

# **Industrial and Academic Collaboration: adding to Britain's value chain.**

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## **Abstract**

It is the purpose of this paper to set manufacturing into its historical and economic context and to explain the trends and issues that have led us to this conference. The implications of collaboration are explored both in the definition and the context of the national value chain.

## **Keywords**

Manufacturing, historical perspectives, value, value chain, joint research, economic outlook.

## **1 INTRODUCTION**

Predicting the future and giving guidance on potential collaborations between Industry and Academia is a difficult task, and perhaps better suited to ongoing

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debate in the Senior Common rooms of our illustrious Universities! The next three days of discussion will perhaps engender a broader understanding of issues at stake.

Adding value to raw materials and resources through human endeavour creates wealth and improves our standard of living. Whether this improves our quality of life or not is a more esoteric debate which is best left to sociologists and philosophers. Increasing wealth is a fundamental axiom of capitalism. In an era when funding for research must be justified in an economic context, whether from the Government or the Industrial sector, it is vital that our Universities and Research Institutions understand the mechanisms of our nation's value-added chain and direct their expertise towards improving our wealth. This can be achieved through applied research, 'Blue Skies' research and teaching: areas where Academia must, and indeed often does, excel.

## 2 MANUFACTURING- AN INTROSPECTIVE APPRAISAL

The importance of the manufacturing sector in the British economy is incontestable-

- 45% of foreign income stems from manufactured exports. (£111 billion of £252 billion in 1994)
- 53% of trade is with the EU (stabilised during the 1990's), with exports to the USA, Japan and Asiatic countries making up a further 26% (Wolf, '94).

To assess the current status of manufacturing we first need to examine the past.

### 2.1 Pre W.W.II

The advent of the industrial era saw a shift in the traditional structure of society from the 'mercantile' model to the 'industrial' one. The former's source of added value lay in the trading of goods, and power lay with those who owned property (i.e. shareholders). In the industrial model, the effectiveness of the industrial process determined the added value and power lay in the hands of management, rather than shareholders. Thus, the relationship between ownership and power changed.

Paralleling this was the principal of division of labour, which served to reduce the skills required in the process to improve efficiency and repeatability. The downside of this was the decline of the artisan- a worker no longer had to know the product in order to manufacture it: thus the concepts of ownership and responsibility declined amongst the workforce. This proved to be the domain of management, who had it as their brief to improve process efficiency- the workers adapted to the process. This form of management lent itself to a centralised form of organisation, which resulted in the concentration of suppliers close to the manufacturer.

### *2.1.1 Example*

By the mid-1920's Ford's River Rouge plant was the most integrated company in the world. The complex included virtually every element needed to produce a car: blast furnaces, an open hearth mill, a steel rolling mill, a glass plant, a huge power plant, 90 miles of railway tracks and conveyors and, of course, an assembly line. This epitomised mass production- an integrated self-sufficient complex where all tasks were designed according to the maxim of scientific management (Taylor) exhibiting both the efficiency of the mass production process, and simultaneously the lack of consumer choice and the mechanistic role which workers enacted (Ford, '98).

## **2.2 Post W.W.II**

Then came the era of the salesman. Rises in standards of living were reflected by the proliferation of consumer goods. Concerted efforts by companies to market their goods resulted in burgeoning overheads as customers were convinced to purchase their products. Although the customer benefited from increased choice, the prevailing attitude was that of the company knowing best. Competition was primarily carried out based on price differentiation- the 'hard sell'.

## **2.3 Post 70's recession to early 80's**

After the hike in oil prices, budgets were curtailed and companies try to consolidate to gain strength. The belief in the robustness of large vertically integrated companies, and companies with diversified portfolios prevailed. Efficiency of the process became important, along with the rise in importance of the logistics function. Employees were laid off as technology became the new Holy Grail of market share redemption. There came the dawning realisation that the markets were becoming global in their scope, and competition correspondingly more intense, due to growing dominance of the Japanese. Competition ceased to be regarded as industry specific- the concept of cross-industrial competition was explored as the larger companies embarked on the accretion of smaller companies to form conglomerates- "Big is beautiful."

### *2.3.1 Example*

Companies such as GM invested heavily in automation in the early 80's, with the expectation of cutting overall costs by reducing the component attributable to labour. In fact the cost of installation and maintenance of robots until their obsolescence far outweighed the cost of a labour force, because they were not suitable for short runs of varied products.

## **2.4 Early 80's to present**

The 80's will primarily be remembered as the time when 'quality' became a key issue. Techniques from Japan (which have many of their roots in the theories of the Americans Deming and Juran) were transferred in an attempt to address the gap in performance between the East and West. The concepts of Quality and Just-In-Time served to highlight key areas for improvement. These have been further refined and

adapted, so that TQM has been adopted by many companies, along with the ISO 9000 programmes. There has also been the development of semi-autonomous work groups, as process flexibility and group technology are implemented to satisfy increasingly demanding customers, which to some degree refute the principals adopted 50 years ago. The 'Voice of the Customer' also illustrates how companies now see themselves as enabling the customers to obtain the product suited to their needs, with initiatives such as Quality Function Deployment.

The current climate finds us in an aftermath of business process re-engineering- the main thrust of many current initiatives is the reorganisation of the enterprise to account for changes in technology, and indeed the overall structure of companies. Supplier interrelationships are 'in'- the networking revolution in IT is finding, or indeed fuelling a parallel in the realms of the marketplace. Companies compete in increasingly diverse markets where customer-order lead-times are crucial- developing the notion of "mass-customisation." As product development lead times become ever shorter, the day of the large conglomerate is over. The barriers to entry in many markets are reduced as small, highly specialised companies avail of the 'network' policy to provide a service at a competitive rate. The 'virtual enterprise' is here; in the dynamic climate of change the inertia of larger companies caused by bureaucratic systems which hold them in place proves too cumbersome- 'agility' is required.

## 2.5 Taking stock

The following points serve to provide a synopsis of Britain's economic position:

- The rise in manufacturing coincided with decline of agriculture as the basis of an operating social model. Although output from agriculture continues to rise, the number of people employed in this sector has constantly declined- Britain had the lowest share of civilians involved in agriculture (less than 5%) than any other OECD country by 1960 (Temple, '97). The current proportion is less than half this again (GIS, '98).
- In 1960 38% of the workforce were employed in industry. This has dropped to 20% in 1993 (Temple, '97). The decline in numbers can be attributed to the increases in productivity, and the continuous growth of the retail industry, an area used more and more to improve the comparative advantage of an offering to a market which demands increasingly specialised goods.
- Britain is the fifth largest global exporter of commercial services, which earn approximately £40 billion (Wolf '97).
- Manufacturing is critical to the UK, not only because of its role in the balance of payments, but also because it provides the impetus for technical change and innovation.
- Employment is decreasing in the manufacturing sector primarily due to increases in productivity.
- Investment continues to be lower in Britain than the OECD average in most industrial sectors. This is true both for capital investment, and R&D, despite increases in the latter- 6% of total value-added in 1993 (Temple, '97). The link between investment in research / capital and the rate of technical change and

innovation is crucial; this is underlined by the erosion of the wage differential between Britain and Germany.

## 2.6 Future

What does the future of manufacturing have in store? Technology is set as always to play a key role, but often the true benefits are not exploited.

### 2.6.1 Example

The Government (DTI) offered grants in the mid-seventies to those who use robots as part of the manufacturing process. In many cases the grants were used to set-up a conventional manufacturing facility, with the robot used for 'show', or assigned some simple, non-critical task.

This illustrates the potential mismatches- the development of 'islands of technology' within a company can hinder change by forcing a process to be designed around it. The same can be said to apply to systems as well as hardware.

The 'Factory for the Future' (DTI, '94) report cites the following factors as fundamental to a company's success:

- **Global competition-** Second and Third World companies are benefiting from markets that encourage innovation, quality, service and price competitiveness. The concepts which have developed (technological breakthroughs and IT infrastructures) are reducing the barriers to entry of many industries, rather than consolidating the major players' positions.
- **Demanding Clients-** the single-pronged approach to strategy- cost differentiation, product differentiation or target marketing (M. Porter, '85) no longer applies. The proliferation of goods providers and reduced design lead-times mean that the market is saturated quickly, and the intensity of competition and increased awareness of the customer forces a company to be proficient in all areas.
- **Fast Changes-** 'Change management' is a term that recognises the advantage of a firm's agility in the face of uncertainty. The prevailing attitude amongst world class companies is one of acceptance and opportunism. Change can provide a company with increased market share if it is quick to react. Reducing a company's inertia to change and ensuring that long-term strategies facilitate change to a greater degree will help a firm to consolidate and improve its stance.
- **Availability of Resources-** The implications of this are twofold:
  - The current global climate allows the migration of manufacturing resources to wherever they are needed. In addition to providing a potential worldwide customer/supplier network, this climate also enables Second and Third World countries to maximise the utilisation of their indigenous resources, namely labour and raw materials.
  - The issue of finite resources- awareness of this can stimulate research in alternatives, and also in maximising efficiency of use.

The report also places an emphasis on **Social Needs** and **Environmental Cleanliness**. Companies need to be more aware of the repercussions of their actions on the wider environment. The need to sustain resources has developed simultaneously with reducing the environmental impact of manufacturing. Design for recycling and reverse logistics are necessary if companies are to comply with take-back legislation, already being implemented on mainland Europe.

### 2.6.2 Example

Shell- demand for Shell petroleum products fell sharply in Germany following the revelation of the company's intention to sink the Brent Spar in the North Sea- despite the fact that ultimately this would have a minimal environmental impact. The negative publicity generated partially exacerbated the Company's subsequent perceived role in Nigerian politics.

## 2.7 To Summarise

The immediate future seems set to be the era of the Global and Extended enterprises. Competition will continue to intensify, and the abolition of Trade agreements will mean that developing countries will be able to take advantage of cheaper labour. The process of the transfer of technology and experience to these fledgling enterprises will provide opportunities to established concerns in the developed world. Responding accurately and rapidly to changing consumer demand will be coupled with the challenge of reducing inventory in the overall demand pipeline. The growth in the service sector, and the effect of this on the manufacturing, is also worth reiterating. The workforce directly involved in manufacturing in developed countries will continue to dwindle, but will become more skilled. Their ability to become 'multiskilled' will be a factor in ensuring that manufacture continues to play an important role here.

## 3 VALUE

An important measure of the performance of any company is the value of their proffered goods. Similar to all important measures, it defies description- but it has a part to play in some of the fundamentals of economic theory, such as the interaction between supply and demand, and transaction cost theory. A few literal interpretations are:

- A fair return or equivalent in goods, services, or money for something exchanged.
- The monetary worth of something; marketable price.
- Relative worth, utility, or importance.
- A numerical quantity that is assigned or is determined by calculation or measurement.

### 3.1 A Possible interpretation

Value can be construed as a measure of customer satisfaction- the willingness of the customer to part with finite resources for the utility which the product or service provides. This premium can be called the difference between worth and cost. Some factors that help determine both of these are listed in table 1.

Table 1 : Components of Value

<i>Worth</i>	<i>Cost</i>
(Inherent) Design	Administration
Reliability	Capital
Image	Resources
Quality	Logistics
Ease of Purchase	Material
	R&D
	Infrastructure
	Labour

Having arrived at a working definition of value, it remains to reconcile this with the concept of aggregating value at the corporate and industrial level. In his book 'Competitive Advantage', Porter describes the Value Chain specific to an individual company as

*'The disaggregation of a firm into strategically relevant activities in order to understand the behaviour of costs and existing and potential sources of differentiation' (Porter '85).*

This seems to refer more to the process of creating the chain, rather than a definition of the chain itself. Perhaps a more interesting (and less convoluted) concept is that of a value system. Porter aggregates individual Value Chains to create a link between the Suppliers and Customers of an industry. This is similar to defining the system as

*'The intermediate activities involved both directly and indirectly in the transformation of raw materials into the finished product in the domain of the Ultimate Customer.'*

Given these definitions, a twin strategy to reduce cost and increase worth in the activities involved in the value system seems conducive to improving the competitive stance of a company. The temptation is to concentrate on the former, since cost is usually more quantifiable. The two being equal, the generation of worth is more likely to prove of real value, since it contributes to product differentiation at a time when 'value for money' means that competing on cost is more of a qualifying criterion than a source of genuine advantage.

#### 4 ROLE OF ACADEMIA IN INDUSTRY

Few here will disagree with the fact that a fundamental factor in determining the success of any economy is the quality of the workforce. The principal remains the same at the micro-economic level. A company wants educated people with good communications skills, with an awareness of background issues (economic, environmental) and a systematic approach to problem solving. Collaboration by academia and industry to produce the kind of graduates required in industry is to be encouraged.

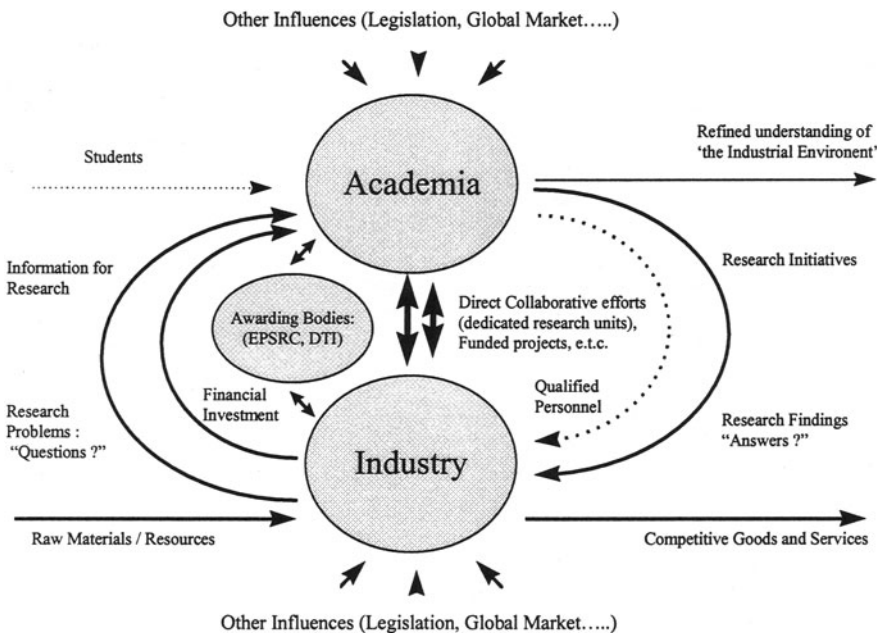


Figure 1: Interactions between Academia and Industry.

A recent survey (Rajan, '98) showed that small and medium enterprises (coincidentally the UK's largest growth sector for employment) regarded nine out



of ten graduates as lacking in business awareness. Whereas large companies have graduate training programmes, smaller companies expect graduates to learn 'on the job' - and are currently unhappy with the performance they are receiving. These companies tend not to cultivate direct relationships with universities due to their size, so problems such as this go unnoticed. Thus, the instillation of business acumen in graduates is an educational issue in much need of redress.

A close relationship in terms of research is also desirable. The links between universities and companies have increased in importance in the area of manufacturing- indeed the boundary between the two is blurred, with commercially funded research groups, and academics adopting roles in consultancy. The research can be divided into the theoretical and the practical- the practical is involved in solving industrial 'messes' (including problems both defined and undefined), and the theoretical provides a conceptual background for advances which will hopefully prove fruitful in the commercial world.

#### *4.1 Example*

Finite Element Analysis is a classic example of how universities developed an analytical tool from theory that became progressively more acceptable and available to industrial designers in many fields. Allied with the development of even more powerful computers, this powerful technique is used daily in a 'user-friendly' manner to solve problems related to structural, dynamic and thermo-fluid mechanics.

With the problems as previously highlighted; e.g. the focus of R&D traditionally on productivity growth rather than other factors critical to competitiveness, the role of R&D is crucial in determining the future success of manufacturing in Britain. This is the critical interface between academia and the industry- where knowledge transfers can occur.

Any weakness in Britain does not seem to lie in the field of fruitful research: one fifth of post war innovations originated in the UK, and the UK has eighty-nine Nobel Prize winners- second only to the US (Lang '96). It is with the transformation of these innovations into global market share and economic expansion that a problem lies. Thus efforts to improve this interface should be recognised by firms and universities alike as a common objective in augmenting our global reputation.

## 5 CONCLUSION

Therefore, a review of the British manufacturing sector yields an ambiguous result. One certainty is that there is no room for complacency- although the level of British exports has been constant since the mid-eighties, the effect of a permanently strong pound in relation to the ECU and the Dollar could disrupt the balance of trade and instigate another recession. It is always tempting to claim that this will be a defining era in the history of the British economy- whatever the future holds in store; the fact is that this statement is valid now. It would also be tempting to follow in the wake of America and Germany, and formulate strategy

accordingly. This exercise is of value, but it is also necessary to concentrate on the national competencies of Britain- her flair for innovation and research, and her workforce.

The role of the universities in ensuring that the calibre of these resources continues to improve perhaps warrants a value chain in its own right. The fact is that the universities, together with industry and the government, are key players in the economy. The apportioning of funds is also critical, and the function of the state and the European Union here warrants further consideration.

The current economic outlook is fair; Britain's GDP, approximately £800 billion, is set to grow by 2.1 % despite the strength of sterling. Thirty of Europe's fifty largest businesses are British. However, the performance of many second tier companies continues to adversely affect national performance. Many look to the service industry as the future of modern business, but without manufacturing as a platform it has no basis for growth. The need to disseminate knowledge from the leading companies to those behind is crucial, and again universities are in a position to effect this.

Thus, the gauntlet has been cast down before the academic bastion! In an era when all activity, whether in commerce or academia, must be justified financially, it is for you to optimise your research 'value-chains' and add value to the nation.

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