THE ROLE OF A SINGLE ACTOR IN TECHNICAL INNOVATION AND NETWORK EVOLUTION: AN HISTORICAL ANALYSIS OF THE LEATHER NETWORK

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Abstract

Innovation is often seen as a vital element in the strategy of many companies seeking to differentiate themselves in a world of excess-capacity and wide customer choice. This single-company view of innovation seems to have been based on the assumption that it is possible for an individual company to "turn on" an innovation tap and change the direction of a business. But more recently, the interconnections between business actors, their activities and resources and the complexity of the innovation process have been emphasised. For example, Dosi (1988) discussed the effects on innovation of complex intersectional linkages and Lundgren (1995) and Håkansson and Waluszewski (2002) highlight how difficult it is to predict the outcomes of any attempt at innovation because of the limitations of actors' "network pictures" (Ford et al, 2003) in a business landscape characterised by interdependency, variety and motion (Hakansson et al 2009).

But despite the interdependencies between a single business company and its counterparts and the unpredictability and uncontrollability of the innovation process, individual companies still need to seek innovation and at least sometimes, they can play a decisive role in its achievement. This paper centres on the experience of a small UK company working mostly in the USA in the transformation of the network surrounding the production, distribution and use of leather[1] in the late 19th century and which led to the introduction of a new chemistry which was to become the dominant process for the manufacture of all leather to this day. This paper chronicles the evolution of the company the network and the specific innovations using correspondence from the company founders and other contemporary sources. It observes the complexities and interactions involved over a tumultuous 25 years.

Keywords: business networking; innovation; network evolution

INTRODUCTION: RESEARCH LOCATION AND RESEARCH METHODOLOGY

This paper is concerned with the process of innovation in complex business networks. The paper uses historical documentation to investigate the interactions of a small UK company working mostly in the USA that had a pivotal role in the transformation of the network surrounding the production, distribution and use of leather[2] in the late 19th century. This historical research location provides an opportunity to examine innovation within the context of network evolution over the long-term. This extended historical analysis also offers a wider perspective on the complex and continuing network outcomes of that networking and the innovations to which it leads.

The paper is based on the letters written by Charles and Alfred Booth the founders and partners of Booth and Company. In many instances the actual letters are available and in others they are heavily quoted in the company history (John 1959) and books published by Mary Booth (1918) and Duncan Crow (1965). Other contemporary material from company records, the trade and national press and industry sources are also used and help to avoid errors in interpretation. Schwerin (2004) highlights the usefulness of re-evaluating company correspondence in this way as a rich source of material from which to identify and examine company relationships and approaches. The use of additional sources is necessary to provide context and to help prevent adapting the history to develop false conclusions which then become established as historical facts. A large amount of contemporary material is now available, particularly in the USA, which allows the interrogation of the position of many actors in the leather network.

It has been suggested (Ford et al 2011) that the process of managing in business networks can usefully be examined using three variables: the network pictures of participants; their purposeful networking and the outcomes of that networking. Clearly, the outcomes of networking will be viewed differently by each of the participants and these views will change over time. Further, perceived network outcomes will affect the network pictures of actors, their view of their own position in the network and their approach to networking. The concept of network position refers to the unique point in network space that an actor occupies at a particular point in time. Network space is multidimensional and, among other aspects, may be expressed in terms of a physical a relational and a technological dimension

[2] Hereafter referred to as the Leather Network.

(Hakansson et al, 2009). Finally, network pictures will affect individual actors' views of what is appropriate networking for themselves and for others and their view of network outcomes.

Business networking involves multiple actors, each of which initiates interaction and reacts to the initiatives of others. Business networking takes place within the context of a pre-existing pattern of interdependencies between actors and contributes to the evolution of those interdependencies. These interdependencies form the links between the variety of resources and activities within individual actors and relationships that are distributed across the network. The networking of multiple actors and the evolution of activities, resources and interdependencies contribute to the constant motion of the network. Thus, the process of innovation in this landscape is multi-actor, multi-dimensional and sequential. Innovation is an outcome of an existing and evolving pattern of resources and activities and the networking of multiple actors. Innovation is a continuing process and its outcomes at any point in time will be perceived differently by those involved in it, whether they recognise it or not. Each of these actors will selectively confront some of the issues or problems that it faces before or within that process while conforming to other aspects of its current interactions. Each will seek to create or consolidate on its existing patterns of interaction and lead or follow counterparts in aspects of their interactions and in the direction of innovation or change.

LIVING IN THE 19TH CENTURY LEATHER NETWORK

Three Actors meet at a time of Financial Crisis:

Booth and Company was founded in 1862 by two brothers Alfred and Charles Booth. Its primary function was to export semi-processed sheepskins from the UK to the US where a rapidly growing population was creating a need for more resources. Booths were a long standing Liverpool family and Alfred, who was based in New York, had training as an international trader. After a difficult start during the American Civil War the company performed well, expanded into other leather materials and set up a small shipping line trading between Liverpool and North Brazil.

In 1873 Booths hired Julius Kuttner as temporary book-keeper in New York. He had come to the US having worked in a corset factory in Stuttgart, Germany where he had developed a machine production line for corsets. He had also worked on improving textile machinery but had ended up "at a loose end" (White, 1956 p4) when he joined Booths. In 1877 Charles Booth was also in the US for about five months - "the business being in a critical condition" (Booth, 1918, p48) - and took Kuttner with him on a trip to Gloversville to learn in detail about problems at the Kent and Stevens

tannery. Gloversville was a large tanning centre in upstate New York which produced its own leather and made this into gloves. Kent and Stevens was a long standing client who owed Booths significant sums. There were a lot of business failures in Gloversville around that time and Kent's position had deteriorated as a result of dishonest activity of Fred Stevens, the junior partner:

But the most serious drawback was caused by the extensive forgeries of Fred Stevens prior to his unceremonious departure. The forgeries are believed to have aggregated nearly $100,000, and the spurious notes held mainly by the National Bank of Gloversville, Hays & Wells' bank of Johnstown and Booth & Co, of New York.[3]

Thus the first element in this story involved three actors, one having a range of commercial resources, one having directly related technological resources and the third having coincidental technological resources coming together during an episode of financial breakdown.

Booth & Co paid off the other creditors and helped secure loans for Kent to run the business via a mortgage (in the name of Kuttner and his wife). It was later agreed that Booths would become more involved and the business was completely reorganized and became Booth and Kent. James Kent continued to work on technical and research matters but Kuttner took a careful oversight over matters in Gloversville, superintending all the commercial areas.

A Technological Innovation Described:

For over 5000 years, tanning had been a slow process that used vegetable extracts which gave brown leather which was relatively thick and hard regardless of raw material. It was in this context that Kuttner's interest in technology was now rekindled because "He (had) found a congenial spirit in James Kent, who was also an inventor" (White 1956). As a consequence of this collaboration, two fundamentally new ways of tanning were developed at Booth and Kent. These were the Dongola process in 1879 and chrome tanning in 1884. The latter was to become the dominant tanning technology

[3] UTICA MORNING HERALD Thursday, April 23, 1878

in the world after the 1st World War and remains so to this day (Thomson, 1985 and Luck, 1986).

The best description of the development of Dongola is given in a detailed account in the New York Times (NYT Oct 4, 1888). James Kent of Kent and Stevens is described as an Englishman with a "genius for investigation and experiment". The abolition of duty in 1872 brought in skins of "every kind of animal from every quarter of the globe" including kangaroos which had been thought good for making gloves. "Mr. Kent, always on the watch for something new, accumulated a considerable supply of these Australian rat skins, as they were called, and began experiments". It apparently took some years before he discovered the "secret of producing a tough, strong, pliable leather, impervious to water. It was worthless for gloves and mittens, but it proved an excellent substitute for the calf of which shoes were then almost wholly made." Mr. Kent enlarged his factory, "guarded closely his secret and prepared to furnish the world with his product". The article goes on to explain that like many entrepreneurs he was a "poor business manager" and had to be saved by Booth & Co. "Mr. Kent became its practical manager, and before he died (in 1886) .....he drew from its profits a competence and had the satisfaction of realizing that to his own efforts was due the beginning of this surprising growth of modern leather dressing." This leather was named Dongola after an ancient town in Sudan which was in the news at the time.

In 1872 Kent had only two rooms and a very small number of employees, whereas by the start of the 1880s with the involvement of Booth & Co this had grown to 500 workers and what the paper called "the largest manufactory of its kind in this country". The glove business in Fulton County had peaked during the Civil war and was stagnating but this new technology gave the leather side a boost and appears to have revitalized the glove side also. In the 1880s the area had 73 tanners dressing leather for gloves and footwear uppers. Booth's staff were being headhunted by out-of-state tanners trying to get access to the technology.

The "Dongola Kid" as it was called was "one of the first products to receive a brand that is known to the trade anywhere". Its desirability as a substitute for calfskin was recognized, and the demand for it "far surpassed anything that Mr. Kent could supply".

The process had two elements of discovery, the first being what is now called "fat-liquoring". "So long as tanners were restricted, on the one hand, to the ordinary methods of stuffing tanned leathers with oils and fats, and on the other to the use of egg-yolk, which had long been common in alum

tannages, combination tannage remained of but secondary importance, and it was the application of the method of 'fat-liquoring' by James Kent in his Dongola leather which gave them the place they now possess, by providing a cheap substitute for egg-yolk, and enabling the tanner to obtain softness and resistance to water without producing the greasy feel which is common to curried leathers." (Procter, 1922 p 376) The value of this element of Kent's work was only realised when it was applied a decade later to the chromium tanning patents that enabled chrome tanning to become commercially viable. When James Kent died unexpectedly at the age of 55 in 1886 after contracting malaria while on holiday Booth and Co became outright owners of the tannery.

A New Relationship and a Related Development:

The second related development had its beginnings in a New York restaurant. Julius Kuttner was a regular for lunch at Racky's restaurant on Frankfort Street, one of the major original streets in the tanning district of New York referred to as "the Swamp". Towards the end of the 1870s he met Augustus Schultz, who also dined there. Augustus Schultz had been born in Germany in 1833 and was working in New York as a chemist for Kuttroff and Pickhardt, a German dyestuff importer.

Both men were clearly of an inventive frame of mind and they discussed improvements in tannery technology. This included ideas for further fatliquors to replace egg yolk and for leathers suited for corset making, which was still an interest for Kuttner. The problem with corsets was that the white alum tanned leather used at the time became wet very easily and rusted the corset steels when they became moistened with perspiration.

It was in this latter area that Schultz went to work and he appears to have been given some access to the tannery in Gloversville,[4] and certainly a lot of help with skins and chemicals on which to work. Through his experience with dyes, Schultz was aware of the use of bichromate in dyeing and knew of

[4] The Leather Manufacturer, vol VI, New York, January 1 1896. "Mr Kuttner replied that considerable egg-yolk was being used in the factory at Gloversville, operated by James Kent, in which the firm Booth were interested, and that a substitute for this article would be very desirable. Schultz went to work at once to produce a satisfactory substitute but his efforts were unsuccessful. Kuttner then told Schultz that some of the alum tanned skins which were manufactured in Gloversville were used in covering the steel parts of women's corsets; that the steel when moistened with perspiration, would rust; and the rust would strike through the leather and spoil the appearance of the corsets." Skins were given to Schultz for him to see if he could find a way to stop this staining via a new tannage.

the research in Germany by Knapp (Wilson (1941, 363) to make a chrome tanned leather.

Other Actors and Other Developments in the Network:

Knapp was not successful in producing chrome tanned leather commercially and it had to wait until the late 1870s before another German, Dr Heinzerling, tried to get closer to a workable solution. A small Scottish business with a mine for bichromate of potash obtained the patents involved in chrome tanning for Britain and the Colonies and made a serious attempt to get the process off the ground. It was not successful and the company was wound up in 1899.

But as far as we know Schultz was unaware of this frenetic activity in Germany and the UK. Working in Gloversville and at his home, he came out with two patents in 1884 for what was to be called the "two bath process". This used bichromate in the first bath and hypo in the second reducing bath. It is not known whether this leather worked for corsets at first, it certainly did some years later, but it is known that little was done with the process in the Booth and Kent tannery in Gloversville. According to White (1956) some experiments were carried out to use the process with kangaroos - which would have been logical as they had become such an important part of the production in Gloversville, but nothing came of it. This lack of enthusiasm for chromium may have been a consequence of the Dongola being so successful. The famous American boxer John L. Sullivan had worn Dongola tanned kangaroo shoes in one of his big fights and as a consequence the product had become very popular.

Certainly there is no indication that Kent had got involved in trying to perfect Schultz's 1884 patents in Gloversville and make a workable leather. The records available do not really explain in detail what Schultz and Kuttner did with the chrome tanning research and why greater efforts were not made to commercialise the process in the Gloversville tannery. What is clear is that Kuttner made no demand for ownership or involvement in the Intellectual Property on behalf of the Booth Company as might happen today.

Further actors involved in the process:

Schultz's chrome patents did attract a lot of interest and we know that Schultz sold them for $25,000 before going on to research the area of domestic central heating. There was a great deal of litigation around the validity of the patents between 1888 and 1892. The Booths were not involved in this.

Mr. Sig Saxe of the Philippine Cutch Corporation became interested in the Schultz's chrome process and recognised that it could replace imported "French Kid"[5], which was very popular at the time for the top-end of ladies' footwear. The two US leathers being used and sometimes called "imitation French kid" were Kent's Dongola process which could be polished by glazing and was both durable and cheap, but was not so smooth and silky as the original and the "brushed kid" tanned by the old Morocco manufacturers in Philadelphia.

These tanners were using a process which involved a sumac tannage and brushing with a special "kid brush" but this leather became wet very easily and was "lacking in mellowness and richness of feel" (White, 1956, p8). It also did not take a high lustre. The French article was very expensive since it was tanned with alum and egg yolk and then aged for several months before finishing and polishing. It was silky and luxurious in feel at first wear but was not very durable.

It was logical, therefore, that this was one of the first areas where progress with the "chemical tannage" might give quick returns. While many who tried the Schultz process gave it up quickly Robert H. Foerderer from Philadelphia persevered and noted that getting the fat-liquor right would be the key to stopping the leather becoming too hard and tough. As fat-liquoring was an essential part of the Kent Dongola process perhaps Foerderer realized that borrowing this approach would give him success. Backed by Abe Stein of New York and Marcus Beebe of Boston Foerderer became involved in the patents and he successfully marketed a chrome tan kid under the brand "Vici" kid in 1889. He started to move quickly to obtain control of the Schultz patents which he succeeded in doing in 1891.

The Schultz patent was licensed out on the basis of a royalty of 12.5 cents a dozen and a $12500 annual fee; not only a high price but also hard to collect and so by 1895 there were many tanneries in Philadelphia making copies. The production of chrome kid had become a specialty of Philadelphia. Many legal challenges were made to the patent but finally after

[5] Leather Trades Review, December 25 1937, p 75.

going to appeal the Schultz patents were supported in late 1895. The UK press was delighted: "this decision, from a commercial standpoint, must be very satisfactory to Englishmen, for it raises the price of chrome tanned leather to the same level as before, and all firms will have to pay their license to the Company."[6]

The high cost of the using the Schultz patents and the complexity of the process meant that others began searching for a simpler way of tanning with chromium. In 1893 an American, Martin Dennis, patented a single bath process as a way of getting round using the Schultz two bath process and made his income by selling the chemicals rather than a licensing agreement. In the long term – over the following fifty years – this process was to supersede the two bath method which finally died out when it was discovered that the hexavalent chromium used in the two bath process was carcinogenic. The tri-valent chromium used in the single bath process is quite safe.

This led to a successful period for Philadelphia tanners which White describes as the "gold rush days of the kid industry." (1956, p9). This glazed leather had all the qualities and none of the defects of the previous product, could be made quickly and sold at a good margin.

Booth's continuing involvement in the developments:

Booths had kept their involvement in chrome leather through buying a product from Richard Patswosky a tanner from New York to replace Dongola glazed kid in the late 1880s. This was called "Bonafide" glazed kid. They gave this up in 1894 to work more closely with John P. Mathieu of Philadelphia.

Julius Kuttner, who was by then a partner in Booth & Co, signed a contract with John P. Mathieu, a Philadelphia tanner, to manufacture for them black glazed kid. Mathieu had succeeded in producing this leather using the "Schultz process" and had given it the trade name "Surpass Kid". A deal made was that Booth & Co. would take the full production of 250 dozen skins daily. Mathieu was 10 years younger than Kuttner and at the age of 30 in 1883 had set up a small Morocco leather tannery making brushed kid

[6] The Leather Trades Circular and Review, February 11, 1896 p 490

in Philadelphia, and then expanded into a new plant he built in Allegheny Avenue in Philadelphia in 1892.

The market was very much a sellers' market and for a long time Surpass Philadelphia only produced black leather in one finish. J.P. Mathieu remained general manager of the Surpass tannery and ran it along with his brother Joseph.

The period between 1893 and 1898 was one of general business depression and that this was particularly felt by the US Leather Company and others working bovine leathers in the traditional way. This was not the case for Booths since although the Dongola kid declined somewhat, the new chrome leather was more than taking its place. Looking back on the 1890s Charles Booth was to say that the decade saw "more progress in the art of leather manufacture than in any decade of the world." He clearly enjoyed being part of it. Over the decade hide usage in the US grew by 21%, sheep consumption by 39% but goat driven on by chrome tanning and the fact that the resulting product was so good for footwear uppers grew by 1600%.

Fatliquoring, Dongola using gambier and aluminium and chrome tanning were being noticed world-wide by this time. In the UK, Professor Procter was the world's leading authority on leather technology. He visited the US and returned extolling the quality and importance of chrome tanning. At about the same time the German tanning and footwear industry chose to transform itself by using the methods it discovered in the USA.

The directories of the times indicated this transformation:

"J.P. Mathieu & Co., Surpass Glazed Kid Works Westmoreland and Ninth Streets, Ontario and 10th Streets. Plant covers five acres. All new and modern buildings. One of the largest, finest, and most attractive leather works of the world. Complete electrical equipment. Produces only "Surpass Glazed Kid," used by shoe manufacturers. Sold exclusively by Booth & Co., New York, Boston and London." (Quoted in Brynmawr 2003)

In response to demand, Booths opened sales agencies in a number of shoe centres, including St. Louis as the production of the chrome kid mounted. In 1900 a warehouse was opened in Bermondsey, London, to accelerate the sale of chrome kid in Europe. At that time the only European makers of chrome kid were the German tanners. Booths decided they would like to get

involved themselves in 1901 when Charles Wade moved to Whitemoor works in Nottingham. Charles Wade began to make chrome kid with the help of Booths. This joint venture remained until 1956 when Booths bought the whole business. It continued chrome tanning until closure in 1978.

Soon the Surpass tannery was to become the largest kid skin tannery in the world, and was bought 100% by the Booths which they ran successfully on a full chromium tannage until the 1950s. Throughout the 20th century chromium processes accelerated until by around 1960 they were used for over 90% of all the leather made in the world. In the last decade there has been some substitution and chromium is estimated as being used for around 80% today with little sign of a serious substitute being found.

DISCUSSION: A SINGLE ACTOR AND INNOVATION IN A COMPLEX NETWORK

Leather production was largely unaffected by the industrial revolution and entered the 19th century with the same processes it had used for centuries. The arrival of steam power and the need to move to factories to produce higher volumes for city dwellers lead to new machinery introductions; some of it very innovative. But the underlying technology remained unchanged, despite the development and use of innovative chemicals in other areas.

When Booths started to commercialise Dongola leather in the 1880s and chrome leather in 1890s the leather industry was to be totally transformed. Both ideas were developed with the involvement of a medium sized British company working in the United States. How did this come about?

Booths Initial Network Position:

The period between 1860 and 1910 is recognised as one of considerable worldwide technical invention so an interest in technology from a well educated and wealthy Liverpool family would be quite normal. The initial Booth business put together in 1862 was really very conventional for the time and at first they were distinguished only by their integrity and Charles noted love of system (Johns, p83). They followed the paths of others before them and the rather niche specialist agent and trader had became more common in the USA in the 1850s and 1860s as more industries developed. (Porter and Livesay, 1989)

A view of the innovations in leather technology would cast Booths as accidental pioneers. Nevertheless their impact was astounding. They were deeply involved in the two most important innovations of all time in leather manufacture: fatliquoring and chrome tanning. The third invention - the Dongola tannage - survived as quite an important leather making process for sixty years and may today be considered a "forgotten technology" (Parsons and Rose 2003) that is likely to be updated and reintroduced in the near future. One element of innovation has always been serendipity, the unexpected discovery of new things by chance. Yet serendipity and randomness might not always be considered discovery by luck. There is perhaps an element of system which might be considered in this approach. Being willing to maintain an openness to accept new external links and to encourage ideas from external actors would be examples of this approach. In Internet times this might be considered outsourcing, or even crowd-sourcing and done largely on-line but 150 years ago a good trading house new that much of its value lay in the quality of its relationships. Booths were known (John 1957,p79) to be keen to look amongst their connections for new business opportunities. Indeed in 1883 Charles Booth wrote about both Dongola and chrome tanning saying ""working up of new business (which) is the life of any concern such as ours".

Randomness as a Strategy:

"Randomness" appeared to be a characteristic of the Booth business. It was allied to a willingness to take an interest in individuals they considered creative or who might offer value in some way in the future. Amongst these were Charles Wade, Augustus Schultz, John Turney and James Kent.

Booths built many connections in the UK into tanning regions around Liverpool and Stockport, around Nottingham and Lincoln and in London. In the US they had strong industry links to Boston, Philadelphia and Gloversville as well as many international connections throughout the British Commonwealth and into Latin America. In their first decade in business much of their networking activity related to making new contacts and developing relationships throughout the world.

Whatever way they viewed their network and whatever limits they put on their network horizon their active connections meant that Booths were observing and interacting with a very large number of actors compared to the vast majority of others in the network. At a time when many individuals and companies were looking for new inventions making it known that they

were open to new ideas inevitably put them in a position where innovation would become part of their portfolio.

Networking to combine different resources:

We know from earlier studies such as Lundgren (1995) that technologies can take decades before being successfully commercialised and that often success comes through the novel combining of a number of technologies, of which only one element might be completely new. Meeting at new interfaces combines knowledge to meet the challenges identified by the relationships in the networks the business has developed. (Dosi, 1988) All these aspects can be found with the Booths involvement in leather manufacturing technology.

Even with knowledge of the need for a faster way of making leather and of changing consumer needs finding a commercially viable chrome leather took 60 years and getting the process near to what we can call stable took an additional ten. A simple social interaction with Schultz Kuttner brought together knowledge from the textile dyestuff industry to the leather industry.

The role of previous knowledge being edged forward in fits and starts with no clearly defined beginning and end is quite apparent in the development of the chromium story. Booths perhaps considered the chrome processing over when the Schultz patents were issued but not immediately exploitable, yet less than six years later they started to test merchandising one of the first versions being produced by others, and a decade later they became a global leader in its commercialisation. So not only was the process hard to define in terms of time it was loaded with periods of inactivity and others of intense action. (Ford, et al 2009, p 91). This also demonstrates the continued process of Booths to network with multiple partners, changing the structure of the network of which they were part in order to always be aware as far as possible of new developments they could help to exploit.

Waluszewski (2004) makes the point that resources and outcomes have different values for different actors and often innovation finds its success in unexpected uses. With Dongola it is likely that Kent on his own would have failed with this product as although usable for glove leather it was far from ideal. Equally his idea had been to make glove leather from a Brazilian hair sheep or a domestic deer but the process initially worked much better on goat and kangaroo.

Embedding ideas in a commercial setting is the moment when the majority of inventions fail. (Wagrel and Waluszewski, 2008) While James Kent was trying to make better gloving leather that would be cheaper than that being imported from France, Schultz was working in the very narrow niche of corset leathers. Yet the pent up demand that was growing, and of which Booths were aware, was for thinner, softer, better performing leathers for footwear uppers that could be made more quickly than the traditional methods. Both the Dongola and the chromium leathers actually found their role in meeting this demand for shoe upper leather as their key profitable outlet. For the Dongola it was the Booths who created the direct contact between the new product and the trade and created the huge boom for the product. For chromium the initial product was not good enough but when it became commercial they quickly became the world leader in exploiting it to meet the greatest need in the US, and world, market for leather.

We also see with Booths' relationship with technology a realisation an understanding of their recognition that their successful role would be more as a facilitator than an inventor. As different actors interact their tangible and intangible resources are likely to be adapted to mutual advantage. "The systematic confrontation of resources also underlies the development of new joint resource combinations in the process of innovation". (Ford, et.al. 2009) In this way they were a mix of a systems integrator and instigator. They brought connections, knowledge and finance to situations in a way likely to stimulate creative evolution of ideas. They were deliberately networking with multiple partners to find the right raw material that best suited each process and the right spots in the market to suit the articles characteristics.

Dosi (1988) outlines the importance of an "industrial web" which he argues is needed to diffuse new ideas into the market place and this was one major resource the Booths offered. They were able to identify the best markets for new leathers and had the network links to provide access and outlets. They were also excellent at sourcing alternate raw materials – kangaroo, deer, and kidskins – from any part of the world. For this they had their connections in the major ports and trading houses in Liverpool, New York and London.

Despite the importance of Dongola, fatliquoring and chrome tanning the Booths are rarely mentioned in texts discussing the history and technological development of leather. While they facilitated and funded much of the research and were the global force behind commercialising the new leather, including helping people like Wade start to making chrome leather in Europe, they never tried to own the technology or to claim any responsibility for it. They did, however, prosper greatly from it over many years and decades.

Dyadic networking:

One element that is used to identify the evolution of networks and the outcomes of interaction is when companies make adaptations in order to allow both partners to progress. Booths asked their UK suppliers to do this in the middle 1860s after they had observed how the financing of the business was working out (John, 1955 p36). Trade financing skill was one of the most important resources the Booths brought to the business via their early training and family connections and their judgement was likely to be valid. In these situations when companies are interacting outcomes can be examined by way of the 6Cs (Ford et.al. (2003), Ford (2002), Ford and Redwood (2005)).

Confront or Conform,

Consolidate or Create,

Coerce or Concede

In this instance Booths were in reality coercing their suppliers into agreeing the new changes which involved delayed payment and agreement to a 5% commission. While "coerce" or "concede" implies a battle over this the Booth approach was quite strong and they succeeded with all their suppliers. The outcome did lead to better sales and profits and their relationships with suppliers were to last many years. That with Turneys of Nottingham remained close for nearly 130 years until the tannery in Nottingham was finally shut for redevelopment into housing.

When Kent and Booth collapsed with huge debts the Booth approach might be expected to avoid conforming or conceding but rather to search for an alternate. They indicated that they considered James Kent a clever technician with a good potential to develop new processes and that they thought the factory well run could be viable, so instead of writing off their losses they paid everyone off and bought in to the plant. This was a networking approach of confrontation and in confronting the relationship in the way in which they did Booths had to accept that this changed their network position and the roles within it.

Table 1: The three aspects of networking

THE FIRST ASPECT OF NETWORKING	CHOICES ABOUT WORKING WITHIN RELATIONSHIPS	CONFORM OR CONFRONT

THE SECOND ASPECT OF NETWORKING	CHOICES ABOUT NETWORK POSITION	CONSOLIDATE OR CREATE
THE THIRD ASPECT OF NETWORKING	CHOICES ABOUT HOW TO NETWORK	COERCE OR CONCEDE

The Kent situation also exhibits the role that time plays. (Mouzas 2009) Since the Booths had worked with the company for some time they had got to know him and it was that knowledge which encouraged them to support him when they might otherwise have been expected to take the first loss as the least loss and walk away.

Networking allows a company to consciously change its position:

A lot of attention is paid to the fact that an unwary company can find its network position fatally damaged by a failure to watch how events are changing the nature of relationships in the network and hence the position of their own business in relation to others.

Alternatively by positively networking a company may be able to alter its position in the network. A new network position might be created by the development of a technology within the business and within a few years this was to happen for Booths. Their investment in Kent had initially meant that they had consolidated their network by taking a tighter hold of manufacturing within it. This meant they would start to think more closely about how the products of Kent's tannery could relate to the needs of all the markets that Booths worked in rather than just the narrow range of Kent's local glove customers.

There was no attempt to create a secret "skunk works" at any stage; the Booths approached this on the basis that if solutions could be found to identified market needs Booths and their associates would benefit. While we do not know the reasoning no correspondence has been found to date indicating any desire to "own" technology only the relentless interest to keep on developing new business areas.

One element worthy of consideration is that Booths had other business and personal interests which forced them into looking at their networks and

network relationships in a different way from other tanners. When the Schultz patents were ready Booths were still busy with the Dongola tannage which was doing exceptionally well. It required a great deal of work in the search for raw material and in servicing the growing market in footwear leather, which was new to Gloversville tanners but well known to Booths via their activities in New York and Boston. They had bought the neighbouring tannery to expand production and used their own shipping line to introduce a direct shipping route from Para to New York primarily to import goat and hair sheep skins.

At about the same time in the UK they had invested to set up a new plant in Nuneaton to make a product from roans (another type of part processed sheepskin) more suited to the US market. Charles had also personally been making trips, such as one to Bordeaux in 1881, to look for better quality raw material.

With shipping, trading, tanning and a global perspective the Booths at that time were themselves a unique organisation. They worked on many interfaces and within a number of networks that were very different to other leather traders or, for example, an individual tannery in Nottingham or Gloversville. With their network position and naturally wider network horizon were in a better position to assess the potential and requirements of a new development in leather than most other actors in the network.

Networking also changes a company's position:

So while we lack, based on the papers available to date, any clear definition of why Booths did not want to control the technology tightly we do know they were exceptionally busy in many other areas within and without the leather industry. They might have been just "conveniently" diverted by other matters. At that time they saw themselves as business people first and tanners second or third. Their letters always describe a love of the industry, not a romance with the product. So their orientation and their network assessment was much more about the markets – for raw and finished leather – than the finer details of the product itself. When the market demanded a new product, or as with the roans their product was not suited for the market, then they made changes.

On the other hand while their intensive networking and bringing together of different actors did change their position in the network it is not clear that they fully realised until later that they were moving from being traders to

manufacturers. Within a few years they would not be seen as suppliers of raw material but as tanners and others in New York and Boston entered the market to fill the spot of raw material suppliers to the industry. Certainly by 1920 with tanneries in the UK and the USA they were to be one of the biggest, if not the biggest, tanning organisations in the world. Growth in the US slowed but they continued to acquire and build in the UK and added plants in Africa and New Zealand. The one small move to support James Kent at a moment of crisis was to steadily transform their role in the global leather network.

Network reaction:

What we do not know is why the traditional vegetable tanners did not react when Booths began selling goatskin and kangaroo Dongola leather into the footwear industry. This was after all a vegetable process (with some adaptations) which they could have used on their own raw material. Indeed in the 1930s we have many records of it still being used on bovine material long after goat and kid tannages had moved on to chromium. Yet at the time we have no evidence of any form of retaliation or moves to defend their market share. For ten years Booths worked extremely hard to strengthen their links into the footwear sector of the US leather network. Did the vegetable tanning sector not notice, or was their response to push more into sole leather, saddlery and upholstery? In this study we have not discovered the answer to this, other than knowing that Booths were successful in penetrating the market to the extent that their Philadelphia tannery Surpass Leather grew to be one of the largest tanneries ever seen in the world.

We do of course know that the US vegetable tanners were preoccupied with the supply situation, including their fear of the growing power of the meat packers. In 1893 they grouped together in the hope that their combined buying power would make them more equal to the meat companies and better able to negotiate prices. For the next fifteen years nearly all the written materials about the new company related to internal problems in the organisation of the business and the revaluation of assets, in particular forests, in order to pay dividends.

As a consequence the US Leather Company management did feel they were embracing change and that they were making a bold move to advance their industry, yet their network pictures were narrowed towards the domestic scene and their traditional markets.

Both companies did last for a further fifty years so it would be wrong to be prescriptive about their approach and methodologies. Financial figures would suggest that Booths were consistently more successful and able to grow while US Leather was always about managing decline. In the end it was technology which killed the US Leather Company as with the decline of horse transportation, leather industrial belting and leather soles for footwear meant their traditional vegetable tanned leather outlets had become too small.

CONCLUSIONS

This study illustrates a number of features of innovation and network evolution. What we conventionally refer to as innovation is merely a subset of the general process of network evolution that is marked by some combination of radical shifts in individual resources, resource combination or activity structure. Also, innovation is always likely to involve major change in particular actors, in their network pictures and in the relationships between them. Innovation is an interactive process and as such it involves combinations of new and existing resources and activities that stretch widely across the network. These resources and activities and the processes of change are outside the complete control of any one actor. The study illustrates that innovation is both a temporal process and one that encompasses many sequential and parallel strands.

The success of an innovation, like any outcome of business networking is specific to time and to the position in network space from which it is viewed. But success always seems to be based on combining ideas from a number of sources with a curious blending of old and new concepts. This process of combination is both random and uncontrolled but can be strongly affected by the linking and encouragement of others that was part of the Booth culture.

The direction which an innovation takes is often quite different from the initial objectives of the actors involved in it. The leathers that Booths helped to develop all had success in quite different applications than their developers had planned. It is also clear from a number of studies that an innovation may take decades before its value is recognised or exploited. Chrome tanning was typical of this with a number of failed attempts to commercialise it before Schultz and those in the decade following worked it into a commercial success.

The case study also demonstrates how companies can effectively network with multiple counterparts to widen their access to activities and resources and influence the direction of innovation. It also shows how changes in resource ties and activity links change the overall topography of the network in ways that a single actor cannot anticipate. Perhaps the genius of the Booth company was in their appreciation of the dynamics of business networks, their understanding of their own limitations, their ability to scan across apparently discrete networks, to build relationships and to develop and combine the resources and activities of others.

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