PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

Productivity and Statistics [and Discussion]

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Productivity and statistics

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Introduction

It is a privilege for me to address this Discussion Meeting, sponsored jointly by the Royal Society and the Royal Statistical Society. I should say at the outset that I am an industrialist and not an academic, nor am I a statistician. Nevertheless, I did use statistics a long time ago as a young research physicist to help me in the design of experiments, and I used error theory to try to understand my results.

As an industrialist, however, I have been closely concerned with quality, productivity and unit costs. Productivity, to an industrialist, is not an academic issue; it is basically a matter of life and death. It embraces not just the operational sides of manufacturing industry, but a wide spread of activities such as distribution costs and the effective use, not merely of fixed capital but, perhaps more importantly, working capital.

I decided to depart from my initial notes in order to emphasize a much broader view of productivity and its importance. I changed what I had intended to say because of the dramatic increase (in early 1988) in the value of the pound against both the Deutschmark and, particularly, the dollar. You may feel this is hardly relevant to this Discussion Meeting, but this upsurge in the value of the pound had a devastating impact on some companies. Let me illustrate by reference to British Aerospace. All sales of civil aeroplanes are denominated in dollars because of the American dominance and, with the long lead times between ordering and delivering an aeroplane, the company has to anticipate the dollar exchange rate well ahead of any sales.

As a Board we took the view, which I still feel – given our knowledge at the time – was sensible and prudent, that a figure in the region of \$1.40–\$1.50 to the pound was about right. The dollar, in March 1988, stood at \$1.85 to the pound, which meant that we could have lost money on each sale (in sterling, because that is the currency in which our costs are incurred). Whatever we may think of advances in productivity, there is no way in which that gap can be bridged, even in the medium term.

I am the Deputy Chairman of British Aerospace and in that industry we do not extensively use statistics to evaluate and improve quality and productivity in the same way that will, and should be used, in for example the automobile industry.

If British Aerospace's bid for the Rover Group is successful, it may be that by early 1989 I will have had experience of both kinds of productivity. Let me give an illustration in connection with British Aerospace. Whether we consider civil or military aeroplanes, they have to work and be operational all of the time and quality is naturally crucial, almost regardless of cost. Every aeroplane is fully tested and examined and we do not use statistical tests of quality. The same is true of weapon systems; the Sea Dart missiles on our ships have been there for up to ten years without being used and yet in the Falklands war they had to work (and they did) when the button was pressed.

Productivity

I have explained my reservations about the potentially narrow definition of the application of only statistics to productivity, and I have done so to illustrate the broad spectrum of productivity and as an introduction to the problems we have in the U.K. This is a timely moment to talk about the subject of quality and productivity because there are many myths about them in this country, which may not have much to do with the use of statistical methods in manufacturing industry.

There has been, until recently, a serious decline in Britain's economy. It is a decline which has cost us many overseas markets and a considerable part of our own domestic markets. It is a decline based on costs, but also on quality, delivery, service and all those non-price factors which are important in the manufacturing industry. When I talk about quality and productivity I am referring to it in the manufacturing sector of industry which is the heart of the economy. I do not mean to denigrate the importance of the service side of our business activities, which is on the whole very good; but the financial institutions are basically derivative and not the 'prime movers' of the economy. There is no doubt that the serious decline in manufacturing industry to which I have referred is closely connected with our low productivity. This situation has been almost endemic over the last 50 years in this country. I will address that historical aspect later, after first considering what productivity means.

If we are to understand the parameters which influence productivity, we have to move away from the narrow popular view in which productivity is usually equated with labour productivity. It is better to think of productivity as a relation between total input and total output. Then, the objective of maximizing productivity becomes another way of looking at the goal of minimizing the costs of producing a given output. Productivity must be recognized as depending on the optimal combination of resources, which must include even money resources through investment policies.

We are now entering the 'second industrial revolution', fired by advancing technology. This revolution could dwarf, in its impact on economic growth, the first Industrial Revolution. If we are to take advantage of these opportunities, then we must examine carefully what are the factors most likely to hinder our drive for increased productivity and industrial efficiency.

Our industrial decline started many years ago, and some of the most interesting statistics about this concern wartime production. Those of us who can remember were of the impression that our aircraft productivity, for example, was very good. It was claimed that this gave us an edge in the Battle of Britain.

In fact Correlli Barnett (1986) documents the fact that to some extent, as a consequence of an odd design, it took three times the man-hours to build a Spitfire Mark Vc than its equivalent, the Messerschmitt Me 109G.

Unfortunately, little seems to have changed. Pratten, of the Cambridge Department of Applied Economics, showed in a study comparing 50 Swedish companies with 50 similar British companies that, on average, labour productivity in the Swedish companies was about one and a half times that in their British counterparts. A study of the automobile industry by the Central Policy Review staff placed British labour productivity, on comparable vehicle models, about a third below that in West Germany, France and Italy. Vehicle assembly was found to take almost twice as many man-hours in Britain than on the Continent. So we had, and still have, an important problem.

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Although I have indicated that productivity is much wider than just labour productivity, the latter does impinge on other aspects of the business. Uncertainties about output rates leave a company unsure about how much output it will have to sell, thereby reducing the effectiveness of the resources it allocates to the total marketing activities. Once again the automobile industry supplies striking evidence. In continental plants making automobile components, monthly production rates seldom vary from planned output by more than 5%, whereas variations of 20% or more are common in British plants.

As a result, distribution channels become periodically under-utilized, or final buyers lower what they will pay for the product because of the uncertainty of delivery. Unexpected brief disruptions of production are particularly hard on the stability of company cash flows, because all costs are fixed in the short term.

Many who have studied productivity in British industry have not found much evidence that the laggard sectors are catching up. If anything, the forces that make productivity low also produce low growth in productivity with the result that the low-productivity sectors are getting worse in relative terms. For sectors not sheltered from international competition, it can be predicted that the ones whose traits mark them for sustained disadvantages in productivity will face increasing foreign competition, losing both domestic and foreign markets to their international rivals. In short, trends in relative productivity are the stuff of international comparative advantage.

Industries which have inherited divisive labour–management relations and which are located primarily in the old industrial regions are probably those destined for terminal decline.

The view frequently voiced by British industrialists is that productivity performance in Britain is relatively good in process industries or those in which the speed of work is machine-paced; it deteriorates in assembly-type industries where the pace of machines is not the controlling factor and where disruptions in one link in a chain of sequential production stages can throw the others out of joint.

Systems

The most important factor in determining both quality and productivity in the future is, in my opinion, the systems approach to manufacturing. In this approach, the design and control of the process takes account of the whole process from material input to the finished product output. It seems that the introduction of systems integration is, for many companies, the key to survival in the next decade or so.

In the industrial countries of the world, standards of living, quality of life, employment, etc. all stem from the creation of wealth.

In these industrial countries, manufacturing accounts for about two thirds of wealth creation and it therefore follows that the reduction in the cost of manufacturing must be top priority in such countries. The way to increase the cost-effectiveness of manufacturing is primarily by increasing manufacturing productivity. Such increase can come only through the improvement of manufacturing technology.

The most significant and important type of advanced manufacturing technology being developed and implemented today is that commonly called computer-integrated manufacturing. It has already demonstrated greater potential to improve manufacturing capability than the combined potential of all other types of advanced manufacturing technology.

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Computer-integrated manufacturing has the unique potential, which the computer gives, to provide manufacturing with two powerful capabilities not available before. These are flexible automation and on-line, moment-by-moment optimization.

It is important to stress that it has the capacity to do that not only for the hard components of manufacturing (the machinery and equipment), but also for the soft components of manufacturing (the information flows, the databases, the controls, etc.).

In addition, it has the capacity to do that not only for the various bits and pieces of manufacturing activity, but also for the entire system of manufacturing. Thus, it has the tremendous potential to integrate the entire system, producing what may be called the computer-integrated manufacturing system. It can provide information on quality, balance the flow of the process and even provide information which is extremely important in developing a progressive pricing policy.

Other countries may well move ahead faster with this than ourselves, and I think it is important to send a strong message out from this Discussion Meeting about the need for increases in productivity and about one of the most important tools for providing such increases.

This is an important meeting and the initiative in organizing it is to be praised. In closing, I hope that the wider aspects of productivity, some of which I have mentioned, are borne in mind.

Reference

Barnett, C. 1986 *The audit of war*. Macmillan.

Discussion

M. Gerson (*Industrial Statistics Research Unit, Newcastle upon Tyne, U.K.*). I am concerned that Sir Kenneth has talked of wealth, machinery and products, but not of the people involved in manufacturing industry. There should indeed be statisticians 'running about all over the factory', and concerning themselves with advice to and on management.

Sir Kenneth Durham. Concern for employees is a key task of management which I thought all of us could take for granted.

I would not like to see swarms of statisticians in factories, nor do I see them giving advice *on* management. They can certainly give advice *to* management on special issues.

S. M. Rizvi (*Polytechnic of Central London, U.K.*). Sir Kenneth has touched upon British productivity and quality assurance. The decline in productivity of British industry in the seventies and early eighties was partly traceable to investment levels. In a paper I read at the RSS Charter Centenary Conference at Cambridge in April 1987, I compared changes in aggregate investment at constant prices and purchasing power parities for the period 1980–84 over 1975–79, for the leading economies of the free world. Whereas the Japanese investment increased by 16%, British investment declined by 2.4%.

The quality of British management also needs to be commented upon. That the degree of professionalism needs strengthening can be judged from the fact that, whereas in the U.S.A. over 60000 M.B.As are produced each year, in the U.K. we produce only 1000–1200 a year.

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If we are to withstand the Japanese assault, an expansion in our management education is clearly called for.

D. J. Sherwin (*Department of Engineering Production, University of Birmingham, U.K.*). Taking up a point made by S. M. Rizvi, a company which cannot show an increase in sales and profits is unlikely to attract investment capital. Market share increases with quality if prices can be sustained. The increase is permanent or sustained as long as quality relative to the competition is held. So without quality there is no investment. Fortunately, quality can be increased at little or no cost. A small investment is quickly repaid.

Sir Kenneth Durham. I agree with this argument and certainly with the view that the cost of extra quality can be low.

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