterprises - one of them in joint ownership with Rank (U.K.) - viz Rank Xerox. Two of these nine are U.K. owned - Gestetner and Roneo Ltd. (Vickers). The ninth is Italian owned - British Olivetti. There has been no significant merger activity to record.

4. CONCLUSIONS

(1) It is difficult to define precisely what is the sector - official definitions are narrower than the activities of companies themselves. Generally, it is a growing, profitable sector with a high technology content in its products.

(2) The industry is dominated by large American owned companies operating on a world-wide scale.

(3) Concentration in the U.K. has been stable on the whole with a tendency for profits and own capitalisation to become increasingly concentrated.

ANNEXE 8.A: OFFICE MACHINERY : ENTERPRISE & U.E.A. LISTING

Identification Number	Name of Company	Type of Company	Parent Company	Major (or Assoc.) Subsidiaries	Subsidiaries in other Countries	Major Products	Mergers/ Takeovers
1	Gestetner Holdings Ltd.	U.K. quoted	-	-	34 foreign subsidiaries	Copiers & duplicators	-
2	National Cash Register Ltd.	Foreign subsid.	National Cash Register Co., U.S.A.	-	-	Machines for recording, storing, computing & processing; cash registers & adders.	-
3	Burroughs Machines Ltd.	Foreign subsid.	U.S.A. parrent	Burroughs Leasing Co.	-	Desk size computers, calculators, adders, large scale data processors.	-
4	British Olivetti Ltd.	Foreign subsid.	Olivetti Italy	Underwood Business Machines	-	Manual typewriters, systems & data processing, computer terminals. (office typewriters sold by trade through about 1,000 dealers)	
5	Addressograph-Multigraph	Foreign subsid.	Addresspgraph-Multigraph, U.S.A.	-	-	Addressing & duplicating machines	-
6	Gross Cash Registers	U.K. quoted	-	Bizerba Ltd.	-	Cash registers & electronic calculators (made public 1965)	
7	Imperial Typewriter Co.	Foreign subsid.	Litton Industries, U.S.A.	-	-	Typewriters, photocopiers & adding machines.	-
8	Rotaprint Ltd.	U.K. quoted	-	-	U.S.A.	Printing & duplicating equipment (began as a selling company for Belgian manufacturer)	
9	Pitney-Bowes Ltd.	Foreign subsid.	Pitney-Bowes Inc., U.S.A.	-	-	Postage meters, mailing & business machines.	
10	S.C.M. (U.K.) Ltd.	Foreign subsid.	S.C.M. Corporation, U.S.A.	-	-	Office equipment (subsidiary of British Typewriters, which is a subsidiary of S.C.M., U.S.A.)	

Identification Number	Name of Company	Type of Company	Parent Company	Major (or Assoc.) Subsidiaries	Subsidiaries in other Countries	Major Products	Mergers/ Takeovers
11	Rank Xerox Ltd.	Foreign subsid.	Rank Xerox (U.K.) (which is subsid. of Xerox Corp., U.S.A.)	-	Worldwide	Xerographic copying equipment, dry copiers, data processing equipment	-
12	Roneo Vickers Ltd.	U.K. subsid.	Vickers Ltd.	Vickers Lane Barber-Greene England Hirst-Buckley 4 + Ltd. Esco Ltd.	Worldwide	Duplicating machines & supplies, office furniture	Acquired Hirst-Buckley in May 1969, who are stationers for computers, manufacture business forms, etc.
13	G.A.F. (Great Britain) Ltd.	Foreign subsid.	G.A.F. Corporation U.S.A.	-	-	Reprographic products	-
14	Veeder Root Ltd.	Foreign subsid.	Veeder Industries U.S.A.	-	-	Counting & computing devices, mechanical & electro-mechanical	
15	Omal Group	U.K. quoted	-	Rex Business Machines Office Appliances Ltd. Office Machinery Ltd.	-	Adding, calculating, dictating, duplicating machinery, office furniture	
16	A.B. Dick & Co. Ltd.	Foreign subsid.	A.B. Dick U.S.A.	-	-	Offset duplicating equipment & photo-copying machines	
17	Ofrex Engineering Ltd.	U.K. subsid.	Ofrex Group	-	-	Office equipment	
18	Elliot Business Machines	Foreign subsid.	Dymo Industries U.S.A.	-	-	Office equipment	
19	Nig Banda Ltd.	U.K. subsid.	Ozalid Group	-	-	Copying machinery, equipment & materials for drawing office & print room	

Identification Number	Name of Company	Type of Company	Parent Company	Major (or Assoc.) Subsidiries	Subsidiaries other Countries	Major Products	Mergers/ Takeovers
20	Bell Punch Co.	U.K. subsid.	Lanson Industries	-	-		Lanson Ind. became a partner of Moor Corp. Ltd. of Canada 1973/
21	Sperry Rand	Foreign subsid.	Sperry Rand Corp. U.S.A.	-	-		
22	Singer (U.K.) Ltd.	Foreign subsid.		-	-		
23	3M (U.K.) Ltd.	Foreign subsid.	Minnesto Mining & Manufacturing Co. U.S.A.	-	-	Photocopying machinery	
24	I.B.M. (U.K.) Holdings Ltd.	Foreign subsid.	I.B.M. Corp. U.S.A.	-	-	Data processing machines, electric typewriters, dictating machines & true recording equipment	

ANNEXE 8.B: OFFICE MACHINERY : SUMMARY STATISTICS

		1968	1969	1970	1971	1972
(£ mill)	Turnover (U.K. only)	184.8	242.9	331.4	326.5	353.6
('000)	Employees	47.7	51.4	56.5	54.9	51.5
(£ mill)	Wages & Salaries	54.7	66.3	81.9	86.9	90.1
(£ mill)	Net Profits*	48.0	76.8	124.5	111.8	124.2
(£ mill)	Cash Flow*	67.1	101.3	163.5	150.7	174.8
(£ mill)	Own Means*	130.9	154.6	188.2	225.2	243.7
(£ mill)	Exports	54.7	80.4	117.3	118.7	127.5
(%)	Exports/Turnover	29.6	33.1	35.4	36.4	36.1
(%)	Profits/Turnover	26.0	31.6	37.6	34.2	35.1
(%)	Profits/Own Means	36.7	49.7	66.2	55.3	51.0
(£/person)	Wages & Salaries/ Employees	1147	1290	1450	1583	1750

* These figures are net of losses and other negative items.

Source: L.B.S. Study.

ANNEXE 8.C: OFFICE MACHINERY : PROFITABILITY BY ENTERPRISE 1968-72

Enterprise	Profit/Turnover (%)	Exports/Turnover (%)
1	13.2	22.0
2	12.5	23.0
3	17.4	25.3
4	-4.9	20.5
5	12.9	21.7
6	16.8	10.5
7	-13.2	52.0
8	12.3	34.3
9	4.9	28.1
10	13.3	43.1
11	39.9	23.0
12	2.9	12.1
13	6.6	10.8
14	7.9	41.8
15	0.9	5.3
16	3.1	28.9
17	8.1	-
18	11.0	26.6
19	4.3	12.8
20	4.3	22.8

Turnover figures include earnings of overseas subsidiaries of Rank Xerox (2) and Gestetner (1).

Both ratios are unweighted averages of yearly ratios.

Source: L.B.S. Study and Companies House.

ANNEXE 8.D: OFFICE MACHINERY : CONCENTRATION MEASURES 1968-72

VARIABLE	1968	1969	1970	1971	1972
4-firm Concentration Ratio					
Turnover	72.3	73.6	77.7	76.9	76.8
Employment	60.4	57.8	58.3	57.6	54.0
Wages and Salaries	61.3	63.1	64.5	61.9	58.2
Net Profits	89.1	91.9	94.0	93.8	94.5
Cash Flow	88.8	91.1	93.2	93.8	93.2
Own Means	79.5	80.4	82.3	85.0	79.8
Exports	75.1	74.1	78.1	78.2	75.6
8-firm Concentration Ratio					
Turnover	88.1	88.0	90.5	89.9	90.4
Employment	80.1	79.2	79.4	79.7	79.5
Wages and Salaries	81.1	81.8	83.1	84.3	82.0
Net Profits	96.6	96.9	97.7	98.3	98.9
Cash Flow	96.5	96.0	97.1	98.2	98.0
Own Means	90.8	91.4	92.3	93.4	92.6
Exports	87.7	88.5	90.7	91.7	90.9
Linda Index : Core Ln*m / n*m					
Turnover	.49/15	.49/15	.65/14	.63/14	.67/14
Employment	.27/15	.27/15	.26/15	.27/15	.25/14
Wages & Salaries	.30/15	.31/15	.33/15	.34/14	.29/14
Net Profits	1.14/4	1.10/4	1.57/4	1.69/4	2.90/6
Cash Flow	1.30/4	1.26/4	1.76/4	1.81/4	2.82/6
Own Means	.63/4	.68/15	.79/15	.84/4	.76/6
Exports	.41/4	.52/12	.68/12	.72/13	.60/7
Linda Index : Superpowers Ln*					
Turnover	.97/2	1.06/2	1.45/2	1.53/2	1.77/2
Employment	.86/2	.94/2	.86/2	.63/2	.53/2
Wages & Salaries	1.04/2	1.03/2	.60/2	.61/2	.66/2
Net Profits	2.63/2	2.71/2	4.01/2	4.80/2	5.77/2
Cash Flow	3.02/2	3.26/2	4.64/2	5.00/2	6.68/2
Own Means	1.07/2	1.30/2	1.63/2	1.86/2	1.49/2
Exports	.68/2	1.17/2	1.73/2	1.65/2	1.86/2
Coefficient of Variation					
Turnover	1.54	1.57	1.86	1.86	2.05
Employment	1.14	1.15	1.11	1.07	1.01
Wages and Salaries	1.25	1.30	1.29	1.24	1.15
Net Profits	2.28	2.61	2.97	2.86	3.03
Cash Flow	2.37	2.78	3.11	2.90	3.30
Own Means	1.77	1.87	2.08	2.20	1.95
Exports	1.42	1.58	1.95	1.93	1.83
Gini Coefficient					
Turnover	.65	.66	.71	.70	.72
Employment	.54	.54	.54	.54	.52
Wages and Salaries	.57	.58	.59	.59	.56
Net Profits	.78	.82	.85	.84	.86
Cash Flow	.78	.83	.86	.85	.87
Own Means	.71	.72	.74	.77	.73
Exports	.63	.66	.71	.71	.69

ANNEXE 8.D: OFFICE MACHINERY : CONCENTRATION MEASURES 1968-72 (cont.)

VARIABLE	1968	1969	1970	1971	1972
Herfindel-Hirschmann					
Turnover	169	173	223	222	261
Employment	115	116	111	108	101
Wages and Salaries	128	135	133	127	116
Net Profits	387	410	517	539	677
Cash Flow	414	437	534	555	660
Own Means	207	226	267	292	253
Exports	159	184	253	249	230
Entropy					
Turnover	-95	-95	-87	-87	-84
Employment	-108	-108	-109	-109	-111
Wages and Salaries	-105	-104	-103	-104	-107
Net Profits	-63	-60	-50	-48	-35
Cash Flow	-61	-59	-50	-47	-38
Own Means	-87	-85	-80	-76	-82
Exports	-95	-92	-83	-83	-86

Sources: L.B.S. Study and E.E.C. Computer Programme.

ANNEXE 8.E: OFFICE MACHINERY : ENTERPRISE RANKINGS

E1 : Ranking by Turnover*

	1968	1969	1970	1971	1972
Superpowers:	11	11	11	11	11
	1	1	2	1	1
Core:	2	2	1	2	2
	3	3	3	3	3
	12	4	4	4	4
	4	12	12	12	5
	5	5	5	5	12
	13	12	12	6	7
	6	6	6	13	13
	10	19	19	7	19
	20	10	7	19	9
	9	7	10	9	6
	7	9	9	8	8
	8	20	8	10	10
	19	8	14	14	16
	14	14	16	16	20
	15	17	17	17	17
	18	18	18	18	18
	17	15	15	15	15

* Turnover figures include sales by overseas subsidiaries of Gestetner (1) and Rank Xerox (2).

Superpower entries:	-	1	1	-
" exits:	-	1	1	-
Core entries:	-	-	-	-
" exits:	-	1	-	-

Spearman Rank Correlation Coefficient

Year to Year:	.96	.99	.98	.97
1968-72	.91			

ANNEXE 8.E: OFFICE MACHINERY : ENTERPRISE RANKINGS

E2: Ranking by Profits*

	1968	1969	1970	1971	1972
Superpowers:	11	11	11	11	11
	1	3	3	2	1
Core:	2	1	2	1	2
	3	2	1	3	5
	5	5	5	6	3
	12	6	6	5	19
	10	10	13	19	6
	6	12	19	13	10
	8	8	10	8	16
	13	9	8	10	8
	14	19	9	20	14
	9	13	4	12	12
	18	17	12	14	20
	17	18	14	17	18
	15	14	20	18	13
	16	4	18	9	17
	20	16	17	15	15
	7	15	16	16	9
	4	20	15	7	4
	19	7	7	4	7

* Profit figures include earnings from overseas subsidiaries for Rank Xerox (2) and Gestetner (1).

Superpower entries:	1	-	1	1
" exits:	1	-	1	1
Core entries:	-	-	-	2
" exits:	-	-	-	-

Spearman Rank Correlation Coefficient

Year to Year:	.89	.91	.90	.88
1968-72	.72			

PART 3: TWO CASE STUDIES

(i) AGRICULTURAL MACHINERY (WRITTEN BY MR. N. OWEN)

CHAPTER 9 - THE STRUCTURE OF THE INDUSTRY

INTRODUCTION

This Study will be understood better if its purpose, methods and character are made clear at the outset. There are two ways of studying the economics of industry; by analysing a broad cross-section of industries with the aid of statistical techniques in search of generalisations about the way industries behave, depending on their structure and circumstances; and case studies of individual industries in depth, attempting to understand their peculiarities and logic. This study is of the latter type. It attempts to penetrate the bald industrial statistics with the aid of discussions with managers in the industry, to obtain an understanding of the context within which the industry operates and its critical operational features. Once having gained such a feel for the texture of the industry, it is possible to see whether and in what ways the structure of the industry influences its perspectives and behaviour.

In this way the Study hopes to find some meeting ground between industrial economics and business management, two disciplines which in many ways seem to have drifted apart. The view of this author, to put it bluntly, is that at the present time these two disciplines do not meet at all. The massed typewriters and computers of academic research have laboured for a long time to produce conclusions about the impact of industrial structure which are either insufficiently conclusive or quantitatively significant to offer guidance to Government policy makers, and still less to business managers. This study does not claim to remedy this but it does try to explain why it is that industrial economics fails to engage with business life, and explores the possibilities of bringing these two disciplines closer together.

The study may well disappoint proponents of both. Students of industrial structure will note and possibly disapprove of the absence of questionnaires, sampling frames and a statistical rigour, and the reliance on observations, opinions and intuition. On the other hand, business managers may regard industrial structure as a provocative perspective

for any industrial study to have as a framework with its free use of such terms as 'monopoly', 'oligopolistic behaviour' and 'market shares', which seem to suggest a condemnatory attitude to business activities right from the outset. No such attitude is present in this study; it simply takes as given a tradition of economic analysis along these lines, which is highly influential in anti-trust policy-making in North America and an increasing number of European countries, and attempts to confront this analysis with as realistic a view of the agricultural machinery industry as can be obtained by an outsider in a few months of observation, aided by the generous assistance of a number of its representatives.

An unstructured research approach was adopted in the belief that the priority in a study of this kind is to understand the nature of the business first and then see if industrial structure has any relevance to it, rather than trying to fit business behaviour into a questionnaire based on industrial structure and competition. It is felt that the insights gained from individuals in the industry amply justified the approach adopted.

The study involved interviews with around 20 companies and conversations with several more on detailed points. Fortunately the companies which agreed to cooperate permitted a balanced representation of large and small companies, manufacturers and importers, and the three main product categories - tractors, implements and farmyard equipment. The opinions of dealers and farmers were also incorporated into the study. Particular gratitude is due to a number of tolerant and patient individuals in the industry who set aside their time to explain the workings of their industry, who must unfortunately remain unanimous for reasons of confidentiality.

DEFINITION AND SCOPE OF THE INDUSTRY

For the purposes of this study the industry embraces all machinery designed exclusively for farm use; tractors, harvesting machinery, tillage and miscellaneous implements, and machinery installed in farm buildings such as milking machinery, crop handling and drying equipment. It excludes garden equipment, tractors used for industrial and construction purposes, motor vehicles and farm buildings. It corresponds to the two Census of Production minimum list headings 380 (tractors) and 331 (agricultural machinery).

Size and Shape of the Industry

The size and growth of the industry is indicated by Table 9.1. The industry serves a replacement market and despite a boom in demand in 1973/74 its size remained fairly constant in real terms at around £200 million for the last few years. As will become more apparent later, the distinction between tractors and other farm equipment is important. The industry has a powerful, export-orientated tractor sector which exports over 70% of its output, and a comparatively weak equipment sector which exports around 25% of its output. The trade balance is strongly positive in tractors and roughly neutral in farm equipment.

Table 9.2 indicates that the industry's size distribution is very unequal. It is dominated by very few companies which dwarf the remainder. Massey Ferguson alone accounted for 20% of the total U.K. agricultural machinery sales in 1973. Of the seven largest companies, five are tractor companies, five are multinationals. In 1973 there was only one top-ranked British-owned company, British Leyland, and only two indigenous equipment manufacturers with turnovers in excess of £10 million, Howard and Ransomes, both of which factor a number of foreign products.

TABLE 9.1

SALES, EXPORTS AND IMPORTS OF AGRICULTURAL MACHINERY - 1968-74

U.K. Agricultural Machinery		Sales, Exports, Imports 1968-74 (£m)*						
		1968	1969	1970	1971	1972	1973	1974
Sales[1]	Tractors	140	143	135	142	160	164	197
	Equipment	76	75	72	74	106	134	172
	Total	216	218	207	215	266	298	369
	Total -1968 prices[2]	216	210	180	170	197	207	207
Exports[1]	Tractors	100	104	93	104	113	119	145
	Equipment	27	29	28	27	24	32	42
	Total	128	133	121	131	137	151	187
Imports[1]	Tractors	4	3	4	4	6	10	11
	Equipment	15	14	16	19	27	44	59
	Total	19	17	20	23	33	54	70
Trade Balance[3]	Tractors	96	101	89	100	107	108	134
	Equipment	14	15	12	8	-3	-12	-17
	Total	109	116	101	108	104	97	117
% Sales Exported	Tractors	71	73	69	73	71	72	74
	Equipment	36	39	39	37	23	24	24
	Total	59	61	58	61	52	51	51
% Home Market Supplied by Industry	Tractors	91	89	91	90	89	82	81
	Equipment	77	77	77	71	75	70	69
	Total	81	82	81	78	80	73	72
U.K. Market[4] (domestic consumption)	Tractors	44	44	46	42	53	56	64
	Equipment	64	60	60	66	109	146	189
	Total	108	104	106	108	162	202	253
	Total - 1968 prices	108	100	93	88	120	140	142

* all values are rounded to the nearest £ million.

Sources: (1) Business Monitor Series, Department of Industry. (Tractor data refer to completed tractors.)

(2) Based on index of wholesale mechanical engineering prices, Monthly Digest of Statistics.

(3) Exports - Imports.

(4) Sales - Exports + Imports.

TABLE 9.2

COMPANIES WITH TURNOVER IN EXCESS OF £1 MILLION - 1973

Company	1973 Sales*	Main Products
Massey Ferguson**	190***	Full line
Ford**	100***	Tractors
International Harvester**	60	Full line
Howard	40	Rotary cultivators
New Holland**	25***	Grain and grass harvesting machinery
David Brown**	20	Tractors
British Leyland	20***	Tractors
Ransomes	15	Tillage equipment and root harvesters
Alfa-Laval**	10	Milking equipment
Fullwood & Bland	8	Milking equipment
Bamford	8	Harvesting and tillage equipment
County Commercial	6	Tractors
Gascoigne, Gush & Dent	5	Milking and farmyard equipment
Simplex	4	Grain handling and storage equipment, milking machinery
Bentall	3	Crop drying equipment
Salopian Kenneth-Hudson	2	Hay making equipment, ploughs
Standen	2	Root harvesting equipment
Root Harvester	1-2	Root harvesting equipment
Bomford & Evershed	1-2	Hedge trimming equipment, cultivators
Alvan Blanch	1-2	Crop drying equipment
Archie Kidd	1-2	Forage harvesters, rollers
Turner Engineering	1-2	Flail mowers
British Lely**	1-2	Hay-making machinery
Twose	1-2	Miscellaneous implements
Parmiter	1-2	Miscellaneous implements
Teagle	1-2	Miscellaneous implements
Stanhay	1-2	Precision drills

* Sales figures are rounded; more precise figures appear in Table 12.2.

** Foreign owned companies.

*** Estimated; no separate accounts published for agricultural machinery divisions.

The polarisation of the industry into tractors and equipment becomes more apparent by looking at the size structures of these two sectors in Table 9.3. The tractor sector is more concentrated; whereas five major U.K. tractor producers accounted for 90% of the employment in this sector, six companies accounted for only 40% of the employment in the equipment sector. Tractor plants are of course larger, operated on a flow-line basis whereas the smaller equipment plants operate a batch system with the exceptions of Howard and New Holland. Whereas 94% of employees in the tractor sector worked in establishments employing more than 200 employees, 61% of the equipment sector employees worked in plants of this size.

TABLE 9.3

SIZE STRUCTURE OF TRACTORS AND EQUIPMENT SECTORS - 1968

Number of Employees in each Establishment	Tractors		Equipment	
	Number of Enterprises*	Proportion of Sector Labour Force (%)	Number of Enterprises*	Proportion of Sector Labour Force (%)
1 - 5	13	less than 1	119	2
6 - 10	11	"	75	3
10 - 24	13	"	109	10
25 - 49	4	"	25	5
50 - 99	7	2	26	9
100 - 199	4	2	14	10
200 - 499	4	4	12	21
over 500	5	90	6	40
Total	65	100	366	100

* Some double-counting may occur to the extent that enterprises declare employment in more than one size-class of establishment.

Source: Reports on the Census of Production, 1968, 50 & 81.

Ownership Patterns

The multinational companies are diversified, the indigenous companies tend to be specialists. Ford is of course primarily a vehicle builder. Massey Ferguson and International Harvester originated as farm equipment companies but have since diversified into industrial and construction equipment. New Holland is part of the Sperry Rand organisation. David Brown

was acquired in 1972 by J.I. Case, the United States full line agricultural machinery manufacturer, now part of the Tenneco Group. Alfa-Laval is part of the Swedish Engineering Group.

Most of the indigenous companies are specialists and have long traditions in the industry; only a handful are linked to companies in other industries. Six companies have been acquired in recent years by companies outside the industry: Simplex by G.E.C., Gascoigne Gush & Dent by Thomas Tilling, Bentalls by Acrow, Stanhay by Hestair, Standen by Tremlett, Salopian Kenneth Hudson by Rubery Owen. In these cases the acquirer acts more or less as a holding company, appointing a Managing Director and relying on fairly relaxed reporting relationships. The acquired companies have not apparently been used as a vehicle for companies outside the industry to exploit their existing facilities in agricultural machinery production or marketing. Mergers between agricultural machinery companies are fairly rare. In recent years Ransomes acquired Catchpole, once a successful specialist in sugar-beet harvesting machinery; Root Harvester acquired Wheatley Trailers. Two other acquisitions were of a horizontal nature, strengthening existing market positions; Bamford acquired Jones Balers securing a 20% of the U.K. baler market; Stanhay acquired Ernest Webb to obtain a 90% share of the precision drill market.

Forward integration is rare in the industry; David Brown acquired eight dealers in Lincolnshire and East Anglia to gain better access to the large acre farm market; Howard acquired the marketing company J. Mann, the U.K. distributor of the Claas Combine. Generally, the structure of the industry has not been greatly modified by mergers and acquisitions.

Market Structure

The profile of the industry provided so far is simply descriptive, depicting the concentration of the industry in terms of U.K. production. Descriptive statistics of this sort do not illuminate the critical aspects of an industry's structure, namely the inter-relations between the companies concerned. They do not indicate which companies compete directly with each other; whether large companies compete with other large companies or whether they each dominate a sub-sector of the market.

In other words, the structure of an industry in terms of aggregate production or turnover tells us little about the structure of markets because it ignores two critical elements - market segmentation and international trade. Table 9.1 provided a general indication of the role of trade in the industry. Table 9.4 shows the market leaders and the role of trade in the industry's main sub-sectors. Market leaders are mentioned in order of their estimated position in these markets; for reasons discussed later, it is difficult to obtain, or publish, precise market shares for a number of markets. Imported machines are asterisked. The detailed market structure to larger sectors, tractors and combines, is shown in Table 9.5.

TABLE 9.4:

MARKET SEGMENTATION IN THE AGRICULTURAL MACHINERY INDUSTRY

Market	1974 Market Size (Nearest £m)	% Imports	Market Leaders
Tractors	63	17	Ford, Massey Ferguson, David Brown
Combine Harvesters	25	80	Claas*, New Holland*, Massey Ferguson
Balers	8	30	New Holland, Bamford, Massey Ferguson*
Forage Harvesters	6	70	New Holland*, John Deere*, Barmford*
Milking Equipment	7	15	Fullward & Bland, Alfa-Laval, Gascoigne Gush & Dent
Rotary Cultivators	7	5	Howard, Bomford & Evershed
Manure Spreaders	5	13	Howard, Massey Ferguson
Grain Drying & Handling Equipment	5	0	Bentall, Alvan Blanch, Simplex
Haymaking Equipment	4	60	Fahr*, PZ*, Bamford*, New Holland*, Lely
Root Harvesters	4	50	Standen, Grimme*, Ransomes*, Root Harvester
Ploughs	3	40	Ransomes, Bamford*, Massey Ferguson*, Colchester Tillage*, SKH*
Fertiliser Distributors	3	30	Vicon*, Bomford & Evershed

* Imported machines.

It is apparent from Table 9.4 that the industry is fairly well segmented into non-competing sub-groups. Three of the five major U.K. tractor companies are specialists. Only Massey Ferguson has significant positions in other agricultural machinery markets; the other two main North American full-line companies, International Harvester and John Deere, have limited roles in the U.K. - International Harvester established plants in Britain only in 1951 after Massey Ferguson had already established dominant positions and John Deere has no production facilities in the U.K. at all. New Holland does not manufacture tractors but has a strong position in all three of the markets for the heavier machines for harvesting grass and grain - combines, foragers and balers. New Holland is not so strongly represented in the smaller haymaking machines which it includes more for the sake of completing the product line than for profitability. Leadership in these markets belongs to German, Dutch and French companies, Fahr, PZ, Lely and Kuhn. The largest indigenous manufacturer, Ransomes, is significantly involved in only two sectors, tillage equipment and root harvesters. Howard has a special position in rotary cultivators, which it pioneered. It also developed a 'big roll baler' and imports the Claas combine which holds the market leadership, through a marketing subsidiary, Manns of Saxham. Milking machinery companies have diversified into other farmyard equipment, notably machinery for treating and handling slurry, but they remain basically milking specialists, as do the crop drier manufacturers. Not surprisingly, as one penetrates further into sub-sectors, specialisation is still greater and market dominance can be very substantial; Vicon in fertiliser broadcasters, Stanhay in precision drills and Bomford & Evershed in tractor-mounted hedge trimmers are examples of this. It is clear that market segmentation is quite pronounced in this industry. Apart from Massey Ferguson and New Holland, it is unusual to find companies with leading market positions in several sectors.

TABLE 9.5:

MARKET LEADERS IN THE U.K. TRACTOR AND COMBINE MARKETS

Tractor Market Shares (%)				Combine Market Shares (%)			
Company	1972[1]	1973[2]	1974[2]	Company	1972[2]	1974[3]	Source of Machines
Ford	29	27	27	Claas	27	28	Germany
Massey Ferguson	32	25	24	New Holland	28	23	Belgium
David Brown	11	11	10	Massey Ferguson	26	22	U.K.
International Harvester	9	11	10	John Deere	9	9	Germany
British Leyland	7	10	9	Laverda	7	9	Italy
Zetor	n/a	n/a	5	Fahr	n/a	3	Germany
John Deere	n/a	3	4	Ransomes	n/a	2	U.K.
				International Harvester	n/a	1.5	France
				Dania	n/a	0.5	Denmark
Total Market (units)	33,000	33,000	30,000		2,600	4,000	

Sources: (1) "Profile of the Tractor Industry", Richard Lee, Agricultural Machinery Journal, March 1974, based on Economist Intelligence Unit's Bulletin, Motor Business.

(2) Conversations in the industry.

(3) "Market Analysis of the Combine Market", Ian Greig, Agricultural Machinery Journal, January 1975.

In tractors Ford and Massey Ferguson usually account jointly for 50-60% of the market and have competed closely for the leadership for many years. A significant cause of changes in shares is supply difficulties; both companies' shares suffered in 1973 due to losses in output due to industrial unrest and boom demand conditions which sucked in additional imports, mainly from Eastern Europe. The significant feature of the tractor market structure is that around 60% of the tractor market is supplied by companies with no interest in equipment, leaving a high proportion of dealers open to the equipment specialists.

In combines, three suppliers account for three-quarters of the U.K. combine sales, only one of which, Massey Ferguson, manufacture combines in the U.K., apart from Lely which manufactures only a handful. The only significant indigenous producer, Ransomes, ceased production in 1974. The two leading positions are occupied by specialists, Claas and Claeys; the latter was acquired by New Holland in 1964. There is very little overlap between these two largest markets; only Massey Ferguson, 80% of whose world wide farm equipment business is concentrated in these two products, appear in the top five in both the U.K. tractor and combine markets.

Concentration in these markets could be described as fairly substantial; in 1974 the top four companies accounted for 80% of the tractor market and 84% of the combine market. These degrees of concentration are comparable with what is known of the concentration in the smaller sectors of the industry, with this important difference; it is rare for the market leader in the larger sectors - tractors, combines, balers and foragers - to corner more than 40% of the market. The usual position seems to be that the leader has around one-third of the market, followed by another company with only slightly less. In other words leadership in these sectors does not imply dominance. In the smaller sectors leadership is more pronounced; the dominant company frequently has a share of 60% or more, and sometimes exceeds as much as 90%.

The Role of Trade

Imports account for around 30% of non-tractor equipment sales in the U.K. and it is important to understand the significance and origins of these imports. As Table 9.4 shows, import penetration is significant in combines, forage harvesters, haymaking equipment, root harvesters, ploughs and fertiliser distributors. In part, the trade position reflects sourcing decisions by the multinationals. The world agricultural machinery industry is dominated by the North American full-line producers, Massey Ferguson, International Harvester and John Deere, all of whom extended their manufacturing operations to Europe after the Second World War. The bulk of the U.K. imports which originate from these companies are sourced from their E.E.C. locations, as Table 9.6 indicates.

TABLE 9.6:

E.E.C. LOCATIONS OF U.S. MULTINATIONALS' OPERATIONS

Company	United Kingdom	France	Germany	Belgium
Massey Ferguson	engines tractors combines mowers	tractors combines balers	components	
International Harvester	tractors (lower HP) transmissions	combines transmissions	engines tractors	
John Deere		implements	tractors combines	
Ford	tractors components		tractors	tractors components
New Holland	balers mowers trailed foragers			combines foragers

Note: In addition implements are bought in on an E.E.C.-wide basis, e.g. Massey Ferguson buys in Huard ploughs from France, New Holland buys in Stolle hay tedders from Germany, International Harvester buys in ploughs from Norway.

All the tractor companies mentioned compete actively in France and Germany; in 1973 Massey Ferguson was market leader in the French tractor market with an 18% share, International Harvester was second with a 16% share and Ford was fifth with 9%. In Germany, International Harvester has led the tractor market for five years, currently holding a 22% market share. Massey Ferguson, Ford and International Harvester jointly manufacture over half the tractors produced in Western Europe. The multinationals are integrating their E.E.C. operations, sourcing their implement requirements from one location and transferring components between plants. At one time, International Harvester produced tractors and combines in each major E.E.C. market; after 1962 a decision was taken to locate combine production in France, tractor production in the U.K. and Germany. Integration embraces component shipments too; International Harvester ships tractor transmissions from France to Germany and engines from Germany to France and the U.K. Ford operates two tractor plants in Europe at Antwerp in Belgium and Basildon in Britain; Antwerp supplies Basildon

with rear axles and gear boxes, Basildon supplies Antwerp with engines and hydraulic units.

The remaining imports are due largely to the activities of a number of medium-small equipment specialists, with outstanding product designs, backed by good dealer organisations in this country. Claas of Germany and Claeys of Belgium both developed reliable high volume combines which were more suited to the damp U.K. conditions and high yields per acre on British farms than the early prairie machines from North America. They were both strongly represented in Britain, Claas by Mann and Claeys by Bamford until 1964, and then by New Holland. Continental companies made significant advances in haymaking equipment. The Dutch company Lely developed the 'spider wheel' windrower, PZ developed hay conditioners and drum mowers, both of which speeded up haymaking operations. The third Dutch company, Vicon, developed the modern fertiliser distributor, based on research at Wageningen University. In Germany Fahr developed a rotary star hay conditioner and Grimme pioneered potato harvesters. In France Huard (ploughs) and Kuhn (haymaking equipment) are the outstanding companies which have penetrated the United Kingdom market. The Norwegian company, Kvernelands, has made a large impact on the plough market, despite the dominance of Ransomes, partly due to its success in the world ploughing championships following the withdrawal of Ransomes from this kind of competition.

Imported products owe part of their success in the U.K. to the factoring operations of manufacturing companies like Bamford and Ransomes and to the existence of importers such as Pearson, Watveare, Bamlett and Colchester Tillage, which have strong marketing skills and, in some cases, notably Pearson, contribute to adapting foreign equipment to suit British conditions. It has been suggested that marketing specialists are more effective because they treat marketing as a profit centre, rather than as an adjunct of production.

CONCLUSIONS

The critical structural features of the industry are:

(1) The importance of the multinational companies and, to a lesser degree, their E.E.C.-wide sourcing decisions.

(2) The distinction between tractor and equipment sectors in terms of company size, ownership and production methods.

(3) The fragmented nature of the equipment sectors.

(4) The importance of market segmentation.

(5) The predominance of foreign companies in several sectors.

The significance of these features for competitive behaviour lies in the fact that the large companies compete primarily with other large companies, smaller companies with smaller companies. It follows that the industry structure has less significance than the market structure since it ignores market segmentation and the role of trade. Concentration was found to be substantial in most sectors of the industry but interestingly, many medium small companies which achieve market sector leadership were judged to have larger market shares than the giants of the industry. In terms of the structure of the relevant market, larger companies face more competition than many of the smaller companies. The more successful of the latter have contrived to occupy and dominate a particular niche in the market, so avoiding head-on competition with the major producers; their main source of competition derives from companies of similar size in other E.E.C. countries.

CHAPTER 10 - THE INDUSTRY'S ENVIRONMENT

The industry has operated within a stable environment. As Table 10.1 indicates, the aggregate demand for agricultural machinery remained static in real terms for most of the period 1963-73. As Table 10.2 shows the demand for individual items is also fairly stable. This is unusual for a capital goods industry; in fact, the industry exhibited less cyclical behaviour than any other mechanical engineering sector in the 1960s. This stability is largely due to the fact that the British farming industry is administered in such a way as to stabilise farm incomes (see Table 10.2). Relative crop prices remain stable and so too does the crop pattern. The two main crops are cereals and grass. Over 75% of the 12 million or so acres under tillage in the U.K. are accounted for by cereals. Mown grass accounts for another 5½ million acres. The remaining crops provide very limited markets for machinery, in order of importance: potatoes, 1.5 million acres; sugar-beet, 0.5 million acres; vegetables, 0.4 million acres. The pattern is set for the industry; the larger companies concentrate on providing tractors, tillage and harvesting equipment for cereals and grass, leaving machinery for the farmyard, milking, planting and harvesting sugar-beet and potatoes and other vegetables to the smaller companies.

TABLE 10.1:

GROSS FIXED CAPITAL FORMATION IN U.K. AGRICULTURE : 1963-73 (£m current prices)

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Vehicles	19	20	19	19	20	20	19	18	35	40	45
Plant and Machinery	86	86	86	88	91	102	94	100	99	129	191
New Buildings	63	65	67	65	75	88	99	114	137	160	209
All Fixed Assets	168	171	172	172	186	210	212	232	271	329	448
All Fixed Assets (1963 prices)	168	168	164	158	168	181	177	179	190	212	264

Source: National Income and Expenditure, Central Statistical Office.

In the long term this type of market poses no perplexing problems for company strategists. Companies can plan confident that the broad dimensions

of the agricultural machinery market look much the same 10 years ahead as they do at present. But in the short term, the market poses definite problems. Demand is strongly seasonal as the Chart 10.1 indicates. Deliveries are peaked in the first quarter and even more so in the second of each year, reflecting expenditure on heavy harvesting equipment in the spring and the farmer's desire to reinvest available income before the end of the financial year in April for tax reasons. The seasonal nature of demand, coupled with farmers' preference for short lead times, compels agricultural machinery manufacturers to consider ways of coping with uncertainty, either by manufacturing for stock, better forecasting or by shifting the stock on to dealers or farmers in the off season by suitable discounts.

To try to understand the workings of the agricultural machinery markets, some econometric results have been assembled for selected products. They identify some of the factors influencing demand and enable some distinction to be drawn between the sub-sectors of the market. They also indicate some of the difficulties in forecasting in this industry.

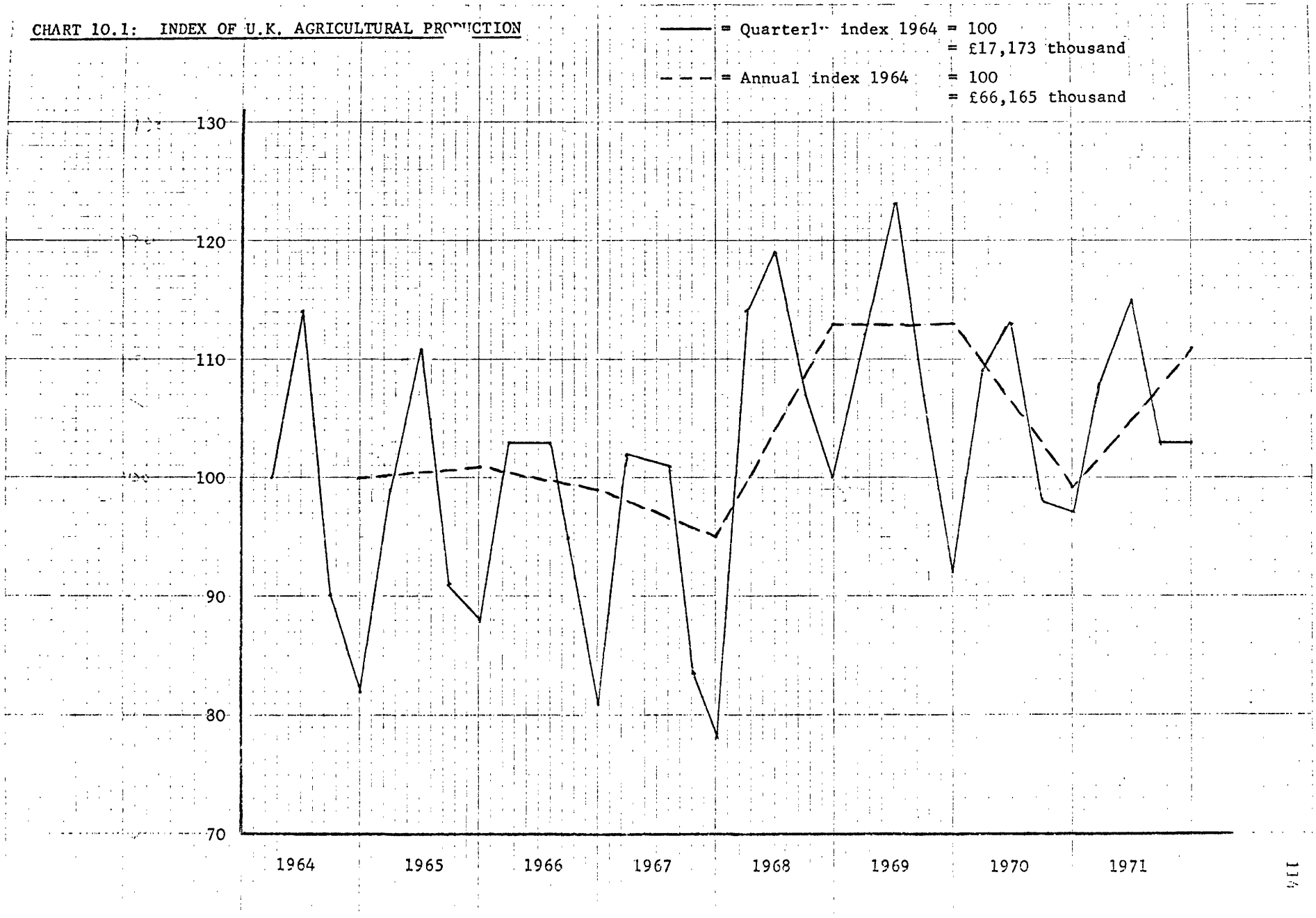
TABLE 10.2:

EXPENDITURE ON SELECTED AGRICULTURAL MACHINES (£m current prices)

Product Category	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Tractors (excluding truck-laying)	30	28	30	34	38	43	42	46	42	52	73	85
Balers	4.3	5.1	4.4	3.0	2.9	4.2	4.0	4.5	3.8	5.9	5.0	7.9
Dairy Machinery	2.7	2.9	3.4	4.5	4.9	6.1	5.9	6.1	8.9	n/a	9.4	10.5
Root Harvesters	1.7	1.9	2.0	2.1	2.3	2.7	1.9	2.3	2.3	3.0	3.7	4.2
Manure Spreaders	1.8	2.0	2.2	2.1	2.4	2.5	2.3	2.0	2.1	3.1	4.4	4.6
Farm Incomes	450	460	460	480	520	480	560	610	684	860	1280	...

Sources: Business Monitor, Department of Industry;
Trade Statistics of the U.K.;
Survey of Farm Incomes, Ministry of Agriculture, Fisheries & Food.

CHART 10.1: INDEX OF U.K. AGRICULTURAL PRODUCTION



Demand Studies in Agricultural Machinery Sectors

The U.K. demand for tractors has been studied in depth by Raynor and Cowling[1] who found that the demand for tractors was largely explained by the changes in the price of tractors, relative to the price of agricultural labour, and the existing stock of tractors in British farms. Farm incomes were not found to be a decisive factor. Between 1963 and 1973 agricultural machinery prices rose by 70% and agricultural wage rates by 150%. Largely in response to this change in relative factor prices, tractors have been substituted for labour in a process of capital deepening. The price elasticity was found to be around 0.7 in the short run and unity in the long run. The existing stock of tractors was found to have a depressing effect on demand, explained by the fact that the tractor is a large item which not all farmers wish to change each year in response to changed economic circumstances. The closer is the farmer's 'stock' of tractors to the level that he desires, the less is his desire to replace them. Incomes were not found to be a decisive factor because tractors are a fairly basic item which farmers accord priority. In a later study[2] the authors investigated tractor market shares and found them to be strongly influenced by the relative horsepower price of each manufacturer, with share price elasticities of around three in the short run and seven in the long run. These results suggest that price changes could be a potent competitive weapon leading us to expect fairly narrow tractor price differentials and a fairly guarded attitude to price competition.

The demand for implements appears to be governed by different factors. Table 10.3 presents the results for three products, balers, fertiliser distributors and manure spreaders. It is apparent that farm incomes largely explain the sales of the two smaller implements, fertiliser distributors and manure spreaders, whereas relative prices and existing stocks have no significant impact on their sales. The sales of balers are not affected by farm incomes. Their sales behave rather similarly to tractor sales in that they are affected by baler prices and the existing stock of balers on the farms.

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(1) "Demand for a Durable Input: An Analysis of the U.K. Market for Farm Tractors", A.J. Raynor and Keith Cowling, Review of Economics and Statistics, November 1967.

(2) "Price, Quality and Market Share", A.J. Raynor and Keith Cowling, Journal of Political Economy, Vol. 78, 1970.

TABLE 10.3:

DEMAND EQUATIONS : SELECTED IMPLEMENTS : DEPENDENT VARIABLE : ANNUAL DEMAND

(£ million)

Product	Constant	Farm Incomes	Relative Prices	Existing Stock	$\bar{R}^2$
Pick-Up Balers	26,900	1.380	-15,680	-.462*	.35
		(0.83)	(1.92)	(2.22)	
Artificial Fertiliser Distributors	-1,921	1.83**	1,820	.062	.95
		(10.63)	(1.40)	(.39)	
Manure Spreaders	11,000	3.27**	-6,900	-.37	.82
		(4.62)	(0.91)	(1.00)	

(t ratios appear in brackets)

* indicates significance at the 5% level.

** indicates significance at the 1% level.

Sources & Methods: U.K. Demand: U.K. Production + Imports-Exports Production figures, were obtained from the Business Monitor Series, Department of Industry, trade figures from Trade Statistics of the U.K.

Farm Incomes: Farm Incomes in England and Wales 1972-73, Ministry of Agriculture, Fisheries and Food.

Relative Prices: Relative Price refers to the ratio of a retail machinery price index to the agricultural wage index. Prices were obtained for representative machines from some of the manufacturers concerned, who were asked to identify machines which had remained broadly unchanged over the period.

Stocks: Series were based on the Agricultural Census for Great Britain, 1963, and developed by adding successive annual purchases and depreciating by 12% per annum, a rate calculated by John Nix, "Farm Management Pocketbook", Wye College, 1974.

From these results and the much more detailed studies by Raynor and Cowling on tractors, there emerges a clear distinction between larger basic items such as tractors and balers and the smaller items lower down in the farmer's pecking order. Sales of the larger items are price sensitive but because they are basic to farming operations they are not affected greatly by farm incomes[1]. Existing stocks are important too; other things being equal, a larger stock this year implies fewer sales next year. Sales of smaller items on the other hand are governed by how much money the farmer has left

(1) This refers to normal conditions; the really significant rise in arable incomes in 1973 due to the rise in the world grain price led to a significant rise in tractor demand.

to spend after making his larger purchases. This confirms the observation made by several companies that farmers consult their accountant at the end of the financial year and use any surplus funds at short notice to buy small items of equipment. In other words, large items are purchased like capital equipment, small items like consumer products.

FORECASTING IN THE INDUSTRY

The strongly seasonal pattern of agricultural machinery demand makes it important that manufacturers forecast accurately one year ahead so that adequate stocks are available for the seasonal peak. Delivery performance is more important in this industry than in other mechanical engineering industries because a small delay in delivery renders the equipment useless to the farmer for another year. Accurate forecasting is the first step in achieving delivery performance and this aspect is considered now.

Most manufacturers base their forecasts on their own judgements rather than formal statistical methods. A few large companies which have developed statistical procedures use them merely as guidelines to be interpreted in the light of their own feel for the market. What concerns us here is whether this approach justifies itself or whether greater forecasting accuracy could be achieved by adopting more formal procedures. This question can be resolved by a simple test; if the accuracy achieved by manufacturers is greater than that achieved by statistical methods, the industry's informal methods are vindicated. Manufacturers typically predict sales for the period 9-21 months ahead, finalising their manufacturing programmes for the following year in the spring of the previous year. The accuracy achieved varies with the product; manufacturers of large items claim to achieve forecasting accuracy to within 5%; manufacturers of smaller implements forecast to within 10-15%. This difference can be explained by the fact that the purchases of smaller items are subject to less planning by farmers, and as will be seen, the larger companies which manufacture the larger items are better organised to monitor market trends. The accuracy claimed by manufacturers is probably overstated in some cases. No company which discussed this question professed to really know the extent of unsatisfied demand for its products. Many do not even know the final demand; they only know the sales to dealers each

year and tend to deduce final demand from these sales, and any knowledge of dealers' stock changes that they possess - fairly slight in many cases. Forecasting errors appear small partly because manufacturers incline towards a conservative manufacturing policy, preferring to leave some demand unsatisfied than to be left holding unsold stocks for perhaps another year, which are a burden on costs and interfere with plans to introduce new models.

Could these forecasting limits be narrowed by statistical analysis? The tractor model was subject to a 10% mean error. This implies that if manufacturers had correct information on the relevant variables - the price of tractors relative to agricultural labour and the existing stock of tractors on the farm, 10% is the average limit of the model's forecasting accuracy. Since the explanatory variables in the model are either pre-determined or predictable it is a useful forecasting model and the 10% limits could be actually achieved if it were used for this purpose. However, it is less accurate than tractor manufacturer's own forecasting methods. The model's strength lies in predicting turning points in tractor expenditure (in real terms). Between 1950 and 1965 there were seven down-turns in real tractor sales. Whereas a naive trend projection would not have predicted any of these, the tractor model predicted four of them; it was also able to predict changes in both directions in 13 out of the 15 years covered by the model.

The largest formal forecasting study of the industry was carried out by the P-E Consulting Group for the National Economic Development Office in 1970[1]. With hindsight it is possible to check on the accuracy of these forecasts after adjusting them for differences between the actual and anticipated rates of inflation. The average forecast error[2] for four products - balers, spreaders, root harvesters and milking machinery - for each of the first three forecast years 1969, 1970 and 1971, turned out to be respectively 23%. 35% and 56%. The error increased with distance from the forecast period as one would expect, but even the first year error is rather greater than the limits of accuracy manufacturers

(1) "Agricultural Machinery: A Study in U.K. Demand and World Trade 1963-75", Mechanical Engineering Economic Development Committee, N.E.D.O., London 1970.

(2) The difference between actual and forecast demand, as a percentage of actual demand.

set themselves. One should also remember that the N.E.D.O. study referred to sectors whereas manufacturers have to consider both the sector demand and their expected share of it[1].

Lastly, it is possible to check forecasting accuracy of the demand equations calculated for balers, fertiliser distributors and spreaders. The baler equation was too weak to use for forecasting at all, but the other two fitted well and were used to generate forecasts for U.K. demand in 1974 at current prices. Table 10.4 compares actual with forecast demand levels for these two products and reveals that the errors are considerable.

TABLE 10.4:

FORECAST ERRORS OF SELECTED IMPLEMENT MODELS

U.K. Demand, 1974 (£ mil)	Fertiliser Distributors	Manure Spreaders
Actual	2.59	4.63
Forecast	1.27	6.11
Forecast Error %	+100%	-25%

Source: N.E.D.O. Study and L.B.S. Model.

On the evidence shown here, formal statistical analysis is unlikely to offer improvements on the industry's own methods, and considering the difficulties involved, the industry's forecasting efficiency is quite impressive.

THE STRUCTURE OF THE MARKET

The industry's market structure is highly fragmented. As Table 10.5 indicates, 95% of farmers farm less than 500 acres and account for 50% of the total agricultural acreage. There is a marked geographical segmentation of the market. The 5% of farmers who farm 45% of the arable acreage are mostly located in the cereal-growing areas in East Anglia and Yorkshire. Farms in the West are smaller and concentrate on dairy herds and grassland farming. This division simplifies marketing; tillage

(1) This is not a criticism of the study which was intended to indicate long term trends, extrapolating from a fairly short data base, 1962-68, and not demand levels for particular years, which were expected to deviate from this long term trend.

and harvesting machinery tends to go East and dairy equipment and hay-making machinery goes to the Midlands and the West. Moreover, the larger and more sophisticated items of equipment, such as high horsepower and four-wheel drive tractors, the larger combines, reversible ploughs, multi-stage sugar-beet harvesters and precision drills, are more likely to find a home on the big eastern farms.

TABLE 10.5:

FARMS IN GREAT BRITAIN

Farm Size (acres)	Number ('000)	% of Total	Area ('000 acres)	% of Total
less than 5	23	9	60	0.1
5 - 50	92	36	2,020	5
50 - 500	130	50	20,940	50
over 500	13	5	18,470	45
Total	258	100	41,490	100

Source: Agricultural Statistics of the U.K., 1972.

Only a tiny proportion of farmers (3%) employ more than five employees. Except for a few farms owned by industrialists and operated by professional managers, there are few big customers. There is no question of their being many large farm machinery contracts of the sort that vehicle manufacturers conclude with fleet operators. Farming remains largely a family business and is traditional in outlook. The farmer will probably use the machine himself and when buying a machine, his decision process is fairly informal. He does not have to consult anyone or present a formal case on paper, as does the purchasing officer of a typical engineering company, for instance.

These features set the agricultural machinery industry apart from most other capital goods industries and help to shape the marketing patterns for the industry. The fragmented, dispersed and informal nature of the market presents the machinery manufacturers with peculiar problems of access and accounts for the key role played by the agricultural machinery dealers.

THE DISTRIBUTION SYSTEM

The machinery manufacturers market their products to the farmer but actually sell them to the 1,200 recognised dealers in Britain. This is an accepted custom of the trade and it is very rare indeed for the manufacturer to bypass the dealer and sell directly to the farmer. Even on those occasions when the manufacturer's representative arranges a deal with the farmer himself, the local dealer will be asked to close the deal and supply the machine. Manufacturers' support for dealers is manifested also by the fact that 250 of them are associate members of the dealers' trade association, the British Agricultural and Garden Machinery Association (BAGMA). Dealers are independent of manufacturers and vertical integration is very rare; David Brown own eight dealerships in Lincolnshire and East Anglia and it is not unknown for dealers to manufacture themselves on a small scale. Dealers are fairly fragmented; the Burgess organisation is the largest group, owning around 80 outlets, followed by Doe and Southern Counties Farmers, each with around 50 outlets. Even the largest groups of dealers are not seen by manufacturers to exert any significant degree of market power, except in limited geographical areas. As we shall see, the discretion that many dealers have to accept or reject the products of particular manufacturers derives not from the market structure of the dealers themselves but from the marketing strategies of the dominant machinery manufacturers.

The questions of particular interest here are: Why do not manufacturers deal with farmers direct? What functions do dealers perform which manufacturers could not perform so effectively themselves? Dealers hold stocks of machines and spares and provide maintenance and repair facilities. The dealers trade association lays down minimum standards for its members relating to capitalisation, specialised equipment, workshop floor space, and the like, which are vetted by an inspectorate. Maintaining the machine population in operation is one of the dealers' crucial roles because timeliness is vital in farming. Most machines are used intensively for a few weeks of the year, in which time breakdowns could cost the farmer his crop if repair facilities or parts are unobtainable. The dealer's proximity to the farmer, the engineering servies he offers and his willingness to put himself out as occasions demand make him indispensible to the farmer. The goodwill that these operations generate give him the status

and trust in his locality, which in turn makes him indispensible to the manufacturer[1].

In contrast, the chemical companies are able to sell fertilisers directly to farmers because no maintenance problems arise. Their attempts to supply machines for applying fertilisers directly have run up against dealers' reluctance to service machines which they have not had an opportunity to sell.

Another feature of his business is that sales of new machines entail a trade-in of an old machine. Dealers accept them in part-exchange, re-condition them in their workshops and dispose of them through contacts or through various auctions around the country. A manufacturer wishing to deal direct has also to become involved in the second-hand market and the repair business. It is unlikely that the farmer would wish to buy a machine unless he could be assured that it could receive repairs and spare parts locally. Fearing that dealers would either refuse to repair a machine that they had not sold outright or have little interest in doing so, the farmer would consider it a false economy to buy direct from a manufacturer rather than from a dealer.

There are also some sociological aspects to this. Being a dealer is a way of life. For one thing he is himself intimately involved with the local farming community and its problems. It is no accident that few agricultural machinery dealers sell cars from the same premises; the cultures of the two trades are different as is apparent from the style of dress, speech and manner. Because of the trade's attractions its profitability tends not to be very great. Despite the advantages of large scale operations and a trend towards larger units, the dealer population is stable, being continually topped up by a stream of optimists, many of whom are encouraged by new tractor companies which have entered the market. The financial rewards for a manufacturer wishing to integrate forwards into distribution are probably less attractive than expansion in machinery manufacture.

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(1) This observation refers to the U.K., where the general quality of the dealer trade is high. In France, the dealer trade is comparatively weak and direct selling occurs.

The only manufacturers who could conceivably integrate forwards are the tractor companies and the full or long line companies; no other manufacturer would have sufficient sales in any particular locality to justify owning its own dealers. But there is a wide cultural gap between the large scale manufacturer and the dealer. The former is concerned with systems, repetition, procedures, and standardisation, all geared to producing large volumes of standardised products at fixed prices(1). Dealers, on the other hand, operate at a personal level on a one-off basis; and their title rightly implies that they 'deal'. Each deal contains two elements: the discount offered to the farmer from the manufacturer's recommended retail price, and the trade-in price on the old machine. Juggling these elements requires skill and it is also part of the personal 'handshake tradition' of the trade which farmers enjoy. It is said that they pay more attention to their discount than the recommended retail price itself - the former is something they can influence, the latter is not. Essentially, the dealer bridges the gap between two trading cultures and because of his vital role, the marketing task for the manufacturer in this industry is mainly to do with dealers; whether they agree to carry his product, whether they actively promote it, whether they provide an information channel between the manufacturer and the final consumer.

CONCLUSIONS

The significant features which emerge are as follows:

(1) The industry operates in an environment which is stable in terms of aggregate demand for machines, the composition of this demand and the technology involved. These features facilitate long term forecasting and the formulation of corporate strategy.

(2) There is a strong seasonal element in the industry which puts a premium on delivery performance and short term forecasting. The industry's informal forecasting methods showed up well in comparison to econometric methods.

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(1) The exception is David Brown. Observers of the industry would probably agree that of the major companies, David Brown, with its personal management style, comes closest to bridging this gap.

(3) The fragmented, dispersed and personal nature of the market makes the manufacturer heavily dependent on the dealer; the reasons are to do with the purely physical problems of reaching and servicing a dispersed clientele and the cultural problem of coming to terms with the farmer's mode of doing business.

CHAPTER 11 - MARKETING AND DISTRIBUTION

It was explained in Chapter 10 that machinery dealers are essentially the 'gatekeepers' to the agricultural machinery market. This Chapter discusses the way that this feature shapes the marketing policies of the industry, the marketing advantages of large companies and the problems of entry.

Developing dealer networks is the key to success in this industry. Whereas a strong network can outweight price and design disadvantages the converse is not true. The tractor is the staple item of any dealer's trade, accounting for an average of around 20% of his turnover. The great majority of dealers are exclusively committed to a single tractor manufacturer. Of the 1,200 or so recognised dealers, those indicated in Table 11.1 have exclusive arrangements with the major companies.

TABLE 11.1:

DEALER ORGANISATIONS OF LEADING COMPANIES

Type of Company	Company	No. of U.K. Dealers*
Tractor and	Ford	130
Full-Line Companies	Massey Ferguson	200
	David Brown	150
	International Harvester	73
	British Leyland	70
	Johne Deere	70
Long-Line Companies	Claas (Mann)**	160
	Bamford	148
	New Holland	130
	Fahr (Watveare)**	80
	Ransomes	50

* These are approximate figures: there is inevitably some abiguity about the term 'dealers' - whether it refers to companies or branche:

** U.K. distributors.

The exclusivity only applies within each of the two categories shown in the Table, because the dealers which handle the tractors of the specialist tractor companies, Ford, David Brown and British Leyland, need to complete their range. Ford dealers handle all the New Holland harvesting machinery, as well as the Ransomes tillage (but not its harvesting) equipment. David Brown and British Leyland dealers look to Bamford and Claas for harvesting equipment. Watveare handle Fahr harvesting equipment and Deutz tractors, all from Germany. These figures do not really convey the strategic importance of the exclusive dealing arrangements which large companies have with their dealers. It is generally recognised that Massey Ferguson and Ford, with nearly 60% of the tractor market between them, have secured the biggest and best dealers and would have no difficulty in recruiting more if they desired them. There never has been an attempt at blanket coverage of the agricultural machinery market in the U.K., in an attempt to exclude rivals, as has occurred in the United States where manufacturers subsidise their dealers' stocks. All major U.K. companies are moving towards a smaller number of more economic dealer operations, through a process of natural wastage. Neither of these two companies ever lose dealers except through attrition and occasionally through termination of franchise by the company, usually through the dealer's failure to observe the exclusivity clause. It is known, for example, that if a Massey Ferguson dealer is taken over by the Burgess organisation, the largest dealer in the country, he loses his franchise, due to a disagreement on this issue some years ago.

Exclusivity works both ways; tractor manufacturers sell only through their franchised dealers. The exclusivity avoids running up against the Restrictive Trade Practices legislation since it applies only at the wholesale level, i.e. a dealer may retail into another dealer's territory but he may not sell to another dealer in that territory. In practice this effectively eliminates trading across franchise boundaries because farmers would not wish to buy from a remotely situated dealer for fear that he might not obtain the spares and maintenance he would need from the local dealer that has been bypassed by this type of sale.

The strength, stability and loyalty of the major companies' dealer organisations, and the necessity of operating through dealers, pose a considerable barrier to entry for tractor manufacturers, a smaller but

significant barrier to combine harvester manufacturers, and a slight barrier to implement manufacturers. Exclusivity entails that, if he is to succeed, the new tractor entrant must persuade a dealer to switch completely, probably writing off his stock of spares in the process, a harder task than persuading him that his prospects would be enhanced by handling an additional range of tractors. Entry is easier in Germany where double franchising is common, and in France where the weakness of the dealer trade necessitates direct selling in some regions.

There are two avenues open to the entrant, forward integration and recruiting dealers with no previous experience. The only instance of vertical integration in the industry is David Brown's acquisiton of eight dealers in East Anglia and Lincolnshire to gain a stronger foothold in the more lucrative large farm/high horse power markets. As Chapter 10 indicates, there are difficulties in marrying the mass production and agricultural trading culture. David Brown appear to succeed because of their informal and sensitive managerial style and their appreciation of this cultural difference. Forward integration would be unlikely to succeed for the foreign tractor companies now attempting to break into the U.K. market, since they would operate without a deep understanding of the market.

Developing a dealer organisation from inexperienced dealers is also difficult. The entry of John Deere into the U.K. market illustrates this very well. Deere entered the U.K. in 1966 and is looking for a 10% share of the tractor market. Many of its early dealers had little experience in handling tractors and their mortality rate was high. They were supported by Deere's credit policy; several over-committed themselves and ran into cash flow difficulties. Gradually dealers of rival manufacturers were induced to switch by the growing acceptability of Deere's products, the company's evident commitment to developing its U.K. market share and its long purse which enabled it to do so. Deere is the world's largest farm machinery producer and the most profitable of the North American full-line producers. It spends more on R & D - both absolutely and in relation to turnover (4%) - than any other major company and has one of the most modern product ranges. Its marketing style is greatly respected in the trade. Eight years after entry its

share of the U.K. tractor market was 4½%[1]. This rate of penetration, which is considered impressive in the trade, indicates the difficulty of entry into this market, bearing in mind Deere's considerable strengths.

Leading manufacturers in E.E.C. countries - Deutz, Fendt, Fiat, Same and Renault - are all represented here but their shares are far less than the U.K. market shares of E.E.C. motor manufacturers and are likely to remain so. This contrast between the penetration of European tractor and car manufacturers underlines a factor which reinforces dealers' grip on the machinery market, namely, farmers' lack of reponse to media advertising, in marked contrast to car buyers. A position in the tractor market can only be developed by pushing sales through a well run dealer organisation, not by 'pulling sales through' by use of the media. Sales promotion budgets of the major companies are very modest - around one half per cent of turnover.

The resiliance of the market leaders' dealer organisations and customer loyalty has been underlined by the recent shortages of tractors. During the period 1972-74 U.K. tractor manufacturers were unable to meet U.K. demand and as a result there was a surge of cheap imported tractors from Eastern European countries, which rose from 4,000 in 1972 to 8,000 in 1973. This is only a temporary phenomenon and has always been regarded so by the U.K. manufacturers. As the supply situation improved in 1974, imports fell to 5,000. Because new machines were unavailable to many farmers they preferred to operate their old machines longer rather than purchase an imported machine, in marked contrast to British car owners, for example. The secondhand market contracted, driving up the price of one and two year old tractors, above the price of new tractors on some occasions, persuading secondhand buyers to buy cheap imported machines instead. The difficulty which the better Eastern European tractors have had in establishing a position in the market is due to inadequate dealer representation, rather than deficiencies in quality; probably the best model is the Zetor manufactured by the Czechoslovakian Skoda works, a well engineered product which includes as standard several features which U.K. manufacturers market as optional extras, offered to the farmer

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(1) This refers to units and understates Deere's share in terms of value since Deere specialises in high horsepower models.

with a seven year guarantee at a price 30% below U.K. levels. The fact that such a tractor secured only a 5% market share in 1974 at a time when the market was under-supplied testifies to the strength and resiliance of the market positions of the established manufacturers.

BARRIERS TO ENTRY IN OTHER MACHINERY MARKETS

Barriers are fairly high for combine harvesters. Successful entry requires the commitment of the larger dealers who alone can afford to stock this expensive item which can cost around £15,000. Conversely, a company with a strong marketing organisation could sell any reasonable combine. In 1964 Bamford lost its imported machine when New Holland took over the Belgian combine manufacturer, Claeys. Bamford looked for a foreign substitute and in 1974 secured an 8% market share with Laverda machines from Italy. Companies with small shares are at a disadvantage in this market. To maintain U.K. coverage seventy or so dealers are needed. Smaller shares imply fewer combines for each dealer - two or three per year for companies with shares of less than 10%, as opposed to eight to ten per dealer for the market leaders. The risks and expense of stocking such an expensive item with a prospective turnover of only two or three a year are obvious. Trading on a sale-or-return basis is one solution for the manufactures in this position, but this reduces the dealers commitment to sell the machine.

Barriers to entry in implement markets are less significant. Even in the tillage equipment market, which is linked strongly to the tractor market and hence the tractor companies' dealers, has seen significant entry from Kvernelands from Norway and Lemken from Germany, bypassing the Massey Ferguson and Ford dealer networks. Fahr from Germany has risen to market leadership in mowing machinery, PZ from the Netherlands in hay conditioners. These cases indicate that entry into the implement markets is possible, provided the manufacturer has a good product and is represented by a U.K. company with a strong marketing capability.

ASPECTS OF DEALER MANAGEMENT

Maintaining Loyalty

It has been argued that the major companies' links with their dealers

is a source of market power but it should not be imagined that this power is conferred by company size per se, as is often assumed in the literature on industrial structure. There is no straightforward, mechanical link between company size and dealer representation. Dealers are independent companies. Cultivating effective relationships with them requires patience, diplomatic skills and a thorough understanding of the trade. There is no question of large companies simply buying their way in, nor can established companies rely on their goodwill with dealers indefinitely. Once an established company begins to acquire a reputation for clumsy or offhand treatment of their dealers its market performance suffers accordingly.

Some examples of the type of difficulty which can arise between manufacturers and dealers will convey something of the marketing skills required of manufacturers. Availability and delivery are obviously important to the dealer. Tractor availability has been a particularly sensitive subject during the last three years when U.K. producers have been unable to meet demand and have delivered to dealers on an allocation basis. The fact that the U.K. tractor industry is used as a production resource by the multinational companies which dominate it, and exports around 70% of its output, is apt to give U.K. dealers the impression that the companies concerned regard the U.K. market as of secondary importance. Maintaining dealer goodwill throughout this period has severely strained the diplomatic resources of tractor companies' marketing departments.

In discussing this issue with representatives of the trade one is struck by dealers' sensitivity to small things on the one hand, and on the other their willingness to overlook large defects provided that the manufacturer maintains a responsive and encouraging attitude. In one instance the dealer was apparently ready to overlook the fact that the manufacturer had introduced an unappealing and unreliable product, which gave the dealer a lot of maintenance problems at the height of the season, because the manufacturer was willing to take the dealer's advice and make the necessary modifications. But in another instance a dealer mentioned that he was disenchanted with a foreign supplier because the latter showed insufficient appreciation of the promotional efforts that the dealer had made in his behalf and ignored the dealer's complaints about a technical weakness in the machine. In another instance an imaginative

promotional scheme devised by the manufacturer went awry simply because it was not presented to the dealers in the most diplomatic way. The scheme linked a give-away item to every machine sold during a specific period, the gift to be financed from the dealer's margin. The scheme failed because the negative aspect of the operation, the financing of the gift from the dealer's margin, was given more emphasis than the additional net profit which the scheme would probably have generated for the dealers. Manufacturers have also to have some regard for dealers' sensitivity to any signs of favouritism. An illustration of this was provided by a company with considerable marketing experience. Two of the company's dealers were proposing a campaign to promote its products and suggested that the company assist by advertising the campaign in a local newspaper. The manufacturer made it a condition of supporting the scheme that two other dealers in the locality also be invited to participate, for fear of alienating the latter.

Dealer reactions condition the manufacturers' marketing mix in various ways, in respect of technical innovation and price. Ford experienced difficulties in the early 1960s with the 'selectaspeed' automatic transmission because the maintenance of this system posed technical problems for the dealers. As regards pricing, attempts to penetrate with a low price can backfire because of dealers' unfavourable reactions. Whereas one might expect that dealers would welcome such a tactic since it holds the prospect of greater net profit for them, the reaction could be unfavourable because they would sense that the manufacturer was losing business and would make little or no profit on the machine and would soon lose his commitment to it. Dealers are very sensitive to manufacturers' commitment to their products. As is mentioned in Chapter 13, a contributory cause of the decline of Ransomes' combine harvester was the fact that the manufacturer failed to communicate a long term commitment to its dealers and its product. These examples indicate that the successful maintenance of dealer goodwill is as much to do with diplomacy as market muscle.

Dealer Efficiency

The fact that industry leaders have the best dealers is not due simply to their ability to attract them by virtue of their market power. Most large companies are in a position to offer managerial advice to their

dealers. Generally, dealers' strength lies in their links with their locality and their knowledge of the trade, rather than in their technical business skills. One fairly basic skill in which deficiencies have been noticed is the ability to maintain control over the business.

The nature of the dealers' business poses a number of cost accounting problems which can often conceal the profitability or otherwise of each of the three principal activities - selling new machines and spares, trading in secondhand machines and servicing. All three are linked; the sale of a new machine invariably entails the trade-in of an old one. Disposing of the trade-in machine may entail buying a still older one in part exchange and so on, in which case the true price of the new machine cannot be determined exactly until this chain of transaction 'washes out'. The service department exists as a support for new sales as well as a means of rendering the secondhand equipment resaleable. There is a tendency among dealers to regard servicing as an expense of selling, which generates goodwill, rather than as a revenue-earning activity in its own right. The difficulty in controlling the mechanics' time contributes here too, with the result that dealers sometimes fail to operate their service departments profitably, even if they intend to do so. Larger manufacturers attempt to supply this deficiency where it occurs, offering advice on how to monitor the profitability of the various aspects of the business. Some companies insist on monthly operating accounts as a means of identifying dealers' difficulties in time to take remedial action. It is usual to run a voluntary computerised accounting service which provides the participating dealers with the appropriate accounting data and an idea of his comparative performance.

Marketing Methods and Scale Advantages

It is apparent from the structure of the industry that marketing is the critical function in agricultural machinery, subject to more significant scale advantages than any other. This is revealed by the fact that most large companies market many more products than they manufacture themselves. They buy in because there are insufficient production economies in many implements to give them a production advantage, but more importantly, a critical mass is required to confront dealers; i.e. a range of worthwile products which can provide a dealer with a living and to which he is prepared to commit himself. The marketing capability seems

to be the machinery companies' most resilient asset; when their own products become obsolete or fail, they buy in foreign machines without apparent loss of market share. Bamford factors as many foreign machines as any company, mainly haymaking machines and ploughs. Ransomes markets German potato harvesters. An established company like Bamlett, which ceased production altogether, now successfully imports foreign machinery.

Before discussing this, an important distinction must be made at the outset between 'scale advantages' and 'economies of scale' and the type of analysis appropriate to each. Academic studies on cost-volume relationships and the work on 'experience curves' developed by the Boston Consulting Group are concerned with the latter, this discussion with the former. 'Economies of scale' refer to total unit costs. The presumption underlying this concept is that there are definite functions common to all business which can be performed more or less economically in companies of different sizes. This concept is useful in discussing certain types of physical operation in production and distribution. It is less appropriate for discussing broader and less precise functions - marketing and product development, where it is not so much a question of larger companies performing these functions at lower unit cost as of performing these functions more effectively, and getting dealers to perform them better too, or doing things that smaller companies do not do at all. In this sense, it is more appropriate to speak of 'advantages of scale'. Accordingly, this section as well as the chapter on product development is concerned with qualitative differences between the companies' marketing rather than with any unit cost type measures of marketing efficiency, such as turnover per salesman. An additional reason for this approach is that the reasons why some companies are larger than others is at least as interesting as differences between the companies; the types of marketing policies pursued must have an important bearing on this question.

Marketing agricultural machinery hinges round the dealer and on what he is willing and able to do for the manufacturer. The dealer's margin is close to 20% for most items - a sizeable fraction of the retail price. The central issue for the manufacturer is simply: what services does he secure in return for this 20% margin?

The advantage of larger companies is that they can secure some or all of these services:

(1) Exclusivity.

(2) Information feedback from the market.

(3) Provision of minimum stock levels of new machines and spares, and repair capabilities.

(4) Value for money in terms of promotional effort.

Dealing with these in turn, the value of exclusivity as a barrier to entry is now apparent from earlier discussions; in addition, it commits the dealer to promote the company's products and provides the manufacturer with reliable representation in those geographical areas he is particularly interested in. Whereas larger firms secure exclusivity as a condition for granting a franchise, smaller companies have to buy the privilege by offering higher discounts.

The principal type of information provided to the manufacturer by dealers relates to sales and stock levels. Information on the state of demand is basic to effective marketing and production planning and many small companies do not receive it. The dealer system tends to insulate manufacturers from their markets, the smaller companies particularly. Without this data, manufacturers have to estimate the level of final demand from their own deliveries to dealers and any guess they might make about changes in dealers' stock levels. These changes can be very significant, bearing in mind that dealers are numerous and might each expect to sell less than ten machines of any one manufacturer each year. A change in stocks of two machines per dealer is a significant fraction of final demand. To illustrate this, the estimate of the 1974 U.K. demand for balers was 8,000 units, calculated on the basis of trade figures and the manufacturers' delivery figures supplied to the Government Statistical Office. The industry itself puts the demand at only 6,000 units. If the Government's statistics were correct, dealers accumulated 2,000 balers in 1974, one third as much as the final demand.

Such behaviour is typical. The familiar feast-famine cycle operates in this industry. If there appears to be a likelihood of short supply, some farmers order several different machines, intending to buy only one, and dealers tend to over-order as well; if the supply situation looks easy, dealers may not bother to stock at all. The manufacturer is presented with a very magnified view of the market's fluctuations which he has to interpret. Without information feed-back, production planning is made very difficult, resulting in chaotic attempts to get machines out of the factories at the seasonal buying peak. As one production manager in a small company put it, "production ceases to be a rational activity".

Large companies can ensure that dealers perform their basic functions on their behalf - stocking the company's machines, displaying them prominently, and maintaining adequate service levels for spares, i.e. ensuring that a minimum percentage of demand can be met. This last aspect is not monitored rigorously, as does the Caterpillar Tractor Company in the U.S.A., for example, but dealers which order spares from the manufacturer at short notice receive less discount and are also encouraged to stock up. In contrast, smaller companies feel lucky to get their products into dealers' yards wherever they can. In part, this difference is due to differences in the products produced. Whereas the larger companies specialise in the more engineered products which require skilled maintenance and presentation to the farmer by a selected group of dealers, smaller companies incline towards more rudimentary products which require as broad a coverage by dealers as possible.

At worst, dealers simply act as order-takers and do not actually promote the smaller companies' products at all. The small company which is not satisfied with this can send its sales representatives around the dealer to the farmer himself if it is able to identify its customers. In other ways too, smaller companies receive less promotional inputs for their money. The promotion offered by dealers to smaller companies varies considerably but all are paid the same discount. For instance, some dealers retain fitters for installing a particular manufacturer's farmyard equipment while others do not, yet all receive the same discount. Many manufacturers offer graduated discounts as an incentive to stock their products, quite apart from quantity discounts for bulk orders. In the course of discussion about this type of incentive with a large and a small company, it emerged that the large company related the discount to

the achievement of some target sales volume, judged by the manufacturer to be within the dealer's reach, the smaller company offered the discount to all of its dealers which were expected to achieve a minimum volume of sales. The larger company used its discount with much greater precision to secure additional promotional efforts on its behalf, whereas the smaller company could not be sure that it was securing any extra promotion at all.

Larger companies derive some of these advantages by exerting their market power. It is market power which secures exclusivity and enables larger companies to insist on operating standards and to obtain information they need. Dealers do not supply this readily. It is said that a major tractor franchise is a 'paperweight', in that two additional clerical staff are needed simply to handle the extra administration involved. Smaller companies could not conceivably insist on dealers supplying regular information on sales and stocks or monitor dealers as closely as the major manufacturers can. The market leaders in the tractor market, Massey Ferguson and Ford, appear to take the firmest line of any companies with their dealers. Another leading tractor manufacturer reported that only 60% of their dealers supplied the information the company required.

CONCLUSIONS

Marketing is the critical function in this industry. Through their control of their dealers the larger companies do much to maintain their market shares. But the advantages of scale are not solely due to market power. Large companies are managed differently and, generally speaking, their marketing policies convey a sense that they are in control of events whereas smaller companies seem to be at the mercy of events. There are several aspects to this:

(1) Large companies tend to be more numerate and able to monitor the market more closely. Through their Trade Association, the Agricultural Engineers Association, the tractor manufacturers have organised a computerised market information system based on tractor registrations. This facilitates detailed monitoring of the market down to the parish level, permitting a degree of 'fine tuning' of the marketing function, i.e. identifying areas of weak or declining penetration and being in a position to set targets for each of their dealers on an informed basis.

(2) Larger companies give more direction to their sales representatives. Most companies in the industry have area representatives whose functions are to keep in touch with farmers and liaise with dealers. The typical staffing ratio appears to be around four or five representatives per £1 million turnover. In smaller companies, the representative operates fairly independently and performs an ambassadorial role. He has little formal training and reports company personally around three times a year and aims to visit dealers with the same frequency. Larger companies train their representatives and guide their operations to a much greater extent. The Sales Manager in the small firm acts in many ways as the senior representative, handling enquiries and taking orders whereas in the larger company he is essentially a manager - guiding and monitoring representatives' activities and liaising with production. In general this must be the proper role of the Sales Manager, though in this rather informal industry there are examples of successful companies whose human assets more than compensate for lack of an explicit and active management of its marketing functions. In one company it is the personal qualities of the Sales Manager and his contact with the farming community; in another, it is the design skills of the owner-manager which cause the world to make a beaten path to his door. The company has no sales representative at all and produces to capacity.

(3) There is a greater awareness among larger companies of the need for market information; information on the company's customers and on their future demands. Demand forecasts are made independently of dealers. Smaller companies tend to rely on the dealers for forecasting purposes, when the truth is that dealers rely on manufacturers to know how many machines they expect to sell. Most large companies have a clear idea of who their customers are, some small companies do not.

(4) Larger companies achieve a greater integration of production and marketing, despite the inhibiting effect of size on internal communications. As Chapter 13 indicates, Massey Ferguson have adapted their production programme to marketing requirements. The Coventry plant operates a flexible production programme

capable of rapid delivery performance in normal demand conditions. Another tractor company does the reverse; marketing adjusts to the requirements of the production programme by pushing certain models at particular times. The more advanced corporate planning procedures in larger companies also assists co-ordination between production and marketing plans and secures a commitment to these plans by all the dealers concerned.

CHAPTER 12 - PRODUCTION CHARACTERISTICS AND SCALE ECONOMIES IN AGRICULTURAL MACHINERY

1. INTRODUCTION

Economists' interest in scale economies amounts almost to an obsession. They tend to interpret production patterns and industrial structures purely on these terms. Some structures are deemed to be deficient in that they prevent the fullest exploitation of the available scale economies; such, for example, is the approach taken by the Canadian Royal Commission to the Farm Machinery Industry, discussed below. Alternatively, industries are criticised for being excessively concentrated in that companies are larger than they need be to exploit the available scale economies.

This chapter is not a rigorous attempt to measure scale economies in this industry. That task, we argue, is virtually impossible due to the number of factors. It is difficult to establish comparability between plants in terms of product mix, make-or-buy decisions, and the vintage of the equipment used. Company financial statements are the main source of information on companies' operations and these reflect many other factors than scale economies, notably company policy on pricing, delivery, stock levels, variety and valuation of assets. The purpose of the chapter is to try and review such evidence on scale economies as can be assembled and attempt to view it in the context of the observed operating situations and managers' own perceptions of scale economies and production problems.

Indicators of Scale Economies

A partial indicator of relative efficiency is provided by the labour productivity data in the Census of Production. This relates to 'net output per employee'. It is, of course, influenced by the product mix, by capital intensity and depreciation policies, but it is nevertheless a useful general guide to such major differences as may exist.

As Table 12.1 indicates, among agricultural machinery companies there is no simple relationship between company size and labour productivity.

In the non-tractor sector the largest companies with over 500 employees seem no more efficient in this respect than those in the 100-200 size class. There appear to be some scale economies operating up to this range, but the relatively poor performance of companies with between 200 and 500 employees suggests that once beyond the 200 employee level, companies begin to encounter problems. In the tractor sector the top 5 companies are vastly greater than the remainder in terms of size, but their efficiency is very similar. There is, however, a striking difference in labour productivity between the tractor sector and the remainder of the agricultural machinery industry, reflecting the relatively capital intensive flow line techniques used in tractor production.

TABLE 12.1:

NET OUTPUT PER EMPLOYEE AND WAGE RATES BY SIZE OF ESTABLISHMENT

Sector	Size of Establishment (employees)	Number of Establishments	Number of Companies	Net Output/ per Employee (£)	Wage & Salary per Operative (£)
Agricultural Machinery (excluding tractors)	25 - 49	25	25	1770	830
	50 - 99	26	26	1890	850
	100 - 199	15	14	2010	930
	200 - 299	4	3	1750	970
	300 - 399	6	6	1750	880
	400 - 499	3	3	1930	850
	over 500	6	6	1990	980
Tractors	50 - 99	7	7	1750	950
	100 - 199	4	4	2110	1050
	200 - 399	4	4	2450	1080
	over 500	9	5	2770	1260

Source: Census of Production 1968, Department of Industry.

The absence of any simple relationship between the company size and labour productivity in the non-tractor sector is corroborated by an analysis of company profitability. Company results for a sample of 26 companies were analysed over the 6 year period 1968/73. The companies range in size from around 100 employees up to the largest company in the

industry, Massey Ferguson. For each company the average pre-tax net returns on net assets and sales were calculated for the period. There turned out to be no significant association between these measures of performance and company size.

Some comparisons of profit margins and growth are set out in Table 8.2 . which reveals some interesting features.

(1) The large companies are slightly less profitable, though not significantly so. The average profit margin of the 10 largest companies was 5.5%, of the remaining 16, 8%. There appears to be a greater opportunity amongst smaller companies to earn high returns; only one of the top 10 companies shown here earned more than 10% on sales over the period 1968/73, whereas 7 of the remaining 16 did so.

(2) There is no link between growth and profitability.

(3) There are some signs that the largest firms grow more slowly than the small firms: three tractor companies, Massey Ferguson, International Harvester and David Brown, together with Ransomes and Bamford, were particularly sluggish.

(4) On this evidence the tractor sector appears less profitable than the rest of the idustry, but the major sectors of the latter - tillage, harvesting, dairy and farmyard equipment - seem to be equally profitable.

(5) In so far as it is possible to allocate companies in particular sectors and compare profitability within these sectors, scale economies seem evident only in tractors; Massey Ferguson's size advantage corresponds to a distinct but not dramatic advantage in profitability vis-a-vis its smaller scale rivals, International Harvester and David Brown.

Table 8.2 must, however, be regarded with some caution. Tax planning by individual enterprises distorts the published accounts, by amounts that are not known. And in some cases a different consolidation of related companies within a group can give different results, and from the outside it is difficult to get this right(some companies have been kind enough to advise on this).

TABLE 12.2:

SIZE, PROFITABILITY AND GROWTH OF 15 LARGE COMPANIES : 1968/73

Company	1973 Sales (£ million)	Net Profit/Sales 1968/73 (average %)	1973 Sales / 1968 Sales
1. Massey Ferguson	188	5.5	1.5
2. International Harvester	58	0.5	1.8
3. Howard	38	10.4	3.6
4. David Brown	34	2,3	1.7
5. Ransomes Sims & Jefferies	16	8.7	1.3
6. Alfa-Laval	10	6.4	2.1
7. Fullward & Bland	8	4.9	2.6
8. Bamford	8	7.9	1.9
9. County Commercial	6	4.8	1.7
10. Gascoigne Gush & Dent	5	5.3	2.5
11. Simplex	4	9.4	2.0
12. Bentall	2.6	10.8	2.0
13. S.K.H.	2.4	-2.0	5.7
14. Standen	2.1	14.3	2.1
15. Root Harvester	1.8	10.0	1.8
16. Bamford & Evershed	1.8	10.5	1.9
17. Alvan Blanch	1.3*	0.3**	1.4***
18. Archie Kidd	1.4	16.4	3.5
19. Turner Engineering	1.2	4.8	4.2
20. British Lely	1.1	3.9	1.4
21. Twose	1.1	10.5	2.7
22. Parmiter	1.0	7.6	3.5
23. Teagle	1.0	7.3	2.0
24. Bettison	0.8	12.7	5.1
25. John Willer	0.5	7.6	2.1
26. Edmonds	0.2	4.5	1.8
Average		7.0	2.5

* 1972 sales.

** net profit on sales 1968-72

*** sales growth calculated for 1968-73 on basis of 1968-72 sales.

Source: Company accounts.

It is worth considering whether the structure of the industry through time reveals anything about scale economies. It has sometimes been suggested that structural changes in an industry over a longish period reveal the relatively efficient company or plant sizes. Efficient size classes of company or plant 'reveal' their efficiency by their ability to maintain or increase their share of the industry's output. Efficiency is used here in the total (and perhaps tautological) sense of a company's ability to compete effectively. A study by Rees[1] which used this approach identifies the optimal plant size range for agricultural machinery (excluding tractors) as 25/500 employees with an average of around 120 employees. This size range embraces the great majority of companies, and 50% of its total employment. In effect, this analysis is simply noting the fact that, with the exception of blacksmiths' workshops at the small end of the spectrum and a few large companies with over 500 employees such as Ransomes and Bamford, all sizes of company in the industry exhibit a similar capacity to grow.

According to the picture which emerges from these exhibits there are very few signs of scale economies in the non-tractor sector of the industry. Company size is unrelated to profitability, labour productivity and capacity to survive. The tractor sector, on the other hand, appears to be both more efficient and less profitable than the remainder of the industry and indicates signs of distinct though fairly modest economies of scale. Tractors, combine harvesters and 'other products' are now considered in more detail.

ENGINEERING ESTIMATES OF SCALE ECONOMIES IN TRACTOR PRODUCTION

An alternative approach to measuring scale economies is through engineering estimates. In pursuit of its exhaustive study on the North American farm machinery industry, the Canadian Government's Royal Commission on Farm Machinery appointed a team of consultants to estimate scale economies in tractor production, referred to hereafter as the Canadian Costs Study[2]. The estimated relative costs for each plant

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(1) op. cit.

(2) MacDonald et al "Farm Tractor Production Costs", Royal Commission on Farm Machinery, Study No. 2 (Ottawa, Queen's Printer, 1969).

size, for each of the major processes involved, are presented in Table 12.3. The consultants used an approach adopted by company engineers when considering investment decisions in new plants. The estimates are based on production technology and North American wage levels prevailing in 1968. The method involved dismantling representative tractors supplied by the manufacturers, designing processes for their manufacture and assembly in plants of three sizes, 20,000, 60,000 and 90,000 units a year. Estimates were based on a constant product mix. Once the cost of each part was estimated a hypothetical decision was made whether to make or buy each component for each type of plant considered.

TABLE 12.3:

TOTAL UNIT COSTS BY SIZE OF PLANT AND PROCESS

	Unit Cost by Plant Size (20,000 unit cost = 100)		
Process	20,000 tractors	60,000 tractors	90,000 tractors
Purchased parts	100	93	91
Foundry costs	100	84	81
Stamping costs	100	78	72
Machinery costs	100	86	82
Assembly costs	100	89	84
Administrative and support costs	100	84	79
TOTAL	100	89	86

Source: Based on MacDonald et al, op. cit., Table 40, p.135.

It was estimated that the unit manufacturing cost in the 90,000 tractor plant is 14% lower than that in the 20,000 plant. In addition, in the large plant it is reckoned to be economic to produce a higher proportion of components than in a smaller plant, realising further economies which increased the cost advantage of the larger plant to 19%. This estimate is considerably larger than the earlier estimate by Joe Bain[1] who put the optimum plant size at 60-90,000 units and its cost advantage over a 30,000 unit plant at something less than 8%. Bain's estimates were based on a questionnaire circulated among company engineers.

(1) J.S. Bain, "Barriers to New Competition", Harvard, 1956.

The plant size structure of the U.K. tractor industry is roughly as follows:

TABLE 12.4:

MAJOR TRACTOR PLANTS IN THE UNITED KINGDOM

Company	Plant Location	Annual Tractor Output (completed & kits)
Massey Ferguson	Coventry	95,000
Ford	Basildon	50,000
David Brown	Meltham	25,000
International Harvester	Doncaster	20,000
	Bradford(1)	9,000
British Leyland	Bathgate	20,000

Source: Published accounts.

If the Canadian Cost Study estimates are correct and apply to the U.K. operating conditions, the implications would be profound. Given that David Brown and International Harvester, each with plants producing around 20,000 units annually, have barely broken even over the past size years, Massey Ferguson with a plant of 'optimal' size might be expected to earn as much as 20% on sales. The profitability of most U.K. tractor operations is difficult to pin down since David Brown is the only tractor specialist; the remaining four major producers do not publish separate accounts for their tractor divisions. For what it is worth, comparison of the financial performance of David Brown and Massey Ferguson (U.K.) indicates that in the size year period from 1968-73 David Brown, on average, earned 3.6% net profits while Massey Ferguson earned an average of 5% net profits on sales. The Massey Ferguson figure may not faithfully reflect the profitability of the U.K. tractor operation since it is a full-line company and its multinationality provides opportunities to transfer profits through manipulation of transfer prices. In practice, these factors probably do not bear significantly on the U.K. accounts. Tractor operations are by far the largest component of U.K. operations and the transfer prices on tractors exported from Coventry to other Massey Ferguson companies and distributors are not centrally determined; they are subjects for negotiation between Coventry and the recipients of its tractors. This being so, the difference in profit margin between the two companies would broadly represent the extent of scale economies in the range of

(1) On 28th August 1975 International Harvester announced a 70% expansion of capacity at Bradford, bringing it up to around 15,000 units per annum.

25,000-90,000 units, if prices were comparable. But, as Table 12.2 indicates, David Brown tractors are 5% cheaper than Massey Ferguson's on a £/HP basis and this alone could account for the difference in the companies' profit margins. In terms of profit performance there is little evidence of scale economies.

To understand why reality is so different from the Canadian estimates it is necessary to consider some salient features of the manufacturing operations involved, against the background of the Costs Study. The Canadian study assumes a very simple product mix in terms of horsepower types, appropriate for the North American market. A 90,000 tractor plant in Europe must inevitably service many national markets given the size of the markets involved. For example, the annual U.K. demand of only 30-35,000 tractors would itself not justify an 'efficient' plant. This diversity of markets requires the simultaneous compliance with a number of legal requirements imposed on tractors in respect of such factors as engine speed controls, electrical witing, driver safety and braking systems. This poses a variety of problems, cutting down the length of production runs and requiring very complex and extensive material and production control systems.

In the machining of components, for example, were it simply a question of producing 95,000 standard mesh gears, a line of machines could be set up connected by automatic transfer machinery and operated continuously without tool changes and with high machine and labour utilisation. But the diversity of its markets forces the Massey Ferguson Coventry plant to manufacture 10 different mesh gears, pushing it towards batch operations with the attendant costs of down time and component storage.

In assembly, product variety poses problems of balancing the production line, i.e. avoiding situations where some sections of the line are under-employed. The more complex tractors impose greater loads (up to 10% in terms of labour content) on those sectors of the line which add the special features. A line can only go at the speed dictated by the slowest operation and to minimise the retardation caused by these bottle neck operations, considerable assembly is completed off the production line. Economies in assembly are offset by some degree by the costs of off-line fitment, To convey the extent of this problem, since the 1950s when Ferguson, Ford and David Brown each produced one basic tractor, variety has increased. Due to the expanded model range of

around seven models each, the choice of options and the introduction of legal standards in many countries, Massey Ferguson has had to double their factory area per tractor unit produced solely to cope with this off-line fitment and with increased variety.

Clearly the variety problem is greatest at the assembly stage because it is at the final stage where the number of permutations of features is greatest. For this reason it makes sense to look for scale economies mainly at the component level rather than at the plant level. For a given degree of variety, the 90,000 plant offers scale advantages, but this fact does not have the crucial significance attributed to it by economic analysis. The real issue for the company is not whether it can minimise unit costs but whether markets can be found for its capacity. And it happens that for Massey Ferguson product variety is a key to selling its 95,000 units, 80% of which are exported. The greater flexibility of build needed to sell 95,000 tractors annually, and the increase in the number of variables that this implies, tends to nullify a large component of the scale economies that this size of plant has the potential to exploit.

Production flexibility is also the basis of the chief difference in the way the Massey Ferguson and David Brown plants are operated. Both companies assemble tractors to order, but whereas David Brown run the production line for two or three weeks on a batch basis alternating between models, Massey Ferguson build randomly, launching each tractor onto the assembly line with limited regard to the model preceding or succeeding it. Orders for tractors are fed directly from dealers into a computer in a coded form. The computer is programmed for the plant production and supply constraints and proceeds to print out three instructions; the tractors that can be built in the following 15 day production programme, the parts required and the track build sequence. From the operational point of view this difference has two major implications. First, the controlled random build method is vastly more difficult to operate and requires considerable investment in computerised material handling systems and the staff with the experience to operate it, in order to sequence components to exactly match the assembly sequence. The batch system operated by

David Brown is easier to operate and can be controlled manually with the usual paperwork system. It is a question of deciding the assembly programme some months in advance, calculating the lead times required for the various components and sub-assemblies and launching batches of components on to the machine shop which correspond to the final assembly programme.

The second major difference lies in the disposition of stocks. The random build system reduces the lead time to only 15 days in normal market conditions and requires large stocks of components since the lead time is insufficient to produce economic batches. David Brown require a far smaller stock of components since the batch system gives rise to a predictable demand for components far enough ahead to allow economic batches to be produced fairly soon before they are needed. The random build system is designed to improve delivery performance and flexibility. Under the batch system the customers may be required to wait till it is the turn of the particular model they ordered to appear in the production programme, whereas the random build system offers customers the prospect of being fitted into the programme rather quicker, as soon as capacity permits.

On balance random building can reduce unit costs, if managed well. Managed poorly, the system could lead to chaos. The flexibility it provides permits switches of build when key components are missing. In batch production, component shortage stops assembly completely or results in incomplete tractors. If the missing component is internally located in the machine the labour cost of rectification can be as high as 50% of the labour cost of the whole tractor. Flexibility also avoids running up against capacity constraints; it also improves line balance and reduces off-line fitment.

On the other hand, the system requires larger stocks of components and investment in computer systems. It also requires quick decisions, places heavy demand on individuals, and seems to require a very flat plant management structure which must require considerable ability at the top. At Coventry the production director has no less than eleven subordinates reporting directly to him.

In terms of facilities the two plants are not strikingly different, granted that David Brown manufacture their own engines whereas Massey Ferguson buy in from their own Perkins plant at Peterborough. Both plants buy their castings from the same supplier and each buy in tinwork, Massey Ferguson from G.K.N.-Sankey and David Brown from their own plant at Leigh. In regard to the operations that both plants have in common, component manufacture and assembly, the main difference lies in the greater use by Massey Ferguson of automated transfer equipment for a limited number of machining operations, notably for gearbox housing and for all major/castings. Looking at the Canadian Costs Estimates set out in Table 8.3 in this context, it is possible to understand why the achieved scale economies in the 25,000/95,000 range are rather less than is suggested in the Table. The fact that both plants buy in their castings from the same dominant supplier, apparently without difference in quantity discount. An industry comment on this question emphasised that the dominant supplier of castings, Birmid Qualcast, has a strong disincentive to discriminate in favour of its larger customers, since this could contribute to the emergence of dominant customers.

As regards the pressing operation, it is difficult to interpret either company's decisions on the pressing operation in the light of the figures in Table 8.3.[1] The fact that the larger plant is calculated to derive far greater economies in the pressing operation than in purchasing would lead us to expect that Massey Ferguson would do their own pressing and David Brown would buy in, whereas the reverse is the case. Taking this argument to its logical conclusion one might expect that David Brown would simply assemble tractors since its estimated cost disadvantage is less in respect of purchased items than castings, tinwork and machining. Economies in assembly are practically nullified by greater variety. Administrative costs, which are estimated to be subject to the most significant scale economies of any process, are undoubtedly proportionately higher in Massey Ferguson due to the investment in control systems needed to handle its random build system. In machining, Massey Ferguson derives an advantage from its automated transfer lines, but the bulk of machining is carried out in both companies with similar machines and in similar batch quantities.

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(1) Referred to in the Table as 'Stamping Costs'. The term 'stamping' is usually used in connection with forgings, whereas what is meant here (and what MacDonald may have have been referring to in his study), was 'pressing', the term used in relation to sheet metal work.

The lessons to be drawn from these observations are these. First, scale economies in tractor production in the U.K. are not very significant. The essence of tractor production cost control consists in achieving the fullest loading of the production line with the maximum rate of completion. It is this objective which preoccupies tractor production managers and the reasons for their success or failure have little to do with plant size.

Second, plants of very different sizes differ far less in respect of the machinery employed and its degree of utilisation than in the way they are operated and the tasks they are asked to perform. Operating styles reflect managers' objectives and it seems important to realise that whereas academic economists' writings on scale economies see plant performance simply in terms of minimising the costs of producing the output for which the plant is designed, managements have to operate in a market context and have a wider set of objectives, embracing variety, flexibility and delivery time in addition to economy of operation.

2. SCALE ECONOMIES IN COMBINE HARVESTER PRODUCTION

In the production of combine harvesters the Canadian Costs Study estimated that the minimum-optimum scale is 20,000 units per year. The majority of plants in operation lie between 500 and 20,000, over which range the Study estimated that unit costs decline by 22%. Is this the reason why in the U.K. there is now only one combine plant, the Massey Ferguson operation at Kilmarnock, producing 1,800 units? In recent years two other plants ceased production, Allis Chalmers with an output of less than 1,000, and Ransomes with 1,500.

The acid test of the entire scale argument is whether or not the achievement of a certain minimum scale makes the difference between survival or failure: whether, in other words, scale economies shape the industry's structure.

It would be easy to argue that small scale was the cause of these companies' demise. The larger of the companies concerned, Ransomes, argued that it was better to withdraw from the industry than to

attempt to compete with the multinationals operating at a sub-optimal scale. But it is not clear that scale is the crucial factor here. A Ransomes spokesman estimated the minimum efficient scale to be only 3,000 units. On the basis of the Canadian estimates Ransomes' unit costs would have been only 3% higher than those of the 3,000 combine plant which the company regarded as the optimal scale. This is a slight margin and one wonders whether other factors, such as the lack of commitment and the marketing strategy adopted, might not have had more to do with the demise of the Ransomes combine than the scale on which the company manufactured it. The trade speaks well of the product itself but notes that so long as doubts hung over the company's commitment to combines, farmers were reluctant to buy a machine for which spares and maintenance might not be fully available. In marketing the product, Ransomes suffered from not having exclusive dealing arrangements for the product. Ransomes have a reasonably successful mutually exclusive distribution arrangement with Ford in respect of tillage equipment, Ransomes' main product. This arrangement does not apply to other equipment. It happened that the dominant harvesting machinery company in the U.K., New Holland, has no tractor of its own, and since Ford is a market leader in the tractor market and has one of the two best dealer networks in the country, New Holland looks to Ford dealers as distribution outlets. Thus it was that the Ransomes' combine stood side by side in dealers' yards with a market leader's product and suffered in consequence.

The indigenous manufacturer receives a certain amount of sympathy from the farming community and derives a marketing advantage from having a plant located in the market. In most other European countries an indigenous combine producer has survived, despite uneconomic scales of production in several cases; Clayson in Belgium, Claas and Fahr in Germany, Volvo in Sweden, Dania in Denmark, Braud in France, and Laverda in Italy. Had Ransomes formulated a more coherent and aggresive marketing policy for their product, the company might have been able to develop its market position and bring its unit costs down at the same time, despite a slight cost disadvantage in the early stages. This example tends to reinforce the point made earlier in the discussion on tractors, that the scale economies argument looks less compelling in a market and operating context than would appear from production engineers' calculations.

3. OTHER SECTORS OF THE INDUSTRY

In the remainder of the industry the vast majority of companies manufacture in batches. Batches are fairly large - rarely less than 100 units - and give rise to a steady production routine ("this month its harrows, next month ploughs"). It would be fair to say that operations management questions do not excite management greatly, except when machines fall behind schedule at the height of the buying season. There is an overwhelming sense that management problems have been coped with; there are, for example, few attempts to measure plant performance in any detail. The chief areas of concern are factors over which managements have little control, such as component shortages. Managements' perception of scale economies were found to be very vague. For example, when asked to comment on the changes that might arise from doubling the size of the existing plant, most managers could envisage few radical beneficial changes. The universal reaction was that management difficulties would increase considerably and that different methods would have to be employed.

The scale economies argument, in so far as there is one in this sector of the industry, boils down essentially to the difference between flow-line production and batch production. Flow-line production systems are said to have several advantages over batch systems: better shop balance, lower work-in-progress, higher labour and machine utilisation and easier control problems. A comparison of the Census of Production results for the tractor industry, which is a purely flow-line operation, and the remainder of the industry were batch operations predominate, would seem to bear out some of these observations. In Table 8.1, labour productivity among the tractor companies was 30-40% higher than in the non-tractor sector. Stock levels were proportionately lower; in relation to gross output finished stocks were lower in the tractor sector by 50%, work-in-progress by 25% and materials by 70%. Stocks are an important component of assets in this industry, averaging around 30% turnover for the non-tractor sector. In most companies they exceed fixed assets.

In this sector it is not apparent that many companies exploit the advantages of flow-line production. Even the way the term is used is sometimes fairly unambitious: 'flow-line' sometimes merely refers to plant layouts where processes are arranged in a roughly linear fashion,

and work-in-progress accumulates in front of machines instead of in the parts store. One consequence of this is that the differential in stock/turnover which exists between the large scale flow-line tractor companies and the smaller batch operated equipment companies does not exist within the equipment sector. Two of the largest companies in the latter, Bamford and Ransomes, have had the highest rates of stock/turnover in the industry in recent years. In Ransomes' case a contributory factor is the company's decision to schedule the production of components to maintain predetermined levels of component stocks, in preference to scheduling directly to the component requirements of a final assembly programme, as is the practice in most of the industry. Maintaining availability of complete kits of components by this method can involve heavy stocks.

Some observations on two well run plants of very different sizes will illustrate the rather muted practical significance of the flow-line/batch production distinction in the industry and place scale economies in perspective. First, the processes themselves.

In general the products of this sector have few components, are not highly engineered and require fairly low machining tolerances. Equipment consists usually of general purpose machines without automation in machining or transfer operations; purchasing and control is usually performed manufally rather than by computers. Products are manufactured in batches, partially against orders and partially for stock.

There are four basic operations in a typical plant:

1. Cutting and pressing metal sections and sheets are cut and pressed and delivered to a parts store.

2. Machining: brought-in castings undergo a number of machining operations in batches and are delivered into a parts store.

3. Welding: metal sections are fabricated into frames or bodywork.

4. Final assembly: kits of parts and sub-assemblies are drawn from stores, marshalled and assembled.

The larger plant employs around 900 employees and the smaller plant around 200. The complexity of the products and the product variety is comparable in the two plants. Both plants cater for a seasonal demand. The larger plant has two assembly lines, one of which alternates between three products, the other producing the main product continuously. The smaller plant has no assembly bays through which the product is passed. Machines are produced in batches on which the plant operates exclusively for 4-6 weeks at a time.

In the context of scale economies it is interesting to note that although there is a four-fold scale advantage permitting the large plant to operate a flow line, there are remarkably few physical differences; and that the significant differences in the operating methods have more to do with managerial style than the scale of operations. The flow line in the larger plant has little by way of fixed equipment and it only requires two days for maintenance staff to switch the line over to another product. There is no transfer equipment and few fixtures. Assemblies are moved between work stations in both plants by the simple expedient of putting their wheels on first and pushing them! Work stations overlap and workers occasionally move from one station to another if bottlenecks arise, just as they are free to do in the smaller plant. Operating differences are even less in the upsteam operations - cutting, stamping, welding and machining, which both plants perform in batches. Batch sizes in the smaller plant are around 100 - sufficient with general purpose machines to reduce set-up times as a proportion of machining time to only 5%. The management do not consider it worthwhile to increase the batch size even though the commonality of many parts facilitate this. Whereas the smaller plant use only general purpose machines, the larger plant use two special purpose machines - numerically controlled equipment to perform several machining operations simultaneously on gearbox housings and an automated paint shop. Scale was undoubtedly a factor in this selection since, when the plant was previously one third of its size, gearboxes were bought-in items, and the paint shop was a makeshift affair. Nevertheless, batch sizes in the larger plant are on average no higher than in the smaller plant.and it is by no means the case that the special purpose machines operate continuously.

Control and Monitoring

The large plant operates a more formal system of monitoring and control. In common with most plants in the industry, the smaller plant's performance is assessed simply in terms of whether its output is according to plan and whether it meets its planned budget. Management in the larger plant also assesses production against plan and against budget, but it also analyses the internal operations in more detail; actual hours worked are measured against standard hours' work achieved; machine utilisation is monitored and detailed reasons are sought for any down time. Those employees in the larger plant who operate functions where individual output can be measured - cutting, stamping and machining - are paid on an individual basis. Assembly workers are paid bonuses on a group basis. In the smaller plant the entire workforce is paid on a group basis.

The greater formality of the larger plant entails more paperwork and this is reflected in the considerably greater proportion of indirect to direct workers - 3 to 1 as against 1 to 3. In production control, the larger plant has 40 clerical staff and 240 direct workers, the smaller has only 2 clerical staff and 130 direct workers.

Problem Factors

The main problem factor in the large plant is to do with managing stocks in such a way as to maintain a timely flow of components. As in many engineering companies the problem centres on up-grading the low status clerical and store-keeping functions to the point where an effective requirements planning system can be made to work. This problem is less apparent in the small plant due to the fact that the operation is just small enough to be grasped in detail by one man, aided by a straightforward paperwork system. The smaller plant has more of a problem with plant balancing arising from the batch assembly process, which places loads on different work sections, in varying proportions dependent on the machine being assembled. It is this consideration which limits batch sizes rather than the familiar economic batch quantity calculations. It also constrains the product mix and inhibits

the company from expanding the production of the more profitable machines at the expense of the less profitable. The problem is coped with to some extent by the labour flexibility within the plant, both in terms of work rate and the types of work employees are able and willing to do. This flexibility is aided by several factors: the groups bonus system; the stability of the product range and the restricted variety of the product; and the amiable labour relations which obtain in small plants, which are invariably located in small country towns where they are often the dominant employer of engineering and, indeed, any manufacturing workers.

This brief account illustrates that although continuous production and batch assembly are in principle very different, and might be expected to form the basis of substantial scale economies, practical differences between these systems in this sector of the industry are not striking. Where differences do emerge the balance of advantage is clear. Large scale permits flow-line assembly and the use of specific machinery, but it requires considerably higher indirect labour content to cope with the greater complexity of the large plant and the more formal control system that is required. Small scale gives rise to plant balancing problems but, in compensation, the small plant has greater flexibility which provides the means of coping with this problem, and is cheaper to manage.

4. CONCLUSIONS

This Chapter illustrates three significant points which tend to be ignored in discussions of scale economies and industrial structure. First, questions of scale are irrelevant to managers because the likelihood of their seeing dramatic changes in size, by factors of two or more, is remote. Their entire preoccupation is with operating existing plants to meet the budgeting and market demands placed on them. Second, large increases in the scale of plants require different and more formal control systems and probably different people to run them. Small plants appear to rely heavily on the familiarity of the workforce with the work and with each other. It is therefor unrealistic to talk about reshuffling an industry's production into fewer larger

plants to achieve unit cost reductions based on engineering estimates. Third, in this industry and probably in others too, differences in production methods are quantitatively as important as differences in scale. They are also more relevant for business policy purposes because managements can change their production methods more readily than the size of their plants.

CHAPTER 13 - PRICE COMPETITION AND PRODUCT DIFFERENTIATION

This Chapter discusses price competition and product differentiation in the industry and examines the impact of industry structure on them.

In trying to get a feel for the impact of structure it is as well to be prepared for the possibility that the major forces which shape the competitive practices of the industry have more to do with the nature of its products, the market, distribution system, and the traditions within the industry, than with structure itself. The Chapter will try to come to terms with these facrors but will also try to abstract from them, by looking at the structural variety within the industry for signs of differences in the modes of competition adopted.

In the academic literature on competition the discussion is really about price competition and its importance relative to other forms of competition. The argument proceeds from the premise that for an industry as whole, price-cutting is unprofitable. The sensible commercial practice is to avoid price competition and compete in other ways - on quality, advertising and distribution. Economic theory argues that the market leaders in concentrated industries are better able to avoid price competition than companies in more fragmented industries. Because there are so few of them they are in a better position to come to an agreement; or alternatively, they can reach an understanding independently because they are in a better position to recognise that price cuts by any one of them would impact noticably on each others' market shares and provoke retaliation. Conversely, in fragmented industries, there are too many companies to reach understandings on price, or for any one company to have any appreciable impact on rivals' market shares. The predictions arising from this argument are that in highly concentrated sectors, profitability is high, prices are fairly uniform and considerable efforts are directed at style changes, advertising and developing a distribution system.

The Canadian Royal Commission Review and its Relevance to the U.K.

In his study, "Oligopoly in Farm Machinery", Professor Schwartzman[1] examined the North American farm machinery industry within this

(1) David Schwartzman, "Oligopoly in the Farm Machinery Industry", Royal Commission on Farm Machinery, Ottawa, 1970.

analytical framework. Four of his conclusions are of particular interest:

(1) The major producers of tractors, Massey Ferguson, International Harvester, Deere and Ford did not earn unusually high rates of return as the theory predicts; in fact their profitability was lower than the average for U.S. manufacturing industry in the post-war period.

(2) They did appear to restrain their efforts at price competition, to judge from the uniformity of tractor prices.

(3) Because of restraints on price competition the level of North American tractor prices was uncompetitive, notwithstanding the fact that it provided a less-than-average rate of return to the tractor industry. Schwartzman calculated that the price level was 8% higher than a notional 'competitive' price level, corresponding to the unit cost of a 90,000 tractor plant, permitting sub-economic capacity to survive. This excess margin he attributed to the oligopolistic structure of the industry. If price competition were present, companies with optimally sized plants would lower their prices and drive the sub-optimal plants out of the industry.

(4) The companies concerned competed actively in other ways, increasing the number of models and variations offered and spending considerable sums subsidising their dealer networks which, as a result, were larger than Schwartzman considered was economically necessary.

Similar observations could be made of the United Kingdom tractor industry, unsurprisingly, since the same multinationals dominate the United Kingdom market. The profitability of the industry's leaders has generally been low. The average profit margins on sales in the period 1968-73 for Massey Ferguson, International Harvester and David Brown were respectively 5%, 0.5% and zero. As in North America, the product range of the tractor companies has expanded despite the fact that the U.K. tractor population declined by 25% between 1966 and 1974. The

four largest tractor producers increased their combined number of models offered from 14 to 25 in that period. As in the North American market, dealer networks are a key factor to which the dominant companies give a lot of attention, but with this important difference. In North America tractor companies finance the dealers' stocks whereas this is not the case in the U.K., with the partial exception of John Deere, which provides credit to the time of retail sale, up to 6 months.

U.K. tractor prices are fairly comparable in the popular middle horsepower ranges, as Tables 13.1 and 13.2 illustrate. Table 13.1 gives the basic data, and Table 13.2 compares tractor prices on a standardised £/HP basis. Ford's and Massey Ferguson's prices are very close, David Brown's are 3-4% lower, International's and Leyland's are around 5% higher.

TABLE 13.1:

PRICES OF POPULAR TRACTOR MODELS AT JUNE 1974

Manufacturer	Horsepower Range								
	45 - 50			55 - 65			70 - 75		
	Model	HP	Price (£)	Model	HP	Price (£)	Model	HP	Price (£)
Massey Ferguson	135	47	1,954	165	62	2,366	185	75	2,660
Ford	3,000	47	2,024	4,000	62	2,436	5,000	75	2,752
David Brown	885	48	1,940	990	58	2,084	1,210	72	2,515
International	454	50	2,163	574	63	2,528	674	75	2,697
British Leyland	245	47	2,073	255	55	2,263	270	70	2,623

TABLE 13.2:

COMPARISON OF TRACTOR PRICES ON A £/HP BASIS*

Manufacturer	Horsepower Range		
	45 - 50	55 - 65	70 - 75
Massey Ferguson	100	100	100
Ford	104	103	103
David Brown	96	94	98
International	104	105	101
British Leyland	106	108	106
Spread of Prices	11%	17%	9%

* Referring to the models and prices in Table 9.1, Massey Ferguson = 100

Source (for both Tables): Company retail price lists.

As regards the overall level of tractor prices, as opposed to their dispersion, the U.K. tractor market has traditionally been regarded as a low price market due to Massey Ferguson's pricing policy. Though comparable now, up to 1970 U.K. tractor prices were around 40% below Continental levels. This resulted in substantial exports of second-hand tractors and it was said that the second-hand Ford tractor was the market leader in the Danish market a few years ago. According to the thinking underlying the Canadian study, a price level is considered 'excessive' or not depending on whether it permitted the survival of uneconomic plants. If the Massey Ferguson plant is considered to be of optimum size, roughly 60% of the U.K. output of two-wheel drive tractors coild be said to be produced in sub-optimal plants. Nevertheless, the price regime operating in the U.K. probably contributed to the departure of three small scale tractor producers in the 1960s: Barford, Doe and Allis-Chalmers. In recent years the price level has not been such as to permit the long run survival of the 20,000 unit plants; two companies with plants this size, International and David Brown, barely made profits at all over the period 1968-73.

What Does 'Price Competition' Mean?

We have described the price regime prevailing in the U.K. tractor market, but how are we to interpret it? Before doing so there is an important conceptual point to clear up here. In academic literature, price competition is almost tautologically identified with price differentials. The mere existence of a regime of near-identical prices is sometimes regarded as evidence that price has been ruled out as a competitive weapon. Conversely, large price differentials are regarded as a sign that price is an active competitive element. The difficulty with interpreting price comparisons lies in their inherent ambiguity. The degree of price uniformity found in the tractor sector could as equally be regarded as evidence of keen price competition, or evidence of a tacit understanding that prices should be comparable to such a degree that price ceases to be an active element in the marketing mix.

By themselves, price comparisons are not very informative about the presence or absence of price competition. In order to interpret them one should ask, and answer, the prior question: "what pattern of price

behaviour would indicate 'price competition'?", bearing in mind the fact that the significance of price differences can vary a lot, depending on the customer's attitudes. A differential of 5% may mean more in the case of a standardised product than a 20% differential in the case of dis-similar products.

What then is the significance of tractor price differences? For instance, do changes in the industry's overall price level account for changes in tractor demand? And do changes in the price differential between one model and another account for changes in market shares? There have been two econometric studies of tractor demand by Raynor and Cowling at Warwick University which answer these questions. The first study concerned the total U.K. demand for tractors, the second concerned manufacturers' shares of the market.(1) In both studies, the same factor emerged very strongly - value for money.

The authors constructed an index of tractor quality, which turns out to be mainly a reflection of the horsepower of each model. They then deflated retail prices by this quality index to give a measure of what might be termed 'horsepower for money'. Changes in this variable, in relation to the wages of agricultural workers, explained over 90% of the year-to-year variations in both the value of tractors and the total horsepower embodied in them purchased in the U.K. market between 1950 and 1964. It also explained 70% of changes in a manufacturers' shares of the U.K. tractor market over this period. Conceptually, this is the correct way to look at prices. The tractor has been developed steadily throughout its history, but considered crudely, a tractor represents capacity to deliver power to farm implements, whether by draw-bar/pull or power take-off shafts. It is therefore appropriate to analyse tractor prices in conjunction with the horsepower involved. The explanatory power of the 'horsepower price' in these models confirms that farmers collectively think of tractor prices in these terms as well.

In trying to come to some kind of conclusion about the prevelance or otherwise of price competition in the industry, the two lessons to be learnt from these studies are, first, that price is regarded as highly significant by purchasers of tractors, and second, there has been a considerable degree of implicit price competition in terms of value

(1) Referred to in Chapter 10.

for money in the U.K. tractor market, and it is this element of competition which largely explains the variations in market shares in recent years.

Implicit price competition amounts to saying that when new features and increases in horsepower are introduced by manufacturers, they are accompanied by price increases which do not fully reflect their additional costs. Conversations with tractor manufacturers confirm this practice. Explicit price competition, in the sense of price reductions on existing models, or alternatively, decisions to raise prices by less than the industry as a whole, is rather muted, though it does exist. Tractor prices generally move together, usually following the lead of Massey Ferguson, followed by Ford, which for many years have been the market leaders. There is no collusion as such; it is merely that those engaged in all sectors of the agricultural machinery industry know each other sufficiently well for there to be little element of surprise in the annual price increases. The explicit active element of price competition is not on the recommended retail price but on the discounts which manufacturers offer to dealers. From time to time, manufacturers launch promotional drives which include as part of a marketing package an additional discount which is intended for the dealer to trade with. This discount can amount to £50 or so, equivalent to around 2% of the price of a typical tractor. This method provides manufacturers with a means of waging limited and selective price wars, restricted in scope to particular models and areas of the market if so desired.

In short, implicit price competition, in the sense of value for money, is active and effective in the tractor market. Explicit price competition is muted, restricted to occasional and selective price cuts of not much more than 2% in typical market conditions.

Price Behaviour in the Non-Tractor Sector

When one begins to study price and competition in other sectors of the agricultural machinery industry, it is immediately apparent that there is not the degree of product convergence that is evident in the tractor market. It is simply not possible to group different models in a way

which facilitates comparisons of different manufacturers' products, as is done for tractors in Table 13.1. Instead one finds a continuous and confusing spectrum of prices and characteristics. Nonetheless, an attempt has been made to draw some detailed price comparisons in the implements sector. Implements are less complex than tractors, consisting mainly of straightforward steel fabrications, with a unit cost of between £150 and £1,000. Entry into these sectors is easy; many companies in the industry manufacture them and many more could easily do so. Some sectors are fairly specialised with concentrated market structures. Two sectors of this type are reversible ploughs and fertiliser broadcasters.

In the U.K. reversible plough market the market structure is very similar to that found in tractors. Ransomes have traditionally held around 50% of this market, slipping to around 40% in 1974, followed by a German company, Lemken, with a 30% share, Massey Ferguson with 15% and Bamford with a Norwegian plough, 10%. The prices of the three leading producers are closely matched, with a spread of only 5% or so in 1974. But the fourth largest supplier, Bamford, entered the market in 1972 at a price 14% below the market leader. Having achieved a market foothold of 10% in 1974, its price stood 20% above the market leaders'. In fertiliser broadcasters changes in relative prices as between an entrant and an established supplier have also been evident. Bamford entered the market in 1971 (with its model 1000) at a price 30% above the dominant firm's corresponding product (Vicon's Vari-Spreader PS400). By the spring of 1975 its price was 10% lower.

Wide and changing price differentials were also apparent in the more basic products. In disc harrows, Ransomes' disc harrow (model HR31/97) retailed at 15% above a broadly comparable Bamford product (D24/20) during the period 1965-66. This price premium had expanded to 25% by 1973-74. In June 1974 the Ransomes implement retailed at well below its closest equivalents - 13% below Massey Fergusons 9 foot model and 39% below the 10 foot 6 inch model. A further example from the tine cultivator sector revealed that a Ransomes implement (C79) retailed at 8% above a slightly smaller Twose product (TB13) during the 1965-70 period. In a later period, 1973-75, this differential had widened to 20% despite the smaller size of the more expensive implement. A com-

parison of the product ranges of two leading companies selected at random provides further illustrations of the wide price differentials in the implement sectors. Four products produced by Massey Ferguson and Bamford seemed broadly comparable, a baler, a reversible plough and two seed drills. At July 1974 the price differentials were respectively 5%, 20%, 40% and 60%. These examples indicated that price differences, at given times, and changes in relative prices over time, tend to be greater in implement sectors than in the tractor sector.

A conventional economic interpretation of these rather different price patterns would argue that price competition is active in the implement sectors and supressed in the tractor sector. Our interpretation is rather different. Price competition is not particularly active in either sector; the relative variability of implement prices is due to the farmers relative indifference about implement prices and the relative lack of comparability of the products.

Product comparability is a pre-condition for price competition and unless this exists, customers cannot make much sense of price differentials. Price comparisons are simple for tractors because the basic tractor design is now fairly standardised and in respect of the principal differentiating factor, horsepower, the popular tractors are conveniently grouped together. In implements it was difficult to match products of different manufacturers and compare prices - hence the fragmentary nature of the price comparisons mentioned above. Even a humble product such as a tine cultivator exhibited differences in weight, width, depth and configuration of the tines themselves, restricting price comparisons to only two or three companies at a time.

An example will illustrate this. The range of fertiliser broadcasters available on the U.K. market at February 1975 varied in price almost continuously between £100 and £1500. Some nodal grouping was noticeable in the £190-£220 price bracket within which nine tractor-mounted versions were offered by six manufacturers. The wide and confusing variations in product dimensions and performance make if difficult to compare these products from the point of view of value for money. The quantifiable parameters of the products are fertiliser capacity, spreading

width and flexibility of application rate. Within the price bracket mentioned, capacity varies between 5 and 12 cwt and spreading width between 22 and 52 feet. The application rate of the least flexible machine could be adjusted between 100 and 760 lbs. per acre; and for the most flexible machines between 4000 and 4800 lbs. per acre. To confuse matters further, the parameter which is perhaps the most crucial in this machine, the uniformity of application, is not specified by manufacturers at all, nor is it easily quantified.

Price in this sector seems relatively unimportant. Econometric studies support this view. The studies of demand forecasting mentioned earlier included three implements, balers, fertiliser broadcasters and manure spreaders over the period 1963-73. Only in the baler market was there any hint of any price effects. Conversations in the industry tend to confirm this finding. Price is not mentioned as an active competitive ingredient; "we set a price and go from there", remarked one company spokesman. Small implements are subject to sudden inspirational demands. "They want it yesterday" is a phrase which recurs among implement producers who wryly remark that many farmers are prone to order vital equipment a few days before they intend to use it. Capacity to supply these demands at short notice is more relevant than the price. Success in this department has more impact on market shares than price, despite the substantial divergence in prices in many cases. Some observers noted farmers' interest in prices, expressed in spirtied attempts to play one dealer off against another. But there is an important distinction between product competition and dealer competition. Farmers enjoy haggling over prices - it is a tradition in the farming industry. But the farmers interest centres more on the discount that can be obtained from different dealers for any particular model, rather than the relative prices of different models.

Prices are usually set by top management with one eye on profitability and the other on the competition ("we like to be within range" remarked one manufacturer). During the inflationary period since 1970 prices have diverged markedly, It would be a mistake to interpret this as a sign that price competition has intensified. The divergence simply reflects differences in the accounting methods used by companies to adjust prices to rising costs, and the speed with which they do so.

An example of how price comparisons can be misinterpreted arises in the grain drier market. Alvan Blanch is currently the market leader in grain driers, but has had a disappointing profit performance in recent years; Bentall holds a much smaller share of this market but is highly profitable, earning over 10% on sales during 1968-73. What appears to be an attempt by Alvan Blanch to penetrate the market through low prices is in fact a reflection of differences in accounting practice. Alvan Blanch committed itself to fixed price contracts during this period whereas Bentall adjusted prices frequently in line with costings and charged customers the price prevailing at the time of delivery.

The reasons why price competition is fairly muted in this industry are four:

(1) It would be a shortsighted policy for a farmer to put price first as a criterion for buying equipment. In common with most purchasers of industrial equipment, a farmer considers that the reliability of his machines and the dealer's ability to support its operation through spares and services, are more important than price. Because timeliness is of the essence in farming, breakdowns and delays in obtaining replacement parts can impose costs on the farmer far in excess of any savings likely to be derived from shopping around for the cheapest model.

(2) Marketing agricultural machinery is essentially to do with mobilising dealers. The relationship between good dealers and the farmer is very good indeed, and if a farmer trusts his dealer he will often buy whatever equipment the latter recommends.

(3) The market itself is highly fragmented; only 3% of farms employ more than 5 people. There is therefore no prospect of single large orders of the sort that are placed by fleet owners to the vehicle industries, for example. It is therefore difficult for manufacturers to identify sectors of the market where selective price cuts would bring extra business and, consequently, the incentive to price cut is fairly weak.

(4) Dealers would misinterpret price cuts as a sign of weakness and would begin looking to rival manufacturers for a replacement as an insurance against the possible withdrawal of the price cutter's product. Loss of dealer commitment would outweigh the modest gains derived through price cutting.

Price Levels and Uneconomic Capacity in the Non-Tractor Sector

It was noted earlier that the Canadian Royal Commission Study concluded that the existence of uneconomic capacity in the tractor industry was due to the excessive price levels prevailing in the North American market. We noted that the U.K. tractor price level is not sufficiently high to permit the long-run survival of plants of 20,000 units. But there is a more fundamental point involved here. In arguing that prices are excessive in relation to the unit costs of minimum optimum plants, what is the standard of comparison here? Most industries comprise a mix of plant sizes, some optimal, many not. Generally speaking one will expect that the optimally-sized plants would earn an above-average profit margin - why else would companies build them? Rather than compare the actual price levels and plant mix in the tractor industry with a theoretical long term situation in which price warfare relentlessly drives out all plants of less than optimal size, as the Canadian Royal Commission does, it would seem more reasonable to compare the tractor industry situation with that of a representative "competitively structured" industry in respect of price levels and the proportion of its output accounted for by "sub-optimal" plants. It is instructive, therefore, to compare the U.K. tractor sector with other manufacturing industries in the U.K., and in particular with the remainder of the agricultural machinery industry.

If the Massey Ferguson plant at Coventry alone is considered "economic", 60% of U.K. tractor output might be said to derive from plants outside the economic size range. If, in addition, the Ford plant at Basildon is deemed 'economic', this proportion falls to only 40%. A study by Rees[1] found that for 30 manufacturing industries the proportion of net output deriving from plants outside the economic size range was 40%

(1) "Optimal Plant Size in U.K. Industries: Some Survivor Estimates", R.D. Rees, Economica, November 1973.

on average. For the non-tractor agricultural machinery sector the proportion was 50% in 1963 and 40% in 1968. In other words, a roughly similar situation existed in the competitively structured machinery equipment sector as existed in the highly concentrated tractor sector. In conclusion, there does not seem to be any link between high concentration and excessive prices, when seen in the context of typical plant size distributions in the manufacturing industry generally, and in the more fragmented non-tractor sector in particular.

Product Differentiation and Market Information

Price competition is present in this industry but it is not the key competitive dimension; some of the reasons for this have been outlined above. But does price competition matter? And if it does, what types of changes in the industry would intensify price competition in ways which were beneficial to the farming community?

A factor which has recurred in the discussion so far is value for money. It was noted that in the tractor market, value for money in terms of £/horsepower is relatively easy to assess (see Table 13.2); it is also the subject of active competition. In the implement market on the other hand value for money is relatively difficult to assess because of the greater variety of product. In a loose sense, value for money is too vague to be useful - all industries can be said to compete in terms of value for money. What is being referred to here is something more precise, namely, the provision of a quantified set of performance characteristics which can be costed and compared effectively with those of rival products. It is argued here that this dimension of competition is more important than price competition and is indeed a precondition for the latter. Unless customers know exactly what bundle of performance characteristics they are buying it is difficult for them to interpret price differentials between rival products and any changes in them that may occur.

The primary requirement of scientific farming is information; information on expected crop prices and on the productivity of the various inputs - land, fertiliser, labour and machinery. As regards the productivity of machinery, the scientific farmer needs information on

the rate of work of various machines in normal conditions, how this is effected by different weather and soil conditions, by delays due to breakdowns, maintenance and adjustment. Ideally, the farmer should be in a position to construct a picture of the operating economics of various alternative machines enabling him to select the system which is optimal for his particular situation. In discussing the dimensions of competition, it therefore seems important to discover whether manufacturers have attempted to quantify the performance of their machines and present farmers with the type of information which would enable them to make relevant comparisons. This is important for the health of the farming sector for two reasons; at the macro level, active competition in respect of machine performance is necessary for continual improvements in the general standard of machinery design; at the micro level it is important from the point of view of matching machines to the individual needs of each farmer in such a way as to minimise his costs. In assessing the informational content of the industry's marketing and its adequacy we try to take note of the industry's context - the problems of measuring performance of agricultural machinery and the strength of farmer's demand for this type of information, trying to come to a view as to whether it would be commercially prudent for the industry to behave differently from the way it does.

Taken as a whole, marketing in the industry is all about product features and not about product performance. Machine performance is rarely mentioned in the sales literature, nor does it feature very much in sales material supplied to dealers. Even less in evidence is information of the total operating economics of agricultural machines, or even the basic facts which would permit the user to infer what these might be. The complementary inputs are rarely mentioned, unless there are engineering reasons for doing so, e.g. the tractor horsepower necessary to drive various implements is usually stated. Thus, for example, labour-intensive potato harvesting machines which require several operatives to sort potatoes from the trash, are marketed without mention of the labour requirements; and conversely, the sales literature for more sophisticated machines with an automatic sorting mechanism neglects to inform the buyer of the unit cost per ton which the product achieves. Fuel consumption is rarely mentioned for tractors or for any other power source, despite the rise in oil prices.

Grain driers in particular are highly fuel intensive; according to an authoritative source[1] fuel costs accounted for around 50% of grain driers' total operating costs. Yet even in this case no data is provided on fuel consumption or conversion efficiency.

The industry's aversion to promoting its products in quantitative terms needs some explaining, and so too does the farming industry's purchasing decisions since apparently they occur without the benefit the relevant data on performance. Manufacturers defend the qualitative style of their marketing in these terms. First, making claims for agricultural performance is a perilous business in view of the variety of the conditions under which machines have to operate. The performance of agricultural machinery depends very much on the skill of the operator, the conditions of the crop, the state of the weather and the soil. Any claims manufacturers make would presumably refer to normal or ideal operating conditions and correct operating methods and there is bound to be some difficulty in defining what these are are in general and even more so in relation to particular cases where manufacturers' claims are disputed. The inherent risks here are compounded by the Trade Descriptions Act which renders suppliers liable to prosecution for making misleading claims for their products. Second, it is argued that farmers are not interested in reading about the performance that is claimed for machinery. They do not have any faith in figures; farming is an open-air business and farmers prefer to watch machines working for themselves rather than to read about them - hence the popularity of machinery demonstrations as an aid to marketing.

To gauge the substance of these two arguments, that machinery performance is too variable to measure reliably and that, in any case, farmers are not interested even it were, it is interesting to consider the institutional framework that exists in the U.K. for testing agricultural machinery performance, some findings of some typical comparative studies of machinery performance and their significance in marketing terms.

The authorities on machine performance in the U.K. are the Government-funded National Institute of Agricultural Engineering (NIAE) and the

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(1) "Farm Management Handbook", John Nix, 6th Edition, Farm Business Unit, Wye College, 1974.

Agricultural Development and Advisory Service (ADAS) which is part of the Ministry of Agriculture, Food and Fisheries. The former began operating its Users' Testing Service in 1963 as a service to farmers, funded partly by fees from the manufacturers concerned, partly by Government funds and partly from revenues from test reports. ADAS provides advice to farmers on types of mechanisation but is not intended to discriminate between the machines of different manufacturers; another of its activities is concerned with surveys of machines in use, jointly with the NIAE. The history of the NIAE Testing Service reveals something of the demand for thoroughgoing machinery testing by the farming industry. The financing of the Testing Service has been a contentious issue. Manufacturers resented paying fees for a service intended for the farmer, especially as the reports may well be uncomplementary to their products. The Government body which originally funded the service, the Agricultural Research Council, eventually excluded testing from the definition of 'research', despite the fact that most agricultural engineers regard such tests as an essential first stage of research into machine design. The main beneficiary of the service, the farming community, has lost what little interest it had in the service and volume of work declined as a result and was eventually terminated altogether. Subscribers to the service peaked at 4,550 in 1965 when 78 reports where published; 4 years later the number of reports published had dwindled to only 16. The farmer has the means of expressing his demands for the service through individual subsciptions and through the highly efficient and effective National Farmers' Union so that the decline in the service can only reflect the luke warm attitude of the farming community to the quantitative aspects of farming machinery. Customers' attitudes which are revealed here go some way to excusing manufacturers from providing information of this kind themselves.

To gauge the sensitivity of machine performance to operating conditions and to get a feel for the number of dimensions of machinery performance which need to be considered, it is useful to consider two surveys carried out by NIAE and ADAS on potato harvesters in 1971 and sugar-beet harvesters in 1973[1]. The potato harvester study was based on work records of 192 machines, the sugar-beet study on 52 machines, observed

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(1) "The Utilisation and Performance of Potato Harvesters 1971" and "The Utilisation and Performance of Sugar-Beet Harvesters 1973", Farm Mechanisation Studies 24 and 26, NIAE, Silsoe, U.K.

over a full harvesting season. Sugar-beet harvesters were compared in respect of their spot, net and overall seasonal rates of work, the surplus trash which was harvested with crop and the proportion of crop which the machines failed to harvest. In addition to these dimensions, potato harvesters were investigated in respect of crop damage. The tests confirmed that performance varies considerably with the operating situation. In the sugar-beet harvester study for example, tests on 12 identical machines (the Standen Rapide) revealed a range of net rates of work (referring to the average rate of work excluding breakdowns and delays) between 0.2 and 0.6 acres per hour, a range of average seasonal work rates (taking account of all breakdowns and delays) between 0.13 and 0.29 acres per hour. The same machines picked up surplus dirt and trash amounting to between 8% and 25% of the crop; they also left between 2% and 15% of the crop in the ground. This degree of variability is typical and lends some weight to the conventional wisdom of the industry which argues that performance claims have a limited role in the marketing of agricultural machinery.

Could matters be otherwise? There is a definite segment of the market, sometimes put at around 5% of U.K. farmers, which is interested in studying the economics of their operations in a numerate fashion; manufacturers of precision up-market equipment make special efforts to identify these progressive farmers. And it is certainly possible to make sense of performance studies, despite the variability due to operating conditions. The precise point of recording the performance of samples of machines over an entire season is that the average performance of different types of machine can be compared, allowing for the random factors to which each machine is inevitably subject. For example, in the sugar-beet harvesting study the net work rate of the two types of intermittent loading trailer machines produced by Standen and Armer, was found to range between 0.2 and 0.6 acres per hour and 0.5 and 1.1 acres per hour respectively. Although these ranges overlap the difference in the average performance of the two machines was statistically highly significant. Within the sample the Armer machines were 50% faster on average, permitting one to conclude that within 95% limits of confidence they are between 25% and 75% faster in the machine population as a whole.

The Study allows reliable comparisons to be made which are hardly possible on the basis of sales literature and farming gossip. It is interesting to consider why Armer's performance advantage is not reflected in the market, which is dominated by Standen machines. A possible reason for this is that in this industry product features are made to count far more than product performance. Apparently the decisive feature in favour of the Standen trailed machine was the mechanism for lifting the beet from the ground. The Standen machine lifted the beet from underneath by a pair of shares whereas the Armer machine pulled the beet from the top - a method considered by many farmers to be less reliable when frost damages the beet tops or hardens the soil. Since the Study covered an entire season it presumably allowed due weight to this factor yet the Armer machine still appeared to be superior in performance terms. One wonders therefore whether the style of marketing typical in this industry is likely to bring about the optimal pattern of machinery use.

The Study also reveals another aspect of farmers' decisions. Three systems of harvesting sugar-beet, one-row trailed tankers, two-stage three-row and three-stage five-row systems, are compared in respect of the capital cost per acre for various acreages. In 1973 the capital cost per hectare for these three systems was £30 at 15, 40 and 90 hectares respectively. The average seasonal use of each type of machine (calculated from Table 2, page 5 of the report) corresponds very closely to these figures, namely, 25, 35 and 100 hectares. It suggests that farmers make their decisions mainly on unit capital costs, particularly as this is an easy calculation for a farmer to make, on the basis of machinery prices and his sugar-beet acreage. This emphasis on unit capital cost occurs again in one of the few attempts to base a marketing appeal on performance comparisons. After the publication of the sugar-beet study, Standen based its marketing brochure for its two-stage three-row system on a capital productivity comparison inferred from the study, namely that the price of its machine was only 50% of that of the French five-row system while its overall work-rate was 75% of the latter, implying that the capital cost per acre of the standard machine is equal to two thirds of that of the French system for farmers with large sugar-beet acreages.

This is a significant step in the direction of more intelligent and informative marketing in this industry - that is to say, an approach which considers the operating economics of machines, identifies target segments of the market to which they are most appropriate, and then seeks to spell out the economic advantages to this segment of the market. The Standen approach adopted for this machine shares one weakness of most of the industry's advertising in that it ignores the non-capital costs, probably over 60% of total costs in this case. By way of illustration, in the comparison of the Standen and Herriau systems referred to above, if capital costs account for 40% of the Herriau machines' total costs the capital cost advantage of 33% offered by the Standen machine would be more than offset by the non-capital cost disadvantage arising from the fact that the Standen machine's work rate is 25% lower, as the Table 12.3 indicates. Stanhay, the importers of the French Herriau system, righly observed that the object of mechanisation is not to minimise unit capital costs but unit total costs, and that taken to its logical extremes, the type of claim made by Standen for their three-row system implies that the optimum system is a garden fork! Stanhay have developed a quantitative approach rather further by referring to a comprehensive study by Dalton & Coney[1] which compares the total operating economics of different sugar-beet harvesting systems, including an appreciation of the effects of harvesting capacity on the timliness and the improved sugar-beet price which farmers could expect from harvesting their beet earlier in the season. The Study indicates that below 50 acreas the (Standen) single-row tanker is the cheapest system, between 55 and 56 acres the (Standen) two-stage three-row machine is marginally cheaper, and that above 78 acres the five-row (Herriau) system is the cheapest. Stanhay also make calculations of their own and attempt to identify individual farmers whose sugar-beet acreages are most appropriate for the five-row system.

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(1) "The Choice of Sugar-Beet Harvesting Machinery", by G.E. Dalton and R.T. Coney, Department of Agriculture and Horticulture, Reading University, 1973.

TABLE 13.3:

HYPOTHETICAL COST COMPARISONS : STANDEN AND HERRIAU

Cost Item	Standen's Relative Unit Cost/acre	Herriau Costs (%)		Standen Costs (%)	
		Example 1	Example 2	Example 1	Example 2
Capital Costs/ acre	2/3*	50	40	33	27
Non-Capital Costs/acre	4/3**	50	60	67	80
Total Costs/ acre (%)		100	100	100	107

* $\frac{\text{Relative price of Standen and Herriau machines}}{\text{Relative work rate}^{(1)}} = 1/2 \div 3/4 = 2/3$

** $\frac{\text{Relative labour costs (assumed equal)}}{\text{Relative work rate}^{(1)}} = 4/3$

Better performance data could improve the match of machine to the acreage on which it will be used. The data on machine utilisation in both the potato and sugar-beet harvester studies illustrate the degree of market segmentation that already exists and the way in which it could become more precise if fuller, more objective and more comprehensible information were made available to farmers. It was noted earlier that the pattern of utilisation of sugar-beet harvesters suggested that farmers tend to based their decisions on the unit capital costs. It is therefore not surprising that the pattern of machine use which had emerged in this market is rather different from that which might be predicted from the Dalton & Coney cost study which considers the total operating economics. Table 13.4 indicates the pattern of utilisation of the sample of machines which were tested and the optimum system for each acreage according to the Dalton & Coney study. There is some broad correspondence here at either extreme but some striking differences too; a substantial proportion of trailed tankers are used on acreages for which they are only the second or third cheapest method. A majority of two-stage machines are employed outside their most advantageous acreage, but of greater interest is the fact that the self-propelled tanker is used widely on British farms across all

(1) "The Utilisation and Performance of Sugar-Beet Harvesters", NIAE, Silsoe, 1973, Table 4.

acreages, despite its relatively uneconomic performance. The NIAE tests estimated its net work rate (.4 acres an hour) to be the lowest of any system currently in use and the Dalton & Coney study found no acreage at which its costs were the most competitive though they noted that its low labour requirement could be an advantage when labour availability was low.

TABLE 13.4:

SUGAR-BEET HARVESTING MACHINERY UTILISATION*

Type of Machine and Manufacturer(s)	Proportion of Machines of Each Type Used (%)			
	less than 50 acres	50-75 acres	more than 70 acres	Total
Trailed tankers (Standen and Armer)	50**	16	34	100
Self-propelled tankers (Standen)	20	40	40	100
Two-stage three-row (Standen)	33	16**	50	100
Three-stage five-row (Herriau)	0	0	100**	100

* "Utilisation and Performance of Sugar-Beet Harvesters 1973", NIAE, 1974, Table 2, page 5.

** The optimal acreage for each machine, as estimated by Dalton & Coney, op. cit., Graph 4, page 13.

There was a similar fuzziness in market segmentation in the potato harvester market. Among the simplest complete harvesting systems, the manned one-row trailed machines, it was found that the more expensive types were used on small acreages - over 50% of them on units of less than 30 acres each - in the same proportion as the cheaper machines, even though operating economics would surely fit them better for the larger acreages. At the expensive end of the market, it was shown that one third of the automated two-row machines were used on units of less than 40 acres, whereas none of the manually operated two-row machines operating on these acreages at all, despite the fact that the relative capital-intensity of the automatic machine favours high utilisation.

CONCLUSIONS

The points which emerge from this discussion are these:

(1) Product differentiation in this industry is mainly concerned with product features, rather than with product performance. This has nothing whatever to do with industry structure but it has a lot to do with the nature of the product and the tradition of the industry.

(2) To a large degree the industry is justified in adopting this approach in view of the sensitivity of machine performance to differences in operating conditions and operator skills, and farmers' apparent indifference to performance measurement.

(3) Farmers rely on informal and often misleading methods of comparing machine performance. Comments from other farmers are inevitably subjective and are based on limited experience; demonstrations are probably equally unreliable because only a small sample of observations can be made, without any testing equipment of the kind used in the course of scientific enquiries. Precisely because of the variability in operating conditions, large scale surveys are essential for reliable comparisons.

(4) The type of anomalies which arise from purchasing machines without information on performance has been evident in the cases examined here. Commercial success did not appear to correspond very closely to operating efficiency. Machines were used way outside their optimal range, implying that farmers were frequently buying machines which did not minimise their total unit operating costs.

(5) There is scope for more numerate kinds of product differentiation in this industry which would be expected to educate the market in machine performance and improve the quality of farmers' purchasing decisions. In turn this would stimulate 'value for money' competition in the industry and make it more technically progressive.

CHAPTER 14 - PRODUCT DEVELOPMENT IN THE AGRICULTURAL MACHINERY INDUSTRY

Methods of Analysing R & D

In the economic literature on industrial organisation an analytical tradition has developed which tries to measure 'technical progressiveness' and relate it to structural features. R & D budgets of companies and industries are analysed to see whether larger companies spend proportionately more on R & D than smaller companies and whether concentrated industries spend proportionately more than fragemented industries. This approach is not pursued here since it seems to be both uninteresting and inappropriate, for several reasons.

(1) The comparison of budgets of large and small firms is difficult because large firms have R & D budgets whereas small firms often do not. This itself may indicate that larger firms take R & D more seriously, but it is more likely that it simply indicates that they take cost accounting more seriously, because large scale organisations require more formal systems of control to be manageable at all.

(2) The R & D/sales ratio is a peculiar criterion in itself since it is the inverse of R & D productivity. Why then should it be considered a desirable variable to maximise? It picks up two distinct elements; the company's emphasis on R & D inputs expressed financially; and the quality of its research outputs. Other things being equal, a company whose quality of R & D work is high generally designs successful products which sell well in large numbers. This will tend to depress the R & D/sales ratio so that the companies which score highly on this test may in fact be the inefficient users of product development resources.

(3) Inter-industry comparisons of R & D intensiveness take no account of the technological opportunities facing different industries and can lead to highly misleading interpretations. One instance was Galbraith's observation that the U.S. petroleum industry was more technically progressive than the U.S. coal industry because the

former had a highly oligopolistic structure whereas the latter was highly fragmented. The very different technological opportunities facing these industries in the 1960s was apparently ignored.

It is precisely this issue which is discussed here, in the context within which the industry works, with particular reference to such factors as the state of the art, the nature of the functions that agricultural machines have to perform, the technical receptivity of the farming community and the capacity of distribution channels to cope with design change. No attempt is made here to measure R & D inputs. For the reasons mentioned above this seems to be one of the least interesting aspects of R & D. Instead the discussion centres on the manner in which R & D is conducted, how it is organised and intergrated with other functions, how responsive it is to changes in the market and technology, and what types of research are undertaken by different types of company.

The Technology of the Industry

The technology of the industry is fairly static. Its most basic and highly engineered product, the tractor itself, may be described as a mature product. By 1960 or so most of its key features had been developed - three point linkages, automatic draught control, independent power take-off and differential lock. Since 1960 the significant improvements have been made in semi-automatic transmissions which permit gear changing to be performed without loss of traction. Recent product developments have been to do with operator comfort and safety, forced on the industry by legislation.

Tractor manufacturers seem committed to the traditional concept of the tractor, a mechanised horse, wedded to ploughing - the function which places the highest demands on the tractor's draw-bar pull and automatic draught control - the device which responds to changes in soil conditions to bring about compensating changes in traction. Some obervers would argue that this emphasis on tractor's ploughing capabilities is becoming less relevant. Ploughing occupies only 7% of the tractor's

working life and is itself being replaced to some degree by minimum cultivation techniques which either involve breaking the soil rather than inverting it completely, or simply drilling directly into the stubble. The widespread use of weed-killers, notably Paraquat, reduces the need to bury the trash by traditional ploughing methods. It is also becoming more difficult to apply the increasing tractor horsepower to the soil efficiently by sing the tractor's pulling capacity; it is difficult to maintain traction without increasing tractor weight and this tends to damage the soil structure and impede good drainage. From the operating point of view, the traditional tractor has the disadvantage that the operator must face in one direction to steer, the opposite direction to control the trailed implement. This is particularly disadvantageous in operations involving two or three implements linked together to perform two or more operations at one pass. The trailing arrangement also implies that the tractor wheels run through the standing crop during the harvesting operation.

There is an alternative and practical tractor concept, embodied in the Intrac system developed and marketed by Deutz, part of the German company, Glockner-Humboldt Deutz. This design resembles a truck in that the operator sits in a cab at the front of the vehicle. Power is delivered simultaneously if necessary to implements at the front and at the rear of the machine; some transport capacity is provided in the middle of the tractor, useful for carrying seed and fertiliser. The advantage of this arrangement is that the operator has a better view of his operations and can perform two or three operations together: such as mowing and loading hay; harrowing, fertilising and drilling. The Intrac system is currently expensive but the cost will doubtless decline relative to conventional tractors as mass production proceeds. As far as is known, the leading tractor manufacturers in the U.K. decided not to develop such a system. The Intrac concept was suggested to them in some detail several years ago by the National Farmers Union, but the idea was not favourably received. In the tractor industry, product competition is limited in what one might term the conceptual dimension, and vigorous within fairly circumscribed design limits. Tractor models remained basically unchanged for ten years or more in both their styling and engineering. Radical changes are unusual, but it is fair to say that in respect of the featurs of tractor design which farmers

are most concerned with, the real price of applied horsepower, the tractor companies have made impressive progress over the years.

The other major product, the combine harvester, has not changed fundamentally either since it was developed during the Second World War. This is particularly true of the mechanism for harvesting the crop; the cutter-bar and reel are in principal the same as those on McCormick's famous reaper which marked the birth of the industry a century ago. In this field too, a revolutionary design has gained no acceptance. Research at the N.I.A.E. laboratories over many years produced the Silsoe Airstream Combine, a design whereby the separation of grain and chaff is effected by a current of air, as opposed to the mechanical methods used in the conventional machine. The resulting simplicity of the design affords significant reduction in size, weight and complexity, and an added efficiency in barley harvesting, the world's major cereal crop. These advantages imply a cost reduction estimated to be around 50%. An added option with this design is that it can be cheaply converted into a combine module which can be carried by a general purpose vehicle. This would go some way to offsetting one of the main drawbacks of self-propelled machines - that expensive capital is tied up in a machine which can be used for only three or four weeks in the year. As yet there is no sign that combine manufacturers are seriously interested in this design.

A number of other products remain unchanged - drills, harrows, manure spreaders. Thus a spokesman of a company which pioneered a pneumatic precission seed drill could observe in 1971 "the only thing anybody ever did to advance the seed drill was to take the horse-shafts off it until we came along". Progress has been made with vegetable harvesting machinery, although performance tests reveal that there is still much development to be done in this area. In general the progress with new techniques is slow - hydrostatic drives in heavy machinery such as harvesters which require flexibility at low working speeds, automatic controls and monitors, suspended cabs. The only automatic control in all the industry's products is the draft control sensing device on the tractor's linkage which automatically transfers extra weight to the rear wheel of the tractor when ground conditions require it. Such 'closed-loop' systems have been applied to combine harvesters by the

Polish industry, enabling the machine's direction and speed to be adjusted automatically to the crop's position and density. Generally speaking, monitoring devices are rare; the farmer has no reliable way of knowing how some machines are performing - whether, for example, seed drills are drilling continuously through all coulters, whether blockages are occuring in vegetable harvester mechanisms. Only recently have grain sensors been fitted to combine harvesters to monitor the volume of grain being lost. Despite the revolution in byraulics after the Second World War, there remain many small but useful applications which have yet to be exploited - adjusting the angle of disc harrows while in motion, power steering for heavy harvesting equipment, controlling the direction of discharge of forage harvesters.

There is very little basic research in the industry. Design work does not usually proceed from the fundamental engineering analysis of a problem. Manufacturers of soil-engaging implements, for example, do not typically begin by attempting to define the engineering parameters of what actually happens at the point of contact between implement and soil. The soil mechanics would be studied experimentally. Similarly, combine harvester manufacturers would not typically design the interior of the machine based on the fundamental understanding of the aerodynamic and flow properties of grain and straw. Development proceeds experimentally on the basis of observation and a feel for the machine's operating conditions. In this respect the industry is rather different from other branches of engineering and this accounts for the fact that there is littls transfer of engineering personnel from other branches of engineering and the reluctance of the Institute of Agricultural Engineers to be incorporated into the body representing mechanical engineers as a whole. The agricultural engineer sees himself as part of agriculture, not as part of the mechanical engineering industry. He might often have a farming background himself and his particular asset is an ability to see and allow for the variety and types of misuse that agricultural machines will receive - what will happen to them when they are driven too hard or backed into some obstacle, operated by relatively unskilled labourers, blocked by crops, stones or metal objects. With experience the engineer will intuitively know what strength particular components require without lengthy analysis and how machines will be affected by soil and crop conditions.

This particular engineering culture that we have tried to describe has both strengths and weaknesses. Its particular strength is that it provides for the integration of the product development function with the other major functions, sales and production. The engineer is not a remote laboratory figure; in small firms he sometimes works directly to the sales director. He spends a lot of time out in the field and attending agricultural shows. He also has considerable two-way contact with production; he draws his personnel from the production department and may often advise on production problems. The problem, if anything, is the reverse. The product development function is insufficiently differentiated from the others. The product development engineer can often be forced into a service function, responding to the complaints of customers. His role is responsive rather than creative and he becomes locked into the traditional working concepts of the industry to a greater degree than engineers with a more conceptual tradition. It is perhaps no surprise that a high proportion of radical ideas derive not from agricultural engineers but from farmers. In haymaking machinery, for example, the big baler, the forage harvester, the rotary star tedder, derived originally from farmers' ideas.

Another consequence of the emphasis on the D rather than the R is an intuitive, trial-and-error approach and a lack of rigour in testing machine performance, reflected in the low standard of performance of some machines. Studies carried out by the N.I.A.E. on sugar-beet and potato harvesters showed that on average, sugar-beet machines left 7% of the crop on or in the ground and harvested dirt and trash equal to 15% of the harvested crop. Potato harvesters performed similarly, leaving 5% of the crop on the ground, picking up between 5 and 10% of dirt and trash and damaging 5% of the harvested crop. The worst figures to occur in the potato harvester sample for ground loss, damage and dirt, measured as a percentage of the harvested crop, were 25%, 20% and 50%.

Another aspect of the industry's conservatism is its attitude to development from outside the industry - ergonomics and electronics. The importance of operator comfort has been slow to gain acceptance,

despite its important bearing on machine efficiency and its marketing appeal, bearing in mind the fact that the majority of farmers operate their own machines themselves and the remainder have difficulty in retaining labour. The gradual adoption of tractor cabs bears this out. Tractors are apt to overturn and prior to the compulsory introduction of safety cabs, killed around 35 drivers a year. A side effect of the safety cab was that noise levels were increased since the cab acted as a sounding box for engine and transmission noises, particularly as it was bolted directly onto the rear axle. Maximum decibel levels are to be legally enforced by 1977 after a year's delay requested by the industry. There is no doubt that this legislation has gone too fast for the market and it is argued that the cab represents an excessive investment to save so few lives; one manufacturer recommended the use of ear-muffs as an alternative to sound-insulated cabs. Quite apart from the safety aspect, cabless tractors are very uncomfortable in winter and it is not unusual to see drivers ploughing with sacks tied around them for warmth. It is also considered acceptable that ploughing tractor drivers should sit in a tilted position for 8 hours a day when the simplest engineering changes could allow an offsetting adjustment of the sitting position. Some root harvesters are uncomfortable to drive, maintain and adjust, and this may account for the enormous variation in performance of root harvesters noted in the NIAE performance reports. The cabless combine is unhealthily dusty for the operator. The combine itself poses other operator problems since there are several controls to be adjusted simultaneously and the average operator might expect to acquire only two or three weeks experience with them each year. The NIAE report on the utilisation and performance of combine harvesters in 1969[1] drew attention to the level of combine harvester grain losses and the poor utilisation of combine capacity and noted in its conclusion that "it is not just a question of educating ... there is clearly a need to ease the task of the driver".

This reminds us of the role that electronics is likely to play in the future of the industry. A combine harvester is the largest item of

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(1) "The Utilisation and Performance of Combine Harvesters 1969", Farm Mechanisation Study No. 19, N.I.A.E., Silsoe.

farm equipment. It is a self-propelled machine for harvesting cereals and separating grain from straw which it ejects from the rear of the machine. A drawback of the machine is that under certain operating conditions quantities of grain are ejected along with the straw and are never recovered. These losses can seriously effect the farmer's net profit margin; in several cases investigated by the Combine Harvester Study the loss exceeded 200 lbs. per acre - around 5% of the crop. Grain losses arise when the machine's forward speed is too great for its capacity to fully digest the crop intake. Therefore an operator attempting to use the machine's capacity to the full is apt to cause grain losses. The grain sensor is an electronic device which is able to decipher the impact of grain from that of straw and thereby register the passage of grain over the rear of the machine. This message is delivered to the operator on a dial so that he can control grain loss by reducing ground speed.

Only one combine harvester manufacturer, New Holland, has designed and fitted such a sensor. This company has also pioneered the metal detector for forage harvesters which shuts off the machine automatically before damage to the chopping mechanism can occur. Apart from New Holland, two independent companies specialising in electronics applications manufacture sensors in the U.K. Around 25% of combines in the U.K. have been so equipped and according to a study on their application[1], they are generally effective once farmers have been educated in their use.

The fact that the development of such devices has been so slow and has come primarily from outside the industry is due to three factors:

(1) A belief in the industry that electronic devices are out of place on a farm because dealers are not equipped to repair them and farmers do not understand them (as one manufacturer put it, "when a machine goes wrong the farmer kicks it!").

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(1) Farm Mechanisation Study No. 25, N.I.A.E., Silsoe, 1974.

(2) Difficulties in marrying together two very different technical disciplines, mechanical engineering and electronics[1]. In common with most human beings, development engineers prefer to operate in a familiar frame of reference. To him, electronic instruments are literally 'black boxes' which he would prefer to leave alone. It is significant that the one combine manufacturer which developed its own grain sensor, New Holland, is part of the Sperry Rand Group which possesses a strong electronics capability to which grain monitoring could be given as an electronics problem.

(3) The industry's empirical tradition. Because the industry is orientated towards development rather than towards research, its product development engineers approach design problems on the basis of "how are we to adapt what we have?" rather than "what is the essence of a problem; what techniques are available to solve it?".

These insights are hardly startling but they serve as an antidote to the type of analysis which looks for answers to these questions in terms of scale economies and industrial structure. We see no sign of this here; it is a question of companies of all sizes being locked into a particular culture which they share with their customers and which they tend to reinforce.

THE INSTITUTIONAL FRAMEWORK FOR RESEARCH

In the U.K. product development in agricultural machinery tends to be polarised between basic research carried out at the NIAE and its Scottish equivalent, agricultural colleges and university engineering departments and development work carried out by the industry itself. There is something of a gap between these two which the National Research Development Corporation (NRDC) attempts to bridge. The NRDC acts as the commercial arm of the research organisations mentioned above, and other similar organisations for other industries: it identifies patentable research work, files patents and negotiates licenses with manufacturers for their exploitation.

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(1) The same difficulty retarded both the development and the commercial application of numerically controlled machine tools.

The NRDC has licensed 19 agricultural machinery inventions and a glance at the licensees is instructive. Only six of the nineteen were previously in the agricultural machinery industry itself; four of these are substantial companies, Howard, Root Harvester, Simplex of Cambridge and John Wilder. NRDC patents are not apparently seized upon by the industry even though it has first choice. Nor are they regarded by small companies in the industry as a means of compensating for their lack of research capability. To judge from the large number of licensees from outside the industry, the prime function of NRDC patents is to serve as vehicles for new entry. The pattern of response from the industry itself underlines further its preference for an adaptive rather than an innovative style of product development.

The Profitability of R & D

One would expect that the importance of R & D activities would reflect their expected profitability. What are the general factors which bear on managers' perceptions of expected profitability of research? Is technical progress seen as a success factor, or can rivals imitate inventions quickly of nullify their impact in other ways? How strong are patents in this industry, for example? There are limits to which patent protection operates in this industry. It is not possible to patent a principle, only a specific mechanism in which the principle is embodied. A company which evolves a new principle will need to develop the market application of it very rapidly in order to reap the commercial benefit, unless it patents an indispensible mechanism. Imitation does not take long because in this industry inventions are usually quite straightforward from a mechanical point of view and once the principle is grasped it can easily be engineered. If one considers a number of new products which have appeared in the last 20 years or so - reversible ploughs, spider wheel rakes, rotary star hay conditioners, foragers, big balers, precision drills, rotary mowers, rotary cultivators, fertiliser broadcasters, rotary milking parlours, self-loading trailers - each product represents a significant departure from tradition, but none involves radical engineering problems in terms of machine function and operating principles. There is, therefore, some basis for the view in the industry that pioneering new products does not pay; imitators learn from the pioneers' inevitable mistakes and take advantage of his efforts to

prepare the market. This is true in small markets. In large markets the reverse is sometimes the case for the small pioneer which could not expand fast enough to cope with the demand and which positively welcome a rival, particularly if it is a well known company, which will improve the credibility of the new product - "it must be good because XYZ are making it".

Apart from imitation, there are two other reasons why good designs do not get their just rewards. The influence of dealers can outweight design advantages; it is not uncommon for a farmer to acknowledge the technical superiority of a particular product but continue to buy a rival's product because his local dealer stocks it. The second reason, which is discussed at greater length in Chapter 11 is that the industry has yet to evolve a numerate and quantitative style of marketing which would allow machine performance to have its fullest impact on the market.

These three factors, the weakness of patents, the inertia caused by farmers' loyalty to dealers and the qualitative style of marketing, go some way to explain why basic research and innovation is not a crucial success factor in this industry.

The Organisation and Management of Product Development: The Multinational Company

There was a time when product development was not a separate function at all. Each manufacturing unit would develop its own products through the efforts of its industrial engineer who would alternate between production and development. Most small firms in the industry still follow this procedure. The multinational company adopts the pattern pioneered by Alfred Sloan of General Motors whereby product development is a separate function under a manager of product. The manager of product is not to be confused with product managers in consumer product industries. Whereas the latter has a strong commitment to particular products, the manager of product is a detached impartial figure whose task is to sweep up and sift ideas for new products and administer the progress of those that are selected. He heads a group on which all other functions are represented. The group has considerable strategic importance since it also reviews the company's products already on the market to determine whether they should

be withdrawn or modified. Its procedures are fairly formal. Any function in the organisation can propose a product. The group meets monthly to sift ideas and selects some of them for market research. If results prove favourable the group looks around for sources which might meet the parameters that the market research indicates - other subsidiaries first, then other manufacturers. Failing these the group might opt to develop a machine itself, appointing a product committee whose prime task is to produce a costed development programme. Once accepted by the group, active control is exercised from the central headquarters prior to any heavy expenditure on the development stage. The report is submitted to headquarters and passed around subsidiaries. Other subsidiaries may argue that they are already developing something similar and could best take on the development work. Such claims are assessed by the company headquarters and development work is allocated accordingly.

The major companies concentrate their research efforts to a high degree, Massey Ferguson as much as any. The development of its tractors is located at its Advanced Project Engineering Centre at Detroit, harvesting machinery development in Toronto, engineering development at Peterborough. Central technical control is exercised to ensure interchangeable sourcing. The principal development work of the various subsidiaries is directed mainly at adapting the designs which emerge from these research centres to meet local conditions and legal requirements.

Once a project is ready for release to manufacturing again all subsidiaries are considered as possible sources. Three aspects of this process are of particular interest:

(1) The project is 'handed over' a number of times both within and between subsidiaries. It is transferred across the various functions involved - market research, engineering, finance, testing. It may also be transferred across subsidiaries at the end of the report and development stages. Occasionally development personnel involved at the report stage may travel with the project to other subsidiaries abroad to continue with development work.

(2) The profitability of a product may depend on its suitability in several of the company's markets so that many factors must be incorporated into its design.

(3) The analytical basis for project selection is in terms of total profit objectives not in terms of a rate of return. Risk premia are not considered. The bygones principle has no place either; the decision to continue or to discontinue is made on the basis of the project's total cost not on the cost that must be expended to complete it.

There are several consequences of this highly institutionalised system:

(1) The process of development is lengthy, taking up to six years from conception to manufacture.

(2) It avoids costly mistakes. Few products have to be abandoned once they are in production.

(3) It is efficient in the sense that control is exercised throughout, minimising costs and using the company's worldwide resources to the best advantage.

(4) It produces an impersonal and disciplined atmosphere due to the fact that the project is assessed and transferred so frequently. This discipline is likely to weed out uneconomic 'pet' projects. On the other hand, it is demotivating to the creative development staff since they are unlikely to have much control over a project or be permitted personally to progress it through from conception to manufacture.

(5) The emphasis is on the engineering and economic rather than the conceptual aspects of a product, manipulating a known technology, rather than shifting paradigms.

(6) The lengthy bureaucratic process loads each product with substantial overheads and encourages the company to look for large volume to support this allocation of overheads.

There is also a corporate strategic factor which must encourage the large companies to opt for the evolutionary types of product development that were noted in the two major products, tractors and combines. Market demand in the important North American and European markets, which tend to be the most receptive to new machinery designs, is static in real terms, encouraging the major companies to diversify into industrial and construction equipment. It is inevitable that agricultural machinery divisions of these companies, with their established market positions, are viewed as reliable sources of cash for diversification moves of this kind. This strategic consideration argues against the expenditure of large sums of money to develop radically new tractors and combines.

Product Development in Smaller Companies: Graindry Ltd.(1)

Among multinational companies, the product development process is remarkably standardised. Among the smaller companies there is a greater variety since the process depends on the people concerned and sometimes on the product involved. Graindry has a turnover of £2-3 million and designs crop driers and handling systems, by far the largest component of their business, and machines for grinding and crushing crops. Crop driers are akin to the fashion business; systems usually have to be fitted into customers' existing buildings. There are frequent changes in the type of drying technique which is in vogue, and the company must anticipate and respond to these changes within a year. Like the fashion business, designs must be produced for a seasonal demand. Tooling requirements are very few because the products are made of sheet steel which has to be cut, folded and welded. Precision is not vital; there are few moving parts to wear out so that the development process from conception to manufacture can be compressed into six months. Cost is important as in any business, but it is not the prime consideration. The product will have a limited run since it may be modified the following year. The chief consideration is technical; will the machine perform its function? This is in contrast to the company's other staple product - crushers and hammer mills. These are attrition machines heavily built of cast iron

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(1) Fictitious names are used in these examples.

with precisely engineered moving parts. Wearing processes need to be studied carefully and this extends the design process to 18 months or so.

The development function is not highly formalised. The development engineer divides his time between designing new products and making production decisions on plant layout and make-or-buy decisions. There is no annual budget as such but development costs are reviewed continuously. The development function draws on facilities within the plant which are costed to it and amortised over the products concerned. Project appraisal is not made in terms of rates return. Projects originate from salesmen's reports and once development to meet the market requirement that they identify is under way, the crucial factor which usually determines which project continues is technical, though occasionally costs force abandonment. Size is not seen as an impediment to product development What is relevant to the company's ability to develop products in its chosen field is its experience, i.e. accumulated output in its field.

Product Development in Smaller Companies: Drillwell Ltd.

Drillwell has a turnover of £1 million. Its research and development programme is an integral part of the company's growth strategy. The company successfully developed a precision seed drill which permitted the seed to be spaced at precise intervals, increasing crop yield by allowing each seed an equal amount of nutrition. The company's first drill was suitable for a limited number of vegetables, and subsequent developments have been directed toward expanding the scope for the precision drill to cope with seeds of different sizes. The direction and content of development work derives from the logical analysis of the company's strengths and opportunities. The company possesses a basically good product and design capabilities. The management identified its market with great clarity; it was a question of deciding which of the world's crops the new machine would be equipped to handle and identifying that small but distinct segment of each market, comprising the more progressive farmers to whom precision drilling would appeal.

Development at Drillwell is an ordered activity in that for each project there is a planned and accurately costed sequence of activities which fit in well with the company's corporate plan. There is no question of

engineers simply tinkering about. In conception this approach is very similar to that adopted by the multinational companies, though the procedures used to implement the development programme is less complex. In the multinational company, each project will involve several separate departments and a critical path analysis would probably be used to bring together engineering and marketing data at the crucial decision points in a project's life immediately prior to large expenditures. In Drillwell this process is coordinated by one man without elaborate network analysis, but the programming rigour is nevertheless still very evident. Progress is much more rapid than in multinationals; the second and largest version of the precision seed drill was developed in only 13 months.

Drillwell seems to combine the administrative discipline of the multinational while retaining the advantages of informality and personal creativity which smaller companies generally enjoy. The company's turnover is around £1 million and its development budget is insufficient to support a qualified senior agricultural engineer on a full time basis. This factor is sometimes cited as an economy of scale in product development, but it is interesting that Drillwell avoids this problem by employing a consultant engineer on a part time basis. Apart from ensuring a supply of qualified advice, the company derives an important benefit from having access to someone who is literate from the engineering point of view in that it can keep abreast of development work in research institutions and universities. The company draws on this work to a degree which is unusual in the industry.

Product Development in Small Companies: Hedgeditch Ltd.

The company has a turnover of around £1 million and a fairly wide product range for a company of its size, ranging from heavy ironmongery - chisel ploughs, cultivators and land rollers - to hydraulic tractor-mounted attachments for mowing, hedging, trenching and lifting. The company frequently pioneers new products and see this as a success factor; as one executive remarked, "we have to live on our wits". Among the company's innovations are a precision drill, a hydraulically operated hedge trimmer, a potato planter and a ditching excavator. The company employs a full time development manager and one director devotes a third of his energies to technical matters. The organisation of the

product development programme is fairly informal. The company holds a weekly meeting attended by all functional heads to discuss problems which have arisen; to the extent that these concern product development, the meeting becomes a de facto product development meeting. The programme does not derive from the corporate plan as such; the approach is opportunistic, based on ideas put forward by sales and product development staff, some of which may originate from farmers or small engineering firms outside the industry. There is little attempt to define and develop Hedgeditch's position in selected markets; the only constraint on the choice of product derives from the production department's concern that each new product should provide the minimum production run each year of around 200 units.

The approach has its strengths and weaknesses. Its informality allows the company to respond to ideas from all quarters and its innovative output is large in terms of the numbers of new products it develops. The weakness of the approach is that it leads to a very diverse range of products which have quite different production and marketing policies. Since all products are handled in much the same way the result must be that some products do not receive the type of marketing they require; standard pieces of ironmongery such as rollers and chisel ploughs are produced and marketed in the same way as the more expensive, highly engineered products such as hydraulically operated lifting and mowing equipment. The apparent lack of "fit" within the company could explain why some of the company's more interesting innovations have failed to generate the commercial advantage which technically they would seem to deserve.

Product Development & Company Size

With some feel now for the organisational context in which product development is conducted in the industry it is possible to say something about some structural issues: is there a minimum company size for effective product development and conversely, does the effectiveness of research diminish in very large companies? Would the industry be technically more progressive given a different industrial structure?

There are obvious differences in style between large and small companies but it is difficult to tell whether these differences correspond to different levels of research effectiveness or whether they simply reflect organisational responses to differences in company size. For the idea of a minimum efficient firm size to be interesting, there have to be indivisible items of expenditure, such as testing equipment and research teams. Pure research is beyond the means of small firms and, in any case, management would probably not know how to direct it usefully. But this need not deprive the progressive small firm of pure research results should they feel the need for them since there are a number of research establishments in the U.K. and in the U.S.A. which companies can consult, as the Drillwell example illustrates. The technically qualified agricultural engineer is an indivisibility but consultancy is a possibility. The small company's disadvantage in pure research should not be exaggerated. As we have already seen, few companies, large or small, show much interest in pure research in this industry and, in any case, the main obstacle to securing research results is not access to research results but the difficulty in assimilating the results into a development process. Nor is the small firm at a disadvantage in respect of development as opposed to pure research because the industry's technology is stable and straightforward, requiring fairly robust products built to inexact standards of precision operating at low speeds. Testing equipment is not prohibitively expensive: a major producer of lawn mowers built a test rig for simulating mowing conditions for only £12,000. A typical product development programme outside the heavily engineered products would not cost more than £50,000.

Developing the more highly engineered products is more expensive. In 1969, Ransomes sought £0.5 million from the Government to develop a modern combine. Though the company was offered a loan by the Ministry of Technology it decided that to develop a combine in competition with the multinationals was too risky and opted instead to develop root harvesters - a more specialised item which is ignored by the multinationals. The expense of the combine development itself did not appear to be as much of a deterent as the competitive aspects. An expenditure of £0.5 million spread over five years is not excessive for what was then a £10 million turnover company, bearing in mind that a typical R & D budget for an

engineering company is around 2% of turnover. The concept of the minimum efficient size of company in this industry, based on the unit costs of R & D, does not appear to be a powerful one.

When discussing scale economies, economists translate the question into one of units costs, i.e. what are the indivisible components in product development and how much more heavily do they impact on the unit costs of smaller firms than on those of their larger competitors? We believe that this approach is rather limited. What appears to determine the type of effectiveness of product development is the organisational style, the company strategy and the personal skills available. It is a question too of what different types of organisation are equipped to do. Given that smaller companies survive in competition with larger rivals, they must have some comparative advantage. This advantage cannot occur in production since large companies operate at high volumes and where they cannot, they have the option of buying in from smaller units. As we have seen, the small company suffers a significant disadvantage in marketing. Product development is the remaining major functional area where the small firm can hope to gain an advantage, and since many of them survive there is a strong presumption that this is were their comparative advantage lies. They rely on their originality and willingness to design products which multinationals describe as "too fiddly". Multinationals look for cost minimisation by designing for several markets. The design is inevitably something of a compromise and may not be ideally suited to any one market. These companies can overcome this disadvantage by using the strength of their dealer networks to push products through.

CONCLUSIONS

The industry has a stable technology and a conservative technical style which might be described as: no R, some D. The roots of this conservatism lie in the conservatism of the farmers themselves, the weakness of agricultural machinery patents, dealer loyalty and the absence of a quantitative language for discussing and marketing machinery performance. In considering scale economies in R and D the concept itself was not very useful for organising a discussion. In so far as scale economies

are based on indivisibilities they are fairly weak. The survival of the small firm in industry itself is an indirect sign of its comparative advantage in product development, given the small firm's slight disadvantage in production and marked disadvantage in marketing. It is largely a question of different firms doing different things; smaller firms are more adept at conceptualising and developing the products, due to their speed, flexibility and contact with the market; the larger firms are more adept at the implementation of product development plans because of their superior administration. Studies of the organisational contexts for product developemtn and the manner with which it was carried out indicated that the procedures of the large companies were very similar and the procedures of the small companies were very diverse. This suggests that there is really only one way to organise product development in large organisations but that in the more informal organisational structures of small firms product development reflected management styles, the type of product and the personalities involved.

As regards the analytical approach that should be adopted towards product development in studies of this sort, it becomes clear from this study that it is not enough to measure and compare R and D expenditures across and within industries. What has been termed the "technological culture" in this study only emerges when the texture and detail of an industry is understood.

When comparing the product development policies of different companies it makes sense to compare R and D/sales ratios only among companies employing similar procedures. In this industry it would be reasonable to infer that John Deere is the most technologically orientated of the multinationals on the basis of its superior R and D/sales ratio - 4% of sales compared to 3% for the others. Among smaller companies it is more relevant to enquire about attitudes and methods, and in particular, whether product development policies are appropriate to the company's corporate strategy if any, the nature of its products and the skills available; whether it is preceded by systematic market research and supported by appropriate marketing policies.

CHAPTER 15 - THE SIGNIFICANCE OF INDUSTRIAL STRUCTURE

The previous chapters have tried to convey the salient features and the flavour of the industry's structure, market, marketing approaches, production characteristics and product development. This final chapter tries to make sense of this material in terms of the industry's structure, not because structure is an influential element in managerial thinking or because it is demonstrably a way of gaining insight into an industry's operations. Neither is in fact the case. The chapter is focussed on structure because the structure-behaviour-performance method of analysis has now firmly caught hold in university teaching of industrial economics and, more importantly, in official governmental policies and attitudes towards monopoly and competition policy in North America and Europe. Investigations of monopoly are undoubtedly guided by industrial structure, both in terms of their direction and content.

The essence of the structure-behaviour-performance approach can be summarised very briefly. Structure refers mainly to the size distribution of companies in terms of their sales. Interest here centres on the degree to which the largest companies dominate the industry ('the degree of concentration'), often measured for convenience as the combined market shares of the four largest companies ('the concentration ratio') but sometimes by more elaborate statistical measures of size inequality. The definition of 'industry' to which these measures refer is open to interpretation; researchers in principal prefer to operate at as low a level of aggregation as possible but often have to make do with whatever definition official statistics provide (e.g. minimum list headings in the U.K., N.I.C.E. in the E.E.C.).

Behaviour refers to the degree of competition in the industry and the relative emphasis which is placed on the various elements in the marketing mix - price, sales promotion, terms of sale, product development. There is a presumption that high concentration is conducive to collusive behaviour, e.g. price agreements, or alternatively to practices which though not collusive are anti-competitive - parallel pricing and restrictive terms of sale.

Performance refers mainly to the extent to which an industry earns excessive profits, 'excessive' being defined in relation to the average rate of return for manufacturing. Also considered are technical progressiveness, achievement of efficiency and any available scale economies. By far the greatest amount of empirical research, and really the only conclusive research, has been directed at concentration, price collusion and profitability. Over thirty studies were carried out between 1950 and 1970 and many more since. A typical study selects a sample of industries and looks at their average rates of return on capital or profit margins on sales and their concentration ratios. There is an impressive concensus among the many studies that there is a definite link between concentration and profitability(1), suggesting that on average the degree of competition in highly concentrated industries tends to be less than might occur in fragmented but otherwise similar industries, by a small but statistically detectable amount. The main purpose of this study is to confront this framework of thought with some observations about the agricultural machinery industry, including those of some of its managers, in the belief that new ways of thinking about structure and performance are needed rather more urgently than a further addition to an already large stockpile of econometric studies on this subject.

CONCEPTS AND PERCEPTIONS OF PERFORMANCE

An enquiry of this type affords an opportunity to compare and contrast businessmen's perceptions of structure and its consequences with those of academic economists. One conclusion derived from the discussions is that to many businessmen the usual interpretation placed on 'performance' by academic researchers and by anti-trust authorities, namely, whether or not profits are excessive in relation to the normal rate of return for the economy, is rather narrow in scope and eccentric in character. The people engaged in trying to make a living in industry regard profits as a measure of their success and find it strange to be told that high profitability is regarded as an index of monopoly behaviour. How then are industries which make losses to be regarded on this basis; are they to be applauded for competitive behaviour, for example? It is also apparent that managements think about structure in ways very different to those of

(1) See Leonard Weiss, "Quantitative Studies on Concentration" in "Frontiers of Quantitative Economics", edited by Michael D. Intrigilator, p.362-403, North Holland, Amsterdam, 1971; and B.S. Yamey "Do Monopoly and Near Monopoly Matter? A Survey of Empirical Studies" in "Essays in Honour of Lord Robbins", edited by Peston & Corry, Weidenfeld & Nicholson, London, 1972.

the academic researcher. When considering company performance in operational detail managements are interested in their ability to supply the needs of their customers in terms of the value for money of their products, embracing price, technical quality, service and delivery. These aspects of performance are difficult to measure and some managements find it convenient, ironically in the context of this discussion, to use market share as a yardstick by which to judge managerial performance. Market share is a convenient tool for 'keeping score' since it abstracts from factors outside the company's control which impact on the company's market. It is therefore natural for a company with a large market share to feel that an industry dominated by a few companies like itself is performing well and that if the industry should earn above-average profits, it is no more than they deserve. To those accustomed to thinking about performance in these terms, the relation between structure and performance is tautologous and not worth discussing; market share <u>is</u> performance.

The way that businessmen view market structure is clearly very different from the economist's conception of it. The structure-performance analysis views the economic system as a set of industries defined by technology and consumer needs; the analysis considers the extent to which the supplies of these products are monopolised and if so, whether there are any adverse consequences of this. While this broadly reflects reality it neglects the extent to which companies themselves can locate market segments and define their boundaries. Part of the art of commercial survival is to create a market niche and develop a defensible share within it, as illustrated in this industry by Howard in rotary cultivators, Stanhay in precision drills, Fullward in rotary milking parlours and Vicon with spinner broadcasters. The Deutz Intrac tractor design probably heralds the growth of a distinct sub-market in which Deutz will probably be the market leader. In other words, structure-performance analysis is only to do with the effects of industrial structure on the company; it ignores the prior and more important question of how market structures are developed in the first place, i.e. companies' impact on structure rather than structures' impact on companies. And because it seems to take as given, something which is the object of business strategy and activity, the spirit of the structure-performance analysis is one which businessmen cannot be expected to have very much interest in.

There are three additional practical reasons for this. The first is that industrial structure to most businessmen refers to the market shares of the particular segments in which they are operating. Most market segments are highly concentrated in terms of the sum of the largest four markets shares or the share of the market leader, i.e. the market leader frequently has a market share in excess of 25%, the definition of 'monopoly' in U.K. legislation. Far from being an exception to a general pattern of fragmented industrial structures, concentration appears to be the normal situation at the market segment level; hence the lack of interest in what its effects are. A second reason is that the effects of industrial structure (structure here referring to the entire industry) are simply too small for businessmen to notice them. A company may be able to perceive changes in profitability related to changes in its own market share, but not to changes in the concentration of the industry or even of the market segment in which it operates, unless the company itself has a large influence on these changes. It must be remembered that the effect of inter-industry differences in concentration on profitability is of a fairly trivial order of magnitude, even though it is often found to be statistically significant. The third reason is that the proposition that concentration has a general tendency to reduce competition strikes many businessmen as odd. To them, the presence of other large rivals implies strong competition; the larger their rivals' market shares are, the more they are conscious of them and concerned about what they might be doing. In fragmented market sectors, on the other hand, companies are less aware of each other and take less account of each others' actions. Psychologically, the competitive atmosphere tends, if anything, to be sharpened in concentrated industries.

It seems, then, that the structure-performance style of analysis forms no part of business concepts; indeed, in several ways it runs counter to those concepts. This is not to say that industrial structure has none of the effects hypothesised by its students; merely that because the structure-performance model is so out of key with business thinking one would not expect its effects to be other than modest.

THE IMPACT OF INDUSTRIAL STRUCTURE

The Definition of Structure

What dimensions of industrial structure are significant? Should market

shares be measured in relation to U.K. production, the U.K. market or segments of this market? When considering the structure of an industry it is helpful to bear in mind that 'industries' are statistical constructs for collecting and organising data. They need not necessarily have any operational significance to those engaged in them. They may be appropriate for some purposes but not for others. The aggregate 'agricultural machinery' has a definite meaning to its members in the sense that they share a common environment, face similar marketing problems and belong to the same trade association; but it does not mean that they all compete with one another or that there are no other companies with whom any of them compete. Market segmentation defines the areas within which competition in the industry occurs; international trade exposes its member to competition from outside. As Chapter 9 indicated, in this industry there is a pronounced degree of market segmentation and specialisation and in many of these market segments the foreign company holds the market leadership. It is important, then, to try and assess in what respects the industrial structure at the aggregate industry level is significant, and in what respects the structure of the market segment is significant. And regardless of this question, what allowance is to be made for international trade; is the structure of the domestic market more important than the structure of the domestic industry? Rather different structures emerge, depending on how these questions are answered.

In Chapter 9 it was noted that the industry leaders rarely held market shares of more than 40% of the segments which they dominated but it is not unusual for smaller companies to enjoy much greater dominance in the segments where they hold the leadership. The trade factor bears most strongly on concentration in segments dominated by foreign companies but should be considered also at the aggregate level. It happens that the leading companies - tractor companies for the most part - export proportionately more than small companies, with the result that the U.K. agricultural machinery market is less concentrated overall than the U.K. industry; the top four companies of the 23 largest companies in our statistical data base accounted for 79% of industry sales in 1972, but only 63% of U.K. sales.

The following approach to measuring structure suggests itself as being the most meaningful:

(1) Refer where possible to market structure rather than industry structure[1] and when weighing the significance of high industrial concentration calculated on this basis, grant less significance to those cases in which intra-E.E.C. trade accounts for substantial market shares, since this element reflects the extent to which the market is exposed to intra-E.E.C. competition.

(2) Place particular emphasis on the market structure of market segments defined as far as is reasonable such that all major companies in the segment compete with each other. Aggregates which contain non-competing companies will tend to understate their market positions.

THE SIGNIFICANCE OF INDUSTRY STRUCTURE

In this industry the largest four companies in our data base account for around 63% of U.K. sales in 1972 - a degree of concentration which is fairly typical of U.K. manufacturing industries. What is the significance of these dominant positions in relation to the total U.K. market for agricultural machinery, as opposed to the market segments in which the major companies are engaged? How are such shares maintained and what do they permit the industry leaders to do?

As Chapters 10 and 11 explained, success in this industry depends on dealer support more than on any other factor. Therefore marketing, and the dealer organisation in particular, is the critical functional area for management in this industry. Securing dealer support has a lot to do with the aggregate volume of business that a company can provide a dealer, implying that companies' share of the total U.K. market for agricultural machinery is of some significance. Massey Ferguson and Ford in particular, and also David Brown, International Harvester, New Holland and Bamford, are able to appoint good dealers and exert effective control over them roughly in proportion to their position in the industry. This advantage is beneficial to the major companies in three main ways:

(1) They are able to insist on exclusivity ('full line forcing'). The effect of this arrangement is that the company uses its position in the high turnover products in which it has a competitive advantage

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(1) In the U.K. legislation which relates to monopoly policy, monopoly situations are considered in relation to the "supply of goods" in the U.K., or part of it where appropriate (Fair Trading Act, 1973, Clauses 6 and 9).

(tractors and combines) as a lever with which it can push many smaller items in which it has little or no particular competitive advantage. This is not to say that Massey Ferguson, for example, pushes second rate products onto the market in this way, because dealers would resent this. In fact, many of the less engineered products supplied by major companies are bought in from leading specialists in these products, such as Huard and Howard. Nor does it mean that the major companies can expect to obtain shares in implement markets as great as those obtained in the markets for their major products, but it does mean that their shares are higher than they would otherwise be.

(2) The industry leaders can obtain more and better directed promotional inputs in return for their dealer discounts.

These advantages are sensed by the smaller companies, which feel that dealers exert themselves proportionately less for a company which provides a small proportion of their business. Even though small companies try to avoid head-on competition with major companies, they inevitably find themselves competing with them, at something of a disadvantage, for dealer representation. In short, the significance of industrial structure in the industry derives from the fact that the nature of the products and the market requires dealers, who in turn require ranges of products sufficient to provide an income. Full line or long line companies with significant overall U.K. market shares can provide these aggregates and so derive a definite but limite commercial advantage which would not exist in an otherwise similar industry which marketed directly to its customers.

What is the pay-off from these marketing advantages that high market shares help to sustain? The indications are that the commerical advantage derives from an increasing and stable volume of business, rather than from increased profitability in relation to that level of turnoer. In other words, high market share contributes to yet higher market shares. It also helps to stabilise sales; it was noted that during the recent period of limited supply, when the tractor companies were forced to allocate tractors to their dealers, imports rose far less than was necessary to meet demand, partly because dealers persuaded many farmers to wait up to 18 months for their new machines. But this is a short term benefit. In the longer term the larger companies are unable to exclude entry of new sellers.

An analysis of the published accounts of 22 companies over five years revealed that the four largest companies in the sample (Massey Ferguson, Ford, International Harvester and David Brown) accounted for 81% of the total industry sales but only 73% of total industry profits. As Table 12.2 indicates, the profit margins on sales of the industry leader, Massey Ferguson, in the period 1968-73 was slightly below average for the industry; the profit margins of International Harvester and David Brown were very much below this level. The marketing advantages referred to above do not seem to be translated into profitability. Nor do they appear to be sufficient to defend industry leadership. The sales of the leading companies, Massey Ferguson, International Harvester, David Brown, Ransomes and Bamford, grew significantly more slowly than the industry sales over the period 1968-73. The share of the four largest companies in the U.K. market declined from 70% to 63% in that period.

One reason why the marketing advantage inherent in high U.K. market shares works in favour of high sales, rather than higher profit margins, is that companies elect or are compelled by goodwill considerations to maintain roughly the same dealers' discounts as the rest of the industry, and secure higher turnover at the same distribution cost per unit rather than try to secure a lower unit distribution cost through smaller dealers' discounts.

At the industry level, concentration does not appear to be having its predicted effects on profitability and price levels. In Chapter 12 this issue was examined in the light of the Canadian Royal Commission Report, "Oligopoly in the Farm Machinery Industry" which concluded that in the North American market tractor prices were uniform and excessive (notwithstanding the low profitability of the companies concerned) and that there was an aversion to price competition in preference for non-price forms of competition such as dealer representation and the expansion of the model range. The U.K. industry shows signs of all these features, but in our interpretation of their significance and origins we depart from the Canadian study. In our view a discussion of these issues in relation to concentration is fairly meaningless in isolation from some prior expectation of how an otherwise similar industry with a fragmented structure would behave. It seems likely that regardless of its structure, the agricultural machinery industry is bound to emphasise distribution rather than price,

because the nature of the market and the products demand good dealer organisations. In this industry, cut-price tactics are not a viable alternative to developing dealer representation. As regards the expanding range of tractors, this is to be expected due to the increasing use of power take-off drives and the need to match horsepower to implements' power requirements. In contrast to the growth in the number of models, basic tractor design has remained unchanged for a decade or more and the concept of the tractor itself has hardly changed at all in fifty years.

Oligopolistic price behaviour was apparent in the U.K. tractor industry The price differentials were found to be lower than in the rest of the industry and price leadership was apparent. But though price differentials were lower and price warfare restricted to narrow limits, it was argued that these differentials and changes could be as significant as anything to be found in the rest of the industry, due to the relative comparability of different manufacturers' products and the price-sensitivity of tractor demand. There is strong econometric evidence of considerable 'value for money' competition in the tractor sector. The level of U.K. tractor prices was always below the international level until recently and even now it does not appear to provide excessive profits or permit the long run survival of unduly uneconomic plants, again, using the non-tractor sector as a standard of comparison. In short, the apparently oligopolistic behaviour of the industry leaders could be interpreted in terms of other factors and in any case did not have its predicted effects. A possible explanation of this is discussed later.

MULTINATIONAL DOMINANCE

An alternative interpretation of the industry structure was proposed by the P-E Consulting Group in its report to the National Economic Development Office[1] which noted that the industry's 'top heavy structure' was due to the dominance of the multinational companies. The report suggested that this had unfortunate effects on the performance of the indigenous companies which had gravitated towards the more fragmented markets for lower cost items, unable to raise the capital necessary to compete with the multinational companies head on. The report noted that the product development

(1) "Agricultural Machinery: A Study of U.K. Demand and World Trade 1963-1975", N.E.D.O., London, 1970.

emphasis of the multinational companies in Britain was orientated more towards adapting American designs for U.K. conditions at the expense of fundamental research into new products. The report observes that "it is significant that many of the recent innovations in machinery design, especially in low-cost implements, have come from Scandinavia and West Germany where the North American companies are less entrenched". This view is related to another, that the E.E.C. agricultural machinery industry is shaped by multinational companies and their location and sourcing decisions. To consider these views and then to shed some light on the performance of the various sectors of the industry, it is interesting to look at the balance of trade in each of the major sectors, indicated in Table 15.1. Some of the major sourcing decisions of the multinational companies were indicated in Table 9.6 and these have a significant bearing on some of the trade movements. One would guess that around 50% of the imports of balers are due to Massey Ferguson's decision to source balers from France; 25% of tractor imports and a substantial fraction of the forage harvester imports are due to the location of John Deere's European manufacturing operations in Germany. Decisions to locate tractors in Britain by Ford and International Harvester and balers by New Holland help to explain the U.K. trade advantage in these categories. But in general it would be an exaggeration to say that the European agricultural machinery industry and its trade pattern is like modelling clay in the hands of a few multinationals. Britain's tractor industry has traditionally been strong due to the designs and inventive genius of Harry Ferguson, the efficiency of Perkins diesels, both of which Massey Ferguson acquired, and the engineering expertise of David Brown, now acquired by Tennecco. Conversely, this country's heavy dependence on European combines has been due, not to the multinational companies but to the specialist producers Claeys (now part of New Holland), Claas, Laverda and Fahr.

TABLE 15.1:

U.K. TRADE IN AGRICULTURAL MACHINERY PRODUCTS : 1974

(£ million)

Product Group	Exports	Imports	Imports/Exports
Wheeled tractors	147.0	11.0	0.1
Combine harvesters	4.1	19.4	4.7
Balers	7.7	2.5	0.3
Forage harvesters	1.4	4.0	2.9
Haymaking machinery	0.5	2.5	5.0
Milking machinery	3.4	1.0	0.3
Other dairy equipment	7.9	2.8	0.4
Root harvesters	0.6	2.0	3.3
Manure spreaders	0.5	0.8	1.6
Fertiliser distributors	0.2	0.7	3.5
Drills and planters	1.3	0.9	0.7
Rotary cultivators	2.0	0.4	0.2
Disc ploughs	0.9	0.0	0.0
Mouldboard ploughs	0.1	12.	12.0

Source: U.K. Trade Statistics

There are six sectors which registered strong adverse trade balances - combine harvesters, forage harvesters, haymaking machinery, root harvesters, fertiliser distributors and ploughs. In only one, forage harvesters, could the adverse balance be attributed to multinationals' sourcing decisions. The two market leaders, New Holland and John Deere, source from plants in Belgium and Germany respectively. It is therefore rather difficult to explain the weaknesses in the industry's trade performance on the basis of multinational dominance. It seems unlikely that the

multinationals have undermined the industry's performance indirectly by pushing the indigenous companies into the fragmented low volume segments of the market. In the first place, the most striking instance of this displacement, the Ransomes' decision to abandon combines in 1974, was mainly brought about by two indigenous European specialists which introduced high volume combines to the U.K., Claeys and Claas. But accepting the point that indigenous companies do in fact seek low volume niches out of the way of the multinationals, their lack of international success in these fields cannot be attributed to the multinationals. The adverse situation in these segments is due to the design skills and volume production of a number of European specialists; the combine manufacturers already mentioned, Fahr, Kuhn, P.Z. and Lely in haymaking machinery; Grimme in potato harvesters; Vicon in fertiliser distributors; Huard, Kverneland and Lemken in ploughs; and Kongskilde in cultivators. The success of several of these companies was based on an early technical lead, allied to a commitment to developing a market position, which allows companies to accumulate the relevant experience faster than their competitors and establish unassailable leads.

Some of the weaknesses of the industry owe nothing to structure or market factors. The blunt fact is that with the exception of fertiliser distributors, the weak sectors are encompassed in the product ranges of two of the most illustrious British agricultural engineers, Ransomes and Bamford, which have failed to capitalise on their early advantages. In the decade 1963-73 sales of these two companies did not grow in real terms at all at a time when British farmers where increasing their expenditure in real terms by 40%. Neither company developed such a coherent long line position as New Holland, for example. Bamford was an early specialist in harvesting and mowing machinery but has tended to manufacture under license or factor foreign products, rather than develop its own. The company manufactured balers and finger-type swathers in the 1950s under license and has since imported foreign combines and more recently forage harvesters. In haymaking machinery the company has been outflanked by continental developments of drum mowers and rotary star tedders. The company imports Kuhn equipment from France and competes against its own supplier in the U.K. market. Ransomes pioneered the steel plough and the cylinder lawn mower, since which time a number of products have been launched and dropped - grain driers and combines, for example. A number of observers in the industry

remarked that the company has failed to develop its strengths, allowing foreign ploughs to invade its domestic market. Ransomes acquired Catchpole, a pioneer in sugar-beet harvesting machinery, but the latter's product was supeceded by a Standen machine. In short, the strengths and weaknesses in the various sectors have more to do with managerial decisions than the industry's structure, either at the aggregate level or at the level of the sector.

THE STRUCTURE OF MARKET SEGMENTS AND THEIR SIGNIFICANCE

An alternative approach to industrial structure is to consider market segments and whether the performance of individual companies within them is related to their market shares. This approach has been developed by the Boston Consulting Group whose thesis is that companies with high market shares are more profitable. The basis of this thesis is that most companies sell their products at similar prices so that profitability depends on relative unit costs. Unit costs are inversely related to the cumulative experience of each business. The B.C.G. have calculated a considerable number of what they term 'experience curves' which relate unit costs to the cumulative output of an industry or company. These relationships indicate that unit costs decline in real terms by a constant percentage with every doubling of cumulative output. It has also found that market share correlates with cumulative experience with the result that market leaders tend to be more profitable. This view is supported by an empirical study of the profitability of American companies(1). The Boston Group emphasise that their relationship is not automatic; it refers to potential profitability which has to be appreciated and secured by good management and therefore one cannot expect the relationsip between market share and profitability to apply in all cases. There is also bound to be some ambiguity about the relevance of companies' 'experience' to a particular business. For example, John Deere has considerably more experience of manufacturing tractors than David Brown but much less cumulative experience of selling them to the U.K. market; and how much of Howard's experience in rotary cultivators transfers to farmyard grain storage equipment?

There is some evidence in favour of the Boston thesis. From the Table 9.2 in Chapter 9 several market leaders can be identified in the various segments -

(1) R.D. Buzell, B.T. Gale and R.G.M. Sultan, "Market Share - A Key to Profitability", Harvard Business Review, January/February 1975.

Massey Ferguson (tractors), Howard (rotary cultivators), Ransomes (ploughs), Fullward & Bland (milking equipment), Bentall (grain drying and handling equipment), Standen (sugar-beet harvesters), and Bomford (chisel ploughs and hedge trimmers). In addition, New Holland (harvesting equipment) should be included also. Assessing New Holland's profit margin on sales conservatively at 10%, the average profit margin for this group is close to 10%, rather above the average for the industry. Remembering that all the companies concerned do not specialise completely in the market in which they dominate, one would not expect the relationship between profitability and market share to be totally clear-cut. Nevertheless, the relationship noted above is extremely suggestive, consistent as it is with a great deal of research into this subject.

The best illustration of this relationship can be found by comparing the profitability within market segments, notably, the superior profit performance of Massey Ferguson compared to its smaller tractor competitors, International Harvester and David Brown, and the superior profitability of Standen compared to its smaller root harvesting rivals, Root Harvester, Teagle and Edmonds. The experience curve manifests itself in several obvious ways. Massey Ferguson confirm that a long learning process applies in the production control methods used to manage its controlled random build tractor operation at Coventry. The real price of tractor horsepower has declined since the War. The experience curve is also reflected in a comment by a spokesman of Howard, which holds an estimated 85% share of the U.K. rotary cultivator market, to the effect that the company's competitors "must find it hard to sell profitably because Howard's experience and production volume result in a comparatively inexpensive product"(1). The experience curve is also reflected in the trade patterns exhibited in Table 15.1. Patterns of trade in several segments, in the view of a number of observers, is largely due to the efforts of specialist producers which are driven hard at developing their market shares and accumulating the relevant experience in manufacturing and marketing their product faster than their rivals.

This approach to market structure is of real practical benefit to companies since it has definite implications for their business strategy, unlike the structure-performance analysis which offers the businessman very little

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(1) Cited by Ian Greig, "Tillage Tackle; A £20 Million Market", Agricultural Machinery Journal, August 1975.

guidance indeed. From the competition policy point of view, the interpretation provided by the Boston thesis is of great significance because, firstly, market leaders do not typically derive their high profits from 'market power' which enables them to charge higher prices than their rivals. The profit advantage derives from lower unit costs based on a greater accumulated experience. In this industry there was very little evidence that market leaders charged higher prices. As Table 13.1 indicates, Massey Ferguson prices for the popular range of tractors were representative of the industry's price levels; David Brown charged lower prices but International Harvester and British Leyland charged higher prices. Ransomes' reversible ploughs and Standen's sugar-beet harvesters are priced at similar levels as rival machines. Fullward & Bland and Howard have tended to price below the opposition, and Bentall slightly above. New Holland's combine harvester prices are high but the quality of the construction of their machines is generally recognised as deserving some premium. In the American study referred to, prices were found not to be related to market shares, except in the instances where industry observers were able to identify a definite quality advantage, in which case a price premium was found to exist. This is not to say that market leaders cannot cash in some of their market share advantage by charging a price premium; as one manufacturer put it, "we add 5% for the name". But according to the Boston Group's exposition of the strategic implications of experience curves[1], market leaders would be unwise to sacrifice market share for a higher profit margin since this would invite rivals to increase their market shares and thereby gain accumulative experience faster than the market leader and narrow the unit cost differential on which the market leaders' superior profitability is ultimately based. In short, market leadership tends to generate higher profitability but does not lead to higher prices in general nor, apparently, in this particular industry. The second implication of this analysis for competition policy is that highly concentrated sectors are the norm, not the exception. According to the Boston thesis, competitive relationships are inherently unstable until a dominant producer emerges with lower costs than its rivals, derived from gaining a lead in accumulative experience which provides a cost advantage which, in turn, reinforces the market leadership. Since these dominant positions are rooted in superior efficiency, attempts

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(1) See "Perspective on Experience", by the Staff of the Boston Consulting Group, Boston, 1970.

to interfere with this process by anti-trust action will tend to be expensive in terms of the economies foregone.

The pattern that we think has emerged from this discussion seems to be this: at the industry level, a high market share tended to reinforce a marketing advantage and there was a hint of oligopolistic behaviour among the industry leaders in respect of pricing policies. However, this behaviour was not associated with high profitability, contrary to the predictions of the traditional structure-performance analysis. At the market segment level, there were signs that market shares were associated with profitability, not through price advantage but probably through the effects of the experience curve on unit costs. There was little sign of any parallel pricing in the non-tractor segments, regardless of their market structure.

Two questions need explaining:

(1) Why does market segment leadership improve profitability whereas industry leadership apparently does not?

(2) Why does oligopolistic behaviour appear to operate among industry leaders but not among segment leaders (with the exception of tractors)?

An answer to both these questions can perhaps be found by considering the impact of an independent variable which has a strong bearing on both market structure and company behaviour, namely, company size.

COMPANY SIZE AND INDUSTRIAL STRUCTURE

In the course of discussions with companies a single but important fact emerged very quickly - many smaller companies do not have much information on market shares in this industry. In many sectors, industrial structure plays little part in managers' thinking because they do not have an accurate picture of the structure of their markets. There are a number of reasons for this. The fact that companies attempt to develop distinctive products inevitably confuses market boundaries; companies tend to be clearer about market shares in segments where they are strong but rather hazy about shares

in segments where they are weak. Sometimes the nature of the product confuses the picture. Where a product is a discrete and relatively standardised item, such as wheeled implements, it is possible to talk about market shares fairly sensibly in terms of units. This is not possible to the same extent in respect of the less discrete items which are designed around the farmers' installations, such as milking parlours and grain handling and drying systems. Another important difficulty, mentioned already in Chapter 11 is that it is difficult to calculate retail sales on the basis of deliveries to dealers, due to the fact that dealers' stocks can accumulate or run down to significant but often unknown extents. The larger companies are well informed about the level of retail sales since they can obtain regular reports from dealers on sales and stocks and are also party to an elaborate computerised information sharing system through their trade association, the Agricultural Engineers Association. This system provides details of market shares down to the parish level if so desired.

The availability and use of marketing information is strongly related to two things, the type of competitive responses to be found in various segments of the industry on the one hand, and to the size of the companies concerned on the other. To begin with company size, detailed studies in organisational behaviour indicate that company size is the single most important factor determining organisational characteristics, notably, the degree of formality and standardisation and the use of information systems. In view of these characteristics, large companies require formal managerial methods and detailed market intelligence systems to be capable of functioning well at all. Such systems permit accurate monitoring of their markets and their position in them and contribute to a responsive style of marketing; for example, tractor companies are in a position to set sales targets to each of their dealers and to monitor their progress towards them, to identify to which rival sales are being lost if market share in any region of the country is falling and take steps to counteract these trends. In such an environment it would be impossible to gain an advantage unobstrusively. It is quite otherwise in sectors occupied by medium/small companies; due to the lack of information about market shares it is quite possible for a company to increase its market share without rivals noticing at all. Three market leaders known to the author, all with substantial market shares, were concerned that their shares remained confidential to avoid

THE INTERACTION OF COMPANY SIZE AND INDUSTRIAL CONCENTRATION

DIAGRAM 15.1:

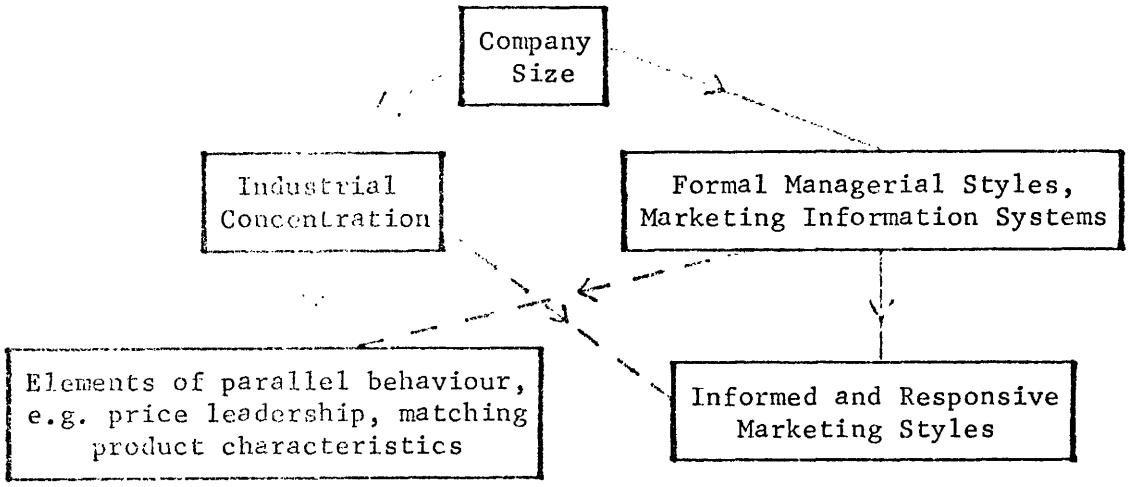

DIAGRAM 15.2:

Industrial Concentration / Market Leader	Concentrated Sectors	Fragmented Sectors
Large Companies	Elements of parallelism + Responsive marketing styles	
Small/Medium Companies	Independent marketing behaviour + Informed & quantitative marketing styles	

provoking rivals, who would not otherwise have known the degree to which the leader dominated the market.

Now, because company size has separate impacts on industrial concentration and on the type of marketing which is employed, there is an interesting interaction between industrial structure, company size and competitive behaviour, along the lines suggested in Diagram 15.1. Company size leads to high concentration and the use of formal and quantitative systems of management. The interesting aspect of this is that these effects in turn lead to opposite and in some ways compensating types of competitive behaviour. Concentration can encourage a degree of parallelism; it was noted in Chapter 13 that a pattern of price leadership existed in the tractor industry and that prices and tractor characteristics are closely matched. But on the other hand, the informed marketing approach of the large companies generates a responsive type of interaction between them. As the diagrame suggests, the picture is further complicated by two additional linkages. Concentration itself can highten a sense of rivalry. Competition for the market leadership in the tractor and combine sectors is stimulated by the fact that in these sectors there are respectively two and three companies with substantial shares within a few percentage points of each other (see Table 9.5). Companies in fragmented sectors appear much less concerned about their rivals. The difference in outlook could be characterised in this way; smaller companies see life simply in terms of persuading customers to buy more of their products, larger companies in terms of persuading customers to buy their products in preference to rivals'. There appears to be a lot of truth in that famous economics examination question; "In perfect competition, what is the firm in competition against?" The point of the question was that because the firm in a highly fragmented industry is in competition with everybody in a generalised way, it is in competition with no-one in particular.

The last link in the diagram running from 'management style' to 'parallel behaviour' is of great importance. The left-hand side of the diagram represents the familiar structure-performance model of oligopoly. The essence of the theory is that in concentrated industries, attempts to gain market share by any leading company will impact on rivals to a noticeable degree and will inevitably provoke retaliation. Because this is a predictable outcome, oligopolists 'recognise their inter-dependence'

and avoid damaging confrontation such as price wars - the commercial equivalent of nuclear warfare. Now if companies do not have the information necessary to detect aggresive moves of this sort (extra discounts to dealers, for example) this chain of reasoning breaks down, As in the arms race, knowledge of the opponents moves is essential for the stability of the system.

The implications of this are clarified in Diagram 15.2 which depicts the three most likely types of situation, depending on the size of the market leader and the structure of the sector (large companies in fragmented sectors is an unlikely combination and is ignored). First, and less interesting, is that 'oligopolistic behaviour' cannot be usually expected among small companies, whatever the structure of the sector, because companies of this type do not typically operate information systems capable of monitoring rivals' behaviour. The second significant implication is that 'oligopolistic behaviour' is apt to coincide with rivalrous and interactive marketing behaviour, because large company size is both a precondition for the former and a direct cause of the latter. This proposition sounds very similar to but is distinct from another, namely, that oligopoly suppresses price competition and encourages forms of non-price competition such as advertising and model changes. The point being made here is not that the large companies spend relatively more on promotion and product development than the smaller companies but that their perceptions of each other are clearer and that competition between them is of a higher quality.

If this interpretation is correct it helps to explain the pattern of profitability in the industry, i.e. the 'oligopolistic' tractor sector earns profit margins rather lower than the average for the industry and the opportunity for high margins (greater than 10% on sales) only occurs outside the dozen largest companies (see Table 12.2). It could also explain why a great number of empirical studies of the relationship between concentration and profitability have revealed a connection between these two variables which is like a seismic disturbance - unmistakably recognisable to those with the appropriate measuring equipment but too weak to be noticed by those on the ground.

(ii) CRANES (WRITTEN BY MISS A. DOVE)

CHAPTER 16 - OUTLINE OF THE CRANE INDUSTRY

CHAPTER 16 - OUTLINE OF THE CRANE INDUSTRY

1. MAJOR PRODUCT GROUPS

What distinguishes cranes from other products in the Mechanical Handling sector is their ability to lift and move heavy objects. The output of the crane industry falls into five major product groups:

- Tower Cranes - these are the very tall structures seen on building sites; they differ from other jib cranes in that they utilise a strictly vertical lift, the boom removing horizontally. They have on average, lifting capacity of up to 6 tons.

- Power Operated Mobile Cranes - these are of several different types: wheel, truck and crawler mounted, both electric and hydraulic; major customers are from the construction industry and plant hire companies. They all utilise a jib for lifting purposes.

- Electric Overhead Travelling Cranes - these have booms slung between horizontal runners that travel lengthwise along the roof of buildings, thereby facilitating the movement of goods from one area of the shop to another; they are installed in most factories and warehouses and so customers are in all sectors of industry.

- Specialist Land Cranes - these include:

  (a) heavy duty types of electric overhead travelling cranes used in steelworks, for example;

  (b) goliath and semi-goliath cranes which are used outside, in railyards and dockyards; they are large steel structures supporting an overhead boom (the semi-goliath, being the shape of an inverted 'L', supporting the boom from one side only); the structure moves horizontally along runners in the ground.

  (c) container cranes which are a specialist type of goliath crane.

- Marine and Dockside Cranes - off-shore cranes, dock cranes and dockside cranes of the jib-types.

- Hoists - the actual lifting mechanism of the crane; these are included since they are normally made by the crane manufacturers themselves.

GROWTH TRENDS IN THE CRANE INDUSTRY

Industry sales are cyclical like all capital goods but appear to be growing over the longer term. Tables 16.1 and 16.2 summarise deliveries by product class for 1966 to 1974.

TABLE 16.1:

DELIVERIES OF CRANES BY U.K. MANUFACTURERS 1966-71 (£ mill)

	1966	1967	1968	1969	1970	1971
Electric Overhead Travelling Cranes	9.9	11.0	9.8	11.3	14.0	14.4
Dockside & Gantry Jib Cranes	5.2	4.1	3.3	3.2	6.9	8.8
Power Operated Mobile Cranes	20.1	19.4	24.2	29.9	34.0	34.8
Special Steelwork Cranes	0.8	1.0	2.7	4.1	3.7	7.9
Tower Cranes	0.9	1.1	0.8	0.5	0.6	1.0
Rail Mounted Cranes	0.8	0.3	0.4	0.4	0.9	0.2
Derrick Cranes	0.7	0.6	0.5	0.5	0.4	0.6
Other complete cranes	0.5	0.4	0.8	0.5	0.7	1.2
Spares	4.0	4.6	4.8	3.8	7.0	7.7
TOTAL	42.9	42.5	47.3	55.2	68.2	76.6

Source: Business Monitor, Third Quarter 1972.

TABLE 16.2:

DELIVERIES OF CRANES BY U.K. MANUFACTURERS 1972-74

	(£ mill) 1972	1973	1974
Electric Overhead Travelling Cranes	26.8	19.6	21.3
Dockside & Gantry Jib Cranes	*	4.9	6.2
Power Operated Mobile Cranes	35.3	44.4	62.4
Wall Mounted & Pillar Jib Cranes for Light Industrial Cranes	0.6	0.8	0.9
Other	7.1*	4.5	2.4
Parts & Accessories	9.5	11.7	15.7
TOTAL	79.3	85.9	108.9

* In 1972 figures for dockside and gantry jib cranes are included with those for all other cranes.

Source: Business Monitor.

NOTE: Changes in official definitions make individual product class figures in Tables 16.1 and 16.2 difficult to compare.

Power operated mobile cranes account for over half of U.K. deliveries, with overhead travelling cranes accounting for nearly one quarter. The present recession in the U.K. has depressed activity although export markets throughout 1974 and 1975 have been more buoyant.

Table 16.3 summarises the U.K. demand for cranes (as opposed to production).

TABLE 16.3:

U.K. DEMAND FOR CRANES

	(£ mill) 1966	1967	1968	1969	1970	1971	1972	1973
U.K. Production*	43	43	47	55	68	76	79	86
Exports**	12	9	9	15	18	28	21	23
Imports**	4	5	8	6	8	11	19	19
U.K. Consumption	35	39	46	46	57	59	77	82
Imports as a % of U.K. Consumption	11%	13%	17%	13%	14%	19%	24%	23%
U.K. Consumption at 1970 Prices***	-	-	51	49	57	55	67	73

Sources: * Business Monitor.
** Overseas Trade Statistics.
*** Adjusted using crane wholesale price index.

The sophistication and complexity of crane design for specific tasks has led many manufacturers to limit their activities within a narrow specialist area. This is reflected in the trade balance for individual types. For example, imports of derrick jib cranes and tower cranes have increased substantially; in contrast exports of travelling jib cranes and overhead travelling cranes have also increased.

Examination of the product lines of the major U.K. manufacturers (see Annexe 16.A (at the end of this Chapter) shows the extent of product sophistication within the U.K. Stothert & Pitt are a good example; they specialise in two separate areas - dockside cargo jib cranes and construction equipment. They are a significant force in the world dockside crane market, exporting between 50% and 70% of their crane production with recent large contracts in Algeria and Saudi Arabia, demonstrating their ability to compete internationally.

Specialisation rests on two factors, design skills and production and labour skills. There is, in a very real sense, a steep learning curve inherent in the acquisition of both sets of skills. The new entrant to a specific sector of the crane market is faced with potential customers who like to see a record of successful experience in manufacture of the specific type of crane, and with the prospect of high production costs and uncertain quality on the initial contracts. The industry and its market are both conservative: crane technology has advanced but designs and manufacturers are still much the same as they were fifteen years ago. Such conservatism makes it difficult for new entrants to appear, but liberalisation of international trade over two decades or more has created a much greater awareness of the importance of marketing and a markedly more intense price and product quality competition.

2. MAJOR STRUCTURAL FEATURES

In the U.K. the majority of cranes are not bought but hired from one of the many plant hire companies that have grown up over the past fifteen years. Turnover of these companies has risen from £15 million in 1962 to approximately £450 million today. Before the growth of plant hire, builders had to fully equip themselves for any work they were undertaking.

However, the cost of this has become very large, a 200 ton crane costing as much as £¼ million and a basic 70 ton telescopic crane £100,000. At such prices contractors require but cannot guarantee constant utilisation of the machine. Consequently hirers who can guarantee minimum levels of utilisation have become the major buyers of mobile cranes in the U.K.

The business appears profitable; the two largest crane hire companies have been making better returns on sales than the manufacturing companies, although with a smaller capital base.

TABLE 16.5

RETURN ON SALES (%)

	Crane Hire		Average of 12
	Richards, Wallington	Sparrow Crane Hire	Crane Manufacturers
1968	19.6	13.4	4.4
1969	9.7	9.4	4.1
1970	7.3	11.0	3.1
1971	8.5	12.6	5.6
1972	9.7	10.1	5.1
1973	11.9	13.4	-
1974	10.8	13.4	-

Source: Company Accounts.

In spite of the higher returns of plant hire companies, the crane manufacturers are unwilling to integrate forward into plant hire since this could put them into direct competition with their other customers. However, some manufacturers, such as Jones Cranes, are subsidiaries in a large group, e.g. George Cohen 600 Group, which may have another subsidiary in plant hire, 600 Leasing.

It is difficult to say anything meaningful about industry structure at the aggregate level. There is surprisingly little overlap between sub-sectors in that nearly all the major manufacturers produce for only one of the sub-sectors. It is noticeable that amongst the companies operating in the U.K. market there are relatively few foreign subsidiaries and no major multinationals. But a large number of major U.K. engineering companies have crane-manufacturing subsidiaries; for example, George

Cohen 600 Group and Thomas Ward & Sons. The largest crane manufacturer in the U.K., Clarke Chapman Ltd., is itself a large diversified engineering company, cranes accounting for less than 50% of its turnover.

Annexe 16.A (referred to earlier) provides a listing of manufacturers with indication of status of the company (e.g. subsidiary, quoted, etc.) names of partent and subsidiary companies, main products and product lines.

3 TECHNOLOGICAL CHANGE AND INNOVATION

By outward appearance cranes have changed littl ver the past decade and there have been no major innovations, just gradual development and improvement. In mobile cranes the hydraulic telescopic type of boom has taken over gradually from the diesel electric type at the lighter end of the market. The 'mono-box' design for overhead travelling cranes for which J.H. Carruthers received the Queen's Award for Technological Innovation have reduced the total amount of steel required and therefore the total cost by limiting the number of overhead beams required from two to one. Their design has been so carefully patented that no other U.K. manufacturers have been able to imitate this new innovation.

Levels of technology vary considerably between the sub-sectors: the heavier types of crane usually require more complex engineering. The steel structures have to cope with much wider range stresses and strains.

ANNEXE 16.A: CRANE INDUSTRY : ENTERPRISE & U.E.A. LISTING

Identification Number	Name of Company	Type of Company	Parent Company	Type of Crane Produced	Major Subsidiaries & Their Products	Associated Subsidiaries & Their Products
1	Herbert Morris Ltd.	U.K. quoted	-	E.O.T. cranes, both standard & heavy; hoists	British Monorail Ltd. - stacker cranes Craven Bros - steelwork cranes Henry Lowe Lifts - lifts Vaughn Crane Co. - E.O.T. cranes Crane Aid Services Ltd.	-
2	Butters Cranes Ltd.	U.K. subsid.	Thos. W. Ward	Dockside & derrick cranes	-	(John Smith (Keighley) (Ltd. - E.O.T. cranes
3	Thos. Smith & Sons (Rodley) Ltd.	U.K. subsid.	"	Mobile & crawler cranes	-	(Frank Parker & Co. - contractor's plant (Marshall-Fowler - crawlers (Thos. W. Ward (Plant Hire) (Ltd.
4	British Hoist & Crane Co.	U.K. subsid.	George Cohen 600 Group	"Iron Fairy" hydraulic mobile cranes	-	(Crane Travellers Ltd. - (crane carriers
5	Jones Cranes Ltd.	U.K. subsid.	"	Truck mounted & crawler mobile cranes	(Jones did not trade as a separate company until 1968; before this it was part of K. & L. Steelfounders)	(600 Leasing - plant hire (K. & L. Steelfounders
6	J.H. Carruthers & Co.	U.K. subsid. (post 1973)	Burmah Oil Co.	E.O.T. cranes, the "Monobox" range	-	
7	Clarke Chapman Ltd.	U.K. quoted	-	Heavy E.O.T. cranes; marine cranes; steelwork cranes; dockyard cranes	Sir W.M. Arrol (post 1968) - dockyard cranes Wellman Cranes (post 1969) & Clyde Crane & Booth (post 1968) - heavy E.O.T. & steelwork cranes*	Merged with John Thompson Ltd. in 1970 (boilermakers)

Identification Number	Name of Company	Type of Company	Parent Company	Type of Crane Produced	Major Subsidiaries & Their Products	Associated Subsidiaries & Their Products
8	Adamson Alliance Ltd.	U.K. subsid. (post 1973)	Crittal Hope Engineering (which was acquired by Norcross Engineering in 1974)	Large E.O.T. cranes; steelwork cranes	-	Butterley Engineering - large E.O.T. cranes
9	Matterson Ltd.	U.K. subsid. (post 1971)	William Hudson Group	Standard industrial E.O.T. cranes	Took over Dexion Wharton Cranes in 1974 who manufacture large E.O.T. cranes	Arrow Construction Equipment
10	Wharton Crane & Hoist (see 9 above)	U.K. subsid. (post 1970)	Dexion Comino International up to 1974, then part of William Hudson Group	Heavy duty industrial E.O.T. cranes	-	Part of the large materials handling group, Dexion Comino International, between 1970 and 1974 (see 18 below)
11	Demag Materials Handling Ltd.	Foreign subsid.	Demag A.G., Germany	Standard industrial E.O.T. cranes	-	German parent makes full range of cranes including mobile cranes
12	Coles Cranes Ltd.	U.K. subsid.	Acrow	Self-propelled mobile & speed cranes	Became part of The Steel Group in 1966 and the latter was taken over by Acrow in 1972	Priestman Bros. - cranes & excavators (also part of The Steel Group) Acrow Crane & Hoist - standard industrial E.O.T. cranes & hoists .
13	Grove Allen	Foreign subsid.	Grove (USA)	Mobile hydraulic truck cranes	Before merger in 1973 Grove (USA) had been providing crane for which Allen & Sons (Oxford) made the chassis	Allen & Sons (Oxford) acquired by Grove (USA) in 1973
The Following Companies have Under 50% of their Turnover Arising from Crane Sales:						
14	Stothert & Pitt Ltd.	U.K. quoted	-	Dockside cranes (also construction equipment, road rollers, etc.)	-	-
15	N.C.K. Rapier Ltd.	U.K. subsid.	The Central & Sherwood Trust	Mobile cranes (also excavators)	Part of Ransomes Ra Rapier Ltd. which is made up of N.C.K. Excavators & N.C.K. Rapier	Previously members of Newton Chambers Engineering who were acquired by Central Sherwood Trust in 1973

Identification Number	Name of Company	Type of Company	Parent Company	Type of Crane Produced	Major Subsidiaries & Their Products	Associated Subsidiaries & Their Products
16	Priestman Bros. Ltd. (see 12 above)	U.K. subsid.	Acrow	Cranes (also excavators)	-	Became part of The Steel Group (1968) which was subsequently taken over by Acrow
17	Ruston Bucyrus Ltd.	Foreign subsid.	Bucyrus Erie Co., U.S.A.	Crawler cranes (also excavators)	-	
18	Dexion Comino International Ltd. (see 9 & 10 above)	U.K. quoted	-	E.O.T. & stacker cranes	Entered crane market between 1970-1974 when it owned Wharton Crane & Hoist Ltd.	Dexion Autoflow Systems - conveyors

* These three companies are autonomous subsidiaries but part of the group.

ANNEXE 16.B: PERFORMANCE RECORD OF 23 CRANE MANUFACTURERS : AVERAGE FOR 5 YEARS FROM 1968 TO 1972*

Company	Profit/Sales	Export/Sales	Value Added per Employee	
Herbert Morris	3.7	18.0	1.53	
Butters Cranes**	5.4	20.5	1.66	
J.H. Carruthers**	5.4	20.5	1.66	
Thomas Smith	-.001	17.8	1.08	
Jones	4.6	43.7	1.34	
British Hoist & Crane	6.0	17.0	1.74	
Sir William Arrol	4.3	30.0	1.29	
C.C. & Booth	11.4	21.0	1.36	- 1968 only
Matterson	1.4	3.3	1.33	
Demag	0.6	9.7	1.90	
Coles	4.1	43.0	1.98	

* Excludes all companies where crane manufacture is less than 50% of total turnover.

** Some of the figures for these two companies were not available so they were averaged together.

ANNEXE 16.C: SUMMARY OF DATA COLLECTED FOR 23 CRANE MANUFACTURERS

			1968	1969	1970	1971	1972
Enterprises:	Turnover	(£ mill)	44.3	48.1	59.0	57.5	49.5
	Number employed	('000)	9,729	8,919	9,363	9,002	8,974
	Wages and salaries	(£ mill)	10.5	10.9	13.3	14.3	13.9
	Net profit	(£ mill)	2.5	2.7	1.9	3.5	1.2
	Cash flow	(£ mill)	3.3	3.5	2.7	4.3	2.0
	Own means	(£ mill)	15.3	13.1	13.5	13.2	13.7
	Exports	(£ mill)	8.9	12.5	20.2	23.9	16.0
	U.K. market	(£ mill)	35.3	34.6	32.3	33.6	33.5
	Profit margin	(%)	5.6	5.6	3.2	6.1	2.4
	Rate of return on own capital	(%)	16.3	20.6	14.1	26.5	8.8
	Value added per employee	('000)	1.43	1.64	1.74	2.07	1.79
	Wage per employee		1.08	1.22	1.42	1.59	1.55
	Total value added	(£ mill)	13.9	14.6	16.3	18.7	16.1
U.E.A.:	Turnover	(£ mill)	55.6	59.8	81.5	79.5	71.9

CHAPTER 17 - MARKET SEGMENTATION IN THE CRANE INDUSTRY

1. MARKET BOUNDARIES

The five sub-sectors were outlined in Chapter 16 as follows:

- Tower Cranes (jib type).
- Power-operated Mobile Cranes (jib type).
- Electric Overhead Travelling Cranes (overhead boom).
- Specialist Land Cranes (overhead boom).
- Marine and Dockside Cranes (jib type).

But although these define separate areas of manufacture, they do not reflect precisely market boundaries. There are, for example, many different specific types of mobile cranes ranging from the small truck-mounted type, sold mainly to the plant hire companies, to the huge crawler machines bought by civil engineering contractors. But these machines are sometimes manufactured by the same companies, implying a degree of potential competition based on the common technology. There are, of course, other potential competitors outside the sector, for example, the excavator manufacturers at present classified with 'construction equipment'; several of these manufacture mobile cranes.

The Tower Crane Market

There are no major U.K. manufacturers of tower cranes - the U.K. market is only worth £4 million per annum. U.K. builders do not use tower cranes as much as their European counterparts because of the wider use of scaffolding in the U.K. The first tower cranes were made in France and French manufacturers still dominate the market at the world level.

Entry into this sector by U.K. manufacturers has occurred in the past; for example, Stothert & Pitt designed and began to manufacture a tower crane. As the U.K. market alone is not large enough to sustain the necessary design overhead and reasonable production levels they needed to gain export markets, this proved difficult in the face of well-established foreign competition. The structure of the U.K. market

involved selling to the plant hire groups, thus reducing the margin available to the manufacturers. Stothert & Pitt therefore withdrew from the market and concentrated on their dockside jib cranes.

Babcock & Wilcox began manufacturing Richier tower cranes under licence but, faced with the same difficulties as Stothert & Pitt, they also withdrew and became import agents for the French produced Richier cranes.

Domination of the U.K. market by foreign manufacturers at first sight appears surprising; all tower cranes are constructed on site and are large enough to make transport costs a significant proportion of total costs. But it is not the builder who usually buys the machine but the large contractors and the plant hire groups. They require a wide range of products with a comprehensive spare parts service. This requires high initial costs in relation to a relatively small potential market in the U.K. Coupled with the conservatism of buyers, this adds up to fairly substantial deterrents to potential new entrants to the market.

The U.K. market is dominated by 'Potain' cranes imported from France by Record Tower Cranes Ltd. They have approximately 80% of the market. Their ability to maintain this share is probably helped by the fact that they are part of the Richards Wallington Group who also own the British Crane Hire Corporation, the largest crane hire business in the U.K. The remainder of the market is shared between two other French firms, Pignon and Richier. Trade statistics show that the U.K. does in fact export tower crane; these are second-hand cranes to developing countries. New markets for these cranes have appeared with the North Sea oil field with their use on oil rigs.

TABLE 17.1:

Company/Nationality	Import Agent	Approx. Market Share
Potain/French	Record Tower Cranes Limited (part of Richards Wallington)	75%
Pingnon/French	Dow-Mac (Plant & Transport) Ltd.	20%
Richier/French	Babcock & Wilcox Limited	
Kroll/W. Germany	Wyesplant Limited	5%
Leibherr/W. Germany	Leibherr-G.B. Limited	

MOBILE CRANES

Coles Cranes Limited is a world leader in the truck-mounted type of mobile cranes and holds the lion's share of the U.K. market. The company's turnover in 1973 was £32 million; the total U.K. industry deliveries were only £44 million (the Coles' figures include sales by foreign subsidiaries). In spite of their dominant position, they insist competition is strong.

Crane hire appears to have been a major factor in their development over the past fifteen years. They foresaw plant hire as a major growth area in the late 1950s and produced cranes to meet the specific requirements of this sector. Now 80% of Coles' production goes into the manufacture of the bydraulic telescopic truck-mounted cranes which form the backbone of the hire business. The hydraulic telescopic boom has been the major technical change in recent years. Its advantages lie in the speed at which it can be erectedand in its mobility. The lifting capacity ranges from approximately 10 to 40 tons, and the trucks can travel at up to nearly 40 miles an hour; the road-worthiness of a crane is important to the hire companies.

The area is competitive with three companies producing the same type of hydraulic machine as Coles themselves. The merger between Groves and Allen's of Oxford in 1973 presents a threat to Coles, since it represents the entry of Groves, the giant American crane company, into the U.K. manufacturing market, with all its technical resources and marketing skills. The other two competitors are British companies: British Hoist & Crane Company, part of the George Cohen 600 Group, and Thomas Smith, part of the Thomas Ward Group.

The hydraulic crane seems to have taken over from the diesel electric crane, although several U.K. manufacturers still concentrate on the latter, notably Jones Cranes, the other George Cohen subsidiary. Jones have a remarkable export record and their cranes seem to sell particularly well in the Arab states and South America. The lattice type of boom with diesel electric transmission can lift larger weights to greater heights than the hydraulic type. Ports tend, therefore, to stick to the former type of crane. Jones have, in fact, produced a new type of crane specifically for the direct loading and unloading of ships.

The trend in mobile cranes is towards heavier units; Coles introduced the Colossus range of truck-mounted cranes in 1971 which can lift up to 220 tons, and dominate this sector of the market. But there is no U.K. manufacturer of the heavier type of wheeled mobile and crawler crane. The American companies have exploited this market niche. The major importers are American Hoist & Derrick Ltd., Bucyrus-Erie and Manitowoc. American Hoist & Derrick are themselves one of the largest crane manufacturers in the world and make a full range of mobile cranes. They do not bother to promote their full range in the U.K. because they cannot compete on price with the U.K. manufacturers. This is because, (a) transportation costs are too high, that is 8-12% of total value, (b) import duty is 6.4% of c.i.f. value, both of these adding 20% to the ex-works price. But they do exist as a threat of potential competition for Coles. Coles has also benefitted considerably from the North Sea oil boom since they have experience in this type of crane manufacture which gave them an advantage over their U.K. competitors.

The crawler market is dominated by Manitowoc and American Hoist & Derrick who in value terms share the market between them. Manitowoc with smaller machines lead in number of units, and American Hoist & Derrick sell the expensive and larger types of cranes. Their major customers are Taylor Woodrow and Wimpey, who buy in the U.K. although the cranes may be actually used in various countries throughout the world. There it is very difficult to assess the size of the U.K. market as such. In value terms it is thought to be about £10 million per annum.

Although overall concentration in terms of the U.K. market appears to be high, the mobile crane industry faces potential competition from manufacturers abroad, particularly from the U.S.A., and Germany in the form of Demag. There is also the threat of entry by U.K. engineering companies, particularly those already manufacturing excavators. Several excavator manufacturers do already manufacture mobile cranes, namely Ransomes Rapier and Priestman. The technological and production requirements for mobile cranes and excavators are similar and they serve a common market.

Mergers have been relatively few. In the late 1960s Coles parent company, the Steel Group, purchased the U.K. crawler crane and excavator company,

Priestman Brothers. The two crane businesses were quickly integrated, but although it had a long history of success in the rope-operated excavator field, Priestman were relatively late in the hydraulic market, establishing themselves in this field with a range of competitive machines only in the last two or three years. Today both companies are still linked to a common parent, but operate completely independently. A new corporate identity emerged as a result of the merger which took place in

June 1972 when the engineering group, Acrow, took over the Steel Group. At the time of the takeover Acrow was smaller than Coles U.K., but the Coles Board felt that association with Acrow would be preferable to a takeover proposed by Slater Walker. Acrow allows its subsidiaries complete autonomy of operation. The company does itself operate in the sector with its subsidiary, Acrow Crane & Hoist, making overhead travelling cranes. The complementary world market coverage of Coles and Acrow probably provides some mutual advantage; they manufacture non-competing products for a common clientele.

INDUSTRIAL CRANES

Industrial cranes include both the standard electric overhead travelling crane, found in most warehouses and factories, and the specialist heavy duty overhead and goliath cranes. The markets for these two types of crane are very different; the latter are sold almost exclusively to nationalised industries such as British Steel, British Rail and the National Port Authority. However, some of the larger manufacturers, namely Clarke Chapman and Herbert Morris, produce a full range of overhead cranes and serve both markets. This accentuates the existence of potential competition from other manufacturers in each market.

Standard Electric Overhead Travelling Cranes

The lighter type of crane in this particular market embodies very little recent technological development. With minimal technical barriers to entry new companies can enter the market easily. The most complex part of the crane, the hoist blocks, can be bought from one of the established companies, such as Matterson, Herbert Morris or Demag. The smaller company can then build the actual structure themselves. Many of these

companies tend to appear when demand is high and move out of the market when demand slackens. The marginal presence of these companies over the years has tended to pull down the price level by undercutting the established firms. The low level of profit deters the large established companies from diversifying into the market.

TABLE 17.2:

PROFIT MARGIN* FOR THE THREE MAJOR MANUFACTURERS OF STANDARD INDUSTRIAL CRANES

	1968	1969	1970	1971	1972
Herbert Morris	5.7	2.8	-0.6	4.0	6.6
Matterson	0.6	-2.0	-0.2	2.1	6.6
Demag	-6.8	0.0	1.4	3.1	5.4

* Profit/Sales

Source: Company Accounts.

The market leader is Herbert Morris with a 30% share of sales. They are an old established engineering company with a turnover in the range of £11 million in 1973; they were the first company to begin serious production of these standard types of cranes, and introduced their 'Universal' range in the mid 1960s. The design sold well because of the ready availability of cheap cranes with a variety of capacities and spans.

Matterson soon followed suit introducing their 'Spacefinder' series in 1969/70. Components are produced in quantity and then assembled to order in similar fashion to Herbert Morris. This company now has 20% of the market.

The two British companies are followed closely by Demag, the German company who began manufacturing E.O.T. cranes in Britain in the 1960s. This company could be described as an 'aggressive' competitor, not being afraid of price-cutting tactics. Their market share is around 20%. The top three firms then account for around 70% of sales.

The remainder of the market is shared between twenty manufacturers. J.H. Carruthers & Company have made significant advances since the introduction of their 'Monobox' range which proved to have a great market

potential. Other competitors include Acrow Crane & Hoist, John Smith (Keighly) Ltd. and A.S.E.A., the Swedish Electrical Company who also manufacture hoists. Many of these manufacturers also produce the heavier type of custom built industrial cranes. Matterson moved into this section of the market in 1974 when they took over Dexion Warton Cranes Ltd.

Specialist Land Cranes

The specialist overhead cranes (costing as much as £1 million) have a much higher unit value than the standard industrial crane. They are all built to specific order requirements. The goliath and semi-goliath cranes are used outside in both docks and railyards; the very large type of E.O.T. cranes are used in steelworks. The uses for these types of crane are many and manufacturers tend to specialise in specific types.

Concentration in this market has changed considerably as a result of the takeover, by Clarke Chapman, of both Sir W.M. Arrol and Clyde Crane & Booth, in 1968, with assistance from the Government sponsored Industrial Reorganisation Corporation. This merger is discussed in greater detail in Chapter 18.

TABLE 17.3:

RELATIVE SIZE OF COMPANIES

	1968 Turnover (£ '000)	1969 Turnover (£ '000)
Sir W.M. Arrol	5,623	-
Clyde Crane & Booth	2,550	-
Clarke Chapman	17,443	28,100

Source: Company Accounts.

In 1969 Clarke Chapman also took over the crane interests of Wellman Engineering Ltd. Clarke Chapman were a large diverse engineering company who prior to 1968 manufactured jib marine cranes and some lightweight E.O.T. cranes. In less than a year after entering the sector the company gained approximately a 70% share of the specialist land crane market.

However, major competitors have survived alongside the new combine. Adamson Alliance, who manufacture steelwork, dockside and container cranes, have increased their turnover from £1 million in 1968 to nearly £2½ million in 1972. This is a much better growth record than companies of a similar size in the standard industrial crane sector. Matterson's turnover rose from £½ million to £1 million over the same period. It is difficult to compare the growth rate of Adamson Alliance's turnover with that of Clarke Chapman. The latter merged with the boilermakers, John Thompson Ltd., in 1970, with a resulting increase in turnover from £28 million in 1969 to £98 million in 1970. Craven Brothers, a Herbert Morris subsidiary, also manufacture steelwork cranes. They have been little effected by the Clarke Chapman merger since they produce cranes of a lower lifting capacity. Butterley Engineering also produce cranes for the steelworks industry, but these are often highly specialised, such as ladle cranes and scrap charging cranes rather than the huge E.O.T. variety. The high degree of product specialisation in this section of the market helps to ensure that survival of these smaller companies alongside the major manufacturer, Clarke Chapman Ltd.

There is little threat from foreign competition since most of the output in this sector is sold to nationalised industries. However, British Rail have bought from foreign manufacturers; in 1973 they bought a large Finnish container crane.

There are greater export opportunities available for manufacturers of these specialist cranes, than for the standard E.O.T. crane manufacturers. This is because of their higher level of engineering expertise. Although the European market is marked by strong national manufacturers, there are export opportunities in the developing countries. Here companies like Clarke Chapman meet strong competition from their counterparts in Germany, Japan and the U.S.A. The Japanese and Germans are thought to be particularly keen to develop these markets because of the saturation of their domestic markets and resulting excess capacity.

JIB MARINE & DOCKSIDE CRANES

The output of this sector is, again, diverse; some specialist overhead crane manufacturers also produce specific jib cranes. The cranes are

all made to order and each manufacturer seems to specialise in a particular field. Stothert & Pitt are the only regular manufacturer of the dockside jib gantry cranes; Clarke Chapman will manufacture this type of crane but tend to leave the market to Stothert & Pitt who have the specific experience. Clarke Chapman concentrate on the manufacture of overhead travelling dockside and container cranes. At one stage, when demand was falling, Herbert Morris and Butters Cranes ventured jointly into Sothert & Pitt's market, but their lack of experience was a great handicap.

There is a high degree of international specialisation in this sector. The market is not merely the U.K. but world-wide. Haggland is the world leader in the manufacture of deck marine cranes; they have an automated plant in Sweden producing in excess of 200 units per annum. Clarke Chapman also produce these types of cranes, but their volume of sales in this sector is much smaller with higher costs of production.

The North Sea oil boom has provided a new market for specialist jib cranes, but historical American dominance in this field has made entry by U.K. manufacturers difficult. Customers like the American dominated oil exploration companies tend to buy from their traditional suppliers with technical and production capabilities. American Hoist & Derrick have benefitted considerably from this.

PRICING

As most cranes and their associated equipment are sold through a process of pricing for each specific contract, it is difficult to assess the degree of price competition. In bidding for a contract it is not only the price which is important but also delivery time, and evidence and guarantees of quality. Manufacturers in all the sectors of the crane market emphasise the competitiveness of their markets perhaps without distinguishing very clearly between price competition and rivalry on other dimensions.

Pricing in the industry has traditionally been based on a cost plus formula, with demand conditions having little influence on prices. This stems from the days when the U.K. market was unique and separate from

international forces, when crane manufacturing was dominated by engineering and production considerations. Patterns of trade have changed radically over the last two decades, and the traditional organisation of the industry has been radically affected by the need to actively market its products against international competition. The bigger companies, at least, have acquired a marketing orientation which reflect foreign competition, static U.K. markets and rising costs.

The combination of a static U.K. market and the existence of numerous small companies has led to difficulties in the standard industrial crane sector. Below capacity working leads to price-cutting tactics, magnified by the tail of small companies who maintain a precarious existence when demand is static or falling. The consequence is thought in the industry to be a form of 'destructive competition' where low prices over many years have been reflected in low profitability, relatively little investment and a resulting inability to reduce unit costs and restore profit margins. Some manufacturers, like Herbert Morris, actively differentiate their products by emphasising quality and reliability and even by different methods of packaging smaller pieces of equipment. There has certainly been a drive to identify users and buyers of equipment and to design and market to those specific people.

Haggland, the world leader in marine crane manufacture, sell specialised crane attachments for different types of cargo. Herbert Morris have a subsidiary - Crane Aid Services - which services all types of electric overhead travelling cranes. These two examples reflect the trend towards direct assessment of market needs.

The future prospects for the downward spiral of prices, profit and investment is not clear at the present time. There are indications that a type of oligopolistic price leadership exists in standard cranes. In other sectors one cannot readily generalise.

Steelwork crane manufacturers have also been conscious of low profit margins, being recently caught between fixed price contracts and high inflation. Generally the prospects for steelwork cranes are good thanks to the British Steel Corporation's £4 million investment programme. The mergers involving Clarke Chapman in 1968 appear to have circumvented the type of destructive competition found in standard industrial cranes.

Mobile crane manufacturers sell their hydraulic truck mounted cranes to large plant hire companies. The latter seem to act as a source of countervailing power in price negotiations and it is difficult to identify any degree of monopoly pricing in spite of Cole's dominant position. Manufacturers of crawler mounted cranes are also dealing with large customers in the form of the major civil engineering companies.

PRODUCTION METHODS IN THE CRANE INDUSTRY

Economic analysis tends to concentrate on allocative efficiency and assumes technical efficiency. But only in few cases is the latter likely to be achieved. In most of the plants visited several products and variations of the same product are produced in the same factory; this is wasteful of capacity and can lead to a great deal of technical inefficiency because of the ensuing complexities of production planning and control. It implies that substantial economies could be achieved by better standardisation of product or, alternatively, investment in capital intensive methods of planning and control (e.g. computer based loading systems or numerically controlled machine tools). But how far this is possible depends on the size of the U.K. market, and the impression one gains is that for many types of crane this would probably be too small. If exports could be increased significantly this type of product standardisation or production control might be economical. There does seem to be perhaps some trend towards this in the higher degree of international specialisation that is appearing in the crane industry world-wide.

It is very difficult to make any assessment of production methods on a short one-day visit to a plant. Many companies do in fact seem to have undertaken fairly recent product rationalisation with a reduction in the number and variety of different products produced. Most companies have standardised spare parts. The largest plant manufacturing cranes in the U.K. belongs to Coles; their plant at Sunderland covers approximately 112 acres and employs 2,600 people, and undertakes the entire fabrication of the telescopic boom crane. But Coles have several other plants in the U.K.; one at Grantham producing the rough terrain cranes and another near Manchester producing the Colossus range. Clarke Chapman, the largest crane manufacturers in the U.K., has a divisionalised structure with strong central financial and, to a lesser extent, marketing functions. The divisions are based on the pre-merger company identities with greater product specialisation and a more balanced capacity utilisation.

ANNEXE 17.A: COMPETITION BETWEEN MOBILE CRANE MANUFACTURERS

Parent Company	U.K. Manufacturers	Truck Mounted Cranes (up to 25 tonnes)	Truck Mounted Cranes (25 - 50 tonnes)	Truck Mounted Cranes (over 50 tonnes)	Wheeled Mobile (up to 15 tonnes)	Wheeled Mobile (over 15 tonnes)	Rough Terrain	Crawler Mounted
George Cohen 600	British Hoist & Crane Co.	x			x		x x	
" " "	Jones Cranes		x		x	x		x
Acrow	Coles Cranes	x	x	x	x	x		
"	Priestman Bros.							x
Grove U.S.A.	Grove Allen	x	x	x			x	
Thos Ward	T. Smith & Sons (Rodley)	x	x				x	
Central & Sherwood Trust	Ransomes-Rapier				x	x	x	x
Bucyrus-Erie U.S.A.	Ruston-Bucyrus		x			x		x
Minor Companies	Henry Gooch				x			
" "	G.E. Macpherson				x		x	
" "	Handimer	x						
" "	Hydrocon	x						
Major Imported Cranes								
American Hoist & Derrick			x	x		x		x
Manitowoc								
Gottwald		x	x	x				
Demag		x	x	x	x	x		x
PPM		x	x					
Pettbone				x			x	
Link Belt		x	x	x		x	x	x

Source: Cranes Today Handbook.

CHAPTER 18 - MERGER ACTIVITY AND THE I.R.C.

The main reason for undertaking this more detailed review of the crane industry is the change in structure sponsored by the U.K. Government through the Industrial Reorganisation Corporation. The I.R.C. was created by the Labour Government in 1966 to promote mergers which would rationalise and make more efficient British industry.

> "The need for more concentration and rationalisation to promote the greater efficiency and international competitiveness of British industry, which was emphasised in the National Plan, is now widely recognised. With the co-operation of financial institutions, many industries have already substantially altered their structure and organisation through mergers, acquisitions and re-groupings. This process has been accelerating in recent years and may be expected to continue. Nevertheless, the pace and scale of change do not yet match the needs of the national economy."(1)

This description of the rationale of the I.R.C. goes on to say that British production units are smaller than those of competitors, that the U.K. market base is too small, economies of scale are not achieved, research and development is not effective, etc. The nub of the argument is that the relevant measure or yardstick for industrial organisation is an international market and not a U.K. market. In the U.K. situation there exists a confusion arising from the differing disciplines exerted by U.K. market forces and international market forces, and industry can find it difficult to organise for a U.K. market and yet remain competitive internationally. On the grounds that the converse is likely to be true, the I.R.C. was intended to be a catalyst for reorganisation of specific industries onto a larger scale.

The I.R.C. assisted in mergers between some of the largest firms in British manufacturing. For example, the British Leyland Motor Corporation was created in 1968 by an I.R.C. financed merger between Leyland Motor Corporation and British Motor Holdings. There is no public investigation of major I.R.C. mergers, for example by reference to the Monopolies

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(1) "Industrial Reorganisation Corporation", London, H.M.S.O. Cmnd 2889, 1966, (Para. 2).

Commission, and so there is no discussion of the advantages that the increase in concentration may or may not bring.

The units created in the crane industry were nothing like as large as B.L.M.C. and have not suffered similar management problems. But it is interesting to investigate the advantages that have been realised, if any.

The land crane market was one area that the I.R.C. picked as one requiring rationalisation. In 1968 Clarke Chapman, a diverse engineering company manufacturing marine cranes and some light weight E.O.T. cranes, acquired Clyde Crane & Booth Company Limited and then bought Sir W.M. Arrol of Glasgow, one of the U.K.'s largest crane manufacturers making heavy cranes for steelwork, shipbuilding and dockyards. In 1969 the crane interests of Wellman Engineering were incorporated in the Clarke Chapman Group. The new Clarke Chapman had achieved a 70% share of the land crane market, in less than a year after entering it, aided by a £2 million Government loan.

It is seven years now since the merger took place and no great rationalisation of production has occured. One crane factory was closed during 1972 and other factories increased their output, but the three companies still operate as separate corporate identities, producing at the same locations, but no longer compete with each other for contracts. Marketing and selling have been centralised. Although not directly responsible for marketing, the companies still have to operate as profit centres and are subject to close financial control by their parent company. It is very difficult to analyse the effects of the mergers because Clarke Chapman only publish one set of consolidated accounts; moreover, in 1970 they took over John Tompson Ltd., a large U.K. manufacturer of power plants. The company's turnover rose from £13 million in 1967 to £98 million in 1970, the increase being very largely due to acquisitions rather than internal growth.

One of the aims of the I.R.C. mergers was to promote a good export performance. In 1968 Sir William Arrol had an export turnover percentage of 30% and Clyde Crane & Booth 21%; Clarke Chapman do not seem to have improved significantly on this. The exports of their crane and bridge

division were 21% of the total sales in 1972, 22% in 1973, and 27% in 1974. There may be other additional returns available to the company because of its large absolute size. Clarke Chapman themselves mention the ability to smooth capacity utilisation by sub-contracting between plants, assisted by common design for standard parts such as gear boxes, Any advantages in economies of scale of production that may be obtained from a large plant are thought to be offset by the management problems that arise in controlling the larger workforce.

The merger at the mobile end of the crane market was less significant. In 1966 Coles Cranes, the major U.K. manufacturer of mobile cranes, became part of the Steel Group. Priestman Brothers, the crane and excavator manufacturer, came under common ownership with Coles in October 1969. This is the only other I.R.C. promoted merger in the crane industry. The crane interests of Priestman and Coles were quickly integrated, but since 1972, when the Steel Group was take over by Acrow, the two companies (Coles and Priestman) again became two separate corporate identities operating autonomously.

The only other major merger resulted in the creation of Grove Allen in 1973 from Allens of Oxford and Groves of the United States. For years before the merger Groves had been supplying cranes for which Allens made the chassis. Since the merger the group has been expanding at both factories in America and in Oxford.

There have been several ownership changes over the period: in 1973 J.H. Carruthers, who received the Queen's Award for Industry after the introduction of their mono-box type of overhead crane, became part of Burmah Oil Engineering Division. Ransomes Rapier was part of Newton Chambers, which has been taken over by another industrial holding company - Central & Sherwood Trusts Ltd. Matterson, the overhead crane manufacturer, became part of the William Hudson Group in 1971. Matterson seem to have benefitted from this move by gaining access to more financing and to the specialised legal and financial advice from the group; also there does not appear to have been any major loss of independence for the company. Carruthers also found they were able to expand production capacity at a faster rate than if they had still been an independent company.

In 1974 Matterson took over Dexion Warton Cranes for a very limited nominal value. The latter had been making substantial losses and would otherwise have gone into voluntary liquidation. They manufacture large custom built E.O.T. cranes, an area in which Matterson were interested. Matterson's major limitations had been lack of manufacturing capacity; Warton's plant is located under twenty miles away from Matterson's own plant. Matterson would not have been able to consider such a merger if they had not had the backing and encouragement of their parent group.

The level of concentration in the crane industry, therefore, has increased considerably since 1968. Without access to privately held information on the relationship between costs and prices and the achievable economies of scale, it is impossible to make definitive statements about the potential and actual exercise of market power.

CONCLUSIONS

It is appropriate to conclude by summarising the main points:

(1) Concentration has increased.

(2) The Government has been party to this increase.

(3) Technical economies of scale are very likely to exist.

(4) The market is increasingly characterised by large sellers and large buyers, a bilaterial monopoly in some cases.

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