

# The location and organisation of the early Lancashire cotton industry ; a systems approach.

Stephen Kenny

## Introduction

The advantages of the application of systems theory as a theoretical framework for the explanation of the spatial distribution of industrial activities have been stressed by a number of authors in recent years.<sup>1</sup> Although this work mainly refers to contemporary industries, both A. R. H. Baker *et al* and J. Langton have advocated the use of systems theory in historical studies.<sup>2</sup> This case study of the early Lancashire cotton industry seeks to demonstrate the utility of the systems approach as a framework for a study in industrial development. Cotton manufacturing is a particularly appropriate example as, even in its formative stages, the industry was a rapidly-evolving, complex structure with numerous linkages between its components, and its treatment in systems terms focuses attention on the relationship between structural, technological and geographical changes. The paper will outline a five-stage theoretical model of the development of the industry in systems terms but first it offers some comments as to the nature of industrial systems themselves.

A *system* consists of a set of objects together with the relationships between the objects and between their attributes, and it follows that through a process of organisation and integration the whole is greater than the sum of the parts. Before it can be analysed, a system has to be abstracted from the complexity of reality and boundaries can arbitrarily be drawn by defining a functional unit. Hence, the cotton manufacturing system consisted first of the production units, in which raw cotton was spun into yarn and then yarn woven into cloth, together with their associated (but sometimes locationally separated) managerial functions, and second the industry-related units, such as the organisations supplying raw cotton or capital and credit, and those selling manufactured goods; the structure is shown with diagrammatic simplification in Figure 1. The links between the units are clearly of paramount importance for without these linkages the system could not operate. Interchanges between the components can result in significant changes in the components themselves with important consequences for the system as a whole, especially through the process of information feedback. Hence, the location of production cannot be isolated from (and indeed is partly a product of) the multiplicity of flows of materials, capital payments, and information between the various elements within the system. Furthermore, some systems can be regarded as 'open' in the sense that certain factors outside the system influence its operation, such as the changing pattern of supply and demand, or technical innovations. Thus the external environment serves not just as a source of inputs and a destinations of outputs, but also as a catalyst providing opportunities and constraints which condition

the system's operation. The changing structure and location of the early Lancashire cotton industry resulted from organisational and technological developments which were either internally-induced realignments of adaption to a changing external environment, so that the system changed its structure *and* location as a condition of continued growth or survival. The system's early development can be divided into three distinct stages, each phase separated by intense organisational, technological, and locational change, although care must be exercised not to view these as clear cross-sections but rather as a process of continuous change.

### The Domestic System

Prior to the emergence of factory-based cotton manufacturing as one of the forerunners of the Industrial Revolution in the late eighteenth century, there was a flourishing, domestic, cotton-using textile industry which had been long-established in Lancashire, where it had developed alongside the older linen and woollen trades. The domestic foundations of the industry exercised great influence on its subsequent location and organisation and, although the period before 1780 presents difficulty due to the lack of comprehensive information, it is possible to reconstruct a representative picture of the cotton trade from a mass of varied and fragmentary evidence. The general view is that a cotton-using industry was established in Lancashire by refugees from Flanders in the second half of the sixteenth century, who found that Manchester provided a suitable commercial environment for their trade.<sup>3</sup> It continued to grow steadily, rather than rapidly, in and around Manchester and Bolton, and by the early eighteenth century textile production began to assume prime importance in the manufacturing life of the region. However, during this period little, if any, cloth made entirely of cotton was produced,<sup>4</sup> the principal product was fustian which was made using a linen warp and cotton weft.

Although the manufacture of cotton-linen goods was a simple transformation process of raw cotton to cotton yarn which was then woven into cloth with the addition of linen yarn, the organisation of these activities was by no means as straightforward and it is useful to conceptualize it in systems terms, as shown in Figure 2. The major *inputs* were raw cotton, linen yarn, labour, and capital.<sup>4</sup> Raw cotton was principally imported through London, it was not until 1789 that Liverpool handled more cotton than London but by 1795 Liverpool had achieved a position of superiority that it was never to lose.<sup>5</sup> The passage of raw cotton from the port to the manufacturer was through a variety of channels; some manufacturers dealt with agents in the ports but, importantly, a specialised group of Manchester cotton 'dealers' developed to facilitate the movement of cotton.<sup>6</sup> Linen yarn was imported from Ireland and the Continent through London, Hull and Liverpool. Some home-produced yarn from Scotland, north-east England and west Lancashire were also used, and the supply channels were similar to those for cotton with merchants playing an important role.

The labour force consisted primarily of hand-spinners and hand loom weavers working in their own homes. A basic division can be made between workers in the emerging towns, who were largely cellar dwellers, and rural labour living on smallholdings of a few acres. No indication of the relative size of the two groups can be

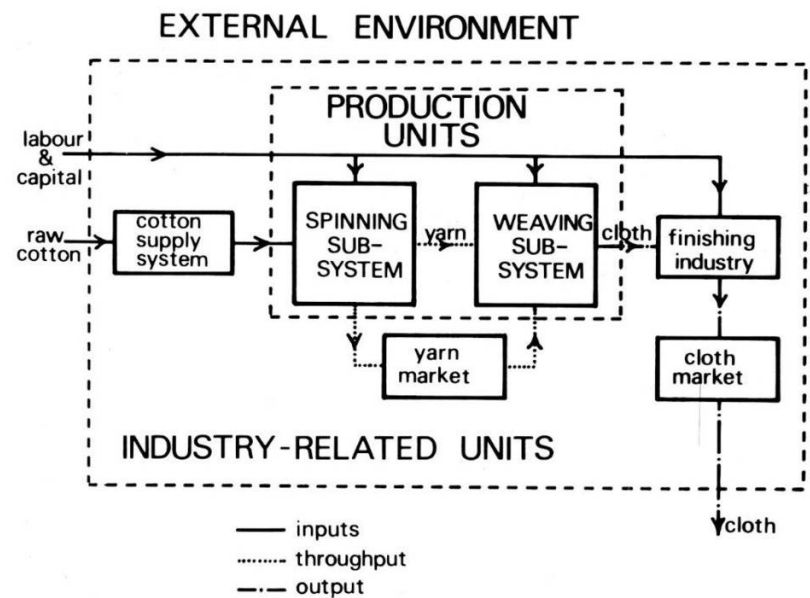
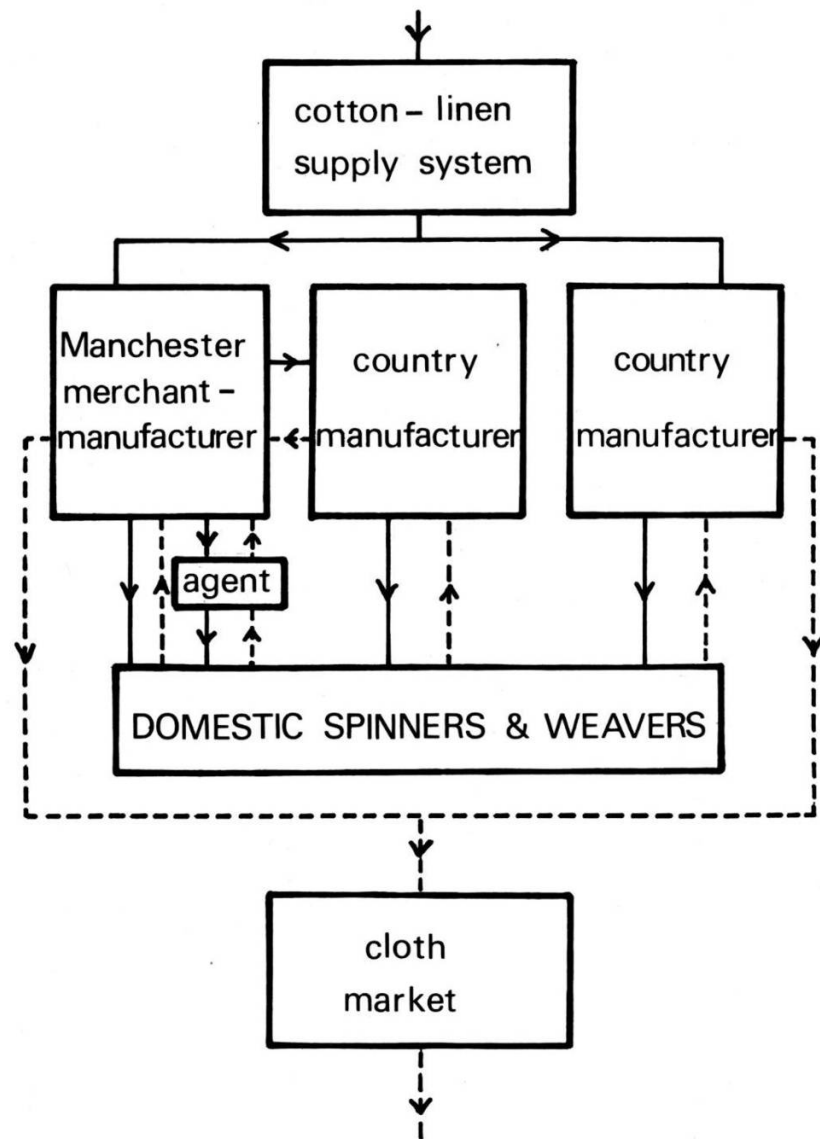


Fig. 1 The cotton manufacturing system

found but, at a time when the urban population was small, it is probable that the rural workers were of much greater importance. The domestic spinners and weavers were usually farmers as well and Radcliffe described their situation in 1770: 'the land in our township (Mellor in Derbyshire) was occupied by between fifty to sixty farmers . . . and out of these . . . there were only six or seven who raised their rent directly from their farms; all the rest got their rent partly in some branch of trade, such as spinning and weaving woollen, linen or cotton. The cottagers were employed entirely in this manner, except for a few weeks in the harvest.'<sup>7</sup> Hence, a dual economy was widespread in the fustian-producing areas of north-west England.

The distribution of raw materials to the domestic labour force and the return of woven cloth assumed a characteristic organisation generally known as the 'putting-out' system. Figure 2 illustrates the operation of this system and shows the central role of the merchant-manufacturers of Manchester who dominated the trade. Local dealers were found scattered throughout the textile district but the bulk of the trade was conducted directly or indirectly through Manchester. Although they maintained a small work force directly, the merchant-manufacturers employed a much larger number of domestic spinners and weavers often spread over a large area, using agents to conduct their business in country districts.<sup>8</sup> The merchant-manufacturers of Manchester were not only the middle-men in the trade, although they were the largest and the wealthiest, and the Manchester Directories of the period enumerate many country manufacturers originating mainly from Bolton, Bury, Oldham and Leigh, who operated under the same system as their Manchester counterparts.<sup>9</sup>



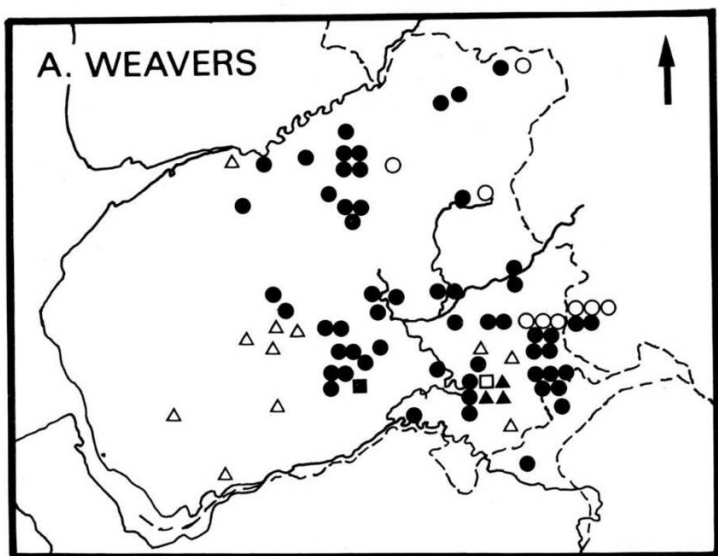
**Fig. 2 The domestic system**

The *output* of the domestic industry was also organised in a distinctive way. The cloth had first to be finished and it was customary for merchants to receive grey cloth from the weavers and then make arrangements for bleaching, dyeing, or printing according to their customer's requirements.<sup>10</sup> Bleaching was an old-established industry, the cloth after treatment was exposed to the sun for long periods in fields known as 'bleach crofts', there were many 'crofters' and 'whitsters' throughout Lancashire in the textile areas with a marked concentration around Manchester.<sup>11</sup> As the finishing trades generally demanded large quantities of pure water they were concentrated in river valleys, notably along the banks of the Irwell and its tributaries in the Rossendale fells and around Ramsbottom, Tottington, Bury, and Bolton.<sup>12</sup>

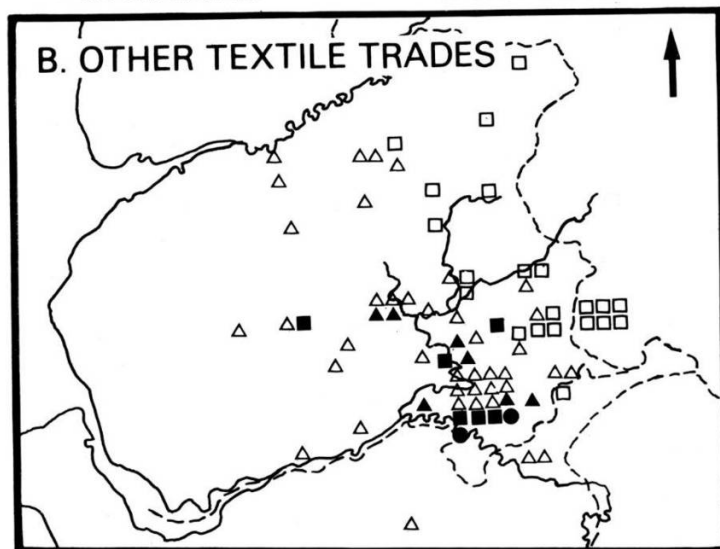
Once the fustian cloth had been finished, it reached the retail market through a number of intermediaries. The greater part of both foreign and home trade was carried on through London by a variety of agents, partners, and warehousemen.<sup>13</sup> The latter exercised a powerful influence on the type of cloth produced feeding back market information to the manufacturers. In addition, Lancashire dealers built up an extensive system of distribution independent of the London market; particularly important were a group of merchants known as 'Manchester men' or 'chapmen' who sent their goods to public fairs throughout the country and also travelled throughout Britain selling their cloth.<sup>14</sup> There were a number of other methods of distribution and it is clear that by the second half of the eighteenth century Manchester was rivalling London as the marketing centre for cotton-linen goods.

Thus, the organisation of production prior to the factory age was by no means a simple process, it involved a complex network of linkages between the various elements and given the primitive state of transport and communications, this imposed important locational constraints. In other words, the distance between producers and the various agencies serving them tended to be minimised, indicating a concentrated spatial distribution. Any locational reconstruction cannot be detailed and comprehensive due to the lack of statistical surveys but it is generally held that domestic production was centred in three sub-regions in the North West; linen manufacture was still carried on in west and north-west Lancashire, fustians were concentrated in the Manchester embayment, and woollens were produced in east Lancashire and the Pennine valleys, despite the steady encroachment of the cotton trade.<sup>15</sup>

In an attempt to define more precisely the extent of these industrial sub-regions, a survey of the numerous surviving wills and inventories from the region covering the period 1741 to 1760 was undertaken and the location of persons engaged in textile manufacture was plotted.<sup>16</sup> The pattern of weavers and associated trades is shown in Figure 3 which reveals the relative location of the various trades (not the actual distribution). Both maps reveal the existence of three distinctive specialist sub-regions. Figure 3A shows that linen manufacture was centred in the western half of the region and that woollens were primarily found in the Pennine valleys around Oldham and Saddleworth, and in north-east Lancashire. Moreover, Figure 3B indicates that clothiers (dealers in wool and woollen goods) were also concentrated in the eastern fringes of the region. The third sub-region was principally concerned with the manufacture of fustians and checks, and consisted of the Manchester embayment,



- cotton
- fustian & checks
- ▲ smallwares
- △ linen
- silk
- woollens



- ▲ whitster
  - dyer
  - calenderer
  - △ chapman
  - clothier
- mls. 0 ————— 20  
 kms. 0 ————— 30

Source : Wills and Inventories, 1740-1760

Fig. 3 The textile trades of Lancashire c. 1750

central Lancashire (especially around Leigh), and in the Blackburn area. In these areas there were many fustian weavers and chapmen, but only one weaver of cotton goods was recorded in Bedford near Leigh. Figure 3B also illustrates the early concentration of the finishing trades in the Manchester area and the town's wide range of textile processes. Hence, the domestic fustian industry was a locationally and organisationally formative phase in the development of the Lancashire cotton trade which exercised a powerful influence on the form and extent of manufacturing following the transition to factory-based production.

#### Late eighteenth century innovation

Towards the end of the eighteenth century the Lancashire cotton industry was transformed by a series of major changes in techniques, technology, and organisation, which brought an end to the domestic system of production and resulted in the progressive movement of most sections of the industry into factories. Basically, the multi-dimensional revolution consisted of a series of innovations to facilitate the spinning of cotton yarn and the application of new sources of power to the process. However, the middle stage of production - the weaving of cotton cloth - was long delayed in its transformation into a powered, factory-based industry.

The need for improvement in cotton spinning became extremely urgent during the course of the eighteenth century. Cotton had traditionally been spun on the primitive single-thread domestic wheel which proved incapable of meeting the growing demands of the fustian industry, especially following the early, minor improvements in the hand loom made by John Kay and his son.<sup>17</sup> These innovations increased the yarn supply problem, so that:

'it was no uncommon thing for a weaver to walk three or four miles in a morning, and call on five or six spinners, before he could collect weft to serve him for the remainder of the day.'<sup>18</sup>

Here was an industrial system the complementary parts of which were grossly out of balance and the 'bottleneck' was finally overcome by three major innovations generated from within the Lancashire textile region itself. Hargreaves' spinning-jenny (1764), Arkwright's water-frame (1768), and Crompton's mule (1779) completely transformed the spinning section of the industry; they removed any possibility of yarn shortages, enabled cloth output to increase rapidly, promoted the movement into factories, and encouraged the application of new sources of power. However, cotton weaving remained technologically backward, Cartwright's power loom (1785) proved defective and, despite attempts at improvement, hand loom weaving remained the principal source of cotton cloth.<sup>19</sup> This created the 'golden age' of hand loom weaving when many thousands of people were attracted to the trade, but the manufacturing system still remained in disequilibrium with weaving now representing the bottleneck.

The application of power took place during the same period; most notable was the widespread adoption of water power and it was not until after 1800 that the steam engine began to achieve superiority. The location of many early cotton spinning mills reflected the need for a site at which there was a reasonable fall in a river with a fairly constant flow, and consequently manufacturers were forced to move away from the

towns into country districts. The three main areas of domestic production - east Lancashire, Nottinghamshire, and the Glasgow area - all possessed suitable sites and so the existing locational trend was reinforced. For example, Arkwright established his second mill (a prototype of many water-powered factories) at Cromford in Derbyshire beside the River Derwent.<sup>20</sup> In Lancashire most of the early mills were on water-powered sites along the rivers running down from the Pennines and the Rossdales - the Irwell, Irk, Tame, Roch, Calder and Darwen. Baines notes:

'On the River Irwell, from the first mill near Bacup, to Prestolee, near Bolton, there is about 900 feet of fall available for mills, 800 of which is occupied. On this river and its branches it is computed that there are no less than three hundred mills.'<sup>21</sup>

The introduction of steam power from the 1780's onwards checked the dispersion of the cotton industry into rural locations and favoured towns which had ample supplies of coal and water. Again, the established locations satisfied these requirements and research by A. E. Musson and E. Robinson has shown that in Lancashire the rapid growth of steam power was assisted by the development of a local engine industry,<sup>22</sup> so that by 1838 almost 90 per cent of mills in Lancashire were steam powered.<sup>23</sup>

### The Early Factory Phase: the System Incomplete

The technological and organisational innovations of the late eighteenth century in effect created a new and greatly expanded industry. However, the new manufacturing system (as illustrated by Fig. 4) was as yet incomplete: by 1820 the factory-based spinning section constituted the world's first mature industrial system, but the system as a whole was unbalanced, unstable, and still had great potential for change. This situation prevailed from the large-scale introduction of powered spinning machinery in the 1780's until the adoption of power looms in significant numbers began during the 1820's.

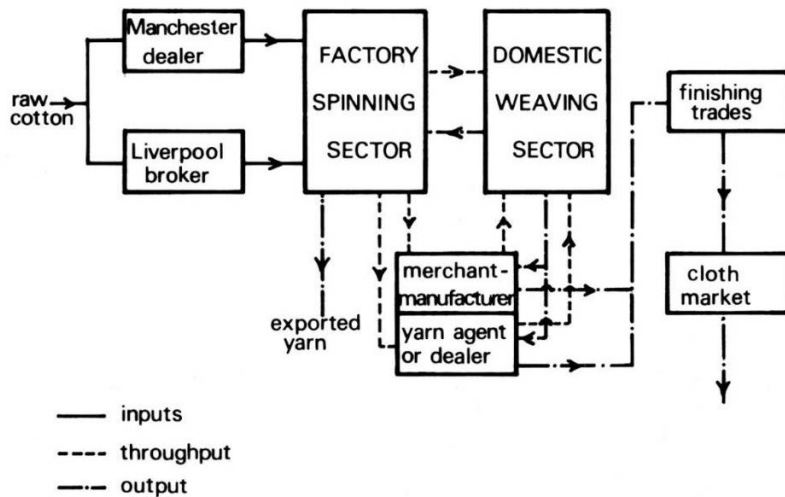


Fig. 4 The early factory system

The rapid growth of the industry necessitated an expansion of the *inputs* to the system and resulted in a number of changes. Raw cotton was imported mainly from the newly-developing cotton-growing lands in the United States and Liverpool became established as the foremost cotton importing port in Britain.<sup>24</sup> To cater for the increased inflow of raw cotton two major channels developed. Initially, cotton dealers were key figures, especially up to 1820, buying raw cotton from importers in the major ports and reselling it to spinners. They were to be found in all the principal cotton towns during this period but Manchester was the centre of the distribution system.<sup>25</sup> Later, there was a movement of the cotton distribution centres away from the principal cotton towns to the major ports, notably Liverpool. This owed much to the rapid expansion of the industry; as spinners began to produce a variety of yarns which demanded an assortment of cottons of different lengths and qualities, they required closer links with the importer, hence specialist cotton brokers developed and from around 1810 spinners obtained their supplies increasingly from brokers in Liverpool.<sup>26</sup>

Labour inputs to the factory-based spinning industry varied from place to place. Generally urban manufacturers experienced little difficulty in recruiting sufficient labour but their counterparts in rural locations found that many of the population living around their mills were reluctant to work in factories.<sup>27</sup> They resorted to various measures to recruit labour; some made use of parish apprentices drawn from workhouses, whilst others built small factory communities.<sup>28</sup> There was also a dramatic and continuous increase in the number of hand loom weavers between 1780 and 1820 as the domestic sector strove to satisfy the demand created by the increased yarn output. Various estimates of the number of hand loom weavers have been made; those weaving cotton cloth grew from around 75,000 in 1795 to about 225,000 in 1811, reaching a peak in the mid-1820's, and standing at approximately 250,000 in 1833.<sup>29</sup> These weavers were drawn from a variety of sources; domestic fustian weavers were the primary source, but it seems that cotton weaving encroached on the other older textile sub-regions, expanding into north-east Lancashire and the West Riding, as well as attracting workers from other trades.

The acquisition of fixed capital is a major problem for most embryonic industries and the early cotton trade was no exception. However, manufacturers managed to acquire factory premises, machinery, and power at relatively low cost enabling the entrepreneur with capital to enter the industry. Often, the first stage was the conversion of premises and here water-powered corn mills were important in the early years of factory spinning, when development was linked directly with the need for water power.<sup>30</sup> When the manufacturer had acquired sufficient capital he could then build and equip a purpose-built factory. However, there was an important intermediate stage when entrepreneurs rented not only space but also machinery and power in another manufacturer's factory, often combining cotton spinning with machine-making. Some major figures in the industry began in this way, such as Robert Owen and the Murray Brothers, and the experience of McConnell and Kennedy is perhaps typical, forming a partnership with fustian warehousemen:-

'we immediately commenced business as machine makers and mule spinners . . . we made machines for others as well as ourselves, putting up our own mules in any convenient garrets we could find. After some time we removed to a building in Canal

Street . . . the owner occupied a portion of it himself, letting off the remainder to us.<sup>31</sup> After accumulating sufficient capital they were able to erect their own mill in 1797 and to help finance this they let off half of the factory to other manufacturers.<sup>32</sup> These processes of capital formation had important spatial consequences; the conversion of old mills and reliance on water power were powerful diffusive forces, whereas the use of rented premises and the subsequent construction of new mills induced a more clustered pattern in the main towns of south-east Lancashire, as it was here that a mutually-reinforcing network of business linkages existed.

The output of spinning mills was channelled by various means into the domestic weaving industry and it is useful to conceptualize these interactions as the *through-put* of the system, as shown in Figure 4. This represented a development of the 'putting-out' system of the pre-factory era, as described above. Spinners often developed direct contacts with the merchant-manufacturers, who remained key figures in the system, or set up warehouses in the major cotton towns to which merchants would travel to obtain their supplies.<sup>33</sup> Cotton spinners also extensively used the services of yarn dealers and agents who were found throughout Britain, notably in the four major producing areas of south-east Lancashire, the Nottingham area, around Glasgow and Paisley, and in Northern Ireland around Belfast, although Manchester remained the largest yarn market.<sup>34</sup> Thus, spinners rarely dealt directly with the hand loom weavers, rather there was widespread use of 'putters-out' as intermediaries. The latter could be small-scale independent entrepreneurs or often they were employed by Manchester merchants. Their sphere of activity was generally quite restricted, as the weaver usually had to travel on foot to the warehouse carrying the cloth produced each week and return home with sufficient raw materials for the following week, this effectively limited the distance to eight or nine miles. 'Putters-out' were found in towns throughout much of Lancashire, especially in the south-east of the county, and they often had a number of warehouses in surrounding villages to serve country weavers.<sup>35</sup> Again, the nature of this sub-system emphasized the close-knit nature of the industry in both organisational and locational terms.

The *output* of the system comprised two elements, the exported yarn of the spinning section and the production of the weaving branch, which was usually bleached, dyed, or printed prior to sale. Finishers either acted independently - buying cloth, preparing it, and marketing it themselves - or more commonly worked for merchant-manufacturers. Little locational evidence is available but Wallwork has isolated two important trends; the siting of finishing works besides streams and rivers in south-east Lancashire due to their need for vast quantities of water, and the increasing concentration of such concerns in the Manchester embayment, which reflected the necessity for close contact with the Manchester market.<sup>36</sup> Moreover, the Manchester directories of the period show the demise the trade of whitsters as this dated process was overtaken by more modern finishers.<sup>37</sup>

The export of cotton yarn from the system was carried on either directly with foreign merchants and manufacturers or through commission agents in Manchester or London. The surviving business papers of large spinning companies show that an extensive export trade was built up in this manner, especially with Germany and Switzerland, but

also throughout Europe.<sup>38</sup> Extensive use of middle-men can also be discerned in the cloth market and Edwards considers that most manufacturers employed the services of commission agents and wholesalers in London and provincial cities during this period.<sup>39</sup> London had been the most important distribution centre but in the early nineteenth century the Manchester market grew rapidly and assumed a position of dominance.<sup>40</sup> In addition, smaller manufacturers rented warehouses in Manchester, Bolton, and other towns in south-east Lancashire to organize the sale of their cloth, for example, the Manchester directories list many country manufacturers who had warehouses or sold their cloth from hotels or inns each week and their numbers grew rapidly during the early years of the nineteenth century.

However, the importance of the industry's connection with the London market should not be underplayed; in particular, the guidance given to manufacturers as to what to produce and when must have been invaluable, as the following letter shows: 'We rather wish you to drop the Sattinets, they are not new here and only fit for 2 months Sale. The Buff Stripes are liked best but still do not pursue it, turn the Loom to something Else . . . We want more Napkins and some made large - try your skill at Table Linen.'<sup>41</sup> The merchant-manufacturer link is in systems terms a feedback loop by which the system learned what was required of it for optimum performance (in this case the greatest profit and most rapid rate of growth). The market links that developed clearly served the feedback role effectively and moulded the development of the production system quickly and sensitively towards the most promising market directions.

Hence, the organisation of production imposed particular locational constraints on both sectors of the industry and, although geographical surveys are rare, it is possible to reconstruct the spatial pattern of manufacturing. A census of the spinning industry was made in 1811 by Samuel Crompton which was the most comprehensive survey carried out during this period.<sup>42</sup> Figure 5 shows the distribution of spindles in the Lancashire textile region as calculated by Crompton and it illustrates the urban mills of south-east Lancashire and their rural, water-powered counterparts in the Pennine valleys. The dominance of Manchester is apparent and other major centres included Stockport, Bolton, Ashton, and Preston. Crompton found no cotton spinning in north-east Lancashire at this early date and the map presents a clear impression of concentration in the Manchester embayment.

A locational reconstruction of the domestic weaving industry is, not surprisingly, impossible but an indication of its spatial pattern can be gained from examination of the Manchester directories of the period. Figure 6 illustrates the origin of country manufacturers attending the Manchester market in 1815 and, as these men operated the 'putting-out' system, this gives an indication of the distribution of domestic production.<sup>43</sup> The map shows that manufacturers were drawn from a wide area but that the majority originated from the northern half of the Manchester area. It gives the impression of a rural 'collar' of domestic production surrounding the core of spinning factories in south-east Lancashire.

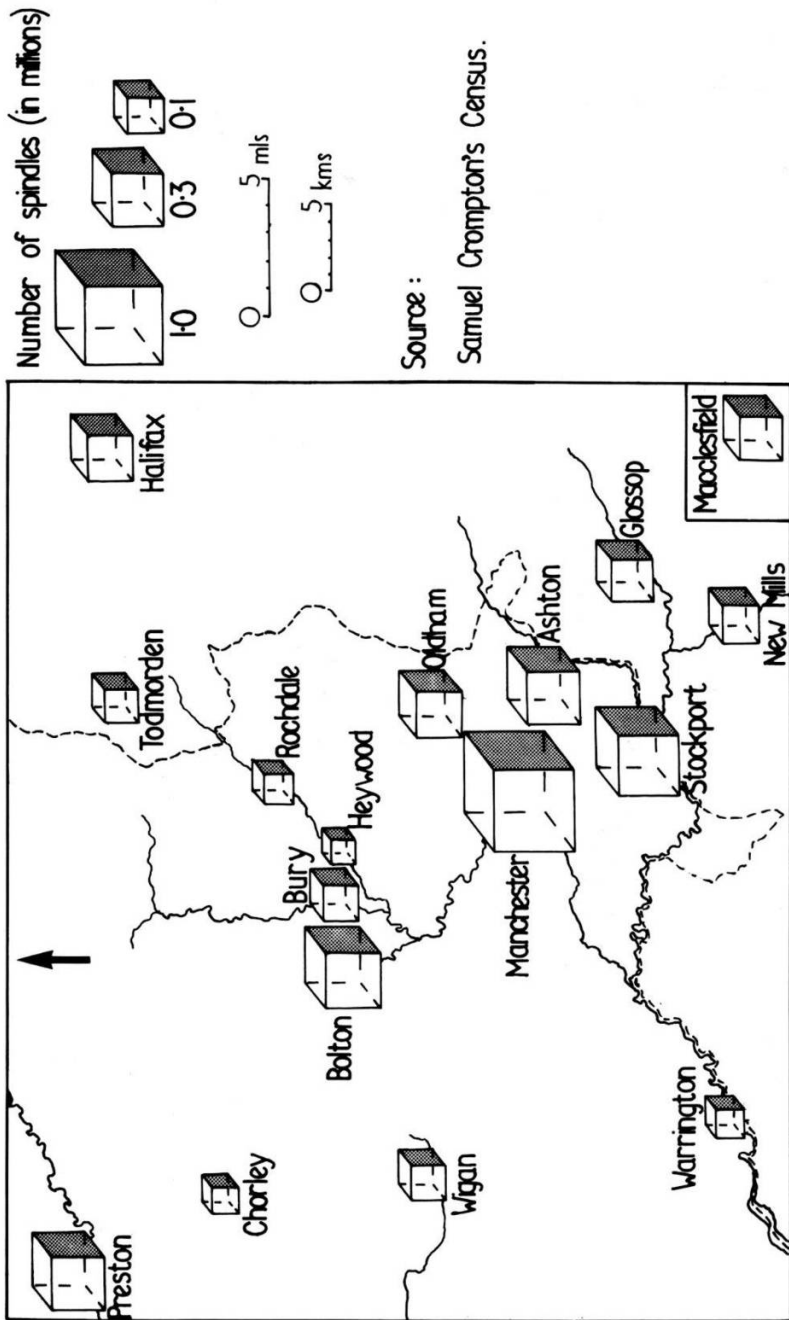


Fig. 5 The distribution of spindles in 1811

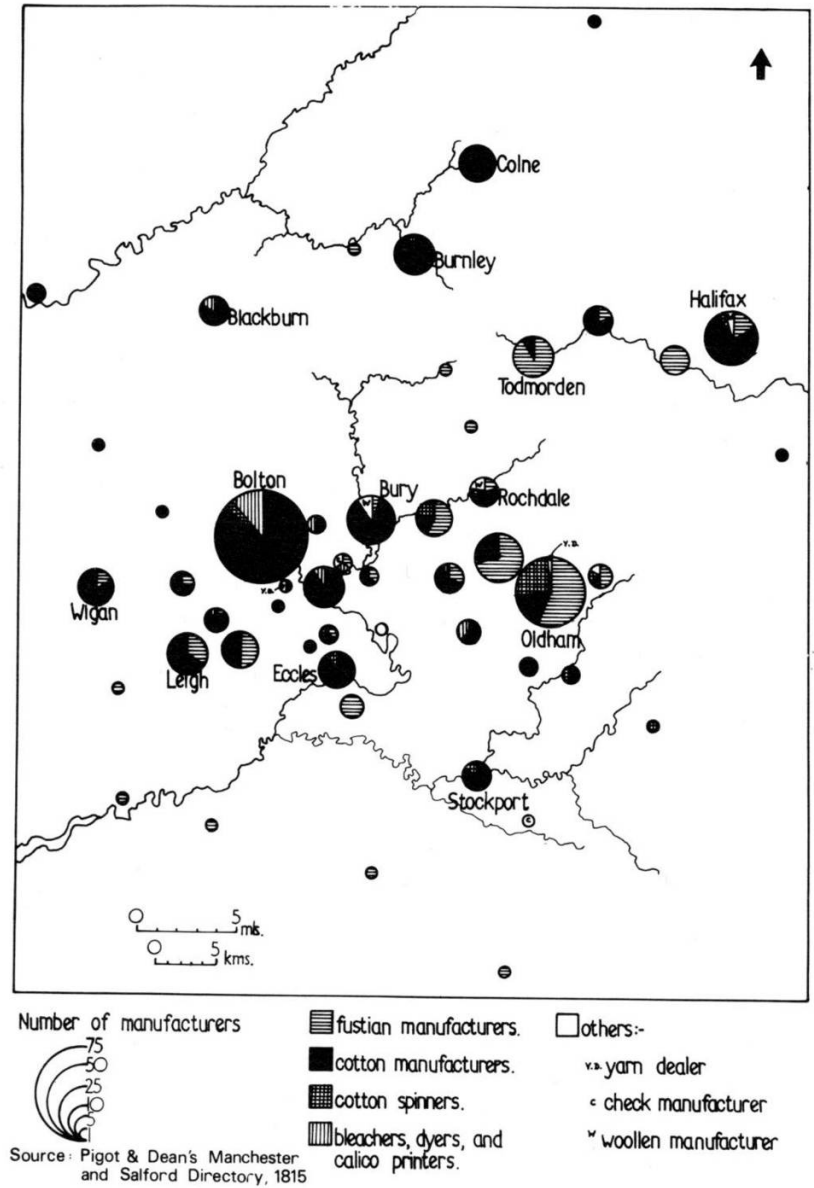


Fig. 6 Country manufacturers attending the Manchester market, 1915

### Early nineteenth century innovation

The partially-formed factory system of the early Lancashire cotton industry gradually evolved into a completely factory-based form following a series of innovations during the first half of the nineteenth century. Most notable of these was the perfection and commercial application of the techniques of power-loom weaving. This was achieved in a piece-meal fashion by a series of gradual improvements but by the 1840's weaving was being carried out in factories on a large scale.<sup>44</sup> Factory weaving had developed slowly before 1820 due to various factors; most notable was the failure to produce an efficient and reliable loom, but also the abundant supply of hand loom weavers prevented an intolerable bottleneck in the productive process, and the entrepreneur's fear of machine-breaking by irate domestic weavers may have retarded development. But between 1820 and 1850 power looms were introduced on a large scale often by spinners channelling their profits back into the industry. Consequently, most looms were installed in 'combined' mills alongside existing spinning machinery and this was a powerful locational force as the earliest official surveys show. For example, the 1835 Factory Returns reveal the marked concentration of weaving in south-east Lancashire and north-east Cheshire, notably in Manchester, Bury, Oldham, Stockport, and Ashton. Only Preston and Blackburn had significant numbers of looms in the north of the region but there were outliers to the major area of production.<sup>45</sup>

The wholesale adoption of the power loom hastened the demise of the domestic weaving industry, which reached a peak in the mid-1820's but declined rapidly thereafter.<sup>46</sup> This did not take place simultaneously throughout all the weaving areas of Lancashire, it was first experienced in and around the major manufacturing centres of south-east Lancashire and north-east Cheshire and, although the trade still persisted in Bolton, Bury, Rossendale, and north-east Lancashire for more intricate fabrics during the 1830's and 1840's, it lingered longest in the more remote, rural areas of north-east Lancashire.<sup>47</sup>

The continuing application of steam power was the other major development during this era and by 1850 it had outstripped the other major source of power - the water wheel - which only accounted for approximately 11 per cent of the total horse power applied to cotton mills in the Lancashire textile region.<sup>48</sup> Rodgers has plotted the geographical variations in motive power in detail and shown that urban mills of Lancashire and Cheshire were dominantly steam powered and that the water wheel still survived in the more remote country mills, principally in the Pennine and Rossendale valleys.<sup>49</sup> Hence, this reinforced the trend whereby the most modern, steam-powered, combined mills were concentrating production in south-east Lancashire and north-east Cheshire.

### The integrated factory system of the mid-nineteenth century

The introduction of the vertically-integrated combined mill completed the transformation of the Lancashire cotton industry from a domestic to a fully-fledged factory system and its impact in organisational terms can be gauged from Figure 7. By 1850 the combined mill dominated the system accounting for 64 per cent of employment, 82 per cent of looms, and 56 per cent of spindles in Lancashire.<sup>50</sup> It was only rivalled by the

old-established specialised spinning mills, and weaving-only mills were as yet little developed. The three branches can be conceptualized as three component sub-systems each closely linked together and it is possible to examine the flow of material into, through, and out of each of these in some detail.<sup>51</sup> However, this is not possible here and the discussion will be confined to the main changes that had occurred by 1850.

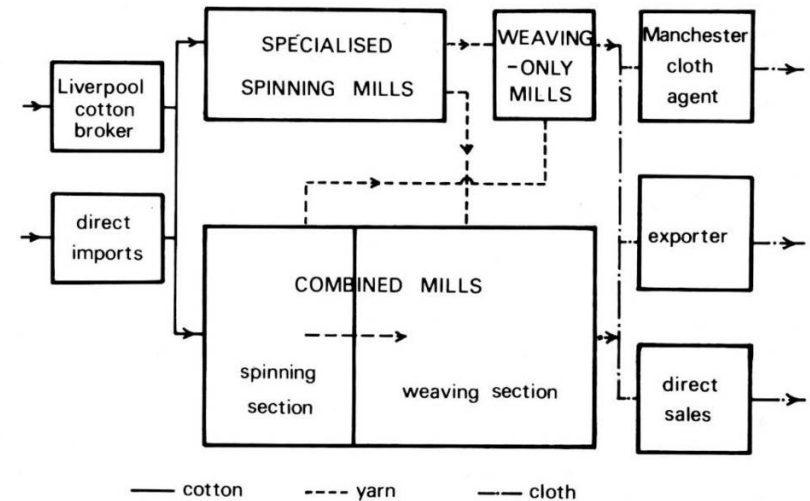


Fig. 7 The integrated system of the mid 19th century

The *inputs* to the industry were little changed. Raw cotton continued to be imported principally through Liverpool, where cotton brokers organised its distribution to inland spinners. However, some of the larger spinning concerns such as McConnel and Kennedy and Horrockses attempted to bypass this system and to import directly from the producers in the U.S.A. Labour supplies generally presented few problems to manufacturers especially those in urban areas; the weaving industry was more labour-intensive and relied heavily on female labour, which tended to be abundant due to the lack of suitable alternative employment, and the spinning industry had introduced larger, self-acting mules, which reduced the problem of obtaining skilled mule spinners. Fixed capital was still raised by the established system of renting 'room and power' especially for newcomers to the industry, but the larger, well-established companies were investing their profits in their businesses to expand factories or to establish new mills, rather than being concerned primarily with survival. Clearly, it would be a natural step to create a combined mill but it is not possible to quantify how many specialised spinners opted to invest in power looms in this fashion. However, it seems likely that this was the major source of investment in power looms.

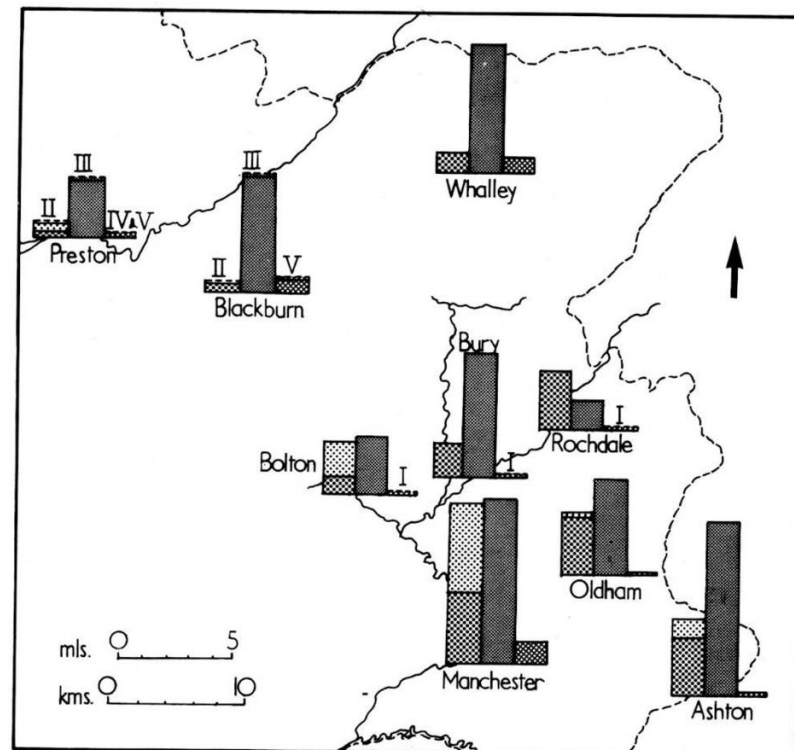
The *throughput* of the system, as shown in Figure 7, consisted of two elements; in combined mills it generally involved the simple transfer of yarn within the confines of a



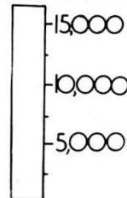
single factory, but in the specialised sector a marketing network for yarn was in operation. Manchester fulfilled this function just as it did in the cloth market and, to a lesser extent, in the supply of raw cotton.<sup>52</sup> By mid-century the city had come to dominate most commercial aspects of the cotton trade and the commercial directories of the period list many yarn merchants resident there and also numerous country manufacturers and merchants who travelled to Manchester each week to market their goods and buy new materials, often through the Cotton Exchange. With the demise of domestic manufacture, the commercial apparatus had superseded the 'putting-out' system and assumed a pivotal position not only in the yarn market but also in the marketing of cloth.

Despite the rapidly growing demand for cotton goods in Britain, the industry's principal market was found overseas and, although some large firms such as Horrocks exported directly, the great majority of *outputs* were channelled through the Manchester market. Contemporary directories list numerous 'merchants', who dealt principally with the home market, as well as 'shippers', many of whom were foreign nationals who handled the export trade.<sup>53</sup> Cotton cloth was finished prior to market - and K. L. Wallwork's study of the finishing trades in the 1840's identifies two important locational trends: first, the need for close links with both manufacturers and marketing agencies, and second, the necessity for a constant supply of clean water.<sup>54</sup> These were reflected in the two major concentrations of print works; the principal one in the Manchester embayment along the banks of the Irwell and its tributaries in Manchester, Salford, Radcliffe and around Bury (illustrating the market orientation), with another more remote concentration in north-east Lancashire, especially around Accrington, and in the Rossendale valley around Bacup.

Thus with the advent of a complete factory system, the Lancashire cotton industry had assumed a complex and closely-interrelated organisation and this was reflected in the locational pattern of manufacturing. Fortunately, by mid-century there were comprehensive surveys of the industry carried out by the Factory Inspectors and one particularly detailed report is available for 1841.<sup>55</sup> Figure 8 illustrates the distribution of employment in the cotton industry sub-divided in to the various branches in 1841. It shows that combined mills were the dominant form of manufacturing; they employed the largest percentage of workers in all the major cotton towns with the exception of Rochdale, and in the entire area of Horner's survey they accounted for 58.7 per cent of total employment in cotton manufacturing. Specialised spinning mills were well-established, especially in south-east Lancashire, and employed 34.2 per cent of cotton workers, whilst weaving-only mills were little developed and comprised only 4.8 per cent of employment. The map also shows that cotton manufacturing assumed a different form in all nine parishes. Manchester was the largest cotton manufacturing centre with a more varied and balanced range of processes than elsewhere. Most of the largest firms in the industry were located there, mainly in the fine spinning trade, and a large part of the, as yet little developed, specialised weaving industry was found in Manchester, reflecting perhaps the importance of its marketing functions. Bolton most closely resembled Manchester, again concentrating mainly on finer yarns, but in Ashton and Oldham, combined mills dominated alongside the coarse spinning trade.



**No. employed in cotton manufacturing**



- fine spinning mills.
- coarse spinning mills.
- combined mills.
- weaving sheds.

Source : Horner's Survey, 1841.

- I a share of 726 employees in 8 mills in 5 towns - Bury, Bolton, Rochdale, Radcliffe, & Prestwich.
- II 241 employees in Blackburn & Preston working short-time.
- III 867 employees in Blackburn & Preston working short-time.
- IV 1182 employees in 10 mills in 8 towns - Preston, Eccles, Leigh, Winwick, Wigan, Chorley, & Lancaster.
- V 158 employees in Blackburn & Preston working short-time.

**Fig. 8 Local variations in employment in 1841**

Coarse spinning was also important in Rochdale but Bury was something of an anomaly in south-east Lancashire, as its combined mills were primarily concerned with weaving. The survey is less informative about the northern half of the textile region, data are only available for the three large parishes of Preston, Blackburn, and Whalley, but it is clear that the combined mill concentrating primarily on weaving dominated throughout this sub-region. Specialised spinning was generally unimportant except in Preston, where a fine spinning industry had been long established, but the parishes of Blackburn and Whalley housed a significant proportion of the small, specialised weaving trade. This is an early indication of the great growth in specialised weaving that was to occur in this region during the second half of the nineteenth century.

### **The utility of a systems approach**

As the Lancashire cotton industry was a rapidly-evolving, complex structure which passed through a series of radical organisational changes with numerous linkages between its components at every stage, it would seem to be an appropriate case for re-interpretation in systems terms and these concluding comments will attempt to assess its validity for a study in industrial development.

The principal merit of systems concepts is that they concentrate on the links between process and form or, in the case of a geographical study, between organisation and location. The latter has tended to be neglected by industrial geographers, for example, they have stressed the importance of physical resources such as high humidity or water supply, or coal and labour, or transport developments in explaining the location of cotton manufacturing in Lancashire. However, this case study shows that explanations cannot be found simply in physical, resource, or transport criteria, rather they should be sought in the 'environment' created by the industry itself (i.e. its own organisation as a system of linkages), and as industries mature the latter becomes progressively more important. Factories do not exist in isolation, they are connected by a complex network of flows of material, money, and information, and a systems approach helps to clarify and codify complex networks of linkages. In doing so, it can bring to light elements which had not previously been considered as important in shaping the industry's growth and location, for example, the evolution of the 'putting-out' system, the methods of raising capital, and the development of marketing in Manchester. It may, of course, be possible to take all these factors into account in an approach not based on systems concepts, but the value of the latter is that it imposes a particular discipline on the analysis, since it demands a systematic and ordered consideration of each set of factors in terms of their place within the system. Moreover, it extends the analysis away from just the manufacturing units to the wide range of related services and industries which were an integral part of the production process, thereby giving a more rounded view of the operation and location of the Lancashire cotton industry. Another useful aspect of systems theory is the concept of information input and feedback by which systems 'learn', modify their activities, and so survive or improve their efficiency or profitability. The example of the London-Lancashire link has been quoted above and such feedback was a common feature throughout the various markets of the industry, and as production expanded and competition became more intense, so the importance of information flows increased.

On the other hand there are a number of disadvantages inherent in the application of systems theory. The definition of an open system necessitates the demarcation of clearly-defined but arbitrary boundaries (both spatial and structural), but in reality the system can overlap these; for example, cotton manufacturing extended into Yorkshire and merchants served industries other than cotton. Moreover, in historical studies it is particularly difficult to match data sources to the defined area. The explanation of the various stages of the system's evolution in terms of inputs, throughput, and outputs is a useful but at times cumbersome and repetitive device and in some cases it appears inappropriate, for example, during the mid-nineteenth century when the combined mill was dominant the throughput merely involved the transference of material across the factory floor. A further problem arises in considering the system's interaction with its external environment as in practice only those elements considered relevant to the industry's operation are abstracted - a subjective and difficult process. Finally, it is often not possible to quantify all the elements within the system and the flows between them, particularly when dealing with historical evidence.

Consequently, it is only possible to postulate a theoretical model of the industry's development and this can be extended beyond the 1850's to the Lancashire cotton industry's heyday prior to 1914. Such a theoretical model would have five stages:

- I Domestic fustian manufacture: a closely integrated system characterised by some degree of balance, but with increasing disequilibrium because of progressive improvement of the weaving process whilst spinning remained primitive. Geographically dispersed production based on a dual economy.
- II Early factory phase: a system in gross disequilibrium. Spinning wholly mechanised, vastly increased yarn production, and the greatly expanded domestic weaving trade now constituting the bottleneck. Factory production favoured in urban coalfield locations or in rural, water-powered sites with the spinning core area surrounded by a rural collar of domestic production.
- III Vertically-integrated system in combined mills: a system now brought back into balance by the mechanisation of weaving. Spatial concentration of production in south-east Lancashire with the demise of hand loom weaving and the relative decline of rural, water-powered mills.
- IV Specialisation: marked by progressive segregation, both commercial and geographical, of the spinning and weaving processes. At this stage the system becomes, to a degree, spatially disaggregated due to the development of sub-regional specialisation of spinning in south-east Lancashire and weaving to the north of the Rossendales.
- V Horizontal integration: the early growth of large horizontal combines, confirming and strengthening the commercial and spatial segregation of the two sub-systems.

The intervals between phases I and II and phases II and III were periods of intense technological experimentation and innovation directed towards balancing the capacities of the two principal manufacturing sub-systems. On the other hand the intervals between phases III and IV and phases IV and V, were marked not by technological but by commercial and organisational change and innovation.

## REFERENCES AND NOTES

1. **R. B. McNEE**, 'A Systems Approach to Understanding the Geographic Behaviour of Organizations, especially Large Corporations' in F. E. I. Hamilton (Ed.), **Spatial Perspectives on Industrial Organization and Decision-making** (1974) 47-75, and **F. E. I. HAMILTON AND G. J. R. LINGE** (Eds.), **Spatial Analysis, Industry, and the Industrial Environment, Volume 1 - Industrial Systems** (Chichester, 1979), see Ch. 1 in particular.
2. **A. R. H. BAKER, R. A. BUTLIN, A. D. M. PHILLIPS, AND H. C. PRINCE**, The Future of the Past, **Area** 4 (1969) 49, and **J. LANGTON**, 'Potentialities and problems of adopting a systems approach to the study of change in human geography' in C. Board, R. J. Chorley, P. Haggett, and D. R. Stoddart (Eds.) **Progress in Geography** 4 (1972) 125-79.
3. **S. J. CHAPMAN**, **The Lancashire Cotton Industry** (Manchester 1904) 1 and **G. W. DANIELS**, **The Early English Cotton Industry** (Manchester, 1920) 12.
4. Given the primitive stage of simple technology, it is difficult to separate the inputs and throughput here as the latter usually involved the simple transfer of yarn from domestic spinners to hand-loom weavers, who were often members of the same family working in a small cottage.
5. **T. ELLISON**, **The Cotton Trade of Great Britain** (1886) 170-1. This shift in fortunes was associated with changes in the pattern of cotton suppliers, whereby the southern states of the U.S.A. took over from the Levant and the West Indies.
6. For greater detail of the cotton and linen supply system see **A. P. WADSWORTH AND J. de L. MANN**, **The Cotton Trade and Industrial Lancashire, 1600-1780** (Manchester, 1931) 232-6.
7. **W. RADCLIFFE**, **The Origin and the New System of Manufacture, commonly called 'Power-Loom Weaving'** (Stockport, 1828) 59.
8. **DANIELS**, *op.cit.*, 56.
9. **The Manchester and Salford Directories** constitute a discontinuous series from 1772 onwards and are housed at the Central Reference Library, Manchester.
10. **CHAPMAN**, *op.cit.*, 4.
11. **O. ASHMORE**, **The Industrial Archaeology of Lancashire** (Newton Abbot 1969) 60.
12. *Ibid.*, 58-60, and **WADSWORTH AND MANN**, *op. cit.*, 142.
13. **WADSWORTH AND MANN**, *op. cit.*, 236-7.
14. **DANIELS**, *op. cit.*, 61.
15. **WADSWORTH AND MANN**, *op. cit.*, 277-8.
16. A ten per cent systematic sample of 11,700 Wills and Inventories proved in the Court of Probate at Chester, 1741-1760, (held in the Lancashire County Record Office) was taken. The area covered included the whole of Cheshire, a part of Flintshire, and Lancashire to the south of the Ribble with some adjoining parts of Yorkshire.
17. **E. BAINES**, **History of Cotton Manufacture in Great Britain** (1835) 116-7. Kay's 'flying-shuttle' invented in Bury in 1738 enabled the weaver to double his output and his son Robert's innovation - the 'drop-box' - facilitated the adoption of the invention for a wide range of clothes.
18. **R. GUEST**, **A Compendious History of the Cotton Manufacture** (Manchester, 1823) 12.
19. *Ibid.*, 44-5 and **ELLISON**, *op. cit.*, 26.
20. **R. S. FITTON AND A. P. WADSWORTH**, **The Strutts and the Arkwrights** (Manchester, 1958) 65.
21. **BAINES**, *op. cit.*, 86.
22. **A. E. MUSSON AND E. ROBINSON**, 'The Early Growth of Steam Power,' **Econ. Hist. Rev.** 2nd Series 6 (1959) 418-39.
23. **FACTORY RETURNS 1838**, P.P. 1839 (41) XLII.1.

24. **ELLISON**, *op. cit.*, 81-88.
25. **M. M. EDWARDS**, *The Growth of the British Cotton Trade, 1780-1815* (Manchester, 1967) 113.
26. **ELLISON**, *op. cit.*, 175-6.
27. **S. D. CHAPMAN**, *The Cotton Industry in the Industrial Revolution* (1972) 53.
28. **F. COLLIER**, 'An Early Factory Community', *Economic History II* (1930-3) 117-9; **R. BOYSON**, *The Ashworth Cotton Enterprise* (Oxford, 1970) 115-6; and **G. UNWIN**, **A. HULME**, AND **G. TAYLOR**, *Samuel Oldknow and the Arkwrights* (Manchester, 1924) 159-76.
29. **D. BYTHELL**, *The Handloom Weavers* (Cambridge, 1969) 54-7, and **S. D. CHAPMAN**, *op. cit.*, 59-60.
30. **EDWARDS**, *op. cit.*, 186.
31. **McCONNEL AND KENNEDY LTD.**, *A Century of Fine Cotton Spinning* (Manchester, 1906) 9.
32. *Ibid.*
33. **DANIELS**, *op. cit.*, 183; **BOYSON**, *op. cit.*, 56-7; and the **Manchester Directories** for the period list numerous manufacturers with warehouses in the town.
34. **DANIELS**, *op. cit.*, 182-6 and **EDWARDS**, *op. cit.*, 133-4.
35. **BYTHELL**, *op. cit.*, 37-8.
36. **K. L. WALLWORK**, 'The Calico Printing Industry of Lancastria in the 1840's' *Trans. I.B.G.* 45 (1968) 143-7.
37. **Manchester and Salford Directories, 1781-1815**, show that the number of whitsters attending the Manchester market declined from 86 in 1781 to 6 in 1802, after which no further were reported.
38. See **EDWARDS**, *op. cit.*, 49-74, for extensive discussion of this trade based on the McConnel and Kennedy Papers, and also **BOYSON**, *op. cit.*, 57.
39. **EDWARDS**, *op. cit.*, 147-8.
40. *Ibid.*, and **UNWIN et al**, *op. cit.*, 104.
41. A letter quoted in **UNWIN et al**, *op. cit.*, 65.
42. **G. W. DANIELS**, 'Samuel Crompton's Census of the Cotton Industry in 1811,' *Econ. Hist.* 2 (1930-3) 107-10. Crompton made the survey in support of his petition to Parliament to obtain compensation for not patenting his invention. It was fairly complete for Lancashire but omits more remote mills.
43. **Pigot and Dean's Manchester and Salford Directory for 1815** is used here. The directories contain lists of merchants and manufacturers operating in Manchester, as well as country manufacturers attending the Manchester market. The former are not differentiated but the latter can be used to illustrate the pattern of textile manufacturing in surrounding areas.
44. Improvements in Cartwright's flawed early attempt were made in 4 stages which culminated in Kenworthy and Bullough's patent in 1841, which produced the power loom that was to become the basis of the weaving trade in its heyday in the late nineteenth century. See **ELLISON**, *op. cit.*, 35-7.
45. **H. B. RODGERS**, 'The Lancashire Cotton Industry in 1840,' *Trans. I.B.G.* 28 (1960) 145-51 and see especially Fig. 5.
46. **BYTHELL**, *op. cit.*, 80-2.
47. *Ibid.*, 263-7 and **A. J. TAYLOR**, 'Concentration and Specialization in the Lancashire Cotton Industry, 1825-50,' *Econ. Hist. Rev.* 2nd Series, 1 (1949) 117.
48. **Factory Returns 1850**, P.P. 1850 (745) XLII. 455.
49. **RODGERS**, *op. cit.*, see Fig. 2.
50. **Factory Returns 1850**.
51. For more detailed discussion of these, see **S. KENNY**, 'The evolution of the Lancashire Cotton Industry c.1750 to 1900: a study in locational and organisational change. Unpublished M.A. thesis, University of Manchester, 1975, pp. 122-34.
52. **R. SMITH**, 'Manchester as a Centre for the Manufacture and Merchenting of Cotton Goods, 1820-30, *Univ. of Birmingham Hist. Journal IV* (1953-4) 64-5.
53. *Ibid.*
54. **WALLWORK**, *op. cit.*, 146.
55. **Factory Inspector's Report 1841**, P.P. 1842 (31) 410 XXII.377. A special survey was made by the Inspector for Lancashire, Mr. L. Horner, enumerating the number of mills, total employment, and sources of power in each parish in Lancashire.