Supply Chains and Total Product Systems

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A Reader

Editors
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and Ruth Carter

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Editors' Note

This reader has been produced in conjunction with an Open University course *T882 Supply Chain Innovation, Strategy and Management*, part of a Masters programme in Technology Management. The course is primarily intended for students and practitioners in the field of supply chains and total product systems. However, in common with this book, it is also of interest to a much wider audience (see www.open.ac.uk/courses).

The reader includes material drawn from an extensive range of sources and disciplines. The case studies in the chapters illustrate practice in four continents and many countries. We believe that its breadth is distinctive, both in scope and in focus.

Our focus is on the complete 'cradle-to-grave' life cycle of total product systems and not, as the casual browser might assume, on purchasing and supply. This is reflected in the selections we present.

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Introduction to the Reader

In the development of this reader we had four main, and interrelated, considerations in mind. First, the term 'supply chain' presents a number of analytical difficulties. It is widely used among managers and by some academic observers as a generic shorthand. But it is applied to widely differing types of approach. In relation to supply chain management (SCM), Harland (Chapter 1.2) observes that 'there is little consistency in the use of the term and little evidence of clarity of meaning', a point that is illustrated by four main categories of use. These range from management of the intra-firm supply chain through to management of networks of interconnected businesses. Furthermore, supply chain practice is evolving dynamically, adding to the lack of clarity. An additional difficulty is that, across the wider literature, 'supply chain' jostles with a range of other conceptualizations which broadly focus on much the same phenomena but with different emphases. Alternative conceptualizations include 'value chains' (used by a variety of authors developing from Porter, 1985 – and subsequently among practitioners who appreciated its disciplined focus), 'supply networks or inter-business networks' (e.g. Harland, Chapter 1.2; Harland et al., 2004), 'global production networks' (e.g. Palpacuer and Parisotto, Chapter 4.2), 'commodity chains' (e.g. Hopkins and Wallerstein, 1986; 1994; Gereffi and Korzeniewicz, 1994), 'global commodity chains' (e.g. Gereffi and Korzeniewicz, 1994; Raikes et al., 2000), 'product systems' (e.g. Lauret, 1983) and 'total product systems' (Rhodes, Chapter 1.1).

These various concepts reflect differences in the purpose of analysis and in academic traditions which, in turn, are reflected in contrasting emphases in analysis and diversity in interpretation. The variety of approaches emphasizes that cross-disciplinary perspectives are important for the development of a comprehensive understanding of these phenomena and their implications, both for practitioners and for the wider society. Thus we have sought to reflect some of the diversity in analysis.

The second consideration was that this appears to be a field that is already well provided for. Although this is of fairly recent origin as a subject area, the body of non-journal supply chain literature has become voluminous. This is illustrated by the

108,837 publications that were listed in a search for 'supply chain' at Amazon.com (August 2004). This may indicate a particular American preoccupation with the subject area (a search at Amazon.co.uk produced a mere 337 results). This volume of publication may also relate to perceived shortcomings among US companies in this respect, particularly in comparison with leading Japanese companies, such as in the automotive sector (Dyer, 1996). Alternatively – or as well – it may reflect the subject's location within the cockpit of management fashion or, more simply, it may represent recognition of the critical nature of this area of management for competitive performance.

Whatever the reasons, the scale of existing publication presents a challenge in terms of establishing market distinctiveness. We take the view that the combination of readings in this volume, which are drawn from diverse research and practitioner sources, and which provide a range of contrasting perspectives and concerns, do provide a collection that is differentiated from the bulk of existing material. While we have only been able to review a small proportion of the 108,837 publications referred to above, they mostly appear to range from prescriptive manuals concerned with, say, the implementation of a particular supply chain software package through to more comprehensive volumes advancing, and seeking to develop, concepts of best practice in areas such as purchasing and supply, logistics or supply chain management and strategy. The latter are concerned with fundamental areas, but we suggest (in Chapter 1.1) that practice is moving on. In particular, combinations of the strategies of lead companies and external regulation such as on environmental and labour issues are pushing *de facto* practice towards what we term 'total product systems'. Management in this context require management approaches that are even more holistic that those of integrated SCM.

Third, we have been concerned to emphasize the relevance of 'supply chain' issues to a broader group of practitioners and academics than has generally been concerned with them. Lund and Wright (Chapter 1.6) suggest that much of the discussion about SCM is undertaken from engineering and logistics perspectives. They point to the absence of consideration – and limited awareness among practitioners – of the implications of changing supply chain practice for industrial relations, their own area of concern. This is only one of several areas of analysis that receive limited attention in both the standard supply chain texts and the wider supply chain literature. One such is accountancy which, as Berry et al. (Chapter 2.6) observe, tends to ignore value created outside the firm – a surprising gap when it is common for well over 50 per cent of an organization's costs to derive from external purchasing. But they also found that management accounting practice is being modified by 'the supply chain impact'. Such gaps lead Harland et al. to observe that the 'existing literature on supply networks tends to focus on the integration of logistic activities and resources; little attention has been paid to more behavioural aspects, such as how individual actors in supply networks resolve conflicts or make decisions' (2004, p. 18).

The issues extend beyond the particular problems of adjustment within particular management functional areas. Much of the evolution of supply chain strategy and

practice has been driven under the umbrella of SCM, and this has been a major factor in reshaping practice and strategy in organizations of all types. But changes in approach to product supply are, in growing numbers of cases, linked to major reorganizations of activities that are global in their reach. SCM strategies are primarily shaped by large organizations that are dominant in particular products, brands or categories. In the main, the lead organizations are based in the industrialized countries but operate on a transnational or a global scale. Their corporate structures have evolved from the predominant model of the past of 'a portfolio of national businesses' and towards forms that are unified on a transnational or a global scale (Murray and Trudeau, 2004). The process has been well summarized by Gereffi (1994) in terms of 'the emergence of a global manufacturing system in which production capacity is dispersed to an unprecedented number of developing as well as industrialized countries . . . The revolution in transportation and communications technologies has permitted manufacturers and retailers alike to establish international production and distribution networks that cover vast geographical distances.' Thus the management and functioning of supply chains – and total product systems – and their impacts need to be considered on this scale, as is reflected in several of the chapters in this volume.

Fourth, our selection was shaped by the intention to use this reader within an Open University postgraduate course on supply chain innovation, strategy and management that forms part of a Masters in Technology Management. The students taking this course were expected to be (and are) mostly experienced managers, and so the combination of academic criteria and relevance to those able to draw on a substantial reservoir of experience has also contributed to the process of selection. Thus, while much of the material is academic, and includes a range of research studies drawn from many sectors, there is also an emphasis on experience in practice. Consequently, we hope that it will be relevant to two other groups: first, students from a variety of academic backgrounds with concerns within, or impinging on, the broad supply chain and product system area; and second, senior and middle managers who wish to extend their knowledge, awareness and capabilities in this rapidly developing context. It is pertinent to the service, manufacturing and process sectors, including the public sector as the significance of supply chain issues is given greater recognition there, and to many, if not most, management functions, including finance, design, production, environmental management, information systems and marketing – as well as logistics and purchasing.

This reader has four major parts concentrating on the following themes:

- theoretical and conceptual issues within the supply context;
- inter-organizational relationships within product systems;
- accomplishing change within organizations (i.e. intra-organizational development and practice);
- issues and challenges for small and medium enterprises (SMEs) presented by large-firm-driven supply chain integration, and potential responses for these enterprises.

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Theoretical and Conceptual Issues

In this part we address some of the fundamental issues in supply chain innovation, strategy and management.

Ed Rhodes (Chapter 1.1) sets out the approach which underpins the emphasis in this book on holistic treatments of analysis and practice in the supply chain context. The chapter provides an introduction to supply chain practice and to some key ways in which it is analysed. It develops the case for moving from a fairly narrow focus on supply chain problems and performance to more systemic views that reflect emerging practice in lead companies, and which take account of the effects of evolving regulatory regimes related to environmental and other issues. These are reshaping approaches to product design and process organization across a supply chain, contributing to changes in supply in the aftermarket, and bringing the processing of end-of-life products into a central role. These changes are conceptualized as 'total product systems'. They encompass the conventionally defined areas of supply chain activity together with the aftermarket and end-of-life phases. Among other issues, this emphasizes the importance of integrated management of the various component and materials feedback loops within product and aftermarket processes. The materials inputs and waste emissions associated with all stages of production are also integral to systemic management of supply chains and product systems.

Harland (Chapter 1.2) traces the development and application of the term 'supply chain management' (SCM) since its appearance in the early 1980s. The review identifies four different, distinct uses of SCM and the literature associated with each of them. It builds a systemic framework – for SCM research and practice – linking these approaches and emphasizes the network character of strategic, inter-business SCM.

Kaplinsky (Chapter 1.3), writing from the perspective of a scholar in development studies, discusses the impact of globalized value chains (essentially synonymous with supply chains), teasing out some critical lessons from the way in which they operate. He emphasizes growing inequalities, both between countries and within industrialized and developing countries, and suggests that the critical issue for participation in the global economy is identifying approaches that are likely to yield both sustainable

and equitable growth in incomes for the participants. Analysis of value chains is critical to the processes of identification, and Kaplinsky suggests three critical elements of this analysis: dynamic rents, governance and systemic gains in efficiency. Governance is a particularly important issue for understanding the functioning of supply chains and value chains, and Kaplinsky suggests a typology of three forms of intra-chain and external governance: *legislative*, which sets the conditions for participating in the chain; *judicial*, which audits performance and compliance with the conditions; and *executive*, that is proactive governance which helps participants within the chain to operate to meet the conditions set. He emphasizes that governance is the responsibility not only of lead companies, but of all organizations within the chain. His chapter provides some insights into the importance of corporate and governmental policy formulation and implementation with respect to globalized product systems.

The next two chapters, Hampson (Chapter 1.4) and Katayama and Bennett (Chapter 1.5), describe, analyse and, taken together, develop a powerful critique of lean production. They demonstrate that, despite their many proponents in manufacturing sectors, lean approaches, with their inevitable rigidities, are not always appropriate for tackling production issues. If they are abstracted from their original context and applied elsewhere, the benefits claimed for them, such as high skill levels and a job for life, often turn out to be illusory. Out of context, they bring stress, have variable benefit and may not be sufficiently supply chain specific.

Hampson focuses on the political environment and industrial relations aspects of lean manufacturing such as quality of work and working conditions – in particular, how to counter 'management by stress'. (Shockingly, he refers to studies of *karoshi* – death from overwork – in Japanese lean production plants.) His conclusions concern the potential for industrial relations systems to shape the outcomes of work reorganization. Katayama and Bennett are concerned with issues of technical organization and draw on case studies, undertaken in the mid 1990s, in four different Japanese manufacturing plants (autos, PCBs, refrigerators and air conditioners). They find lean production lacking in robustness in a climate of variable demand, which leads them to develop the notion of 'adaptable production' – the more versatile design of production systems to allow for changing circumstances.

Supply chain practice is primarily shaped by large, lead companies such as brand manufacturers and retailers. These are able to use their large market shares and buying power to shape practice within the firms involved in the various production stages. This tends to include an emphasis on cost reduction throughout a chain, which is achieved through one combination or another of improvements in organization and practice applied by most firms in a chain, the use of advanced logistics methods and a continuous, global search for low cost sources. Among other issues, these approaches put pressure on wage costs and working conditions, particularly in high wage industrialized countries (ICs). A critical issue is then: how can workers and unions in the ICs respond to these challenges? In Chapter 1.6, Lund and Wright review aspects of supply chain practice and consider the impact of supply chain integration on industrial relations. They draw on experience in the US grocery sector to examine the issues. They suggest that management–union relationships can

be changed in some powerful ways but that these are not all one sided. Integrated supply chain practice can create both challenges and opportunities for all the parties involved. For example, inter-organizational collaboration can bring advantages to the organizations involved but also involves dependencies and vulnerabilities. Unions and their members can derive bargaining and other advantages from these changes. But this requires new approaches, such as action that is more inclusive in relation to the wider community – for example, developing awareness among consumers to the point where they are prepared to give support through boycotts and other action.

On a more specific issue that links knowledge management (KM) to change processes, den Hertog et al. (Chapter 1.7) draw our attention to the way that 'intangible investments are still a widely underestimated area of the knowledge-based economy'. They discuss 'de-materialization' – in which a steadily increasing share of value in a product can now be attributed to intangibles, for example training, licensing, distribution and servicing. Such intangibles represent the soft components of innovativeness and competitiveness. They explore definitions of intangible investments and examine their role in five sectors: fashion, flowers, brewing, publishing and financial services. Their conclusions point to the increasing role of service activity in innovation and the development of greater numbers of linkages and mutual dependencies between industrial and service organizations. The authors emphasize the importance of knowledge management within organizations and suggest that future industrial and technology policy must take account of the higher profile of intangible investments in innovation processes. This underlines the growing importance of a systemic view of supply activity which values and seeks to understand rich inter-organizational connectivity.

Leiper et al. (Chapter 1.8) illustrate one aspect of the total product system concept through a case study of an environmental supply chain management (ESCM) initiative in a leading construction company. They report a substantive shift in the sector's environmental agenda from such concerns as waste minimization and environmental project management to considering 'the more complex issues of sustainability and the life-cycle impacts of products and services used and consumed in the creation, maintenance and operation of the built environment'. In their case study they evaluate the extent to which four key 'best practice activities' have been applied by the company. They find that the commitment and performance of the many suppliers involved in a construction project are paramount for the main contractor and describe an array of tools and techniques that were applied. These include a risk-based approach to ESCM and introducing SME suppliers to a sustainability philosophy through a programme of training and accreditation. They conclude by identifying a major sectoral challenge: to convince as yet unconverted clients and suppliers of 'the benefits of a business philosophy centred on environmental awareness and the concept of sustainability'.

1.1

From Supply Chains to Total Product Systems

Ed Rhodes

Introduction

The evolution of supply chain management and practice has had an integral and expanding role in contemporary global economic and socio-political change over the past 25 years or so. This role is moving closer to centre stage with the emergence of business models equating to 'total product systems'. The impacts of advanced supply chain practice include driving fundamental changes in approach to product design, the concept of 'product', production methods, distribution, marketing, aftermarket support and end-of-life (EOL) reprocessing. Viewed in their full context, methods of supply chain management (SCM) have major influences on societal functioning and on economic development at global, national and local levels. Even the supply chains for simple products can involve several different industries and link many companies, large and small. Those for complex products may span several technological domains and economic sectors, linking hundreds or sometimes thousands of companies.

Complexity is evident, for instance, in the scale and scope of supply chain operation in capital and consumer goods sectors (such as aircraft, cars and apparel) and in services (such as hotel chains, fast-food franchises and financial services). In such cases, elements of the design, production and distribution processes associated with an end-product, together with the associated management and support services, may be carried out in large numbers of organizations in many countries in all continents. This provides the context in which 'a very small firm in one country may be directly linked into a global production network' (Dicken, 2004, p. 253). 'Geographic dispersion has occurred on a massive scale' (Ernst, 2002, p. 504). Supply chain organization has provided the channels through which much of this has occurred. Consumer and other products, together with the methods of production and marketing that underpin them, are projected from the countries of the industrial core into

those of the semi-periphery and periphery, reshaping economies and societies. But this is not one-way traffic. There is also substantial movement in the opposite direction as patterns of specialization and integration are fostered on a global scale. Also, transnational companies have developed in newly industrialized countries (NICs) and in some developing countries (DCs), and become engaged in similar management of supply chains on an international or global scale. At the individual level, developing supply chain practice is directly or indirectly reshaping people's lives, whether as workers (in all categories), subsistence farmers, consumers or owners of small retail and other businesses. Those not affected must now be a dwindling minority of the world's population.

An extensive academic literature is concerned with aspects of these phenomena. Much of it is located in management accountancy, business management, organizational behaviour, and various branches of economics, as well as the supply chain 'mainstream'. Not surprisingly, the mainstream literature is primarily concerned with overall supply chain strategy, with practice in areas such as purchasing and logistics, and with analysing issues of 'lean supply' and other perceived problems. The emphasis of this literature is primarily technicist, presenting supposedly 'neutral' solutions to current managerial preoccupations. There is a focus on what are thought to be the most efficient methods for achieving high standards of performance in target areas that include cost reduction, managing outsourcing, shortening replenishment cycles, minimizing inventory, achieving consistent high standards of product quality, reducing time to market and 'getting close to the customer'.

These are highly significant competitive objectives, although the difficulties confronting those who seek to achieve them are not always adequately explored or are underestimated. Supply chains are highly complex phenomena, and the long term challenges of co-ordinating and developing their functioning are ill matched with managerial cultures where rapid career moves are combined with the influence of successive management fads and fashions (Pascale, 1990; Scarborough and Swan, 2001; MacDonald, 2004). A further problem is that supply chain practice tends to be abstracted from its broader contexts and effects. For example, the pursuit of cost reduction on a global scale takes several routes. Increased outsourcing has been one of the vehicles of change, and the search for suppliers offering ever lower costs can lead to suppliers who exploit lax regulation of labour conditions, environmental protection, and so on. The product flow in such cases has been traced to large retailers and brand owners with highly damaging consequences – a factor that is reshaping approaches to SCM.

It might be expected that these broader socio-economic issues are central to the supply chain literature. Instead (with some exceptions) they are the concern of different bodies of literature including development studies, geography, industrial relations and some branches of economics. For instance, development studies specialists seek to understand the relationships between commodity chain functioning and economic development and associated extreme disparities in the global distribution of economic activity and wealth. Approaches from these fields potentially contribute towards more holistic perspectives of contemporary supply chain functioning and management. However, as Harland points out (Chapter 1.2), the various bodies of

knowledge 'have remained largely unconnected' – although she and colleagues have subsequently taken steps towards establishing such connections (Harland et al., 2004). If there is a shift towards management of total product systems as is suggested here, multi-disciplinary research and analysis are ever more urgent.

Different academic traditions apply a varied terminology to what, broadly, are the same phenomena. Usage includes supply networks, value chains, global commodity chains and product systems. The chain metaphor is probably the most widely used, particularly among practitioners. But it conveys images of rigidities, whereas the multiple connections, the dynamic changes in patterns of sourcing and the varied roles of the actors that are found in practice, are more adequately captured by the metaphors of networks and systems. A further step is needed – I suggest the concept of total product systems – to capture the full implications of current advances in practice. Combinations of factors, including the lead actors' competitive strategies, activism among consumer, union and other groups, and the effects of environmental regulation are reshaping the SCM agenda. This is reflected in evolving approaches to production and product design and organization, and in shifts towards integrated management of the four phases of the 'cradle-to-grave' (C2G) product life cycle:

1 production phase – all stages from raw material generation through intermediate processing stages to completion of end-products;
2 distribution and sale of end-products;
3 product use and support in the aftermarket;
4 end-of-life (EOL) stages.

The rest of this chapter is divided into two main sections. The first establishes some of the main contours and issues evident in supply chain development. The second reviews the concept of total product systems as an extension of SCM.

Mapping the Issues

Supply chain evolution

Major differences in approach, methodologies and patterns of contemporary evolution in supply chains are evident within, across and between industrial sectors, and at the national level. They demonstrate contrasting strategies and varying patterns of practice – differences that, in substantial part, are attributable to the lead companies in chains, also referred to as: key actors (Kaplinsky, Chapter 1.3); focal firms (Harland et al., 2004); original equipment makers (OEMs) or 'primes' (Amesse et al., Chapter 4.4). In general terms, supply chains have been perceived primarily in terms of materials flows through the various stages from processing primary materials to intermediate processing and end-manufacture and on to the delivery of finished products to end-users – as in the example in Figure 1. But service products also have supply chains and, for some types of product, data generation and processing constitute the counterpart of materials flows, for instance in handling applications, cases

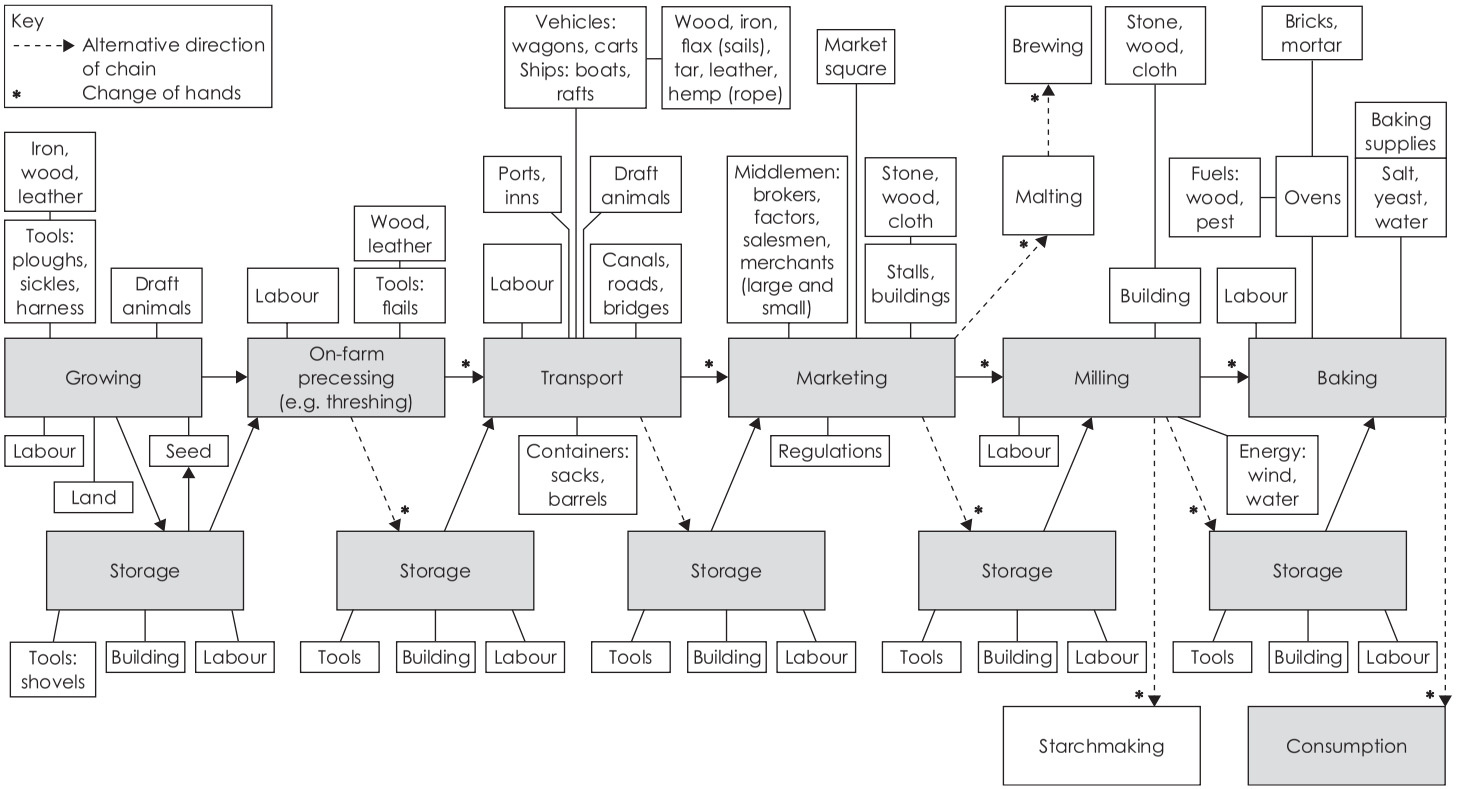

Figure 1 Grain flour supply chain: material flows from primary processing to delivery (Pelizzon, 1994, p. 35)

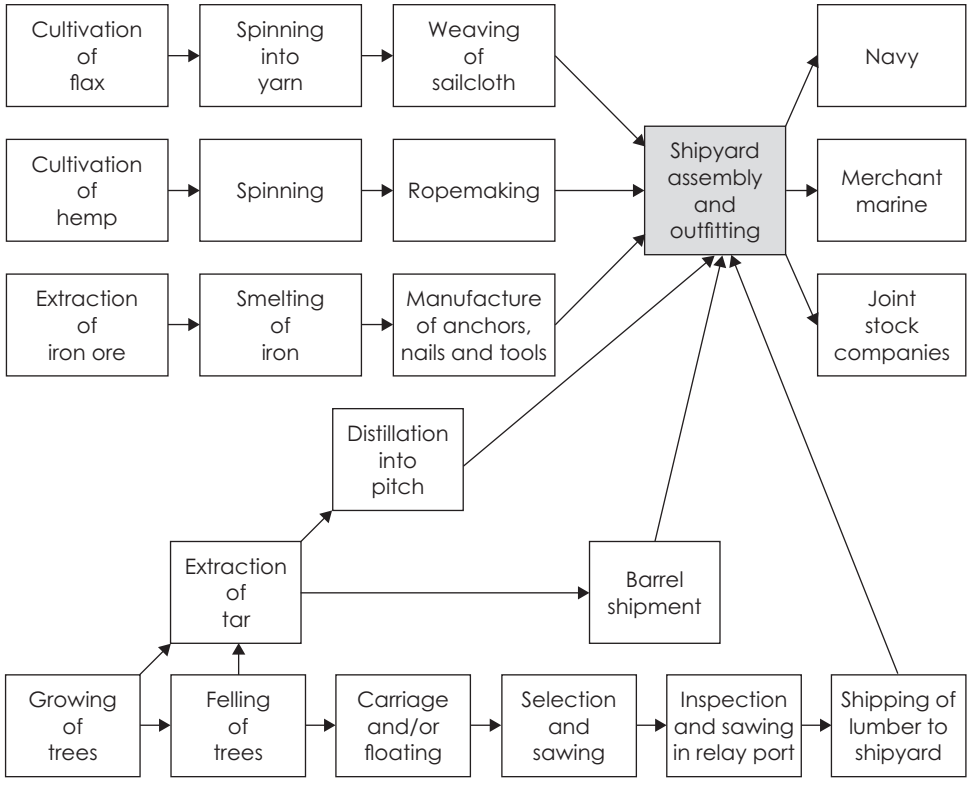

Figure 2 Shipbuilding supply chain: convergence of intermediate products (Özveren, 1994, p. 22)

and claims in public services and in the financial sector. Figure 2 illustrates a further general characteristic in the downstream flow towards the final assembly of end-products. There is a progressive convergence of intermediate products (components, subsystems etc.) that derive from different sectors with distinct materials technologies and process technologies. Such convergence from different technological domains adds to the challenges that face attempts to co-ordinate on a chain-wide basis.[1]

The seventeenth- and eighteenth-century 'commodity chains' in Figures 1 and 2 establish the long standing antecedents of some of the issues encountered in contemporary practice. They are summarized by Hopkins and Wallerstein (1994) as chains that 'were geographically extensive, complex, and in constant recomposition' with, in the grain flour example, a 'constant geographical reshuffling of the links in the chain'. Concern with 'flows and stocks' of materials, components and so on reflects the influence of logistics and procurement as core functions within SCM. The 'management of physical distribution' appears to have provided initial steps towards SCM in the 1960s and early 1970s (Gattorna and Walters, 1996), while Harland (Chapter 1.2) suggests that the actual term SCM dates from 1982. This shift in terminology and associated changes in practice relate to a number of developments.