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Diversification and Performance in the UK Defence Industry

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ABSTRACT

This article examines the relationship between diversification and performance in the UK defence industry. The theoretical arguments which have been advanced to support a general link between diversification and performance are examined together with an assessment of their applicability to the defence industry. This is followed by an empirical analysis of over seventy leading UK contractors. It is shown that there is no evidence to suggest that product diversification has had a positive impact on performance and some evidence of a negative impact. Geographical diversification, however, appears to be related to asset and sales growth.
INTRODUCTION

The ending of the Cold War has had major implications for the UK defence industry. Real defence spending has fallen by over 20% since the mid-1980s and many important contracts have been delayed or cancelled. The problems facing the defence sector have been exacerbated by the move to a more competitive procurement system which represents a significant break with the relatively stable and cosy traditional arrangements involving cost-plus contracts and non-competitive tendering. As a consequence, there has been a major restructuring of the industry characterised by substantial job losses and a series of mergers, take-overs and plant closures. At a policy level, there has been considerable debate concerning the extent to which the state should manage the process of change. Thus, whilst the government has generally adopted a hands-off approach to the restructuring process, many commentators have called for a more interventionist approach within the context of a strategic policy for the industry.

For many defence contractors, an important response to the recent changes has been a serious consideration of an expansion of business within civilian markets. However, the merits of such civilian diversification have been a subject of contention. Some have argued that diversification is unlikely to succeed given the vast difference that exists between the mechanisms of doing business in civilian and defence markets. An alternative view is that diversification is essential for many firms given the long term decline in the UK defence market. Unfortunately the debate is difficult to resolve given a lack of comprehensive information concerning the extent of recent diversification in the defence industry and the relationship of diversification to performance.
This article examines the relationship between diversification and performance in the UK defence industry from both a theoretical and empirical perspective. First, the general theoretical arguments which have been advanced to link diversification to performance are examined together with an assessment of their applicability to the defence industry and a brief examination of the existing empirical evidence. This is followed by a new analysis of recent trends in diversification and performance amongst a sample of leading UK defence contractors derived from the DATASTREAM financial database. It is shown that there is no evidence to suggest that product diversification is associated with a major improvement in performance and there is some evidence of a negative impact. In addition, the analysis shows that geographical diversification is associated with firm growth. Finally, the article concludes with an examination of the policy issues raised by the evidence presented in the article.

THEORETICAL CONSIDERATIONS

The theoretical links between diversification and performance have been widely discussed by economists and specialists in strategic management. A common argument is that diversification may improve performance by allowing the realisation of economies of scale and scope. Thus, to the extent that diversification increases the size of a firm it may reduce unit costs by allowing fixed assets to be spread across a higher level of output. Alternatively, increasing the scope of the firm may allow a firm the opportunity to exploit the commonalities which exist across different businesses. This latter idea is closely related to the managerial concept of synergy in which the impact of two businesses operating jointly is greater than the sum of their individual parts.
Whilst the existence of economies of scale and scope is clearly plausible, it is often argued that the realisation of such cost savings depends upon the degree of relatedness between a firm's new and old businesses. A key issue is the extent to which a firm's assets of labour and capital can be utilised in new ventures. If a firm’s production technology can easily be adapted to produce new products then scale economies may be realised from the increased output arising from diversification. Moreover, economies of scope may arise, for example, from the ability of the firm to transfer the accumulated experience of working with this technology to the new market. Similar advantages may accrue from the ability to sell new products to existing customers as the firm is likely to be able to exploit its existing market knowledge.

In addition to relatedness in technology and markets, a key asset which many management theorists have argued is crucial to the success of diversification is the scope of skills possessed by existing managers. According to Prahalad and Bettis, for example, businesses possess a dominant managerial logic which encompasses “the way in which managers conceptualise the business and make critical resource allocation decisions.” Very argues that the important factors governing the transferability of this logic are similarities in key-success factors and the nature of competition in existing and new business areas. However, whilst such factors may aid success, Backaitis et al. argue that exploitation of the opportunities of synergy and scope are not automatically realised but require conscious effort by management teams.

The above arguments clearly imply that diversification into unrelated businesses is a potentially hazardous and costly exercise. Diseconomies of scope, for example, may arise if managers attempt to operate businesses which require distinctively different competencies.
Moreover, if diversification involves growth, it may result in managerial diseconomies of scale due to the disproportionate increase in the management time required to operate the new complex business. There are of course potential mechanisms to overcome these difficulties, for example, by creating decentralised management structures or acquiring existing expertise in new areas through merger or acquisition.\textsuperscript{10}

An alternative view of diversification is that it may raise profits by reducing competition rather than enhancing efficiency. Traditional arguments have concentrated upon the ability of large diversified firms to engage in anti-competitive practices such as cross-subsidisation, predatory pricing, reciprocity in buying and selling and raising barriers to entry.\textsuperscript{11} However, recent discussion has centred upon the role of diversification in increasing the likelihood of multi-market contact amongst firms. This approach argues that the greater the number of markets in which two firms interact, the more they will recognise their mutual interdependence and the greater the likelihood of implicit or explicit collusion aimed at increasing profits.\textsuperscript{12}

The issue of relatedness may also be important for arguments concerning the relationship between diversification and market power. Encaoua \textit{et al.}, for example, demonstrate within the context of a simple model of oligopoly, that diversification into a market for a good which is a substitute from the consumer’s point of view will raise a firm’s market power and tend to raise profits, whereas diversification into the market for a complementary good will tend to reduce market power and profits.\textsuperscript{13} Intuitively, the argument is simply that control over the output of a substitute good may allow the firm to co-ordinate optimal price and output decisions thereby gaining greater effective control over the original market.
In addition to the search for market power and efficiency savings, the reduction of risk has also been widely discussed as an important motive for diversification.\textsuperscript{14} Clearly, if a firm diversifies into a market in which profit streams are imperfectly correlated with those arising from its existing business, this will inevitably reduce the variability of the diversified firm's profits. However, given that shareholders can reduce risk by diversifying their portfolio of shares, such product diversification is now generally held to be associated with managerial motives. Amihud and Lev, for example, have argued that managers are primarily concerned with maintaining incomes and security of employment.\textsuperscript{15} Thus, when shareholder control is weak, they may seek diversification to reduce profit variability and hence the risk of job and income loss arising from poor performance. Of course, such risk reduction may be purchased at the expense of a fall in expected average profits and hence diversification could have a negative effect upon performance.

An alternative managerial approach to diversification arises from the observation that manager controlled firms may be more interested in sales growth than profit maximisation. Mueller, for example, has suggested that growth may provide a range of pecuniary and non-pecuniary benefits to managers.\textsuperscript{16} Thus, diversification may be seen as a mechanism for achieving such growth when existing markets are stagnant. Again, however, such growth may be at the expense of profits and suggests a negative correlation between diversification and performance.

Although many studies view diversification as a growth strategy, an alternative approach argues that diversification is primarily a defensive reaction to falling profits arising from the decline of existing markets. Indeed, Kastens has argued that diversification is usually a negative strategy involving a company trying to avoid fundamental problems in its basic
operations. A more positive view of such defensive diversification, however, could be based on the idea that diversification permits the further utilisation of surplus assets arising from market decline. Such a strategy may be preferable to reducing the size of the existing business as it may be difficult to dispense with large scale fixed assets and average costs may rise significantly if they are not utilised at a high level. The strategy may hence enable a company to avoid the fall in profitability which would otherwise occur.

The empirical evidence concerning the impact of diversification on performance has yielded conflicting results and there are differing interpretations of the current state of knowledge. The current dominant view is summarised by Besanko et al. who state that “Research on the performance of diversified firms has shown mixed results. Where diversification has been effective, it has been based on economies of scope among businesses that are related in terms of technologies or markets. More broadly diversified firms have not performed well...”

Thus, the received wisdom, to the extent that there is one, suggests that there is no real evidence of a link between diversification and performance per se, but that firms who diversify into related markets or products often achieve a significant improvement in performance. In addition, Clarke (1985), concludes that there is some evidence of a link between manager control and diversification although further work is required for definitive results. Finally, research by Scott, and, Hughes and Oughton has found that multi-market contact has a positive impact on profitability. Interestingly, the latter study finds a negative impact of diversification per se on profits and speculates that this may imply some risk-profit trade off, which would support the managerial view of diversification.

The above considerations raise a number of interesting issues for the analysis of the defence industry. First, it is generally agreed that the defence market has many unique features and
does not operate under the same conditions as most commercial markets. Thus, it could be argued that management of a large defence firm is likely to have involved the development of a particular logic of management which is not easily transferable to other areas of business. Similarly, the high technology nature of much defence work, often involving small scale production of expensive items is far removed from the mass production involved in many consumer markets. There is also a vast difference between selling goods to a range of individual consumers or firms and selling to a single political customer as in the defence market. Thus, defence assets may often be highly specific and substantial barriers may have to be overcome to enable successful diversification. A corollary of this is that a move into new defence markets, perhaps through geographical diversification into overseas defence markets may more easily allow the exploitation of existing skills and competencies.

Managerial theories of the firm, emphasising the ability of managers to use their power to pursue their own objectives such as risk reduction are generally thought to be most relevant to large oligopolistic firms characterised by a divorce of ownership from control. The conditions prevailing in the defence market would seem to be very favourable to the development of managerial control. Many areas of defence production are dominated by one or two major firms and traditionally high profits have created the conditions in which non-profit-maximising behaviour might be plausible. Given the uncertainty created by recent changes in the defence market and the reduced prospect for defence sales growth it seems reasonable to hypothesise that risk reduction or sales growth may be a major motive for diversification in many defence firms. Defensive motives for diversification are also likely to be of some relevance as defence firms seek uses for surplus assets created by falls in defence demand.
Thus, it appears likely that diversification by defence firms into civilian markets will frequently require a major change in the logic of management, reflect managerial motives and be defensive in nature. If this is the case then it is unlikely that diversification will be associated with improvements in performance. A possible counteracting tendency, however, is the potential ability of large defence contractors to extend their market power into new markets through anti-competitive practices, multi-market contact or collusion. Indeed, given the close relationships which often exist between defence firms used to collaborating on major contracts, it is quite plausible that collaboration may be extended to new markets. The net effect of all these factors is difficult to predict and clearly highlights the need for detailed empirical work.

THE DATASTREAM DATA

An empirical study of the links between diversification and performance in the UK defence industry is hampered by a lack of data. There is no official SIC (Standard Industrial Classification) category for defence firms and such firms are, therefore, spread across a wide variety of industrial categories. However, the UK MOD regularly publishes a list of major contractors and data on many of these firms is available from the DATASTREAM financial database. Unfortunately, the data only covers quoted companies and this together with gaps in the data restricted the present study to a sample of 72 contractors. Nevertheless, virtually all the major core UK contractors were included in the sample, which represents companies accounting for a large proportion of defence procurement expenditure. The time period selected for the study was 1991-1995. This was the period when defence cuts began to bite most severely in the UK and when many contractors were involved in substantial restructuring. A longer period would have further restricted the sample.
The measurement of diversification is a problematic exercise and many alternative measures have been proposed in the literature. For the purposes of this study two widely used indices were utilised - the diversification index (D) and the number equivalent Berry index (B). The D measure is simply defined as 1 minus the proportion of sales accounted for by a firm’s largest 3-digit SIC sales category. Thus, if 90% of a firm’s output is sold to the aerospace industry, the diversification index is simply 0.1. A high D hence represents a relatively diversified firm. Clearly, this index has the virtue of simplicity and ease of calculation. However, it only includes information on the firm’s largest sales area and omits information on the distribution of sales across other SIC categories. Given this limitation, the alternative Berry index was also calculated. This is defined as the reciprocal of the sum of the squared market shares of the firm in all 3-digit SIC categories. Thus, if a firm sells 50% of its output in each of two industries, the Berry index would be the reciprocal of \((0.5)^2 + (0.5)^2\), i.e. 2. This number equivalent index is useful as it can be interpreted as the number of industries operated in by an equally diversified firm. Thus, an index of two implies that the firm’s level of diversification is equivalent to operating equally in two industries. The process of squaring also ensures that extra weight is given to the firm’s principal activities. It should of course be noted that neither index can reflect the extent to which changes in diversification are related to changes in sales within civilian or defence markets as the basic data makes no distinction between such markets. All that is being measured, therefore, is the overall extent of diversification of the sample firms.

In addition to providing data on the industrial sales of the sample firms, DATASTREAM also supplies a geographical breakdown of sales. It was hence possible to construct indices of geographical diversification using the D and B measures outlined above. In order to do this
sales were allocated to eight broad geographical areas. A high level of these indices hence indicates a wide geographical dispersion of sales.

The starting point for the analysis of the sample was to examine the extent to which the defence related companies had been involved in diversification over the period 1991-1995. Table 1 provides information on the mean level of diversification in the sample in 1991, 1995 and the proportionate change over this period. Perhaps surprisingly, the calculations reveal that the average company has reduced its level of product diversity by 5% or 9% depending upon the particular index examined. However, there is evidence of a significant increase in geographical diversity of 13% using the B index and 19% using the D index. This suggests that UK companies have been pursuing the option of increasing exports as their primary response to changes in the defence markets rather than engaging in major programmes of product diversification.

Of course, the average data presented in Table 1 obscures the distribution of changes in diversification across the sample. Table 2 hence shows the proportion of firms which have increased or reduced their index of defence diversification by 20% or more. It can be seen that almost 25% of firms have become significantly less product diversified whichever index is used. However, a much smaller proportion have become significantly more product diversified. The reverse is clearly true for geographical diversification, again lending credence to the notion that diversification into new overseas markets has been a major strategy of the leading defence contractors.

Whilst the D and B indices are useful measures of overall diversification, they make no distinction between related and unrelated product diversification which both theoretical considerations and previous empirical studies suggest is important. In order to examine this
issue, two further measures of diversification were hence calculated. These are based upon two measures calculated by Varadarajan in his study of major US manufacturing firms. The first of these is *broad spectrum diversification* which is simply defined as the number of 2-digit industries in which a firm operates. An increase in broad diversification indicates that a firm is moving into distinctly different industrial sectors and can be construed as being an approximate measure of unrelated diversification. The second measure is *mean narrow spectrum diversity* which is defined as the number of 3-digit categories the firm operates in divided by the number of 2-digit categories. An increase in this narrow measure indicates that a firm is on average operating in more 3-digit categories within each 2-digit category and is hence increasing its average level of related diversification. It should be noted that Varadarajan uses 4-digit industries rather than 3-digit industries in his measure, but these were not available from DATASTREAM. This clearly limits the ability of the present measure to pick up changes in related diversification.

Table 3 shows the proportion of firms which have become more or less diversified according to the two spectrum measures. It can be seen that the vast majority of firms register no change in these indices and only a small proportion were becoming more diversified. Interestingly a significant minority of firms were becoming much less broad in the range of industries served but a much smaller proportion were becoming less diversified according to the narrow measure. Thus, firms reducing their level of diversification were more likely to be completely withdrawing from 2-digit industries than reducing their average level of related diversification. Of course, the relatively small number of firms which registered any change in these two indices implies that these conclusions should be regarded as somewhat tentative.

**DIVERSIFICATION AND PERFORMANCE**
Before directly examining the relationship of diversification to performance, it is useful to put this into context by comparing the performance of the sample of companies to other major UK companies. Given that the sample only contains quoted companies, a convenient method is to compare the market capitalisation weighted share price performance of the sample to that of the FT (Financial Times) All Share Index of leading companies. Figure 1 shows the long term picture from 1970 onwards, whilst figure 2 gives a more detailed picture of the sample period 1991-95. It is interesting to note that the share price of defence companies roughly tracks that of the All Share Index until the late 1970s when it begins to lag behind, suggesting a serious deterioration of performance in the 1980s. This period of poor performance coincides with a sequence of major changes in the industry including privatisation in the early 1980s, the introduction of competitive tendering in the mid-1980s and the changes in Eastern Europe towards the end of the decade. However, during the 1990s, there again appears to be an approximate correspondence between the two indices. This suggests that the major contractors have successfully adapted to the new conditions despite the fall in real defence expenditure they have faced in recent years. The previous analysis indicates that one potential explanation for this could be the widespread move into new overseas export markets.

An analysis of the link between diversification and performance is potentially complex as there are likely to be many factors other than diversification which affect company performance. However, given the small sample size of the present study and the limitations of the DATASTREAM data, the testing of a multivariate model was not possible. The approach adopted in this study is, therefore, simply to look at the correlation between changes in the diversification indices and changes in performance over the sample period. Clearly, such an approach can only offer a preliminary understanding of the link between
diversification and performance, but, given the relative paucity of information on the defence industry it provides a useful starting point. Moreover, many of the other factors which affect performance may be relatively constant over this short period of time.

Previous studies of the link between diversification and performance have used a variety of different performance indicators. Table 4 hence examines the correlation between changes in the B and D indices of diversification and changes in three commonly used measures of profitability - the return on equity, the return on capital employed and cash earnings per share. In addition, given the potential importance of managerial motives, sales and asset measures are examined. The growth of sales per employee, which is a measure of productivity, and, the change in the company share price, a measure of the market valuation of the company, are also considered.

As far as product diversification is concerned it can be seen that there is a significant negative relationship between changes in the diversification indices and performance for two of the three measures of profitability. This lends credence to the hypothesis that the particular conditions prevailing in the defence market are unlikely to make diversification an easy route to improved performance. This is also reflected in the negative relationship between diversification and the productivity and share price measures. However, care must be taken in interpreting the evidence as simple correlation coefficients cannot indicate the direction of causation. It is plausible, for example, that it is the poorly performing companies who have been forced into product diversification in an attempt to prevent further declines in performance.

Interestingly, no significant relationship between product diversification and growth is indicated, as might be expected if product diversification was stimulated by managerial
motives. However, there is a link between the two measures of growth and geographical diversification using the Berry index. This suggests that companies seeking growth have tended to move into new overseas markets rather than enter new domestic markets. Whilst the data in the study precludes a detailed analysis of this issue, it is likely that in many cases this geographical diversification involves selling in overseas defence markets. Clearly, this may be seen by many companies as a less risky route to diversification than attempting to overcome the barriers to entry into civilian markets. Indeed, this seems to be confirmed by the absence of any significant relationship between geographical diversification and performance.

An examination of the correlation between changes in the degree of relatedness of product diversification and performance is difficult as most companies in the sample registered no change in the two spectrum indices over the time period of the study. It is, however, possible to examine the relationship between the level of spectrum diversity and performance in a static sense as there are wide variations in diversity across companies at any one point in time. Table 5 hence examines the correlation between relatedness and performance for 1995, the latest data point available for analysis. It can be seen that there is some indication of a relationship between diversity and performance. There is a significant negative relationship between broad spectrum diversity and the return on capital and a significant positive relationship between narrow spectrum diversity and performance. This tends to support the view of those who argue that relatedness is the key to improved performance from diversification. However, again the results have to be treated with caution as in each case no significant relationship was found between relatedness and two of the three measures of profitability. The only other significant finding from Table 5 is a relationship between company size and broad spectrum diversity, suggesting that larger companies are more likely to be diversified across a wider range of 2-digit industries.
CONCLUSION

The data examined in this study suggest that geographical diversification has been a more important strategy than product diversification for leading UK defence contractors in recent years. Moreover, there is no evidence to suggest that product diversification has had a positive impact on performance and there is some tentative evidence of a negative impact. Geographical diversification appears to be associated with growth and no deterioration of performance. There is also some suggestion of a relationship between diversification relatedness and performance. However, all these conclusions can only be regarded as preliminary, given the relatively small sample and limited methodology of the research. Nevertheless, the study raises a number of important questions and hopefully provides the basis for further, more detailed research.

One interesting issue arising from the above analysis concerns the extent to which the government should assist defence firms to diversify. In general, successive Conservative governments since 1979 have adopted a relatively hands off attitude to product diversification, arguing that such decisions are best left to commercial evaluation by private contractors. This policy has, however, attracted considerable criticism from those who argue that such firms require assistance to overcome the barriers to entry into civilian markets.27 The evidence of this study certainly suggests that diversification is a difficult exercise and it is possible that better performance could have been achieved with greater government assistance for retraining and diversification planning. However, the performance of companies in terms of relative share price movements suggests that companies have adopted overall strategies which have enabled a level of performance comparable to other UK firms.
Whilst the UK government has been reluctant to assist product diversification, it has been willing to promote defence exports and the UK has enhanced its position as a major arms exporting nation. The evidence of this study is generally supportive of such a strategy although in the long term overseas markets are likely to become increasingly competitive. Moreover, the study has been confined to large contractors which have probably long acquired considerable experience of working in overseas markets. Smaller contractors may clearly find the penetration of overseas markets a more difficult proposition. In addition, moral and strategic concerns regarding the appropriateness of sales to particular countries are likely to be the subject of continued debate.
Table 1: Mean diversification indices of sample firms

<table>
<thead>
<tr>
<th></th>
<th>D Index</th>
<th></th>
<th></th>
<th>B Index</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Diversification</td>
<td>0.32</td>
<td>0.29</td>
<td>-9</td>
<td>2.08</td>
<td>1.97</td>
<td>-5</td>
</tr>
<tr>
<td>Geographical Diversification</td>
<td>0.36</td>
<td>0.43</td>
<td>+19</td>
<td>2.31</td>
<td>2.61</td>
<td>+13</td>
</tr>
</tbody>
</table>
Table 2: Proportion of firms exhibiting major changes in diversification 1991-95

<table>
<thead>
<tr>
<th>% of firms</th>
<th>Product Diversification</th>
<th>Geographical Diversification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D Index</td>
<td>B Index</td>
</tr>
<tr>
<td>&gt;20% more diversified</td>
<td>13.8</td>
<td>0.02</td>
</tr>
<tr>
<td>&gt;20% less diversified</td>
<td>24.6</td>
<td>23.0</td>
</tr>
</tbody>
</table>
Table 3: Relatedness and diversification

<table>
<thead>
<tr>
<th></th>
<th>More diversified</th>
<th>No Change</th>
<th>Less diversified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broad Spectrum</td>
<td>10</td>
<td>66</td>
<td>24</td>
</tr>
<tr>
<td>Mean Narrow Spectrum</td>
<td>13</td>
<td>75</td>
<td>12</td>
</tr>
</tbody>
</table>
Table 4: Diversification and performance correlations*

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Product Diversification</th>
<th>Geographical Diversification</th>
</tr>
</thead>
<tbody>
<tr>
<td>(% Change 1991-1995)</td>
<td>D Index</td>
<td>B Index</td>
</tr>
<tr>
<td>Return on equity</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Return on capital employed</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Cash earnings per share</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total sales</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Total asset</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Sales per employee</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Share price</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*ns. = not significant; a plus indicates a significant positive correlation; a minus indicates significant negative correlation. All significance levels are at the 10% level.
Table 5: Relatedness and performance correlations in 1995*

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Broad Spectrum</th>
<th>Narrow Spectrum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on equity</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Return on capital</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>Cash earnings per share</td>
<td>ns</td>
<td>+</td>
</tr>
<tr>
<td>Total sales</td>
<td>+</td>
<td>ns</td>
</tr>
<tr>
<td>Total assets</td>
<td>+</td>
<td>ns</td>
</tr>
<tr>
<td>Sales per employee</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Share price</td>
<td>ns</td>
<td>ns</td>
</tr>
</tbody>
</table>

*see notes to table 3.
NOTES


8. Very, "Success in diversification: building on core competences".


27. Bishop, "Government policy and the restructuring of the UK defence industry".