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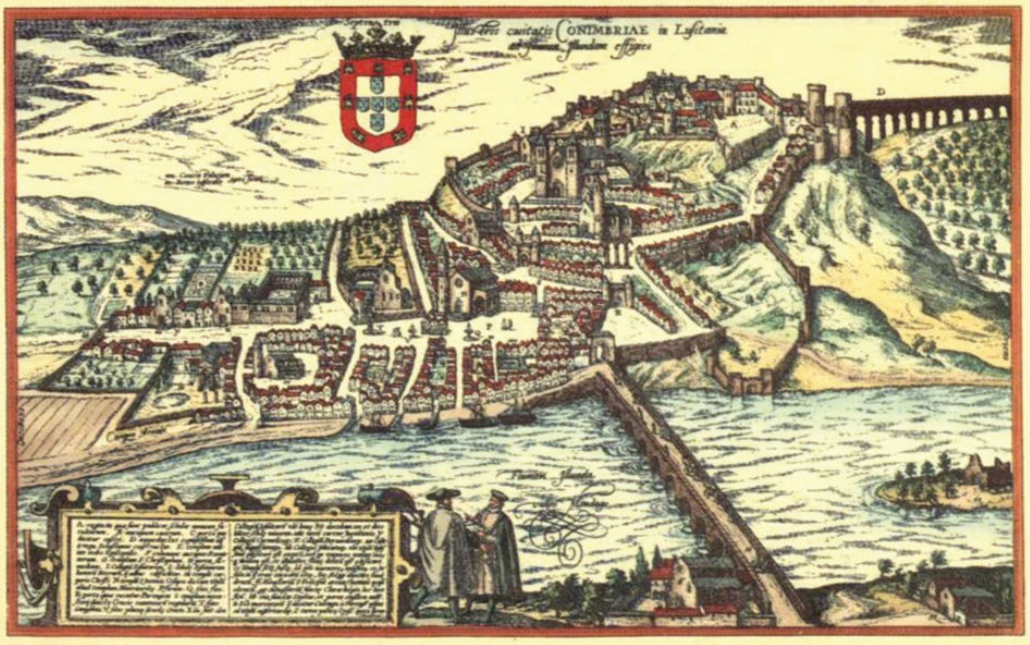

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NEW PROCESS TECHNOLOGY IN EARLY INDUSTRIAL REGIONS

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Resumo

A introdução de novas tecnologias no sistema produtivo das indústrias tradicionais pode jogar um papel importante no aumento da competitividade nacional e internacional das velhas regiões industriais. Este artigo refere-se à introdução de novas tecnologias na indústria metalúrgica de Sheffield, no norte de Inglaterra. Baseia-se numa sondagem a mais de 50 grandes estabelecimentos fabris com mais de 100 trabalhadores. O artigo identifica os factores mais importantes que exercem influência na introdução e utilização das novas tecnologias no sistema produtivo. Vários dos estabelecimentos têm sofrido transformação dos sistemas produtivos, como resultado da aplicação de novas tecnologias, sobretudo as micro-electrónicas. Demonstra-se aqui que existem vários obstáculos à introdução de novos sistemas produtivos. O artigo termina com uma discussão das políticas económicas locais que podem aumentar a ambiência industrial regional para reforçar a concorrência das indústrias tradicionais, nas velhas regiões.

Palavras-chave: Novas tecnologias. Políticas económicas locais. Velhas regiões industriais. Indústrias tradicionais.

Résumé

L'introduction de technologies nouvelles dans le système productif des industries traditionelles peut jouer un rôle important dans l'augmentation de la compétitivité nationale et internationale des vieilles régions industrielles. Cet article se concerne l'introduction de technologies nouvelles dans l'industrie métallurgique de Sheffield, dans le nord d'Angleterre. On a fait un sondage de plus que 50 grands établissements avec plus que 100 employés chacun. L'article identifie les facteurs les plus importants qui excercent une influence sur l'introduction et l'utilisation des technologies nouvelles dans le système productif. Plusieurs des établissements ont éprouvé une transformation de leurs systèmes productifs comme résultant de l'application de technologies nouvelles, surtout les micro--électroniques. On démontre ici qu'il existe plusieurs obstacles à l'introduction de nouveaux systèmes productifs et l'article contient, comme section finale, une discussion des politiques économiques locales qui peuvent augmenter l'environment regional industriel pour renforcer la concurrence des industries traditionelles dans les vieilles régions.

Mots-clés: Technologies nouvelles. Politiques économiques locales. Vieilles régions industrielles. Industries traditionelles.

Abstract

The introduction of new process technologies into traditional industries may play an important role in enhancing the national and international competitiveness of early industrial regions. This paper explores the introduction of new process technologies into the Sheffield metals based industrial complex in Northern England. It is based on a survey of more than 50 large industrial plants with over

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100 employees each. It identifies the key factors influencing the introduction and use of new process technologies. Many of the plants have experienced a transformation of their production process as a result of the new technologies based mainly on microelectronics. It is shown that there are a number of barriers to the introduction of new process technology and the paper concludes with a discussion of local economic policies which might enhance regional industrial environments and thus strengthen the competitiveness of traditional industries in old industrial regions.

Key words: New technology. Local economic policy. Old industrial regions. Traditional industries.

INTRODUCTION

In most developed countries early industrial regions have experienced major industrial restructuring associated with declining employment in their traditional industrial activities. Conceptually, it is important to make a distinction between the industrialisation of early industrial regions through the introduction of new industries and the regeneration of early industrial regions through the revival of traditional industries. The predominant role of new technologies in reindustrialisation and regeneration will be rather different. In reindustrialisation much emphasis will be placed upon the role of new technologies in creating new products and hence new industries (such as micro--electronic based products and biotechnologies). In regions characterised by regeneration of traditional industries new industries do not emerge but new process technologies transform the production activities of existing industries.

Considerable emphasis has been placed in the literature of new technology and regional development on new industries in early industrial regions or new industries in new regions. Less attention has been paid to the introduction of new process technology into traditional industries located in early industrial regions. A review of the relationships between new process technology and regional development is provided by FOLEY, WATTS and WILSON (1992a).

It appears that there is one group of early industrial regions for which new process technologies are of particular significance for regional development issues. These regions tend to lie between the periphery (with national government or EC regional assistance) and the centre (with strong regional economies) of particular economies. The peripheral regions have often had a marked inflow on new branch plants whilst the more central regions have experienced high new firm formation rates. Early industrial regions occupying intermediate locations have failed to gain significant amounts of inward investment and have experienced low new firm formation rates. The future of the manufacturing sectors in these regions depends upon nurturing and maintaining those traditional firms which have survived the two recessions since 1979. The very survival of these firms suggests they have some degree of resilience. The future of these early industrial regions as centres of manufacturing industry may necessitate the active support of their traditional industries through the introduction of new process technologies to enhance the competitiveness of the region's plants in national and international markets.

NEW PROCESS TECHNOLOGY AND REGIONAL DEVELOPMENT

Previous research has established that not all regions adopt new process technology at the same rate. There is a difference between regions (such as South-West England and Scotland) in the proportion of establishments using new technologies. Not only are there differences between regions but the regional patterns vary with the technologies (NORTHCOTT and WALLING, 1988, p 154). Of course, some of these differences might arise because of variations in the extent to which individual industries can use new technologies but similar regional contrasts have been identified within individual industrial sectors (O'FARRELL and OAKEY, 1992).

Just as each region shows a deviation from the national norm, so too each local labour market within a region will have its own characteristics. Sub-regional data on the use of new technology are not available and there exists only anecdotal information about the nature of the technology used in geographical units smaller than a region. These tend to confirm the existence of variations in the use of new process technology between local labour markets in a specific region. Clearly, some regions and local labour markets are adopting new technologies at a slower rate than other regions and other local labour markets.

Geographical variations in the use of new process technologies can occur for a number of reasons. Attention has already been drawn to the difference between industries in their suitability for new technology. Another important reason for variation may be that since most new process technology arises from the manufacturers of process equipment rather than through development internal to an establishment (THWAITES, 1983, p. 42), there maybe time lags in diffusion to other areas, industries or firms. Firms supplying new process technologies may be slow in spreading their distribution and maintenance network from the original region (or industrial sector) and other regions may lack support facilities for new technologies. Other research suggests that establishments with R&D facilities

and those which belong to larger organisations are most likely to introduce new technology (HARRIS, 1988). The overall situation is summed up in the view that the 'ability of established centres of production to respond to the opportunities offered by new technology... is different given their inherited firm structures, managerial abilities, labour market characteristics and relations with dominant markets' (GIBBS, 1987, p. 318).

It is essential to emphasise that this discussion is concerned only rarely with innovation, the most usual route to new process technology for most firms is the purchase of new process technologies from equipment suppliers. The new process technology may be an innovation from the point of view of the firm but it is not an innovation in the sense of the first commercial use of a new technology. This paper takes the view that it is the use of new technology rather than the generation of new technology that plays the most important role in improving a firm's economic performance.

The development of appropriate policies for enhancing the introduction of new process technologies in early industrial regions depends upon answering at least two key questions. First, to what extent are new process technologies used in the region's plants and second, what are the barriers and difficulties firms are facing in moving towards a more technologically advanced production environment. This latter question can build upon earlier studies noted above which have contributed to an understanding of inter-firm and inter-area variations in the use of new technologies.

AN EARLY INDUSTRIAL REGION IN THE 1980s

The two key questions are explored within the metals based industrial complex centred in the city of Sheffield, located on the boundary between the midland and northern regions of England. It is an early industrial region which witnessed the development of the metal industries in the late eighteenth century, based on water power, followed by a massive expansion based on Bessemer steel from 1870 onwards and, subsequently, the manufacture of high grade engineering steels and stainless steel. The Sheffield area still contains the largest concentration of electric arc furnaces for steel making in the UK and produces much of the UK high quality steels. Although eligible for some EC and British government regional and urban aid it did (and does) not have the aid available to areas such as Wales and Scotland, nor does it have the strengths of the regions lying to the south. It has one of the lowest new firm formation rates in the UK and has not received any major inward investment in manufacturing capacity on a greenfield site over the last thirty years, with exception of one food processing plant. Regeneration of the existing industrial activities through new process technologies seems essential for the long term future of the area's manufacturing base. It therefore forms a suitable location in which to explore the role of new process technologies in the contemporary regional development of early industrial regions.

The Sheffield local labour market is centred on the third largest local administration in England in terms of its current population size of around half a million people. Employment is dominated by the service sectors. The major manufacturing activities are metal manufacturing, the manufacture of metal goods and mechanical engineering. It is within these three groups that research was concentrated. A preliminary investigation of the use of new process technology in all sectors of the Sheffield economy will be found in FOLEY, WATTS and WILSON (1992b). The selected industries accounted for about 65 per cent of the Sheffield manufacturing workforce in the late 1980s. A survey of firms operating medium and large plants (more than 100 employees) within these industries was carried out between mid-1990 and mid-1991. The establishments included in the survey employed over 11,000 workers (one third of the employees in the relevant sectors).

THE USE OF NEW TECHNOLOGY

Although the main interest of the study was in traditional industries, no less than 85 per cent of the establishments used new technology in their production process. Over half the Sheffield establishments (56 per cent) had introduced an item of new technology into their manufacturing operations in the last three years. The failure to introduce new technology within the last three years (by 44 per cent of the Sheffield establishments) may simply reflect the fact that the establishments were already users of new technology by the mid-1980s. Nevertheless, 15 per cent of establishments were not using new technology including one, where new technology had been stripped out, following takeover, and second-hand older technology re-introduced.

The nature of the new technologies used in one-fifth or more of these establishments is shown in Table I. The technologies were dominated by CNC machines (found in over half of new technology using establishments) and automatic test and calibration equipment (present in two-

Table I - New technology users: technologies in use, 1990-1991

Applications	Establishments	
	n	Percent
CNC	25	57
Automatic test and calibration equipment	19	43
Specialist technologies	16	36
Robots	12	27
J.I.T	12	27
CAD	12	27

Source: Interview schedule n=44

-fifths of the establishments). There was strong evidence of the use of the 'newer' new technologies such as robots in an important minority of establishments. The significance of robots in this listing may reflect their suitability for the hostile environments associated with the metal industries. There were also a number of specialist technologies outside these more general categories, such as a gas extraction furnace (special steels) and vibrator finishing (cutlery).

SELECTING A NEW TECHNOLOGY

Some 29 establishments had introduced new technology into the manufacturing process over the last three years. The technologies included CAD/CAM, CAD, CNC and robots (each of similar importance in being adopted a tenth or more of the establishments) and a number of specialist technologies including a vacuum induction degassing furnace (reported to be one of only two in the world).

The extent of the challenge presented by a particular new technology will be influenced by the extent to which it represents a marked break with the past. In three--quarters of the 29 establishments the most recently introduced significant new technology represented a radical new development for the firm and only in a quarter of cases did it represent incremental change. For most firms, the radical nature of the new technology introduced over the last three years presented a considerable challenge and a high degree of uncertainty, although only one quarter of those introducing new technology reported that it was the first major investment in new technology that they had made.

The link between the introduction and new technology and increased competitiveness was assessed by identifying what firms saw as the main impact of the introduction of new process technology. Not surprisingly, in assessing the effects of the introduction of new technology firms place emphasis on its advantages in increasing competitiveness, output, productivity and product quality (Table II).

In an attempt to identify barriers within the region which might reduce the introduction of new process technologies each firm was asked which factors had had an influence upon the introduction of the last item of new technology. Firms were asked to respond to a prepared list of factors. The opportunity to suggest other unlisted factors was offered but rarely taken up. The factors influencing the introduction of new technology emerged quite clearly. At the time of the survey an important influence was availability of finance, cited as a factor by two thirds of the firms (Table III). Cost of finance was also important but only to just under half of the firms. This particular result is, of course, strongly influenced by the period during which the data were collected. Not all industries/firms can adapt as easily to new technologies and therefore, not surprisingly, both the nature of the product and the nature of the production process influenced the decision in half the cases. At the bottom of the list of the five major factors comes skills shortages arising either from within the firm or from within the labour market in which it operated; a factor influencing just under one fifth of the firms.

Table II - Main effects of last item of new technology

Effect	Establishments*	
	n	Percent
Increased		
Competitiveness	20	69
Output	19	66
Productivity	18	62
Product Quality	17	59
Enhanced possibility new products	15	52
Saving on materials wastage	15	52
New work organisation	15	52

* Establishments introducing new technology in last 3 years
Source: Interview schedule n=29

Table III - Factors influencing a decision to introduce new technology

Constraints	Establishments*	
	n	Percent
Available finance	18	67
Nature of product	15	55
Nature of production process	13	49
Cost of finance	12	46
Skill shortages	6	22

* Establishments introducing new technology in last 3 years
Source: Interview schedule n=29 (2 missing cases)

These labour issues were explored in more detail primarily because local policy makers in early industrial regions may be able to influence the characteristics of the local labour market. It will be recalled that 44 of the establishments (85 per cent) saw themselves as users of new technology. The most striking finding is that despite considerable publicity given to questions of skills shortages of all types less than one half of the establishments using new technology had experienced skills shortages. In total 39 per cent of the new technology users were experiencing skill shortages. Shortages relating to traditional skills were of major significance.

To a certain extent the information on past skills shortages is only of historic interest. The long term future of the local economy and the adoption of new technology by local establishments can be influenced by firms perceptions of future labour market conditions. Looking a year ahead, shortages associated with traditional skills were expected to decline in importance but, in the longer term, most firms were concerned about potential shortages of traditional skills rather that the skills associated with the

newer technologies. Nearly one fifth of the establishments argued that skills shortages were restricting plans to use further new technology within the establishment.

Training appears to play a critical role in the introduction of new technology. Amongst all users of new technology 75 per cent of the establishments had altered their training requirements as a result of the introduction of new process technologies and just over half of those changes had taken place within the last three years. Establishments which had introduced new technology in the last three years had experienced distinct impacts on their training needs. In around one third of the cases training costs increased and training needs exceeded in-house capacity. In one-quarter of the cases, the use of new technology necessitated the introduction of a training strategy for the first time.

POLICY ISSUES

It is worth recalling that the evidence upon which this paper is based is drawn from traditional metal-based manufacturing industries and is focused specifically on new technology, skills and training issues arising from larger plants. Although small plants are numerically more prevalent the smaller number of large plants tend to account for the majority of employees in manufacturing especially in early industrial regions. Although evidence is drawn from one local labour market and is concerned with new technologies that are well established ones rather than those at the leading edge of new technology it has highlighted the role of financial and labour factors in the introduction of new process technology. Most emphasis has been placed upon the labour factors as it is these over which both firms and local administrations may have some degree of control.

Perhaps the most important policy issue to emerge from the analysis is the dominant role of financial factors in the adoption of new process technology. Thus policies aimed at easing the availability and cost of capital should perhaps be a policy priority at national level. Stimulating the development of local capital markets may be of little relevance to larger establishments since many are part of major multi-locational organisations and thus will seek funds for capital investment from their parent companies or they have access, by virtue of their size, to a wider capital market.

A second important issue is that labour is not the major factor in holding back the introduction of new technology. It should also be noted that shortages of craft skills appear to affect less than half the establishments. Even if these skills shortages are removed the overall effects on the take-up and use of new technology are likely to be limited. Nevertheless, policies related to training for new technology at the local level need to be explored. Unlike capital investment, which tends to be controlled from outside the local area, most of the multilocational firms in this study offer individual establishments a high degree of autonomy in training matters. No less than 77 per cent of externally owned establishments were able to control their own training strategy and 80 per cent were able to control their own training budget. Local control over training allows firms to respond to local training initiatives (Foley, Watts and Wilson, 1993).

An employment policy to encourage the take-up of new technology and/or greater utilisation of new technology within firms already using it, needs to be targeted on firms (as trainers and users of new technology) and at external training providers in both the public and private sectors. Removal of barriers preventing the full utilisation of labour resources within a local labour market must necessarily include a training strategy which is not only cost effective but also related to local needs. A dilemma in policy terms is that since only a third of new technology users experience craft skill shortages, 'across the board' training initiatives may, in fact, waste resources. Such inefficiency can arise by providing training not needed by the large proportion of establishments with no recruitment or training difficulties. Indeed, training may be misplaced unless clear markets for that labour have been established. Not only can unmarketable trained potential employees waste resources, it may also raise undue expectations among the newly-trained.

The implications at the local level is that training for local needs has to be targeted very carefully indeed. Detailed locally focused schemes may provide a more effective use of limited financial resources than spending on generalised national schemes that may not meet local requirements. A flexible mix of training strategies to meet local requirements for skilled employees is essential if the take-ups of new process technologies in early industrial regions is to be encouraged.

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