The Division of Labour and Industrial Networks

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Abstract

This paper deals with the problem of division of labour and industrial development from a network perspective. Our starting point is Young's (1928) seminal insights into how the process of the division of labour creates a series of connected qualitative and quantitative changes in industrial structures. Our main argument is that these qualitative and quantitative changes can be reframed as a cascade of connected learning processes that take place inside as well as across firm boundaries. In particular, we stress how business relationships create a useful platform for teaching and learning different sets of complementary capabilities. We illustrate these arguments with a case study of the introduction of new technology in the Danish printing industry and how one company took advantage of this technology to restructure its internal processes and business relationships.

Introduction

This paper deals with the division of labour in industrial networks. Our approach starts with Adam Smith's views on the division of labour as a process of specialisation within and between trades. Young's (1928) use of Smith's theorem highlighted how the division of labour induced a process of both qualitative and quantitative change that affected the internal structure of firms as well as the activity chains that connect the producer of raw materials to the final consumer. Penrose's (1959) analytical separation of resources and the services they can render provides a foundation for understanding the dynamics of industrial systems based on how resource development can emerge through "learning-by-doing". The industrial networks approach takes a Penrosian perspective on resource development but regards learning as a process that places within as well as across firm boundaries. In particular, learning has often an important multi-party character, with the effects of learning being spread over a variety of connected firms (Håkansson, 1993).

The objective of this paper is to approach the subject of the division of labour from an industrial networks perspective by paying explicit attention to the role of business relationships in fostering learning in industrial systems. The paper is divided as follows: in the first section we will focus on traditional approaches to the division of labour and highlight how the industrial networks can shed new light on the how this process drives industrial development. In the second section, we will introduce a case study of the introduction of one technological innovation in the printing industry. We will focus on one company in the Danish printing industry showing how the introduction of this innovation affected both intrafirm practices as well as the activity chain in which the firm was embedded. In the final part of this paper we will draw some conclusions on the nature of division of labour and how collective learning spread over a variety of firms and their relationships can help us understand industrial development.

The Division of Labour and Industrial Development

"Every important advance in the organisation of production […] alters the conditions of industrial activity and initiates responses elsewhere in the industrial structure which in turn

have a further unsettling effect. Thus change becomes progressive and propagates itself in a cumulative way" (Young 1928, p. 533)

In his analysis of increasing returns and economic progress Young (1928) uses printing as an example of an industry that has become increasingly complex and subject to a finer division of labour. The successors of the early printers were not only contemporary printers, but also what Young (1928, p. 538) described as the "…increased intricate nexus of specialised undertakings [that] has inserted itself between the producer of raw materials and the consumer of the final product". For Young the progressive division and specialisation of labour is regarded as an essential process through which increasing returns are realised. With the extension of the division of labour, Young argues that the internal economies of firms dissolve into internal and external economies of the more specialised undertakings that replace them as well as contributing to new economies.

The inspiration for Young's analysis is Adam Smith's theorem on the division of labour. Loasby (1999a) examines the arguments advanced by Smith on the three categories of the division of labour. The first category is based on the notion that increasing familiarisation with the details of a task opens up possibilities for finding more efficient ways of performing that task. The second category relates to the division of labour between as opposed to within trades. For example, the emergence of specialist machine-makers may lead to improvements based on the operation of that machine rather than directly on the operations that the machine is required to perform - economies of roundabout methods of production in Young (1928). The third category of improvements rely on particular form of specialisation practised by those "…whose trade it is, not to do anything, but to observe everything; and who upon that account are often capable of combining together the powers of the most distant and dissimilar objects" (Smith 1976, quoted in Richardson 1975, p. 352).

Richardson (1975) examines Smith's arguments and concludes that they contain the seeds of an endogenous theory of technical progress and economic growth. The growth of output brings with it new activities and processes which in turn drive further increases in output and a corresponding increase in the size of markets. Technological improvements and exploitation are part of the same process and drive each other, even if they are conceptually distinct.

As Young, Richardson (1975) saw the implications of increasing returns as leading to increasing specialisation and interdependence rather than a growth in concentration. For this to happen as Richardson (1975, p. 356) points out, the market has to be large enough. Often, specialisation offers significant advantages only if accompanied by investments in capital equipment that may only be justifiable if operating at an appropriate scale. The market opportunity for a firm seeking to specialised in one particular activity may be provided by firms who originally supplied it but can no longer justify carrying out, either because of cost disadvantages or because the new activity is underpinned by a new and unfamiliar set of capabilities. Richardson (1975) notes that although some of these firms may still be classed as belonging to the same industry, others may operate in totally unrelated fields. Smith's theory of economic growth points towards industrial structures in constant evolution. As Richardson (1975, p. 358) remarks, the very process of evolution leads to increasing productivity and enlarged markets, ensuring that the latest adaptation is no longer adequate for the opportunities it has itself created.

Kaldor (1972, p. 1243) referring to Young (1928) remarks: "Economists ceased to take any notice of it long before they were able to grasp its full revolutionary implications". Kaldor's argument was that Young's seminal contribution was to blow apart the distinction, so crucial to equilibrium economics, between resource creation and resource allocation. Every change in the use of resources, every reorganisation of productive activities creates an opportunity for further change that wouldn't have existed otherwise. The process of economic development "…can be looked upon as the resultant of a continued process of interaction – one could almost say, of a chain-reaction – between demand increases which have been induced by increases in supply, and increases in supply which have been evoked by increases in demand" (Kaldor 1972, p. 146).

As Loasby (2000a) remarks, Penrose's (1959) treatment of the growth of the firm might have been designed to provide a foundation for Young's theme, even if her book doesn't even cite it. Penrose's major contribution was to take the notions of the division of labour and the growth of the firm and underpin them by an insightful distinction between resources and the services they render. Resources are capable of providing a variety of productive services and, in turn the provision of those services may modify the attributes of resources and thus enable the provision of new services.

The Penrosian perspective on the firm was that it should be seen as "…a collection of productive resources the disposal of which between different uses and over time is determined by administrative decision" (Penrose 1959, p. 24). This deceptively simple view of the firm dissembles two important arguments. First, the productive resources the firm controls are regarded as a bundle of possible services, rather than a fixed set of characteristics available as public knowledge. As Penrose (1959, p. 75) remarks, it is the heterogeneity rather than the homogeneity of both human and material productive services that makes firms unique. And, more tellingly, Penrose (1959, p. 77) argues that to discover more about the productive services of a resource can be done either by researching the features of the resource or investigating ways of combining its known characteristics with those of other resources. The growth of firms that Penrose describes is essentially one of self-reinforcing processes: the services that resources can render depend on the capacities of the people using them but the development of these capacities is partly shaped by the resources available. Although the focus is internal to the firm, Penrose is sensitive to the effects of the external world can have on the productive services the firm's resources can render. Technological developments, for example, can become available to the firm in the form of new knowledge which has to be assimilated into and combined with the existing stock of knowledge but also physically embodied in the form of purchased capital equipment, for example (Penrose 1959, p. 79).

Penrose's focus on the internal workings of the firm and learning leads us to the second half of the definition of what constitutes a firm, namely the administrative structure that directs the use of resources. As Penrose (1995, p. xiv) acknowledges, the administrative structures provide not only the platform for deciding how the existing stock of knowledge is to be mobilised but does also constitute a framework for the creation of new knowledge. What may be perceived as an opportunity for the creation of new productive services, what the firm "sees" and how it reacts to events in the external world are largely dependent on the knowledge possessed by managerial personnel as well as how that knowledge is structured within the firm (Penrose 1959, p. 80).

As Loasby (1999b, p. 38) remarks, what is missing from Penrose's discussion is the treatment of the interaction between intra and interorganisational issues that were at the heart of Young's (1928) analysis of the division of labour and increasing returns. The consequence of Smith's second and third categories of improvement lead to a

redefinition of activity structures not just within firms but also in the patterns of connections between them, as Richardson (1972) recognised. The division of labour has two distinct dimensions specialisation and integration, as Piore (1992) argued. Thus to the fragmentation of activities and capabilities, corresponds a countervailing effect of new attempts at integrating what has been decomposed. Inevitably, this process of fragmentation and reintegration leads to changes in how activity structures are to be governed between firms, markets and interfirm cooperation.

From an industrial networks perspective, the consequences of advances in the division of labour, namely the increasing specialisation and need for reintegration, are enacted and developed within a structure of existing business relationships (Håkansson and Snehota, 1995). The process of resource development requires adaptations and changes in these structures and it occurs largely through a process of learning (Håkansson, 1993).

For Håkansson (1993, p. 214) the opportunities to explore the heterogeneity of resources at the firm level leads to two problems. At one level, the process of specialisation to explore resource heterogeneity is likely to lead to further specialisation in a self-reinforcing sequence. At another level, there are other limits to explore the heterogeneity of resources the firm controls and has access to. Thus the effects of trying to explore resource heterogeneity leads not just to learning at the firm level, but also learning within the larger structure in which the firm is embedded.

Learning can be accomplished in three different ways (Håkansson 1993). First, a firm can learn as a consequence of its own activities, as Penrose (1959) so well illustrated. Secondly, a firm can learn through others by adopting a relatively passive stance. They can use their counterparts' knowledge and experience, often in the form of blackboxed products or solutions that require less knowledge to use than to produce, as Demsetz (1988) suggests.

The third form of learning suggested by Håkansson (1993) can be seen as an interactive form of learning spread over two or more actors. In this form of learning, two resource holders, through a process of close interaction, develop knowledge about how to use and match each other's resources and produce joint values (Håkansson 1993, p. 215). Specialised joint values are the outcomes of interactive learning and it can lead to a cumulative process of further interactive learning in connected relationships – or, adapting Young’s (1928, p. 533) felicitous expression, learning becomes progressive and propagates itself in a cumulative way.

In summary, the process of progressive specialisation and increasing returns that Young described, can be recast in terms of Penrose's arguments on the growth of the firm and Håkansson's views on how different forms of learning drive the process of exploring resource heterogeneity, in a self-reinforcing sequence. To explore the full implications of Young's argument we need both the Penrosian seminal distinction between resources and the productive resources they can render as well as the broad learning framework introduced by Håkansson, contemplating both intra and interfirm processes in driving the process of economic growth.

In the next section, we will introduce a case study focusing on the Danish printing industry that illustrates the effects of the division of labour on an existing activity structure and business network. This case study, conducted by the second author, was part of a larger industry and cross-national comparative study reported at length in van Dijken et al (1999).

The Printing Industry and CTP technologies

The production of printed material encompasses a wide variety of technologies and is integrated in many different production chains (e.g. magazines, newspapers, books, packing material). Figure 1 illustrates the work-flow and key interfaces in the traditional graphic activity structure. The tasks along this chain can be split up in different ways. Regardless of who performs these tasks, there are always strong interdependencies between the different actors involved in the chain. For example, the quality, speed, and cost that can be achieved in the printing process depend on the quality of the source material received from the customers.

The close interdependence and complementarity between activities is a key feature of the printing industry. For example, the quality demanded of the final product (e.g. magazines) has an important bearing on the types of processes conducted upstream and how these processes are

coordinated.

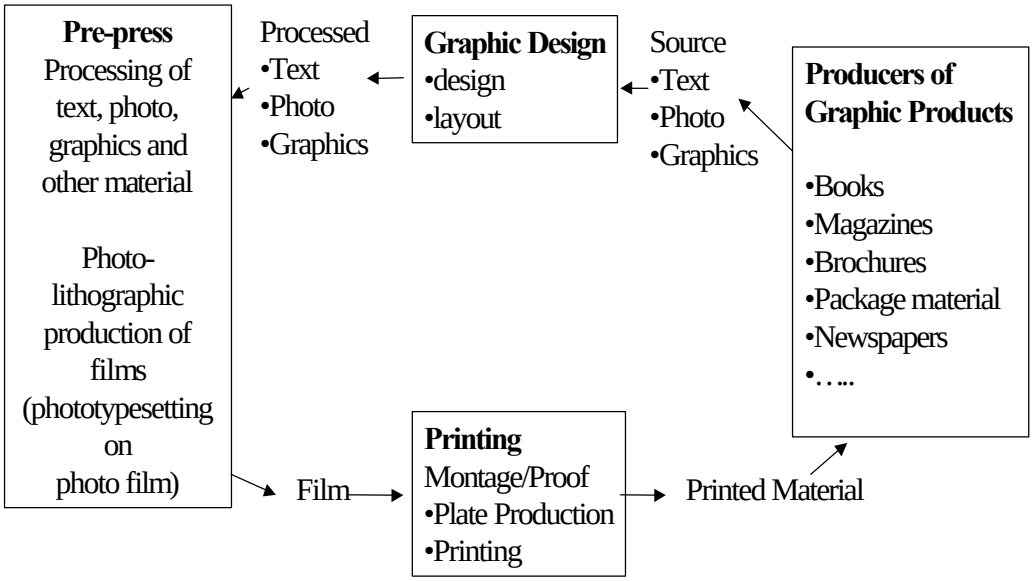

Figure 1 Principal steps in the traditional graphic production chain.

The modes of coordination of activities along this activity chain can also vary. For pre-press based on photographic processes, we find both integrated pre-press divisions and specialised subcontracting pre-press shops. Different business strategies within particular segments lead to further variety. As a result, the capabilities of printing firms and pre-press shops vary considerably. To some customers quality and short lead-time are essential, while price is the main parameter in other segments. Overall, the trend appears to be towards more customer-specific products leading to smaller orders, more variety, shorter delivery times and quicker product development, demanding higher flexibility and reduction of costs throughout the activity structure.

The printing industry has experienced radical changes of technology during the last decades. Reprographic processes and the pre-press functions have been gradually digitised even if computer-to-film is still standard practice. This case study focuses on the introduction of computer-to-plate technology (henceforth CTP), a new front-end

technology that allows text and picture to be transmitted directly from digital form to an offset printing plate, into a Danish business network.

The introduction of CTP induces changes both to the internal production system of the actors involved as well as the activity structures and relationships along the chain. In the pre-press stage, CTP replaces photo-typesetting on film and takes over sheet assembly (montage). It reduces the number of functions and thus the number of people involved in the pre-press process. Introduction of CTP requires that the printing company upgrade its technological infrastructure (servers, high capacity networks, and storage capacity) to enable the processing of printing data. A printed page (text only) requires 500 Kb, while pages with pictures can require 1 Gb or more.

The main advantage of CTP is reduced costs in pre-press production. The elimination of the film process reduces the use of workforce; suppliers of CTP expect that in most cases one worker can substitute 3-4 workers. CTP eliminates the use of film, but as the plates used for CTP are more expensive, material costs are unchanged. The price for CTP plates, however, is expected to fall with higher volumes.

CTP also offers higher quality, higher productivity, potential reduction of lead time, and with fewer processes and less handling, a reduction in scrap. To publishers of magazines and newspapers CTP technology offers several advantages. Production time can be reduced and the digital technology makes reprinting of text much easier. In addition, CTP technology gives enhanced possibilities for the processing text and photos.

The structure of the printing industry often constitutes a barrier to the adoption of CTP. In our case, Danish printing companies are small and pre-press functions have in most cases been outsourced to pre-press firms. Given the magnitude of the investment (about DKr 3 million or Euros 0.4 million) and the volume needed to make it profitable only about 40 Danish companies were judged to be able to introduce CTP. Small pre-press shops lack financial resources and volume to introduce CTP. Furthermore, traditional pre-press shops will lack the technical infrastructure and capabilities to make a smooth transition to CTP. Pre-press shops with experience in digital photo work might fare better.

Most printing firms face the problem of reintegrating pre-press in their printing production or redefine their cooperation with pre-press shops as part of the transition to CTP. These barriers to the adoption of CTP are related to the early phases in the learning curve of CTP and might be radically changed when CTP becomes mature

and industry standards develop. Internally, the traditional way of producing based on the competencies of skilled graphic workers constitutes both a resource and an obstacle. The capabilities of printing firms are embedded in the practices, routines and creativity work of skilled graphic workers - a situation that makes the transition to CTP difficult. Traditional graphic qualifications have to be enhanced with new capabilities in computer-based text and image processing.

Another barrier to the diffusion of CTP is that it places high requirements on the financial and technological resources of companies. To make the investment profitable it takes an annual production of 8,000 m^2 plates. Adopters tend to be larger companies with more than 40 employees, medium sized (more than 20 employees) may follow within 2-3 years, while smaller printers may never be able to justify the introduction of the technology.

One supplier of CTP equipment gives this description of the profile of a company that will benefit from the introduction of CTP:

- more than 50% of the pages have to be PostScript convertible
- the company had worked with PostScript-based systems in at least two years
- they have installed an image setter (4-up or 8-up)
- they use a digital launching programme
- they have experience with scanners and digital proofing
- they have more than two printing machines
- reproducing of plates is less than 5%

With CTP, functions such as layout and design are transferred to screen work demanding a combination of creative skills and technical knowledge of software. As a result of these changes, companies have to reorganise workflow and change procedures used in the handling of orders and data. One of the largest changes is that proof-reading has to be done electronically and that errors cannot be corrected afterwards, as was possible in the montage of films. If full advantage is to be gained from the use of CTP, all input data ought to be in digital form. Therefore, customers must adapt their production to enable them to deliver digital source material.

Companies, which have introduced computer to film or digital photo-techniques, have already developed their technological infrastructure and their competencies on data discipline. The dimension of the transformation process depends on how far the

individual firm is in its transition to digital pre-press. If the adopting firm has completed this development, this makes the transition to CTP less difficult.

In summary, CTP can be regarded as an innovation with extensive systemic effects. The introduction of CTP is a strategic move, requiring companies to engage in a transformation of their production processes and business relationships. The smooth flow of material and information along the activity chain in digital production is crucial. There are many possibilities for creating errors at every stage of the process. In the film-based production there was a clear division of work between the pre-press and the printing processes, including cumulative experience of where the errors could happen as well a clear division of responsibility for sorting out problems. In CTP production the pre-press shop and the printing departments/firms have to find new ways of working together. New procedures to ensure that errors are found at the right time, and specify who has the responsibility for extra costs if errors occur.

The CTP equipment market is technology and supplier driven. The CTP technology has been pushed forward by the suppliers and CTP systems are developed targeting different segments of the printing industry. The focus of systems development varies from high flexibility (including the possibility of upgrading of the system), quality (e.g. four colour systems), functions (e.g. size, high speed), etc. In their search and learning processes, suppliers are dependent on their interaction with customers to gain experience from operating CTP plants. Furthermore, in the development of new CTP concepts they are also extremely dependent on close relationships with plate producers to achieve good results.

Producers of CTP technology are primarily OEMs, most of them American companies producing machine systems and / or software. Distribution, however, often takes place through the dominant machine suppliers in the traditional pre-press market or in alliances with the suppliers of plates. Adopters of CTP have to choose between the incumbent players offering customised installations based on OEM equipment and the new specialised CTP suppliers offering the newest technology.

A Company Case: the introduction of CTP in SP's business network

Our company case examines the introduction of CTP in a medium sized pre-press subcontractor, SP Repro A/S (65 employees). SP is a young company (started in 1989) founded to exploit business opportunities in digital photo technologies. The

customers are printing companies that print books and advertising magazines. It is one of the fastest growing firms and an innovative frontrunner within the pre-press sector. The technological infrastructure and capabilities of this company has simplified the adoption of CTP in relation to the digital pre-press work.

The decision to adopt CTP was seen as a strategic initiative to develop the pre-press business of SP. The firm made this move to position itself more advantageously in the production chain, where pre-press companies have come under increasing pressure from advertising agencies and printers who encroach on pre-press areas through the use of new technology. SP planned to use the CTP technology to offer an integrated pre-press service to printers, combining pre-press and plate production as well as performing tasks such as proof-reading and storage.

The idea of investing in CTP was generated as part of an interactive process in which SP's customers played a crucial role. Ensuring a customer base for the CTP investment was important for SP. Before the decision to adopt CTP, SP formed a partnership with two of their main customers to ensure work for the new CTP units.

One of these partners was NB, a printing company with rotation and arc offset printing technology. NB is a mature company with a cost focused strategy, only investing in new technology that has technically proven and economically effective. NB had invested DKr 50 million (Euro 6 million) in new printing machines thereby increasing its printing capacity by 300%. If this capacity was to be used, they had to make a similar increase in their montage department, an increase that would imply an expansion of the workforce from 3 to 12 people, assuming unchanged technology.

NB’s management wanted to introduce CTP as an alternative, but their problem was that they would have to reintegrate pre-press work to pursue this option. This would imply making the investment in new printing machines dependent on complementary investments in a technology they no longer mastered. This made cooperation with SP feasible, transferring the plate production to them and letting them deliver finished CTP-produced plates instead of films, a better option for NB.

The transfer of NB’s plate production (including their montage workforce) had an important strategic benefit for SP. The traditional pre-press production was in decline and SP wanted to expand their capabilities into plate production. The cooperation with NB and another key customer created a business opportunity for the investment in CTP and it was a central factor in SP’s decision to invest in CTP.

In their search for possible CTP solutions corresponding to their product profile, SP examined various technological solutions through direct contact with specialised suppliers of CTP technology, to OEM suppliers and companies that had implemented CTP in their graphics production. SP had developed a close relationship with Danish suppliers, who coooperated in the analysis of SP's needs and helped define alternative solutions. As part of this process, suppliers facilitated meetings with R&D people at CTP producers and organised visits to operating plants.

SP's problem was that all CTP facilities they visited were integrated plants that operated in closed systems supplying internal customers only. These plants could not provide SP with clues about operational problems in an open system, where data and products were exchanged with external customers. Furthermore, the suppliers had no tradition of conducting analysis of customer / product profiles related to the use of CTP technology in pre-press companies. After this process SP's option, as to which CTP system it should purchase, was still shrouded in uncertainty.

SP used a small independent consulting firm as a partner to analyse the different CTP options. The result was the investment in a CTP plant from CREO (delivered through Agfa-Gevaert, Denmark). This plant was developed for standardised products and the production of plates for high volume production. This plant did not cover all the needs of SP and so they invested in a second plant from Gerber (delivered through their Danish agent, Collibri), a more flexible plant. The decision to invest in two different CTP units were connected to SP's objective to have a full transition of its production to CTP and to be able to serve all of its existing customers with CTP solutions.

The adaptation of the CTP technology to SP's production and market was based on an intensive interaction with suppliers and customers. The suppliers were responsible for the installation and running in of the CTP plants and had staff located at SP during this process. The suppliers invested significant resources in the analysis of SP's business profile, in the definition of the CTP system, as well as in the implementation and backup of the CTP system. Internally, the company owner's son who combined traditional graphic competencies with extensive skills in and computing managed the introduction of CTP.

Key workers were trained in the use of the technology in internal workshops. In this process it became clear, that the suppliers' know-how was shallow and SP soon had more detailed knowledge of the operation of the plant than the local representatives of the suppliers had. For an efficient use of CTP, data discipline and standardised

procedures are very important. All employees are involved in the activities to create standardised procedures through workshops and seminars at weekends. Most of the employees have traditional pre-press skills and the company had to recruit two systems people to work with the computer system, which is the core part of a digitised pre-press production.

In the operational phase the cooperation with the printing companies and their customers became central. The first step was the integration of NB's plate work in SP's pre-press work. The combination of SP's digital competence and NB's competence on plate discharge resulted in an immediate improvement of plate production. The number of mistakes was reduced due to this close cooperation.

The transfer of the plate work and the workers from NB to SP also had a number of positive spin-offs. It built up a mutual understanding of the plate process and the pre-press work and facilitated communication in case of mistakes. Taken together, it contributed to the build up of mutual trust across the professional and cultural distances that existed between the two companies, a distance reinforced by the fact that workers in printing and pre-press have traditionally belonged to different trades in Denmark.

The lack of experience and know-how made it difficult for SP to communicate effectively with suppliers and customers. Some publishers found the transition to CTP troublesome and demanding as the changeover from traditional routines gave rise to problems. Many actors in the activity chain did not have experience in working with the new technology and many new and unexpected errors occurred. In addition, use of many different advertising companies as final customers made it difficult to control the learning process due to the lack of experience in finding errors and the proliferation of different types of errors. Despite these teething problems, CTP has reduced the cost of the production by eliminating the use of film, lowering labour costs and reducing lead-times. Reduced prices combined with flexibility and faster deliveries have been the most important benefits as far as customers are concerned.

The CTP was a strategic investment and SP did not expect it to be profitable in the short run. CTP technology created many new orders from customers who wanted to have a technologically advanced supplier. In effect, the CTP investment was the best marketing investment the company has ever made. The technology sells itself and has been such a good advert for the company that SP felt able cut down on marketing expenses.

Analysis of the case

The introduction of CTP in the printing industry constitutes another example of "the increasingly intricate nexus of specialised undertakings" in the production chain that Young (1928) alluded to. Our case study shows how the introduction of a new technology into an existing business network is built on patterns of interaction that cut across a complex activity structure involving a variety of actors. The strategy of SB to introduce CTP was based on a vision of how the business could be redefined and the activity structures in which the company was embedded could be redesigned to accommodate this new vision. To implement this strategy SP leveraged existing relationships in a bid to secure future business for its CTP plants.

The partnership with two its customers namely NB, with the transfer of the plate production operations and its montage workforce to SP, created an interesting business opportunity for SB. Once these agreements were in place, SP could look at and appraise specific CTP alternatives. In the first phase, close interaction with suppliers, the need to look at working systems and relate them to the context that SP would face turned out to be crucial. Plant visits were important but ultimately unsatisfactory as the context of printing departments supplying internal customers did not fit the envisaged context of SP's operations. The problems of data transfer across organisational boundaries and the need to specify plants in relation to a varied product and customer profile loomed large in SP's calculations but did not feature in the plants SP visited.

Thus the decision to introduce CTP was based on relationships in SP's existing network, but in their search for concrete CTP solutions they were dependent on new relationships with equipment suppliers. SP's existing capabilities in digital pre-press enabled the company with the help of consultants, to establish contacts with appropriate suppliers. Once SP decided to invest in two different plants from two different suppliers, interaction with the suppliers' representatives took a central role in the implementation and run-in of both systems. SP got the two CTP units below market prices and received special attention from the two suppliers' representatives who had strong incentives to working systems to prospective customers as well as gain experience of installing these systems. Both suppliers transferred personnel to SP to help with this process but it turned out that if the suppliers could teach SP how to operate the equipment, SP could soon teach the suppliers how the equipment could be

used. Once SP gained confidence and experience in the operation of the CTP plants, and the relevant workers had been trained, the company was ready to try establishing relationships with new customers.

In summary, CTP changed the internal work processes within SP as well as the organisation and division of labour in the firm's production chain. The adaptation of CTP to SP's subcontracting pre-press business created a series of cascading and interconnected changes. These changes included the development of new capabilities, the development of new product concepts (full pre-press services) and the development of relationships with existing and new customers. Initially, the partnership between NB and SP, allowed each company to take advantage of each other's complementary resources to implement CTP in close cooperation with equipment suppliers. Once, the technology was installed and working, SP managed to attract new and more advanced customers who in turn, contributed to stimulate another round of interactive learning processes in the application of the technology.

Conclusions

We started this paper with Young's (1928) notion that economic progress could be understood as a process of increasing returns and that external economies could be seen as more than the sum of the internal economies of firms. Young warned that a focus on the firm alone was unlikely to reveal the extent of changes induced by the division of labour, since internal economies were only likely to lead to small progressive changes in a firm's output. In a prescient observation, worth quoting at length, Young (1928, p. 528) argued that looking at the sources of external economies would reveal a different picture:

"Out beyond, in that obscurer field from where it [the firm] derives its external economies, changes of another order are occurring. New products are appearing, firms are assuming new tasks and new industries are coming into being. In short, change in this external field is qualitative as well as quantitative. No analysis of the forces making for economic equilibrium, forces we might say are tangential at any moment in time, will serve to illuminate this field, for movements away from equilibrium, departures from previous trends, are characteristic of it."

The argument we developed in this paper is that to do justice to Young's insights, we must take into account how the division of labour affects both the internal organisation of firms and the business relationships they have developed, and how these contribute to learning processes that spread across a variety of connected actors. In these processes, stability and variety play an important role as Håkansson (1993) remarked. Stability is often a pre-condition for interactive learning; in order to evaluate what a counterpart can do, a firm will need to develop an intimate knowledge of that counterpart over a period of time. If a measure of stability is important the existence of a degree of variety in the network structures within which organisations operate is also an important ingredient for collective learning. Similarly, Loasby (2000b, p. 307) argued: "Without variation there is no experience to act as a basis for learning; without a stable framework there is no assurance that any valid connections can be made between actions and outcomes that will have any future relevance".

As we have seen in the analysis of our case, there is often important multi-party and connected effects arising from the range of relationships each party is involved in. In SP's case, connections played an important role at the supplier and customer interfaces. The interaction with two key customers provided the incentive to look seriously at the business opportunities afforded by the introduction of CTP. On the supplier side, the interaction with the supplier's own customers partly helped SP shape its decision criteria as to what type of CTP systems it should invest in. Once those plants were installed, learning took place inside the firm and in interaction with the suppliers' representatives. These representatives taught SP how to operate the plants and trained its operators while later, SP showed them how the equipment could be used. In a subsequent phase, the integration of SP's operations with NB's former plate production operation as well as cooperation with printing companies and their customers led to a further cycle of learning. However, these learning processes were not trouble-free as actors in the production chain were confronted with unfamiliar errors and had to develop new routines for spotting and rectifying these errors. In particular, the use of many different advertising companies as customers led to a proliferation of different types of errors and made the learning process slower and more laborious.

In summary, Young's vision of industrial dynamics is one of continuous generation of value as a consequence of rearranging connections both within and across firms. The increasing returns Young refers to do not apply only to the individual components of

industrial systems but also to the connections between them. As we have attempted to show, the dynamic processes Young illustrates require a variety of learning processes encompassing firms, relationships between firms and network structures that gradually transform an existing structure through a series of small but interconnected changes.

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