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Roles of Trade Associations and the Dutch *Rijksnijverheidsdienst*, 1900-1940

Sue-Yen Tjong Tjin Tai

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PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Technische Universiteit Eindhoven, op gezag van de rector magnificus prof.dr.ir. F.P.T. Baaijens, voor een commissie aangewezen door het College voor Promoties, in het openbaar te verdedigen op woensdag 11 november 2015 om 16:00 uur

door

Sue-Yen Elise Tjong Tjin Tai

geboren te Nijmegen

Dit proefschrift is goedgekeurd door de promotoren en de samenstelling van de promotiecommissie is als volgt:

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	prof.dr. E.J. Nijssen
adviseur:	dr.ir. M. van der Veen (Kamer van Koophandel)

To Johan de Knijff

Contents

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Small firms are often family businesses. When children see their parents running a business every day, working in the family firm becomes embedded in their way of life. From the time I was five until I was nine, I watched my father preparing his dissertation. Having trained as a surgeon, in his spare time he was studying the treatment and cure of broken thighbones in children. My mother, my three brothers and I accompanied him when he travelled to see patients who had moved away from our home town. The typewriter came with us on holiday, so if I woke up at night, I could hear my father typing. After his thesis was printed, my brothers and I played for months with the paper offcuts. In all those years, we could see how natural it was for my mother to support my father. Coincidentally, my husband grew up in similar circumstances. His father, a minister, wrote his thesis about a theologist's bible interpretation. The main difference was that his father studied early in the morning.

So, when I started this thesis, it felt like a natural step. I thoroughly enjoyed the historical research and cherish the further intellectual enrichment. As I feel privileged for having been offered this opportunity, my thanks go to everyone who contributed to this research project.

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Rijswijk, August 2015 Sue-Yen Tjong Tjin Tai

‘I have become familiar with the needs of small firms because they consult me regularly. They want government measures that will improve their circumstances and of course their profits.’

Floor Kist, *Rijksnijverheidsdienst* consultant, 1910

‘The blacksmiths in Nieuwkoop are lagging behind due to their lack of knowledge about the latest machines and production methods … without more professional knowledge, they will struggle to survive; this specialist knowledge will provide the foundation they need in order to progress.’

1912 State Budget

1 Introduction

1.1 Innovation in SMEs and Intermediary Organisations

In 2014, the Dutch Minister of Economic Affairs, Henk Kamp, announced a 55 million Euro programme for small and medium-sized enterprises (SMEs). He saw this as important, because 'SMEs are the engine of our economy and the driver of innovation. Therefore, they deserve support that seamlessly connects with their businesses. For the first time ever, government, regions, businesses and top sectors have agreed to this support and how to make it accessible. This will make it easier for SMEs to innovate, take opportunities and expand.'[1] The programme stimulates the innovation and collaboration of Dutch SMEs by granting subsidies for knowledge vouchers, feasibility studies and collaborative research and development projects. According to Kamp, government support of innovation in SMEs is self-evident, as 'we stimulate the recovery of our economy, we create employment and generate income, which is good for all of us.'[2]

Policy makers of the early twenty-first century view innovating SMEs as crucial for economic development. The Dutch SME programme is only one of many, as illustrated by the SME programme in Europe (Horizon 2020) and the Small Business Innovation Research programme in the USA (SBIR).[3] As well as stimulating research and innovation, these programmes promote SMEs' collaboration with external parties, ranging from governmental departments and agencies, knowledge institutes and consultancies, to other firms.

Initiatives to stimulate SMEs are not new. Nor is the collaboration with external parties. Around 1900, several associations tried to convince the Dutch government to establish a programme for innovation in SMEs, citing policies in other countries. In 1908, J.S. Meuwsen, chairman of the *Middenstandsbond* (Dutch Association for SMEs) referred to the programme in Austria to illustrate the need for a Dutch SME policy. Austria had established several regional and local institutes to stimulate trades (*Gewerbeförderungsinstituten*). These institutes had model workshops with up-to-date tools and machinery to train SMEs. Its consultants provided technical and business advice. Government schemes enabled SMEs to purchase machinery at low cost. Meuwsen concluded that 'The main objective of the Austrian government is to stimulate SMEs by using all possible means to improve their technical competencies, so that they are able to survive independently, notwithstanding the enormous competition from large firms.'[4]

SMEs in the early twentieth century had different challenges than their current peers. In those days, SMEs had to cope with radical changes as a result of industrialisation. Nowadays, SMEs are confronted with societal and technological

challenges such as sustainability and the impact of information and communication technologies. There are also similarities. In order to survive, SMEs of every era have to be flexible and able to adapt, so that they can grasp the opportunities that transformations provide. For SMEs it is especially challenging to respond effectively to transformations, because they are more limited in their resources and capabilities than large firms.[5]

During technological changes like electrification and computerisation, firms adopt technological artefacts such as electrical motors and personal computers and absorb new knowledge and information. This requires firms to learn and adjust their skills, which they can facilitate with internal expertise and their connections to external knowledge sources. Large firms have easy access to internal expertise through their own experts or their research and development facilities. In contrast, generally SMEs do not have these resources, so they have fewer scanning abilities and their absorptive capacity is lower. Creating connections to external knowledge sources can be difficult for firms of all sizes due to market and innovation system failures. Consequently, firms are faced with gaps like barriers to knowledge, lack of advisers or lack of relationships that enable access to knowledge sources.[6] Again, SMEs are at a disadvantage compared to larger firms because they have fewer resources and capabilities.

Innovation studies show that gaps in market and innovation systems are bridged by intermediary organisations.[7] These intermediary organisations exist because firms and knowledge suppliers have difficulty closing these gaps themselves due to incongruencies in their goals and perspectives.[8] Intermediary organisations perform roles in brokering and knowledge transfer and thereby enable firms to adopt new technology, transform existing routines, change their capabilities, and enhance their learning capacity.[9] In other words, intermediary organisations play a role in changing and improving firms' existing products or processes. Thus, they contribute to innovation that is *new to a firm.* This brings us to the focus of my dissertation, the significance of intermediary organisations in firm-level innovation processes within SMEs.

1.2 Studying the History of Innovation using Contemporary Literature

This dissertation is a historical study of innovation in SMEs which uses insights from contemporary literature to investigate the roles of intermediary organisations in firm-level innovation processes.

As Meuwsen indicated above, the early twentieth century saw major societal and technological transformations. The Netherlands industrialised relatively late compared to its neighbouring countries, so the transformations ran parallel with innovations in transport and energy.[10] Thus firms were also confronted with new

mobility technologies: bicycles, automobiles and aeroplanes. Electrification introduced electromotors that enabled SMEs to mechanise. Nevertheless, from the late nineteenth century, many Dutch feared that SMEs would not survive industrialisation, despite the prevailing view that it was an inevitable consequence of the liberal economy. They saw SMEs as the backbone of the Dutch society, so their decline would have a major societal impact. For this reason, several associations lobbied for an SME policy and the establishment of intermediary organisations.

Studying the early twentieth century is insightful because then only a few intermediary organisations existed, unlike the numerous ones in our present-day complex knowledge infrastructure. In the Netherlands, the earliest intermediary organisations date from the nineteenth century. These clubs and associations distributed knowledge through education and publications. The first intermediary organisations that specifically targeted SMEs were established around 1900.[11] Entrepreneurs had established the first national trade associations in the late nineteenth century already. These associations advocated the interests of SMEs, which extended to education and the implementation of new technologies.[12] The *Rijksnijverheidsdienst* (RND, Technical Information Agency), established in 1910, was the first Dutch government agency that encouraged knowledge transfer to firms.[13] Thereby, RND aimed to stimulate and enable Dutch SMEs to innovate.[14]

Tracing the progress of intermediary organisations for SMEs between 1900 and 1940 also gives us more insight in the development of the Dutch knowledge infrastructure. The economic crisis in the 1930s and the ensuing government intervention resulted in the establishment of several government institutes and policies to stimulate the national economy. Naturally, this impacted existing intermediary organisations and their roles.

This study also contributes to the historiography because so far no historical study has systematically investigated the importance of intermediary organisations for SMEs grappling with the technological changes that were taking place in the Netherlands in the early twentieth century. Several historians have studied how SMEs responded to the challenges of industrialisation and changes in that era. There is one study that reviews some of RND's activities.[15] Another study, on the introduction of desktop publishing for small printing firms between 1970 and 1990, shows how trade associations and suppliers supported innovation in SMEs.[16]

This dissertation is not limited to the intermediary organisations' perspective. It will study the situation of innovating SMEs as well in order to avoid exaggerating the significance of intermediary organisations. Thereby, this thesis will also contribute to the historiography of firm-level innovation (*new to a firm*). So far, studies on the history of innovation have mainly investigated innovation based on technology or knowledge that is *new to a sector* or *new to a country* (sector

or country-level innovation). These studies focused on large firms in knowledge-intensive and science-based sectors that conducted research and development in their own facilities.[17] The majority of SMEs lack the resources to establish their own laboratories, so for innovation they depend more on external parties than large firms do.[18] Nevertheless, there are few studies of firm-level innovation in SMEs, or about the contributions of external parties.

Intermediary organisations are studied in various research areas and disciplines in contemporary innovation studies. These studies are aimed at mediation in innovation processes and often involve learning and knowledge. They show that intermediary organisations enable innovation in SMEs by conducting various roles, ranging from knowledge transfer and transformation, testing and evaluating equipment, to research and standardisation.[19] Only a few researchers have tried to synthesise existing studies and inventorise the roles of intermediary organisations, so further research is hampered by a lack of categorisations and typologies.

As mentioned above, a historical study of intermediary organisations enables a review of evolving roles through time during the development of the Dutch knowledge infrastructure. This is relevant because contemporary literature lacks these studies. Typically, contemporary research analyses intermediary organisations of the past three decades and investigates roles and activities over periods of up to about ten years.[20]

Summarising, the aim of this dissertation is to investigate the trade associations and RND's roles in innovation for SMEs in the Netherlands from 1900 to 1940. The research is based on a historical study of firm-level innovation in SMEs that uses the insights of contemporary innovation studies on the roles of intermediary organisations.

1.3 Research Approach

This dissertation consists of a multiple-case study of three sectors and a separate study of *Rijksnijverheidsdienst* (RND).

The multiple-case study traces the history of three cases of innovating Dutch SMEs between 1900 and 1940: bread bakers and their transition to mechanisation, wagon makers and their transition to bodywork for motorised vehicles, and the development of the bicycle sector. In all three sectors, the challenges differed as well as the involvement of trade associations and RND. Thus these cases provide insight in the roles of trade associations and RND under varying circumstances. Their roles were investigated in an explorative manner, guided by a basic outline of the roles of intermediary organisations obtained from reviewing contemporary literature. By taking stock of the roles and activities of trade associations and RND in each of the three cases, I was able to use the results to categorise these roles. Due to the lack

of suitable SME archives and only a couple of historical studies of these sectors, I had to find additional sources.[21] These consisted of trade associations and RND archives, trade journals, commemorative books, websites and historical associations' publications.

The study of RND investigates its evolving roles as well as its changing relations with other organisations and stakeholders between 1910 and 1940. Thereby, it also reveals the significance of RND for innovation in SMEs and for the Dutch knowledge infrastructure. For this study, I collected data from several government archives. Unfortunately, the original RND archive was destroyed during a World War II bombardment.

The following sections present a historiography of SMEs during industrialisation (1.4), trade associations and RND and their significance for SMEs (1.5), contemporary literature on intermediary organisations and their roles (1.6), the research question (1.7), and the methodology and data collection (1.8). Section 1.9 introduces the historical context of SMEs in the Netherlands and the industries involved in the case studies. Finally, section 1.10 is a reader's guide to the remaining chapters of this thesis.

1.4 Historiography: How SMEs Responded to Industrialisation

Although there are no systematic studies of intermediary organisations' roles for SMEs during transformation processes, several historians have studied how SMEs responded to one of these transformations: industrialisation. Until the 1980s, business historians tended to focus on large firms, as these had transformed pre-industrial ways of life and work into a global consumer society and a world economy based on mass production.[22] Many of these firms were knowledge-intensive and research-based. Furthermore, the work of business historian Alfred Chandler on the rise and the importance of corporate management in large firms had an enormous impact on business history and dominated the direction of research for a long time.[23] In the meantime, SMEs were seen as close to extinction, a leftover of the past with no future.[24] This changed in the 1970s and 1980s, when economic crises halted the continuous growth of large firms, and mass producers of standardised goods suffered serious competition from foreign industries and smaller, more flexible firms.[25] Economists then re-appreciated SMEs as flexible, innovative businesses, viewing them as the engines of economic growth and job creation.[26] The renewed interest in SMEs also spread to business history and the history of technology, so that researchers in several countries were able to study how SMEs responded to the challenges of industrialisation.

The next section presents a historiography of SMEs in countries outside the

Netherlands and their responses to industrialisation. The subsequent section uses historiography to compare whether Dutch SMEs had the same responses. The last section explores the historiography of the role of knowledge and mediation in firm-level innovation.

The historical studies focus on the decline of traditional crafts or on how SMEs were able to adapt and survive, mainly through firm-level innovation. In addition, these studies show several examples of how SMEs were able to survive thanks to the involvement of external parties. In the Netherlands, trade associations and RND stimulated firm-level innovation through knowledge mediation and other activities.

1.4.1 SMEs in Industrialising Countries outside the Netherlands

This section presents a historiography of SMEs in industrialising countries outside the Netherlands. It first reviews studies of SMEs in Germany, France, Japan, India, and the USA; then an international study of SMEs and their responses to industrialisation. Next, I introduce study results in three sectors: Canadian furniture, English cheese making and bread baking in the USA, Belgium and Germany.

The studies show that the decline or disappearance of SMEs and artisan production was not solely due to the rise of mechanised factories and the availability of cheap mass-produced goods. Other factors influenced these changes as well. Furthermore, quite a few SMEs were well able to adapt to the challenges of industrialisation and new technologies. The historiography indicates that responses and changes differed per sector and per country. Lastly, several studies show how external parties fulfilled roles in the responses of SMEs to the challenges of industrialisation.

Referring to Tadao Kiyonari's research, economic historians Konosuke Odaka and Minoru Sawai describe the transformation process of German SMEs from the old craft industries into new ones as 'easy in, and easy out'.[27] 'Easy in' refers to the continuing existence of many old craft industries in Germany around 1900, which Odaka and Sawai view as a legacy from agricultural times and as the result of regulations enabling trade associations to protect their markets. 'Easy out' refers to how these SMEs seized the new opportunities that appeared in the early twentieth century: in subcontracting, batch production, repair work and services.[28] Furthermore, historian of technology Ulrich Wengenroth mentions that during this transformation period, SMEs could rely on municipal savings banks and co-operative credit unions for loans and financial services.[29]

Wengenroth presents three German case studies of small-scale businesses to demonstrate that the process of industrialisation and mechanisation did not necessarily cause a decline in SMEs. First, he reviews the cigar making industry and concludes that it was a change in consumer preference that caused its decline.

Efforts to mechanise this industry failed, except for basic cigar forms. Then the advent of World War I meant cigar makers were recruited as soldiers to the army, and cigar production suffered. In contrast, the production of cigarettes continued thanks to successful mechanisation. As a result, consumer preference switched to cigarettes, which led to the decline of the cigar industry.[30] Second, by comparing wheelwrights and blacksmiths, Wengenroth shows that electrification can have different effects on SMEs. For wheelwrights, mechanisation with electric motors was a lost cause, because the wooden wheels they made were no longer needed when these were replaced by rubber tyres and steel wheels and axles. Additionally, farmers stopped bringing their wooden equipment to wheelwrights for repair once they could buy electric hand tools. Unlike wheelwrights, blacksmiths could transfer their skills from horseshoes to tractors, reapers and automobiles. Furthermore, they started selling and servicing industrial and consumer products like automobiles. Wengenroth concludes that SMEs such as blacksmiths filled a gap between mass production and users and consumers, by installing and servicing products.[31] Third, he suggests that the survival rate of SMEs cannot be measured by the number of years they exist in a specific trade. He shows that businesses may seem to be disappearing, whereas in reality, they keep going by using the same resources or the same location. For example, Opel started manufacturing sewing machines, then switched to bicycle production, and finally to automobiles. Similarly, a farrier's shop became a sales and service shop for cars. Another example Wengenroth mentions is the transformation process of a mill over two centuries, from paper producer to cardboard maker, to oil mill, hemp brake and tanning-mill, and finally to a restaurant.[32]

In France, SMEs faced many challenges in the early twentieth century, according to historian Michel Lescure. The number of SMEs declined for various reasons: large firms subcontracting less to SMEs, state policy that encouraged cartels, and the centralisation of banks, making it increasingly difficult for SMEs to finance investments. These factors also impacted local production systems. Changing clothing habits challenged the regional ribbon industry, and the lack of flexibility and collective organisation affected the cutlery industry.[33] Nevertheless, Lescure identifies successful SMEs who carved out niches by specialising in a technology supported by their innovative capacity, by producing capital or consumer goods in batches, or by becoming subcontractors.[34]

In Japan, some SMEs responded to industrialisation by localising new equipment. According to economic historian Johzen Takeuchi, Japanese craftsmen used their traditional skills and systems to replace the materials of new, imported equipment like brass and steel, with locally available materials. This was a process of problem-solving and learning-by-doing. A knock-on effect was that traditional craftsmen were able to catch up with new technology, as illustrated by the wooden shipbuilders who transitioned to metal shipbuilding.[35]

Colonial historian David Arnold studied SMEs in India starting to produce new machines. Similarly to Takeuchi, he studied how bicycles, rice mills, sewing machines and typewriters diffused in India, while also investigating how producers and users assimilated and appropriated them. He shows how the process of diffusion shaped producers and users' knowledge as well as their position in India.[36]

Historian Mansel Blackford examined small businesses in the USA since colonial times, while assessing their relationships with medium and large firms. Until 1880, America's economy was dominated by small businesses. After that, large industrial firms emerged, then agribusiness, chain stores and other developments which all resulted in the decline of small manufacturing firms. However, according to Blackford, small businesses did survive and prosper thanks to flexible production and by specialising in products for niche markets.[37]

Historian Philip Scranton points out that industrialisation in the USA created many opportunities for SMEs. His research shows that the Second Industrial Revolution between 1865 and 1925 was not only due to the rise in mass production, but also the deployment of specialty manufacturing through custom and batch production. Scranton investigated sectors making machinery and tools for mass producers and those making consumer goods like jewellery, silverware and furniture. The SMEs he studied were linked with larger firms in industrial districts or networks. They survived by being flexible, employing skilled labour, having close interaction with their customers, suppliers and competitors, and using opportunistic pricing. To manage their markets, they established trade schools, industrial banks, labour bureaus and sales consortia.[38]

Social scientists Charles Sabel and Jonathan Zeitlin argue that SMEs were not passive victims of industrialisation, because this process was not a radical transition from decentralised handicraft to mass production of standard goods.[39] According to the authors, firm owners were aware that they could transition to either flexible specialisation or mass production and hedged their bets through flexibility and establishing organisations. Furthermore, case studies of silk merchants and weavers in Lyons, Swiss watchmakers, Solingen cutlers and British metal works show that these firms were well aware of American mass production systems, quickly realising that the required degree of standardisation was incompatible with their markets.[40] Nevertheless, they did apply standardisation in order to mechanise their production of semi-finished goods and components. So, the case studies show that when mass production impacted SMEs, they actively searched for niches where they could survive. Inspired by the Americans, they adapted their workshops to ensure efficient batch production. Several organisations and solutions were important for quality assurance, managing the competition and supporting the survival of SMEs. Examples are boards of arbitration, self-regulated price lists and wage agreements, neutral organisations that created standards, collective regulation of labour which included communal financing for training, and organisations that kept local industries up to

date on trends in industry and technology.[41] The need for these organisations is illustrated by case studies of the Spitalfields silk manufacturers in London and the cutlery industry in Solingen, Germany, where the absence of regulation or self-regulation resulted in downward spirals of price and wage cutting, loss of skilled workers, and diminishing product quality. However, these organisations were not without disputes, especially in debates about changes.[42]

Other historians conducted sector studies as well. Historian Ben Forster and economist Kris Inwood studied late nineteenth century furniture workshops in Canada. Amid mass production and industrialisation, these workshops carried on as small-scale firms. Their owners acquired general-purpose machinery, but continued to depend mostly on manual skills. Mass production was not feasible, because manufacturers could not easily process wood in mass-scale production lines due to its characteristics as a natural material. Furthermore, as furniture is a fashionable product, manufacturers needed to stay close to their customers in order to produce the right models.[43]

In their article about English cheese making between 1650 and 1950, business researchers Richard Blundel and Angela Tregear studied how artisan firms transformed relatively late into factories, because there was no need to mechanise earlier. In the late nineteenth century, farmers had no incentive to convert their farmhouse production of cheese into factory production. The new railway system made it attractive for them to send the milk to London and other major cities, so many farmers stopped producing cheese. From then on, cheese was mainly imported from New Zealand, Canada, and the Netherlands, where it was produced in factories. Meanwhile the remaining English farmhouse producers struggled with poor performance. Agricultural societies and local councils took initiatives in the early 1900s to improve cheese quality through training, itinerant schools and a voluntary grading scheme, but these had hardly any impact. In the 1930s, the British government intervened in pricing and quality control. On-farm production stopped when World War II distribution resulted in regulations that stated that for efficiency reasons, only large industrial plants could produce cheese.[44]

Studying bread bakers in several countries shows how geography, organisations and consumer expectations influence the survival of small businesses in different ways. In the USA, small bread bakeries lost the competition with bread factories. At first, industrial bakeries had difficulty finding sufficient demand, because around 1900 consumers were used to home baked bread.[45] Then, urbanisation, an increase in working women, higher incomes, and quality improvements of commercially baked bread increased the demand for bread from bakeries.[46] Next, wheat substitution during World War I made home baking more difficult.[47] In parallel, full mechanisation and standardisation of the baking process by manufacturers increased the maximum production capacity of

industrial bakeries from 15,000 loaves per day in 1900 to 100,000 loaves per day in 1930.[48] Additionally, truck transport enabled a new distribution system covering large regions.[49] The result was that by 1930, factories produced about two thirds of the USA's bread.[50] In contrast, small bread bakeries in Belgium were able to survive with limited mechanisation, because high labour costs and the prohibition of night work made factories lose their competitive advantage.[51] Furthermore, Belgian consumers expected their bakers to bake bread with a unique flavour.[52] In Germany, small bread bakeries were also able to compete with bread factories due to restrictions in night work.[53] German guilds regulated competition, distribution and pricing.[54] The guilds, which were re-established in 1868, also reinstated training schemes. Mechanisation and the use of additives were limited, as bread bakers did not want their staff to lose their jobs and because bakers and consumers believed that natural bread tasted better.[55]

In conclusion, the above historiography confirms that many SMEs in industrialising countries were able to survive and respond to industrialisation and new technologies in an effective manner. Some changed their trade, or started service work. Many SMEs mechanised and improved their production to a suitable extent, and they survived by taking up niches that mass production could not fill. This was illustrated by German SMEs like blacksmiths (mechanisation), Japanese firms (new products through learning-by-doing), American small businesses, including small machinery manufacturers and jewellery, silverware and furniture makers (flexible production and specialisation), silk merchants and weavers of Lyons, Swiss watchmakers, Solingen cutlers, British metal works (appropriate standardisation, mechanisation), Canadian furniture workshops (general-purpose machinery), and German and Belgian bread bakers (customer preference, some mechanisation, night work regulation). In all these cases, SMEs started using new machinery, new processes or manufactured new products. This involved a learning process for which SMEs had to absorb new knowledge and information.

The situations where SMEs severely declined or artisan production virtually disappeared were not necessarily solely due to the rise of mechanised factories or the availability of mass-produced goods. The examples above show that it happened because of a combination of difficulties in mechanisation and lack of craftsmen due to the war (German cigar making), or that production ceased on account of a more profitable alternative (English cheese makers). Only for US bread bakers does the literature conclude that SMEs lost out to bread factories.

The historiography also shows that external parties and collective activities helped SMEs to survive. Trade associations regulated competition, ensured training, or kept firms up to date on trends in industry and technologies. Credit facilities and banks financed SMEs. Examples of collective activities that were important for SMEs were regulation, self-regulated price-lists and wage agreements, standardisation and education.

The historiography of Dutch SMEs in the following section explains what actions they had to take to survive industrialisation.

1.4.2 Dutch SMEs, Industrialisation, Trade Associations and RND

Historical studies of SMEs in the Netherlands show similar findings to the industrialising countries mentioned in the previous section. Many SMEs were able to survive and respond to the challenges of industrialisation and new technologies. In some cases, their number severely declined or artisan production disappeared, but not solely as a result of mechanisation or mass production. The studies show that several external parties played a part in transforming SMEs, in particular the trade associations and RND. SMEs also engaged in collective activities to survive.

Business historians Jacques van Gerwen and Ferry de Goey studied Dutch entrepreneurs in the twentieth century.[56] They observed that new mobility technologies like bicycles, cars, electric trams and aircraft created many opportunities for SMEs, especially in repair and services.[57] Nevertheless, between 1900 and 1940 the majority of SMEs found it difficult to survive due to harsh competition and the economic crisis. The authors note that this situation was made worse because of their insufficient technical and commercial knowledge.[58]

Business historian Keetie Sluyterman identified the rise of a new type of SME between 1880 and 1914: the cooperative movement. The introduction of the centrifugal separator enabled a larger-scale butter production than individual farmers could handle. However, conflicts about the milk prices offered by dairy factories made farmers form dairy production cooperatives. Other cooperatives established sugar beet factories, or started producing potato starch or strawboard.[59]

Economic historian Jan Luiten van Zanden studied industrialisation in Amsterdam between 1825 and 1914 and concluded that SMEs in the Dutch capital were impacted by two trends. On the one hand, small firms lost their markets to large industrial firms, which he illustrates with the case of the blacksmiths. On the other hand, from the late nineteenth century the diffusion of the gas engine, and later the electromotor, enabled mechanisation and the survival of SMEs. Additionally, the surplus of labourers resulted in low wages and thus low labour costs for SMEs.[60]

Monographs of Dutch SMEs illustrate that in some sectors the number of SMEs declined strongly due to industrialisation or lack of scale. According to C.A. Verkuylen, clog makers faced many challenges in the early decades of the twentieth century: lack of organisation of their sector, increasing wood prices and wages, imports from Belgium, lack of capital to invest in mechanisation and

a lack of suitable and affordable machines, competition from rubber and leather shoes, and a decreasing number of labourers wearing clogs due to unemployment in the 1930s.[61] Historian Dick van Lente notes that sales of clogs increased somewhat thanks to the assistance of RND consultants. They helped to improve the quality of clogs with new designs, and stimulated new advertising and marketing activities.[62] Verkuylen mentions a 1928 law that increased import tariffs on clogs. This improved the situation for clog makers and stimulated mechanisation. Nevertheless, the number of firms dropped from 3,884 in 1919 to 1,827 in 1941, with 8,396 employees in 1919 and 4,526 in 1941.[63]

From the early 1900s, small tanning firms in the Netherlands disappeared because chrome tanning in factories produced better quality leather. Economic historian Jan Aart de Jonge illustrates the impact of chrome tanning by its output: in 1911 eleven chrome tanning plants produced 75 percent of the overleather.[64] As chrome tanning was only suitable for upper leather, SMEs continued to produce sole leather, which was based on vegetable tanning.[65]

According to De Jonge and also Ad Eillebrecht et al., the number of SMEs among Dutch cigar producers declined mainly because they lacked the capital to stock tobacco. This was necessary to minimise the cost of tobacco and ensure the highest possible quality.[66] Until the 1920s, the only machinery available was for the preparatory steps of cigar making, so it remained an artisan activity well into the twentieth century.[67] After 1910, the cigar industry was challenged by excise-duties, increasing wages and then low-price imports from Germany after World War I. Finally, the economic crisis of the 1930s stimulated mechanisation: the number of machines increased from 393 in 1931 to 1,908 in 1938.[68] However, the Dutch cigar maker trade unions successfully lobbied for a law against mechanisation to safeguard employment. Some entrepreneurs supported this law as well, not wanting to get caught up in a never-ending mechanisation race. So, from 1936, the law did not allow the use of machines for cigar production, unless they had been purchased before the law was instated or an exemption had been granted. According to Sluyterman, the law did not achieve the envisaged protection of employment, nor did it halt mechanisation.[69] So, as far as cigar producing SMEs without machines were concerned, this law did not improve their business perspective.

Dutch SMEs in the printing sector managed to survive because they were well organised. Historian Erik Nijhof studied Dutch printers in the twentieth century and concluded that around 1914 the sector developed a printing system consisting of trade associations and trade unions. This cooperation was established in order to stabilise prices and wages. Subsequently, they successfully extended their cooperation to training, export, quality control and the introduction of new technologies. Dutch printers imported all their new printing machines from the USA and used these without making essential changes. The printing system managed the introduction of new machines by ensuring that suppliers bought old machines, so

that these would not be sold to starting printers.[70] Thereby, it limited overcapacity in the sector and helped existing printers to survive. According to Nijhof, the Dutch printing system was exceptional. It could only be created and maintained because a language barrier protected the printers' market.[71]

Dutch wagon makers were able to survive with assistance from the government through RND. In his review of RND activities, Van Lente studied this agency's support of wagon makers. In the early 1900s, wagon makers were already suffering from severe competition within their sector. Then, the rise of motor vehicles opened up a new market for them to make bodywork for motorised buses and lorries. According to Van Lente, RND supported this transition by organising courses, giving personal advice about technical, organisational and bookkeeping matters, organising excursions to automobile manufacturers, and making drawings and writing articles for trade journals. He concludes that in 1938, there were at least twenty-one Dutch producers of bus and lorry bodywork. However, because of the lack of statistics, Van Lente states that it is not known how many wagon makers made the transition to bodywork, continued as farm wagon makers or closed their workshops.[72]

The research data on blacksmiths and manufacturing firms are contradictory, illustrating that it depends on which SME examples you examine. Historian Michiel Koorenhof observed that the number of blacksmiths declined between 1900 and 1940 because farmers started buying mass-produced agricultural tools and equipment. Furthermore, blacksmiths were not able to expand the scale and size of their businesses.[73] Trade associations initiated many activities to stimulate the sector, but blacksmiths saw their fellow blacksmiths as rivals and it was difficult to motivate them for collective activities.[74] Van Lente also reviewed RND's activities for blacksmiths and concluded that they were successful in stimulating the introduction of electrical machinery in smithies. He concludes that despite electrification and new opportunities like central heating systems and greenhouse construction, blacksmiths continued to lose ground to mass production.[75]

In contrast, historian Giel van Hooff describes the progress of Dutch manufacturing firms in the late nineteenth century. Most of these firms were small businesses, many of which had started as blacksmiths. They mainly made products at the request of their customers or manufactured products copied from other blacksmiths and foreign manufacturers.[76] Thus, based on Koorenhof's study of the decline of blacksmiths and Van Hooff's dissertation about new manufacturing firms, we see that the originally rural blacksmiths who worked for farmers disappeared as a result of industrialisation and that some of them were able to make the transition into manufacturing.

In conclusion, the historiography shows that similar to SMEs abroad, many Dutch SMEs were able to survive and respond to industrialisation and new technologies in an effective manner. Some changed their trade, or started service

work. Many Dutch SMEs mechanised, improved their production, and survived by creating niches that mass production could not fill. This was illustrated by clog makers, printers, wagon makers, blacksmiths and manufacturing firms. In all these cases, SMEs had to absorb new knowledge and information. For example, new clog designs, new machinery (printers), manufacturing new products (wagon makers) or copying products (blacksmiths and manufacturing firms).

The cases where the number of Dutch SMEs severely declined or artisan production virtually disappeared were not necessarily down to mechanisation or mass production. The examples above show that some of the reasons were: a lack of suitable machines and many other challenges (clog makers), the introduction of a new and superior factory technology (tanning firms), and late mechanisation along with many other challenges (cigar makers).

These cases also show that trade associations, RND, other organisations and collective activities fulfilled a role in SMEs' survival. Trade associations regulated the competition, ensured training, or managed the introduction of new technologies. RND improved product design, stimulated marketing and sales activities and supported retraining. Dutch SMEs' joint activities included regulation, education and the co-operative movement.

Summarising, SMEs were able to survive industrialisation by seizing new opportunities, mechanisation, improving their production and selecting suitable niches. In all these cases, SMEs had to find and absorb knowledge. The next section focuses on firm-level innovation and knowledge and the role of external parties in knowledge mediation.

1.4.3 Firm-level Innovation, Knowledge and Mediation

This section further explores the historiography of knowledge and firm-level innovation. It shows that external parties mediated knowledge and that a new type of organisation emerged around 1900: the intermediary organisation.

The SMEs that survived by taking on service or repair work, by mechanising and improving their production, or by changing their products, were taking part in a process of adopting innovations new to their firms (also referred to as the diffusion of innovations).[77] They adopted technologies, such as the electrical motor, production machinery and other industrial products that were already used elsewhere. In other words, they did not improve or change their existing products or processes in a way that was new to their sector or country, nor did they invent new products or processes.[78] According to economist Bronwyn Hall diffusion of innovation is an intrinsic part of the innovation process. This is because diffusion leads to learning, imitation and feedback that enhance the original innovation. She views diffusion as a critical process for technologically laggard countries, regions and firms that need to catch up.[79]

This dissertation defines innovation as 'the development and introduction of products, services or processes which are new or improved for these firms and which are expected to result in improved performance, like increased sales, lower cost and better quality.'[80] So, innovation is the implementation of something that is new to a firm.[81] Firm-level innovation is therefore different from country-level and sector-level innovations. When SMEs implement something new to their firm, knowledge fulfils an important role.[82] Knowledge is either already available in the firm or needs to be acquired.[83] The historiography above often referred to knowledge by mentioning education and learning-by-doing. However, these studies did not systematically investigate or indicate how SMEs acquired knowledge.[84] Two recently published studies on innovation in Dutch SMEs started to bridge this gap.

Business historians and historians of technology Mila Davids, Harry Lintsen and Arjan van Rooij studied the role of knowledge circulation for innovation in Dutch firms in the twentieth century. According to the authors, Dutch firms, small as well as large, traditionally followed an artisan innovation pattern. Between 1900 and 1940 firms also started following professional innovation patterns.[85] In the artisan innovation pattern, knowledge was tacit and experiential and masters transferred this knowledge to their apprentices during training in the workshop.[86] Firms acquired new knowledge from colleagues, suppliers and customers, usually in family and local networks. Firms could also acquire knowledge by way of artefacts such as machines or products. Alternatively, firms acquired knowledge from foreign experts, for example, technicians. In the professional innovation pattern, knowledge was codified and objectified, so that it could be laid down in writing and printed.[87] Knowledge was not tacit nor experiential, but reproducible by way of specifications, tables, tests and quality control. Journals and courses enabled circulation of this knowledge. These two channels were elements of a new knowledge infrastructure that also consisted of schools, laboratories, and a new type of organisation: the intermediary organisation (or knowledge broker). The authors introduce several examples of intermediary organisations: engineering consultants, business or trade associations and government agency RND.[88]

Davids et al. use a case study of the mechanisation of Dutch bread bakers between 1900 and 1930 which is based on my PhD research and also forms part of this dissertation. Referring to this case study, the authors conclude that bread bakers used artisan and professional innovation patterns in parallel, the latter becoming more and more dominant. Based on a review of some cases between 1900 and 1940, they conclude that in most other sectors the artisan innovation pattern was still dominant, although the professional innovation pattern was gradually entering several sectors.[89]

This research on knowledge and innovation relates to historical studies about the owners of knowledge and the ensuing power struggles. According to

historian of technology David Noble, engineers justified the value of their profession by introducing codified and objectified knowledge. They transformed science into a means of capital accumulation for large corporate firms by working closely with their educational institutes and large industrial firms.[90] According to historians of technology Ruth Oldenziel and Adri Albert de la Bruhèze, the professionalisation of engineers shows how new stakeholders claimed their own kind of expertise and were intent on shaping the direction of technology development. The contest with existing stakeholders such as traditional craftsmen resulted in power struggles over whose knowledge was considered more valuable.[91]

In his PhD thesis, historian of technology Frank Veraart studied the diffusion of computers in the printing industries around 1985. He also analysed how knowledge and information were mediated. Veraart defined two mediation methods for capturing the differing impact of mediating activities on SMEs. Direct mediation involves knowledge and information transfer activities during which SMEs and the intermediary have personal contact, such as personal advice, courses and demonstrations. Indirect mediation refers to activities aimed at a wider public, for example exhibitions, fairs, publications, advertisements and television programmes.[92] Various actors and organisations can conduct mediation: suppliers, colleagues, customers, trade associations and government bodies. Veraart concluded that the knowledge and information from both types of mediation influenced new users of computers when making decisions about innovation, however, indirect mediation is less effective than direct mediation.[93]

The historical studies by Veraart and Davids et al. also refer to contemporary literature on mediation. Veraart uses a typology from Howells to interpret mediation activities from the SME perspective.[94] The references to contemporary literature in Davids et al. originate from my PhD research (see section 1.6).

To conclude, many SMEs in industrialising nations were able to survive by adopting new technologies. In this process, SMEs needed access to knowledge. SMEs were often helped by organisations which lobbied, regulated competition, fulfilled roles in knowledge mediation or influenced innovation. In the early twentieth century, a new type of organisation, the intermediary organisations, began brokering knowledge to firms. The following sections look at two of these organisations in the Netherlands: trade associations and RND.

1.5 Historiography: Trade Associations, RND and their Roles in Innovation for SMEs

This section consists of a historiography of trade associations and RND and their roles in innovation for SMEs. These organisations supported and stimulated SMEs in various ways.

1.5.1 The Importance of Trade Associations for Innovating SMEs

This section introduces the definition of a trade association, then reviews historical research on trade associations and their significance for SMEs. Finally it presents the few historical studies about trade associations and their roles in innovation.

A trade association is important for SMEs, because it is an 'organisation that represents the collective interests of entrepreneurs or firms', something which individual SMEs cannot do.[95] This thesis uses a more informative and wider definition by Lanzaloco which illustrates the variety of roles that trade associations can fulfil, as they represent the 'interests of specific groups of producers and firms, … not only (do they) provide all those services needed by firms, such as marketing, fiscal and financial advice, research and innovation, regulation of competition, etc., but they also act as pressure or lobby groups for defining, promoting, and defending the interests of their membership in the political arena *vis-à-vis* government authorities, public administrations and state agencies.' [96]

Historical research shows that trade associations represent the interests of SMEs by promoting the industry and shaping government policies.[97] Trade associations stimulate their members' economic survival by organising social and political activities.[98] They can also act as a service firm to lower transaction costs or as a conciliation board.[99]

Despite the aggravating economic circumstances in the nineteenth century, Dutch SMEs tended to avoid membership of trade associations because they valued their entrepreneurial autonomy.[100] At that time, Dutch entrepreneurs hardly had any government regulations to worry about. It was not obligatory to be organised since the guilds had been abolished, so they did not have to adhere to guild-regulated price-lists or quality standards. There was also no formal education nor entry exams to ensure trade standards. In general, this worked well for SMEs. Some local guilds and associations continued to exist, but these were mainly to regulate prices on a voluntary basis.

This changed in the late nineteenth century. Firstly because industrialisation forced SMEs to compete against products from factories elsewhere. Secondly the crisis in the agricultural sector made many unemployed switch from agricultural work to trades. Both developments resulted in tough competition and downward price pressure, which made business conditions harsh for SMEs.[101] However, SMEs' preference for autonomy did not change. Despite the fact that trade associations could improve circumstances by protecting the sector, most SMEs continued to struggle on their own. They did not trust an organisation whose members were their rivals, because any collective activity, like training or improving the sector's reputation, would also help their competitors to survive.[102] SMEs only became members in larger numbers when it was obligatory (e.g. during

World War II) or when external circumstances were extremely severe or threatening (World War I with lack of raw materials, threat of government regulation, economic depression). In the latter case, the need for a collective lobby or organisation was unmistakable.[103] Business historians Bram Bouwens and Joost Dankers concluded that in the early 1900s Dutch SMEs started establishing more trade associations because they found themselves more and more up against a common threat. Initially they were confronted with new labour laws, and then with price increases and material shortages during World War I. They therefore needed an organisation to represent them in order to lobby governmental bodies effectively. Furthermore, these organisations took initiatives in education, improving the trade's reputation and protecting the sector.[104] So, the number of Dutch trade associations and business interest associations increased from 342 in 1907 to 1,666 in 1920.[105]

Researchers of trade associations mainly studied how these organisations represent their members' interests.[106] Sociologist Frans van Waarden concluded that the main interest of trade associations is to influence regulation, so they lobby against governmental regulation and policies which are not in their interest.[107] He also concludes that as an alternative, trade associations can opt for self-regulation. This is used to avoid external regulation, to protect and stabilise the market, or to sanction non-compliance.[108]

Bouwens and Dankers studied five roles that Dutch trade associations fulfilled in the twentieth century. These roles are described in a study conducted by VNO-NCW, the largest Dutch employers' association and Berenschot, a consultancy firm.[109] First there is the role of the diplomat who lobbies. The second is the negotiator role whereby trade associations negotiate with external parties. Third, there is the role of the adviser who gives advice and supplies information. The fourth is the guild role which consists of self-regulation. Last, there is the club role which shapes shared norms and values and the trade's identity.[110] In this study the adviser role does not include stimulating innovation. Likewise, Bouwens and Dankers did not assume these innovation activities were part of the adviser's role, nor did they identify the adviser as an important trade associations' role in the early twentieth century.[111] They concluded that from 1900 to 1950, trade associations mainly fulfilled the roles of diplomat, negotiator and guild. These three roles became stronger between 1930 and 1950 because of the economic crisis and the resulting governmental regulations.[112]

The available historical research confirms that trade associations fulfilled roles in innovation, although it does not necessarily use the term innovation. Trade associations organised training that enabled SMEs to improve their business and working conditions.[113] They conducted quality control activities to ensure product quality and to protect their members' market share.[114] They promoted new technologies and monitored foreign developments.[115] Groups of firms influenced research in universities.[116] Such groups of firms founded organisations which stimulated mechanisation.[117]

Davids et al. conclude that trade associations were important for innovation. Referring to the bread baker case study (part of this dissertation), the authors outline the trade associations' four functions as knowledge brokers. First, they developed local learning networks. Second, they mobilised knowledge sources and financial resources. Third, they developed their members' competencies, and last, they influenced the knowledge institutes' development activities.[118]

Veraart also studied the role of trade associations in innovating the Dutch printing sector in the 1980s, concluding that they fulfilled their role in a reactive way with respect to new computer technology. Trade associations conducted training sessions, published articles and coordinated and planned the requirements for new jobs. In contrast, suppliers played a proactive role in trying to shape and influence this new technology and its use. They demonstrated these machines and collected user experiences from printers as input for further product development.[119]

1.5.2 *Rijksnijverheidsdienst* and its Roles in Innovation for SMEs

Several researchers have studied *Rijksnijverheidsdienst* (RND, Technical Information Agency) and its activities for SMEs. In his study of Dutch initiatives and policies for the crafts between 1890 and 1930, Van Lente reviewed RND's roles. RND was established in 1910 as the first Dutch intermediary organisation for the industrial sector. He noted a difference between the original proponents' aims for RND and its actual activities. Around 1900, most SMEs still worked like artisans, with hardly any machinery. The proponents of the civic organisation *Maatschappij van Nijverheid* (MvN, Society of Industry) wanted the SMEs to meet the challenges of industrialisation and stimulated them to develop a crafts niche making artistically designed products of good quality. Once RND consultants came on the scene, they wanted SMEs to transform their workshops into small industrial firms with the potential to grow into medium or large firms.[120]

Nevertheless, Van Lente also notes that RND conducted programmes to save some old crafts. It was apparent that these SMEs needed courses to upgrade their technical, organisational and bookkeeping knowledge and skills. That is why RND appointed technical assistants to mechanise and improve firms such as blacksmiths, wagon makers, clog makers, shoemakers and cabinet makers.[121]

In their book commemorating RND's 75th anniversary, researchers in product design and innovation Johannes Eekels, H. Christiaans and R. Kaasschieter present a summary of the agency's activities from 1910 to 1985.[122] They claim that RND always supported innovation, but there is no systematic analysis of its activities. Their book distinguishes RND's individual and collective activities. Individual activities consisted of personal advice on technical, production and

organisational topics. Collective activities, aimed at groups and industrial sectors, consisted of lectures and demonstrations by the consultants and technical assistants and collaboration with other organisations that supported SMEs. In addition, Eekels et al. distinguish passive and active RND advice. Passive advice was given when individual SMEs took the initiative to approach RND. Active advice meant RND took the initiative, sometimes in cooperation with other organisations. According to the authors, RND's advisory activities transformed from mainly passive to active: by 1985, consultants spent 75 percent of their time giving active advice.[123]

Davids et al. analysed RND's activities to understand SMEs' innovation patterns. The authors concluded that RND's role consisted of facilitating knowledge transfer to SMEs by way of personal contact with its consultants. The typical knowledge sources the consultants used were equipment and suppliers.[124]

Summarising, the historiography of trade associations and RND reveals these organisations' wide variety of roles and activities. The trade associations organised training and quality control, promoted new technologies and mechanisation, monitored foreign developments, influenced knowledge development and research, and developed networks for learning. RND stimulated SMEs to transform their artisan workshops into small industrial firms through mechanisation and education. The historiography shows several ways of describing knowledge mediation, based on whether the mediator takes the initiative or not (passive or active), the distance to the receiver and the size of the intended audience (direct or indirect). As this topic features in several types of innovation studies, the next section looks at intermediary organisations and their roles in innovation for firms, particularly in knowledge mediation.

1.6 Contemporary Literature: Intermediary Organisations

This section reviews the contemporary literature on intermediary organisations and their roles in innovation for firms. Due to the political and economic interest in innovation and the recognition that external parties are important for stimulating innovation in firms, many researchers in various fields have studied mediation. For this purpose they use terms like 'intermediary organisation', 'broker' and 'innovation intermediary' to refer to actors and organisations which have different names in everyday speech, for example: trader, supplier, customer, consultancy, research council, trade association, government agency, or chamber of commerce. Moreover there is no common understanding of where and how to use terms like intermediary organisation, broker and innovation intermediary. Innovation researcher Jeremy Howells and organisation researcher Margaret Dalziel relate this to the lack of theory. Partly this is a result of the disparate literature on mediation. It originates from various fields and has hardly any cross-referencing.[125]

To better understand the term 'intermediary organisation' the next section will look at how it is referred to in this dissertation. Then, a section presents literature that will help to explain why intermediary organisations exist and how they function. Next, a review of available literature provides a basic outline to conduct exploratory research on roles. This is followed by a section presenting contemporary literature and a historiography that investigate how these roles evolved over time.

1.6.1 About the Term 'Intermediary Organisation'

Researchers use terms like 'intermediary organisation' to denote its contributions to innovation, however, it is basically 'an organisation which passes messages or proposals between two people or groups.'[126] Hence, in principle, intermediary organisations can work in any area where distances need to be bridged, whether geographical, cognitive or otherwise. The wide applicability of the term is further depicted by science and technology dynamics researchers Barend van der Meulen, Maria Nedeva and Dietmar Braun who define these organisations by their structural position: 'any organisation that mediates the relationship(s) between two or more social actors'. They state that any conceptualisation should therefore account for the organisation itself and its relationships.[127]

Innovation researchers differ in their views of intermediary organisations. Moreover, they use numerous different names to refer to this phenomenon, for example: third parties, brokers, knowledge brokers, technology brokers, intermediary agencies, intermediaries, knowledge intermediaries, innovation intermediaries, and boundary organisations.[128] One of the topics of debate is how broadly to define innovation. Dalziel refers to economist Joseph Schumpeter's definition of innovation and therefore proposes to consider intermediary organisations which support innovation in the broadest possible sense, thus include any activity that supports firms in their survival and their economic profitability.[129] Other researchers took different approaches: organisation researcher Henry Chesbrough focusses on intermediaries' objectives. He observed that intermediaries create an absorptive capacity for inbound innovation to benefit innovators and to support the outbound transfer of knowledge for inventors; Howells studied a very wide range of intermediaries' activities; management and organisation researchers Graham Winch and Roger Courtney focused on the intentional service role of these organisations, while innovation researcher Harro van Lente et al. investigated intermediaries' impact on knowledge flows in innovation systems.[130]

This dissertation uses the term 'intermediary organisation' to refer to organisations that intentionally conduct activities to support innovation in SMEs,

in particular activities that encompass knowledge, alongside any other activities. So, in this study, the term refers to 'an organisation that enables innovation in SMEs as one of its explicit objectives by connecting, translating and facilitating flows of knowledge'.[131] According to this description, one of the objectives or the main objective of intermediary organisations is to support innovation in SMEs. For example, the trade associations which entrepreneurs established from the late 1800s aimed to regulate competition, stimulate craftsmanship and improve the reputation of their trade.[132] The two latter objectives involve innovation. For government agency RND, supporting innovation in SMEs was a main objective. The above description of 'intermediary organisation' excludes other external parties which may support innovation in SMEs, but only incidentally. Examples are suppliers, customers and other SMEs. Where it is necessary to distinguish publicly financed intermediaries from other intermediary organisations, this dissertation uses the term 'innovation agency' to refer to 'a publicly financed intermediary organisation which enables innovation in SMEs as its main objective'.[133] For example, RND.

According to innovation researcher Jeroen de Jong, the involvement of intermediary organisations for innovation in SMEs depends on the type of innovation. Based on a questionnaire among Dutch SMEs in 2004, he defined a typology of six types of innovation relating to the number of relationships with third parties. These were: supplier driven innovation, customer driven innovation, garage innovation (with informal contacts), chain innovation (often with the help of financial advisors), knowledge implementation and system usage. His findings showed that the majority of innovations in SMEs consists of supplier driven innovation (38 percent). Intermediary organisations are mainly involved in two innovation types: knowledge implementation and system usage. During 'knowledge implementation' entrepreneurs acquire new knowledge and start using this in their firm. 'System usage' involves several parties, including intermediary organisations which define new standards and request permits and subsidies.[134]

Other third parties contribute to innovation in firms in different ways. Several authors point out the importance of early adopters, who are also named early users or lead users.[135] Early adopters (other SMEs and firms) fulfil a role by demonstrating technology to potential users and writing articles for trade publications. They may also act as unofficial sales staff. A firm that is an early adopter reaps economic benefits with the advantage of access to more information and the position as an industry leader, while sharing the risk through communicating its experiences lowers the psychological stress.[136]

Summarising, this section defined what the term intermediary organisation signifies in this thesis: 'an organisation that enables innovation in SMEs as one of its explicit objectives by connecting, translating and facilitating flows of knowledge'. The next step is describing why these organisations exist and what type of work they do.

1.6.2 Why Intermediary Organisations Exist and How They Work

We will now examine the literature on the reasons why intermediary organisations exist and what they do. This informs a later explanation of intermediary organisations' roles.

Intermediary organisations exist to bridge gaps in the innovation process between different individual actors, groups and organisations.[137] These gaps are the result of market or innovation system failures due to various reasons.[138] Firms may experience barriers to knowledge they need, they may not have advisers with the necessary knowledge, or may lack relationships or bridging ties to gain access to advisers.[139] In comparison with large firms, SMEs are at a disadvantage in their ability to access external technology and know-how, because of the more limited time and money at their disposal for external networking.[140] In addition, SMEs depend more on external knowledge sources than large firms as most of them do not have in-house research and development facilities.[141] Firms and knowledge sources cannot close the gaps themselves due to incongruent goals.[142] Furthermore, the market does not bridge these gaps either.[143]

Many intermediary organisations receive funds from public sources or are not for profit. An obvious question is whether taxpayers' money can be saved by replacing these organisations with private consultancies or organisations. According to Dalziel there are two reasons why this is not feasible. First, SMEs may find the services of private firms inaccessible because of their high cost or because these services are insufficiently customised for small businesses.[144] Furthermore, SMEs cannot count on the services of private firms, as private consultancies may opt for contract failure on account of conflicting objectives or change of interest. Second, SMEs may not receive the required value for their money because the quality of intermediary services is difficult to appraise and verify. This might tempt private consultancies to reduce the quality of their work in order to maximise profits.[145] Another reason is suggested by Winch and Courtney, who conclude that publicly financed intermediaries exist because their lack of private interests in the innovation process means they can act as neutral parties, and thereby fill a need. In the 'neutral space' provided, different parties can negotiate standards and specifications, review new technologies or validate research proposals.[146]

Consequently, researchers concluded that intermediary organisations do more than linking firms with other parties to pass on information or knowledge. They are also involved in activities to process, translate or generate knowledge, in order to bridge gaps. For these activities, they collaborate with different parties.[147] Thus the roles of intermediary organisations encompass both brokering and knowledge activities.[148]

In order to link various parties, intermediary organisations build relationships,

for which they need to gain the trust of SMEs and other organisations.[149] First, SMEs have to trust intermediary organisations before they will ask them for advice. That is why intermediary organisations need to be visible and accessible to SMEs.[150] Second, intermediary organisations also need to prove their trustworthiness and credibility to knowledge sources in order to gain access to knowledge.[151] Third, they need to be trusted by a range of other organisations such as customers of SMEs, governments and regulatory bodies. This is because the standards and documents they produce may be used for dispute resolutions, and their performance audits of firms determine customer payments and incomes of firms.[152] So, Winch and Courtney conclude that in order to be effective, intermediary organisations that promote innovation need the trust of other parties. This trust is easier to achieve if intermediary organisations are neutral and independent.[153]

According to innovation researchers Laurens Klerkx and Cees Leeuwis, additional problems arise for neutral and publicly financed intermediary organisations as private firms in the knowledge infrastructure may distrust them. This is because intermediary organisations often offer business and technical support to SMEs below the market rate. Private consultants and knowledge service providers may regard these subsidised rates as unfair competition, even though their revenues are probably not impacted – SMEs did not approach them in the first place anyway as the consultancy rates were too high.[154] Nevertheless, this shows that intermediary organisations cannot afford to only build relationships with their customers and suppliers. They also need to maintain relationships with other knowledge service providers and consultants. For similar reasons, intermediary organisations also need to maintain credibility with stakeholders in the governmental and societal arenas in order to obtain their goodwill and support.[155]

Dalziel highlights the specific contributions that trade associations can provide as intermediary organisations. She views them as innovation enablers because they shape networks in four ways. First, they identify and legitimate agents like educational institutes and associations which help firms to hire employees. Second, they facilitate inter-agent ties by organising networking activities. Third, they increase the access to resources through network brokerage, for example by mediating between firms and university researchers or domestic firms and foreign customers. Fourth, they facilitate joint actions through network closure. For example, there is a high degree of network closure where most firms are members of a trade association. This facilitates communication, creates trust and makes it easier to collaborate and share proprietary technologies and knowledge.[156]

Intermediary organisations are involved in many types of relationships ranging from bilateral to complex multilateral ones. The classic type is the triadic relationship between a supplier, an intermediary organisation and a customer (SME). Intermediary organisations also supply service directly to firms, on a one-to-one basis. Furthermore, intermediary organisations operate in complex multilateral

relationships, like many-to-one-to-one.[157] The multitude of relationships also constitutes the value of intermediary organisations, as pointed out by Van der Meulen et al.[158]

Intermediary organisations not only build and maintain relationships to support innovation in SMEs, they can also offer their network as a service to firms. In that case, intermediary organisations are the glue that holds a network together by taking care of day-to-day network management issues, enhancing trust and resolving conflict.[159]

In their historical innovation studies of mediation for mass consumption technology, Oldenziel and Albert de la Bruhèze used the term 'mediation junctions' to conceptualise the negotiation space in which intermediary organisations work, build relations and struggle for power.[160] Veraart showed that the notion of mediation junctions also applies to the diffusion of innovation to firms as new users of technology.[161] Oldenziel and Albert de la Bruhèze describe mediation junctions as the locations where intermediary organisations meet with other actors, where they can try to bridge gaps. For example, they may mediate between producers and users and thereby shape each party's expectations and images.[162] However, as mediation junctions are negotiation spaces where different parties try to bridge gaps, this is also where their different power positions will come to light. So, mediation junctions are also the location of power struggles over contested terrain, as I illustrated in the abovementioned example of consultancy services.[163] Furthermore, mediation junctions are not freely accessible, so some parties are excluded from negotiations.[164]

Summarising, intermediary organisations exist because firms and knowledge sources are not always able to close the gaps between them. Intermediary organisations also offer a neutral space where several parties can negotiate, have struggles and connect, and where they further shape and develop knowledge and technology. Relationship building is an important activity that requires trust from firms, knowledge sources and other parties. It is influenced by differences in power positions. The next section will discuss to what extent intermediary organisations' roles encompass both these knowledge and relational aspects.

1.6.3 Intermediary Organisations' Roles in Innovation

This section first of all defines the terms roles, functions and activities. It then introduces the current contemporary literature on intermediary organisations and their roles. This is followed by a review of specific categories of roles which will provide us with a basic outline.

Contemporary literature refers to 'roles', 'functions' and 'activities' to study the significance of intermediary organisations.[165] According to the dictionary,

a role 'consists of a function and position, where function refers to the useful thing that an organisation does or intends to do, and position refers to where an organisation is in relation to others'.[166] The dictionary then explains that organisations achieve useful things by conducting 'activities'. So, role descriptions refer to functions and positions. The inclusion of position is also proposed by Van der Meulen et al., who point out that intermediary organisations' performance and changes crucially depend on changes in the organisations with which they mediate relationships as well as changes in the type and nature of the relationship(s) itself.[167]

Howells observed that current research on roles in innovation intermediation led to disparate results and an abundance of roles. He identified four research fields with literature on intermediary organisations: diffusion and technology transfer, innovation management, systems of innovation literature, and service organisations. He observed some overlaps, however, there was hardly any cross-referencing. Furthermore, some studies focused on intermediaries as organisations, whereas others approached intermediation as a process. According to Howells, this disparity is the reason for the lack of innovation intermediation theories. He deplores this, as it also limits the recognition of the role of intermediaries in innovation processes.[168] Van der Meulen et al. state that theory formation in this area is hampered by the complexity of intermediary organisations and mediation. Not only do intermediary organisations depend on changes in the organisations with which they have relationships, they are also impacted by the status and the quality of these relationships. Furthermore, mediation involves translations from one actor to another, often including political factors.[169]

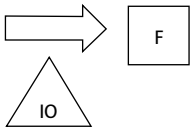
Howells' findings made him develop a typology of roles consisting of the phases in a firm's innovation process.[170] It uses the linear view of innovation, so starting with 'foresight and diagnostics' and ending with 'assessment and evaluation'. This typology illustrates very well that intermediary organisations do more than brokering and knowledge processing and transfer. They can indeed support many other phases in the firm's innovation process for example, in prototyping and piloting facilities, and during the sales and commercialisation process. Unfortunately, as Howells' typology is based on activities from the firm's perspective and does not include relational aspects, it is of limited use for systematic research into intermediary organisations' roles.

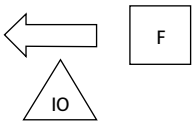
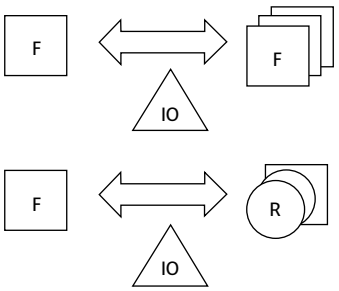
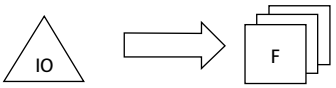
So far, only Dalziel has proposed a categorisation of roles which works for studies from the intermediary organisation perspective.[171] She uses the term 'innovation intermediary' and defines innovation in the broadest possible sense. An 'innovation intermediary' can conduct any activity to support the success, growth or survival of firms. For the purpose of readability, the rest of this text will refer to 'intermediary organisation'. Based on twelve studies, Dalziel defined three categories of activities that intermediary organisations conduct: interorganisational networking activities, technology development and related activities, and other

activities as listed in Table 1.1. For interorganisational networking, she defined four activities with different flow directions and different parties, which are also illustrated in the table. First, inward knowledge flow during provision of information or advice, from several sources to a firm. Second, outward flows of knowledge to facilitate promotion or influencing, from one or more firms to a range of recipients, including customers, suppliers and governmental bodies. By combining networking and knowledge transfer activities Dalziel points out that transferring knowledge is a way of networking and vice versa. For example, provision of information or advice also consists of introducing knowledge sources and receiving firms to each other. The third activity is 'nurturing business or research linkages', according to Dalziel, the intermediary is a facilitator between several parties in combining their knowledge or experience, brokering or standards development. In 'leadership roles', intermediaries conduct activities to create a community and consensus for collective activities, for example research programs and technology roadmaps. For unknown reasons, she does not extend these descriptions to the category of technology development activities.

Dalziel specifically identifies technology development activities as a category. This is in contrast with other researchers who focus solely on knowledge transfer activities of intermediaries, because those are what these organisations usually provide. However, ignoring that intermediary organisations may also fulfil roles in technology or knowledge development unnecessarily constricts innovation research and the understanding of intermediary organisations. This is confirmed by Winch and Courtney's research. They concluded that intermediary organisations are also involved in knowledge development. However, organisations which conduct both knowledge transfer and research activities do this in separate departments. The organisations they reviewed fulfil a key role in innovation through independent validation of new ideas. This reduces the uncertainty for new users (SMEs), thus stimulating the implementation of something new to a firm.[172]

Table 1.1 Dalziel's categorisation of intermediary organisations' activities

1. Interorganisational networking activities	
a. Provision of information or advice (inward flow of knowledge or perspectives from a range of sources to the focal firm)	

b. Facilitation of promoting knowledge or influencing perspectives (support the outward flow of knowledge or perspectives from the focal firm to a range of recipients), e.g.: - Cluster promotion - Industry promotion - Helping users to articulate innovation needs	
c. Nurturing business or research linkages - Helping to combine the knowledge or experience of two or more partners - Brokering - Standards development	
d. Leadership roles: undertake community and consensus building activities to create collective benefits - Foresight and diagnostic activities - Coordinate generic research and provide technology roadmaps to promote concurrent investments in new technology	
2. Technology development and related activities	
a. In-house technology or knowledge development with partners b. Provision of access to expertise and equipment c. Standards development and support for systems development d. Testing and validation of new technologies and equipment e. Adapting technologies for alternative applications f. Intellectual property management g. Activities associated with the commercial exploitation of inventions h. Provide funding for technology development	
3. Other activities (complementary to networking or technology development activities)	
a. Providing physical space b. Training activities c. Advice related to sales and marketing activities	

Source Dalziel, 2010, 5-8.
Key: IO - intermediary organisation, F - firm, R - research organisation

A critical assessment of Dalziel's categorisation leads to several observations. First, as mentioned above, when referring to 'innovation intermediaries' Dalziel defines innovation in the broadest terms. Consequently, such an intermediary can conduct

any activity to support the success, growth or survival of firms. Thus the activities she presents are not limited to those pertaining to knowledge only, as shown by 'activities associated with the commercial exploitation of inventions' and 'provide funding for technology development'. Second, some activities are typical for a late twentieth-century knowledge infrastructure, for example, 'coordinate generic research and provide technology roadmaps to promote concurrent investments in new technology'. Third, although the 'technology development and related activities' fully apply to SMEs, these also suggest a bias towards larger firms with a high-tech and research and development context. This is confirmed by her article, which describes intermediary activities for semiconductor technology development and defence research.[173] To summarise, Dalziel's categorisation is a good basis for classifying intermediary organisations' roles, removing those which do not encompass knowledge. She defines the roles integrating knowledge, flow directions and relational aspects and concludes that intermediary organisations can play a part in both knowledge transfer and knowledge development.

Distinguishing between knowledge transfer and knowledge development roles in the literature reveals that researchers have identified quite a range of activities in knowledge transfer. Intermediary organisations transfer specialised knowledge, diffuse best practice techniques and give contractual advice as well as guidance with sales and marketing activities.[174] They can provide information on markets, business planning and funding.[175] In addition they conduct educational activities such as lectures, discussion sessions, training on the workshop floor, courses and schools.[176] Intermediary organisations can also transfer knowledge to SMEs who are not yet interested in innovation. Through demonstrations and publications, examples of successful knowledge adoption can be distributed among SMEs, to convince them of the effectiveness.[177] It also matters what type of intermediary organisation is involved in knowledge. For example, Dalziel points out that trade associations have the advantage of possessing specific knowledge of their members' situations. Furthermore, their activities are driven by their members' needs.[178] As Dalziel indicated, knowledge transfer can also be directed from firms to other parties.[179] Intermediary organisations conduct promotional activities for the sector, for example when they try to influence purchasing or user behaviour.[180] They can also support firms in articulating innovation needs by mobilising support for new activities such as product quality and research programmes.[181] To summarise, research shows that intermediary organisations can conduct a range of knowledge transfer activities to support the distribution of knowledge and information. These involve either a flow from several parties to one or more firms, or the flow is directed from one or more firms to external parties.

Several studies of intermediary organisations identified roles and activities in knowledge development. These organisations transform knowledge from several sources in order to make it suitable for local firms.[182] For that purpose,

they scan, process, generate and combine information and knowledge.[183] As mentioned above, Winch and Courtney showed that intermediary organisations test and evaluate products, equipment and processes.[184] Some organisations develop technology or technical knowledge through in-house research or in collaboration with partners.[185] To support these activities, they provide technology roadmaps to promote investments in new technology.[186] Intermediary organisations also help clients assess their ideas for intellectual property protection and activities associated with the commercial evaluation of inventions.[187] Standardisation is a certain type of knowledge development whereby intermediary organisations use the mediation junctions to specifically link firms and users with government, standards and regulatory bodies. This alignment between producers, users and third parties is needed to implement standards successfully. For example, intermediary organisations negotiate with firms as users to agree new standards.[188] Intermediary organisations define specifications and norms for firms in several ways. They can be specification setters who formally set and verify the norm, they can be providers of specification advice, or they can develop reference designs.[189] Other intermediary organisations are involved in accreditation activities, for which they conduct audits and inspections of products and business processes. Another type of standardisation involves tests and quality control for firms, which can be spot-checking products, an external audit service for partnering agreements between clients and firms, or benchmarking against key performance indicators.[190] In summary, the studies illustrate that intermediary organisations conduct a number of activities in knowledge development. These include collecting, processing and transforming knowledge and technology from several sources and may involve negotiations between parties. Regarding standardisation activities, intermediary organisations specifically link with governmental and regulatory bodies as alignment with all parties is important.

In conclusion, the literature shows that intermediary organisations can fulfil roles and conduct activities in both knowledge transfer and knowledge development. It also illustrates the various flow directions and sets of relationships within these activities. When defining intermediary organisations' roles, we need to take both knowledge and relational aspects into account. Their roles therefore depend on the context and are not fixed, as we will discuss in the next section.

1.6.4 Changes in Roles

Contemporary literature pays very little attention to how intermediary organisations' roles have evolved. This section presents some suggestions why their roles vary and change. The historiography then identifies events and developments which had an impact on Dutch intermediary organisations in the early twentieth century.

According to some researchers, an intermediary organisation's roles evolve

because the parties it has relationships with change over time.[191] So far, contemporary researchers have not studied these changes extensively.[192] The available literature mainly indicates the circumstances that caused roles to change.[193] Some researchers say roles evolve because of changes in the external environment and the intermediary organisation's mandate, or firms' changing needs and strategies, along with new requirements.[194] Roles also change as a result of the intermediary organisation becoming privatised.[195]

Historians have observed various developments in the Netherlands which led to changes in intermediary organisations' roles between 1900 and 1940: innovation and industrialisation, World War I, economic crises, and increasing government regulation.[196] According to Oldenziel and Albert de la Bruhèze, all these developments affected the mediation junctions, because the ensuing changes in power relations had the knock-on effect that negotiation space at the junctions contracted or expanded for the various actors and organisations.[197] The authors conclude that in the early twentieth century, mediation for consumer technology in the Netherlands was open-ended, with no systematic state or marketplace intervention. This created negotiation space for consumer organisations, but it disappeared after the 1950s, when government institutes and corporate laboratories took over the space.[198]

To conclude, the literature shows that early twentieth century intermediary organisations' roles evolved for various reasons, including changes in stakeholders, policies, government intervention and historic events. These circumstances partly overlapped with the challenges facing SMEs.

Sections 1.5 and 1.6 gave us insight, through the historiography and contemporary literature, into innovation in SMEs during industrialisation, knowledge mediation, the contributions of trade associations and RND and the evolving roles of intermediary organisations in innovation. These insights prepared the ground for my thesis research, which investigates the roles of trade associations and RND for innovation in SMEs in the Netherlands from 1900 to 1940. The next step is defining the research question.

1.7 Research Question

The historiography shows that between 1900 and 1940, industrialisation brought challenges as well as opportunities for SMEs. Their ability to handle these challenges and grasp the opportunities depended on a wide range of factors: their education, their capability to access knowledge and capital, the availability of schools and training, their organisational power and influence, regulations, customer preferences, product characteristics, competition and competing products, and import restrictions. Many SMEs survived by adopting technologies

which were new to their firms (firm-level innovation). Such a diffusion of innovations from elsewhere involves learning and so knowledge provision to firms plays an important part. When firms need to acquire new technology, they can reach out to various external parties, including intermediary organisations. This was illustrated in historical studies which mentioned two examples of new intermediary organisations for Dutch SMEs in the early 1900s: trade associations and the Dutch government agency RND.

Some Dutch trade associations contributed to innovation in SMEs. In addition to lobbying on SMEs' behalf, they organised training, performed quality control and managed the introduction of new technologies. The Dutch government agency RND was a consultant to SMEs, organised lectures, demonstrations and supported sales and marketing activities.

Contemporary literature on intermediary organisations provided more insight on mediation in innovation processes. This resulted in a basic outline for further researching the roles of trade associations and RND in innovation for SMEs. It makes a distinction between roles in knowledge transfer and roles in knowledge development while the role definitions also comprise different knowledge flow directions and relationships.

The review of the historiography and contemporary literature raised the following research question for a historical study of intermediary organisations' roles in innovation for SMEs:

> 'What roles in innovation did trade associations and RND fulfil for SMEs in the Netherlands between 1900 and 1940?'

With the following sub question:

> 'To what extent did these roles depend on specific sector, market and product characteristics?'

As the historiography showed the diversity of SMEs and the differences between sectors, I decided to design and conduct a multiple-case study of three sectors from the SME perspective. This study aims to answer the following sub questions:

> 'In particular, what roles did trade associations and RND fulfil in knowledge transfer and knowledge development?'

> 'What were the relational aspects of these roles?'

Finally, the historiography and contemporary literature suggest that a separate study of how RND's roles evolved through time would contribute to both historical and

contemporary literature. This study also enables us to find out what roles and activities RND undertook for SMEs in other sectors than those of the multiple-case study. It investigates the following sub question:

'Why and how did RND's roles evolve?'

The next section presents the research methodology and data collection.

1.8 Methodology and Data Collection

To research the roles of trade associations and RND in innovation for SMEs in the Netherlands between 1900 and 1940, this dissertation conducts a historical study of firm-level innovation in SMEs, using insights from contemporary innovation studies on the roles of intermediary organisations. The research comprises a multiple-case study and a separate study. The multiple-case study looks at three sectors with different characteristics and challenges. A separate study investigates RND's evolving roles in innovation.

According to social scientist Robert Yin, the case study method is very useful for both contemporary and historical research attempting to answer how and why questions. A well-designed single case of a representative, unusual or rare situation can be very insightful, given a good theoretical grounding. However, multiple-case studies have an advantage over single-case designs; because the evidence is often considered more compelling, the overall study is consequently regarded as more robust. Yin explains that case study results are generalizable to broader theory if the research is designed and conducted consistently, is well linked to the existing literature, collects data from multiple sources and tests for alternative explanations.[199]

1.8.1 Multiple-case Study of Three Sectors

SMEs, their products and their challenges are diverse, all of which probably affect the roles of intermediary organisations as well. That is why for achieving insightful results, only a multiple-case design would suffice. I selected the three sectors for the case studies step-by-step. I began studying one sector and once the results confirmed that this approach made sense, I selected two other sectors. First, I studied the bread bakers sector because the literature review indicated that the sector had a high percentage of SMEs and a high electrification rate. In 1930, Statistics Netherlands counted 13,813 bread bakeries, of which 96 percent had between one and ten employees.[200] Whereas around 1900 the percentage of bread

bakeries with an electromotor was negligible, by 1930 this percentage had increased to 60, which was more than twice as high than the average 26 percent electrification rate of all Dutch firms.[201] This data indicated a fast adoption of new technology, pointing towards an interesting set of circumstances that stimulated bread bakers to innovate. This was also confirmed by the study results. Moreover, the bread bakers association appeared to be critically important in the sector's innovation process. In contrast, RND conducted only a few activities.

Next, I selected two other sectors. For these, I looked for sectors where the innovation challenge was different from the bread bakers. Additionally, I was looking for sectors in which trade associations and RND fulfilled more or less prominent roles than in the bread baking sector. This resulted in the wagon makers sector and the bicycle sector being the second and third cases.[202] For a comparison of the three sectors, their threats and challenges, and the varying levels of trade associations and RND activity, see Table 1.2.

The bread bakers' had three challenges: competition from the factories, working days and nights, and poor quality of bread. They responded by applying mechanisation and improving bread quality. In contrast, as Table 1.2 shows, the wagon makers had to transition to another sector due to motorisation. The bicycle sector was new and therefore had to compete with imported bicycles. Firm-level innovation (or diffusion of innovation) in these cases took place in different ways. Bread bakers baked their bread for a local market, and started using electromotors, kneading machines, standardisation and other innovations, all of which mainly originated from other countries. Wagon makers also produced for a local market. Originally, they made wagons and carts. When they transitioned to body making for motorised vehicles, they continued producing for a local market by learning and implementing innovations from the automobile industry, which mainly originated from other countries. Although the bicycle sector was new, many entrepreneurs used the skills they already had in sales, marketing and metal production. This sector developed through inventions and innovations from France (the bicycle) and Britain (new models and further technological improvements). Compared to bread and vehicle bodies, the bicycle was a global product, so Dutch bicycle producers had competition from foreign manufacturers as well.

In the wagon makers and the bicycle cases, the roles, the importance and the activity level of trade associations and RND in innovation differed from the bread bakers (see Table 1.2). The trade association was important and influential for bread bakers. However the trade associations could not conduct many activities for wagon makers. In the bicycle sector, trade associations were hardly involved in innovation. RND's involvement varied in a different way. RND advised very few bread bakers. However, the RND assistant did help many wagon makers with the transition to making bodywork for motorised vehicles. RND advised several bicycle manufacturers.

Table 1.2 A comparison of the three sector case studies

	Bread bakers (1900-1930)	**Wagon makers** (1900-1940)	**Bicycle sector** (1860-1940)
Threats	Bread factories	Motorisation	Import (quality and price)
Challenges	Improve bread quality and survive economically	Facilitate transition from artisan crafts to industry	Develop a new sector via interaction with users
Developments	Mechanisation, standardisation, and quality control	Retraining and improving production efficiency for making motorised vehicle bodywork	New firms, infrastructure for Dutch bicycles, and cartel formation
Activity level			
Trade associations	++	+	-
Rijksnijverheidsdienst (RND)	-	++	□

Key to activity levels: ++ very high + high □ average - low

This dissertation is a historical study that aims to explain how different contextual factors (sector, market and product characteristics) influenced intermediary organisations' roles in innovation for SMEs. Each case study describes its sector from the SME perspective. The cases observe SMEs' challenges and their responses over several decades.[203] Thereby, they show how external events and developments impacted their situation, their responses and the intermediary organisations. Furthermore, the case studies take into account other actors and other information sources of knowledge mediation in order to assess their importance. To summarise, the cases examine how SMEs innovated in three sectors; from these cases we can extract the roles that trade associations and RND performed and review the impact of the differences in context.

In each of the three sector cases, SMEs had different innovation challenges and the trade associations and RND had different activity levels. Because of these variations, the comparison of the three sectors gave deeper and more robust insight into the roles of trade associations and RND as well as the influence of differing contextual factors like markets, products, etc. I also reviewed the activities of other actors and organisations in these sectors to assess the impact of the activities the trade associations and RND conducted for SMEs. The latter is what Yin refers to as testing for an alternative explanation.[204]

Each case explored the roles and activities of trade associations and RND in knowledge transfer and knowledge development (see Table 1.3, see chapter 5 for the

table with results). After conducting the three case studies, I analysed the collected data in order to categorise intermediary organisations' roles in innovation for SMEs.

Table 1.3 Data collection and analysis table for multiple-case study research

Type	**Roles and activities including knowledge flow directions and relationships**		
	Case 1 Bread bakers	**Case 2 Wagon makers**	**Case 3 Bicycle sector**
Trade associations			
Knowledge transfer			
Knowledge development			
***Rijksnijverheidsdienst* (RND)**			
Knowledge transfer			
Knowledge development			

1.8.2 RND's Evolving Roles

In a separate study, I investigated how RND's roles evolved as well as how its relations with other organisations and stakeholders changed between 1910 and 1940. From a methodology point of view, this is a single-case study. To avoid confusion with the three case studies mentioned above, I refer to this as 'a separate study'. As input it uses the categorisation of roles resulting from the multiple-case study.

1.8.3 Reflecting on the Methodology

The research results confirmed that a structured multiple-case design improves the quality of the results and the conclusions.[205] The variation between the cases in main sector challenges and activity levels of the trade associations and RND provided three case studies with a good variation in situations and results. All the case studies covered the same early twentieth century period, which made it easy to observe the differences and similarities in each case. As the cases differed in their circumstances, I gained insight into what sector, market, knowledge, technology and innovation factors made it easier for bread bakers to deploy innovation activities compared to wagon makers and the bicycle industry. I would have missed these insights or could only have hypothesised these if I had only studied the bread baking sector.

Furthermore, studying the three cases enabled a comparison of the impact of societal trends, World War I and the economic situation. The results showed that in all three cases, World War I was important for the trade associations in that they acquired more members, and the economic crisis of the 1930s had a similar effect.

Additionally, the separate study of RND focusing on the evolving roles of the innovation agency provided a deeper understanding of how an agency can function in different sectors and how its roles not only depend on the time factor, but also on relationships and changes in the external environment.

1.8.4 Data Collection

To collect data, I used a wide variety of sources in order to compensate for the relatively few documents, letters, reports and publications on innovation activities that individual SMEs left in archives. So, in addition to some SME archives, I studied the RND archives in the *Nationaal Archief* (National Archives), *Brabants Historisch Informatie Centrum* (BHIC, Historical Information Centre Brabant) and *Historisch Centrum Overijssel* (HCO, Historical Centre Overijssel). Not only do these archives store letters from SMEs asking RND consultants for advice, they also have a great deal of RND correspondence, documents, reports and minutes of meetings which helped to open up the black box of how SMEs innovated around a hundred years ago. Furthermore, annual and monthly RND reports contained overviews of RND activities and its organisational developments. National, provincial and local trade and business associations stored letters, documents and minutes of meetings in their archives. Fortunately, trade journals filled in the archival gaps as they published minutes of meetings and many articles about the association, the sector and technological developments. To find and consult these journals I visited various organisations such as the *Nederlands Openluchtmuseum* (Dutch Open Air Museum), SME and trade associations archives, the *Nederlands Bakkerijmuseum* (Dutch Bakery Museum) in Hattem, and the *Koninklijke Bibliotheek* (Royal Library). In addition, I used documents, photographs, artefacts and publications from various public and private organisations, both on and offline: the *Bakkerijmuseum*, *Contactgroep Auto- en Motorrijwielhistorie* (Conam, Contact group History of Automobiles and Motorcycles), Dutch Bicycle Museum Velorama, the ANWB (Royal Dutch Touring Club), and the veteran cycling club *'De Oude Fiets'* (The Old Bicycle).

The literature review included historical studies, statistical reports, newspapers, magazines, commemorative books and other non-academic publications. I also conducted a contemporary literature review of innovation and mediation.

It was a challenge to quantify the collected data. The few available statistical studies from 1880 till the late 1920s tend to neglect artisan firms and SMEs, or do not study these consistently.[206] So I used quantitative data and statistics in combination with archival research and literature review to illustrate and confirm trends.

The variety and diversity of data sources enabled a critical review by crosschecking the statements and views of spokespersons. This was necessary because the available sources and publications could be biased or were possibly used for propaganda purposes. For example, the RND reports were very informative and contained quantitative data on its activities. However, the consultants not only wrote these reports to show how they helped SMEs, but also to justify RND's existence and thereby their own positions. Likewise, trade associations justified and defended their own position, whether it was for import quota, government support for schools, or being taken seriously by other organisations. I therefore checked and critically reviewed various stakeholders' interests, stories and histories. For example, the BRHN (association of small bicycle retail firms and workshops) complained about not being taken seriously by the RAI (association of large bicycle producers and traders); however, RAI's side of the story revealed that they felt the BRHN had approached them very aggressively by threatening their members with blacklisting, something the BRHN did not mention.[207] Another example is that RND regularly reported the SMEs' keen interest in RND activities. Trade publications confirmed this positive feedback, while also featuring letters and accounts from sceptical and resisting SMEs, which demonstrate the slow process of diffusing innovation.[208]

1.9 Context

1.9.1 SMEs in the Netherlands between 1900 and 1940

Around 1900, the Netherlands was a nation of merchants. Because of its size and its geographic position, its politics were based on maintaining a neutral position and supporting free trade. So, the country benefited from international trade flows, but conversely, it suffered whenever there were economic crises.[209]

The importance of trade is illustrated by the amount of workers in the tertiary sector. Around 1900, the Dutch workforce was equally distributed over the primary sector (agriculture and fishery), the secondary sector (industry) and the tertiary sector (trade, transport, and services).[210] This distribution shows a relatively high percentage in the tertiary sector (which included trade), whereas the percentage in the primary sector illustrates some impact of industrialisation. After that, industrialisation continued to change the distribution, so that between 1900 and 1940, the primary sector declined to about 20 percent, industrial employment increased to 45 percent and the tertiary sector stayed more or less constant at around 35 percent.[211] Mechanisation and industrialisation increased employment in machinery and shipbuilding, textile and food industries. In the same period, new industries developed in the electrotechnical, chemical and petroleum sectors.[212]

At the turn of the century, Dutch firms mainly consisted of SMEs. In the

following decades, the number of large firms increased.[213] By 1940, the percentage of SMEs was still high, but the increasing turnover of very large firms (more than 500 employees) meant that SMEs' importance for the Dutch economy had dwindled. Table 1.4 shows how employment increased in medium and large firms from the turn of the century till 1930.[214] It is difficult to compare the number of firms between 1900 and 1930 because there is no reliable data for 1900; the only statistics available are for 1905 (*Ongevallenstatistiek*, Accident Statistics) and these do not include firms without employees. According to the 1905 statistics, there were 75,552 firms with one to forty-nine employees in 1905. By 1930, 392,189 SMEs (with zero to fifty employees) were counted. The number of large firms was 1,701 in 1905 and 3,168 in 1930.[215]

Table 1.4 The percentage of employees in various Dutch firms (1889-1930)

Employment (percent)	**1889**	**1909**	**1930**
Small firms (1-9 employees)	76.0	54.7	37.2
Medium firms (10-50 employees)	8.6	15.4	19.1
Large firms (> 50 employees)	15.4	29.9	43.7
Total	*100*	*100*	*100*
Number of employees	545,653	802,469	1,234,984

Source Scheffer, 1942, 542-546.

By 1900, industrialisation and mechanisation had impacted Dutch SMEs. This was mostly on account of the increasing competition and price-cutting among SMEs following a flood of low-priced products from factories in and outside the Netherlands. Depending on the sector and whether they were located in the city or in the countryside, many SMEs could not survive the competition from the factories. Consequently, they switched to repair work, or closed down their firm and joined the factory workforce. More and more products like textiles, butter, sugar, flour and paper were being processed in factories. Furthermore, the production of metal and wooden goods was taken over by mechanised plants. Thus shoemakers, tailors, gin distillers and carpenters, especially those in the cities, had to close their workshops. Their rural colleagues could survive longer, as long as the distribution from the factories to the countryside was limited by the transportation infrastructure.[216]

Small firms struggled to respond to industrialisation and mechanisation. This was because small firms could not mechanise their business with steam

engines – these were too expensive, required a lot of space, and were too cumbersome to operate without specialist technical staff.[217] Additionally, SMEs lacked good, formal education.[218]

Van Gerwen and De Goey characterise Dutch SMEs between 1900 and 1940 as family-run, low social status, with firm owners and employees gradually increasing their education level.[219] Once new SMEs had successfully managed the first and most difficult years, their long-term survival rate was high.[220] The historians also observed that the majority of SMEs showed no ambition to expand their firms.[221]

According to Van Gerwen and De Goey, Dutch firms were confronted with four major developments between 1900 and 1940. To begin with, the Second Industrial Revolution brought new technology that stimulated the rise of large firms (electrical, chemical, mobility). These new technologies also created opportunities for SMEs, such as bicycle repair workshops or selling manufactured paint and branded food products.[222] Most importantly, the electromotor enabled SMEs to mechanise and thereby improve their competitiveness.[223] Second, firms were impacted by various external threats such as new laws to protect employees and pressure from trade unions.[224] Third, World War I, which led to the institutionalisation of relations between businesses, trade unions and the government, more cooperation between firms, and an increased growth of larger firms due to the lack of imports.[225] Fourth, the economic crisis of the 1930s which increased government intervention and business cooperation.[226] So, Dutch businesses started the century in freedom, with all its pros and cons for SMEs. Then, more government regulations, external pressure from trade unions, World War I and the economic crisis brought firms together, so that by the 1940s, they were part of a coordinated economy, supported by cooperation between the government and business and trade associations.[227]

Trade associations fulfilled an important role in the coordinated economy. Sectors which were better organised could more effectively implement internal and external regulation to survive crises. For SMEs this was even more important than for large firms, as they had less bargaining power. This is why SMEs formed their own national trade associations before large firms did. They had begun establishing national trade associations in the late nineteenth century already, when confronted with industrialisation and the agricultural crisis of the 1880s.[228]

To conclude, between 1900 and 1940, Dutch SMEs had to respond to huge economical, technological and political changes. Their success and survival depended not only on new opportunities and their individual capabilities, but also on the organisational strength and vision of their trade associations and the role of the government in regulating and supporting SMEs. By examining bread bakers, wagon makers and entrepreneurs in the bicycle sector, each with their own different challenges and opportunities, the case studies will further unravel how SMEs survived. For RND it meant it had to respond appropriately and effectively to various changes while maintaining its relationships with firms, trade associations and other organisations.

1.9.2 The Industries in the Case Studies

This section introduces the sectors examined in the case studies, namely the bread baking, bicycle and wagon-making industries. For each industry, I will summarise several characteristics such as the product, production, mechanisation, labour, knowledge, stakeholders, the niche for SMEs, and developments between 1900 and 1940.

The main development in the bread baking industry was its high degree of mechanisation and standardisation between 1900 and 1940 (Table 1.5).[229] This was particularly the case in the United States. In other industrialising countries like Belgium and France, the industry was less mechanised because of customer preferences and other local factors.

Table 1.5 Developments in the bread baking industry

	Bread baking industry, 1900 to 1940
Geography	World. US led mechanisation of bread baking
Product	Bread. Daily necessity.
Production	Increasing batch sizes (determined by the size of kneading machines and ovens). Factory capacity increases from 15,000 loaves per day in 1900 to 100,000 loaves per day in 1930 (US).
Capital intensity	High (assuming full mechanisation). Otherwise medium-low.
Degree of mechanisation	Fully mechanised production in US by 1930. Limited mechanisation outside the US.
Labour	Relatively high labour costs in US, driving the push for mechanisation in factories to lower bread prices. Outside US - state regulations limit night-time working.
Firm size distribution	US - by 1930 large factories dominate (two-third of production). Outside the US, SME share is 80 to 90 percent.
Market	US - from local market to regional market.
SME Niche	Lack of transportation technology and distribution infrastructure to deliver bread daily to a large area enabled SMEs to survive. In some countries: customers preferred artisanal bread with characteristic flavour.
Knowledge	From craft-based to science-based industry.
Whose knowledge	Engineers and scientists have knowledge of scale increase and mechanisation.

Bread-baking mechanisation was a long historical process. Firstly, it took several decades to develop machinery suitable for all the manufacturing steps. It started with kneading machines and ovens. Later, transportation systems and specialised machines for weighing and treating dough were added. Secondly, mechanisation was only possible after acquiring sufficient understanding of the bread-baking process, especially the transformation of its ingredients. Scientists and engineers developed standards, tests and specifications to manage the quality. Thirdly, these high product volumes needed transport technologies and a distribution infrastructure network over a large area. While this benefited entrepreneurs and customers who could only afford cheap bread, other customers paid a price: factory bread with its predictable quality was achieved by standardising ingredients and using additives, yet not all customers appreciated the taste. Consequently in some countries (Belgium, Germany), customer preferences restrained entrepreneurs' push towards mechanisation. Nevertheless, mechanised bread factories impacted small bread bakers for two reasons. Factory workers were low-skilled, earned low wages and did day and night shifts. The sector's severe working conditions led to workers' willingness to strike and form unions, a development that also spread to those working in SMEs. Furthermore, night work in factories forced many SMEs to conform to these hours to keep up with the competition and avoid losing their customers.

The bicycle was introduced as an entirely new product and its industry was based on mechanical engineering (Table 1.6).[230] Although there were blacksmiths, wagon makers and manufacturers of tools, guns and sewing machines among the early producers, bicycle production did not disrupt existing crafts or industries. Additionally, the sector created opportunities for SMEs in repair services. Up until 1900, the shape of the bicycle had changed regularly: innovations improved brakes, wheels and tyres. In the late nineteenth century, bicycle design stabilised. At the same time, the bicycle's increasing popularity stimulated mass production. More production technology innovations then enabled the product to come down in price, which in turn stimulated demand.[231] The bicycle was a global good right from the start. Initially a luxury product, it gradually became a utility vehicle. This transformation to utility vehicle was the result of changing user preferences, price-cutting pressure and mass production in the early 1900s. For example, the introduction of the more accessible safety model and the automobile led to upper class users being less interested in cycling. Mass production meant that work was mainly low-skilled and engineers managed the production and quality control. Whereas in the bread-baking and automobile industries, the United States led the way in innovation, Britain took the lead role in the bicycle industry, with Germany joining them in the late nineteenth century. American manufacturer Pope fulfilled a prominent role between 1880 and 1900. He monopolised the US market by building and protecting a strong patent base and exporting his mass-produced bicycles all over the world.[232]

Table 1.6 Developments in the bicycle industry

	Bicycle industry, comparing 1860-1900 to 1900-1940
Geography	World. Leading countries: France (till 1871), Britain (from 1870), US (1880-1900), Germany (from 1900).
Product	Bicycles (first velocipedes and high-wheelers, from 1890s: safety model). From luxury to utility product.
Production	From small batches to mass production and large series. Suppliers for parts (in British and German industrial regions).
Capital intensity	Originally low. Later: high, many machines needed.
Degree of mechanisation	From low-medium to high.
Labour	From craftsmen to low-skilled machine operators.
Firm size distribution	Large and very large sized firms in mass production. Small and medium-sized firms in supply, assembly and services.
Market	Global market.
SME Niches	Repair services combined with assembly of small series. Customisation of bicycles, e.g. for transport, ambulances.
Knowledge	Science and technology based (codified knowledge). First mainly product innovations, later more production technology knowledge and innovations.
Whose knowledge	Engineers. At first to develop product technology, later for production technology.

Between 1900 and 1940, the emerging automobile industry disrupted the local carriage and wagon-making industry, even though it also created opportunities for many entrepreneurs in automobile production, transportation and services.[233] In this period, the automobile in the United States changed from a luxury product to a utility vehicle (Table 1.7). Whereas bread was a traditional and local product that was sold to a limited degree to regional markets, automobiles were global goods from the start. Relatively few carriage and wagon makers were able to switch to automobile production, whether they were local and craft-based or more international and advanced in production. This was not because of backwardness, as in the US, several carriage factories had partly mechanised assembly lines to produce large volumes of vehicles which they exported over the world. The change to automobile production was difficult because carriage and wagon makers had to transition from their craft-based industry to the globally oriented and engineering-based automobile industry. Wagon makers were wood workers, whose most important skill was producing wheels, whereas the automobile industry was

based on metal work for engine and chassis development, for which science and engineering knowledge was needed. Many carriage and wagon makers did find opportunities in automotive body making and services.

Table 1.7 Developments in the automobile industry

	Automobile industry, 1900 to 1940
Geography	World. Leading industries in US, Britain, France and Germany.
Product	Automobiles. At first a luxury product, later also for business and utility.
Production	At first single, customised products, mostly focused on engine and chassis production. Later mechanised mass production (Model-T Ford).
Capital intensity	High, engine production was science and technology based.
Degree of mechanisation	Increasing as a result of standardisation and mass production.
Labour	At first, skilled craftsmen to build engines, car bodies, etc. Then, increasingly low-skilled workers in mechanised plant.
Firm size distribution	At least medium-sized firms. Factories: very large.
Market	Global market from the start.
SME Niche	Supplier of specific parts, skills or services.
Knowledge	Science and technology based knowledge to develop engines and automobile technology. Transnational knowledge.
Whose knowledge	Engineers.

Between 1900 and 1940, the industry's continuous innovation led to improved engines, chassis, wheels, tyres, instruments and bodies. In parallel, standardisation enabled mechanised automobile production, particularly of the Model-T Ford car. During this period, there were also hybrid situations between traditional wagon makers' practices and industrial mass production. In Germany for example, Opel, Daimler and Hanomag continued customising wooden bodies for their vehicles well into the 1920s. Only craft-based wagon makers were allowed to do this work, ensured by their guilds. These wagon makers even had factory work stations in a separate area, so that no one would mistake them for low-skilled labourers.

In summary, the three industries developed similarly at a general level. All three cases demonstrate the shifts to more mechanisation and mass production, encouraged by scientists and engineers. This impacted the knowledge production as well. In craft-based firms, knowledge was mainly tacit and deployed by craftsmen; in mass-producing manufacturing firms, knowledge was more codified. Engineers

and scientists developed and implemented this knowledge, generating a production process that required mostly low-skilled labourers. Bicycles and automobiles were made for global markets. Global manufacturing and marketing were not feasible for bread, but the production machines and wheat were traded globally. At the same time, mass production and mass consumption did not phase out SMEs. In all three cases, SMEs could find opportunities in specific niches of these industries: in service, customisation and small-batch production. To fill these niches, they needed suitable skills and knowledge, in particular codified knowledge.

The three industries transformed in the early 1900s, resulting in huge changes in knowledge, products, production and markets that shaped the interests of craftsmen, workers, engineers, scientists, entrepreneurs and firm owners. These changes resulted in struggles over wages, working hours, regulations, patents, and knowledge. In this dissertation, I examine the roles of intermediary organisations in innovation for SMEs by focusing on knowledge circulation.

1.10 Reader's Guide

The following chapters include the three case studies, the multiple-case data analysis, the RND (*Rijksnijverheidsdienst*) study, and the concluding chapter. As I submitted the case studies and the RND study for publication in academic journals, they appear in the chapters as the published or submitted article.

First, I present the three cases in the multiple-case study. These historical studies of innovating SMEs over several decades also enable us to explore the roles and activities in innovation that trade associations and RND performed for SMEs.

Chapter 2 examines the mechanisation of Dutch bread baking between 1900 and 1930.[234] The activities of the bread bakers association were crucial in order to survive the competition from bread factories, break through the negative spiral of diminishing bread prices and quality, harsh working conditions and night work. The case study traces the roles and activities of the bread bakers association and its knowledge institute in mechanisation, standardisation and quality control. Consequently bread bakers could acquire the specific knowledge they needed for mechanisation and bread quality improvements.

Chapter 3 investigates wagon makers' transition to a new industry when motorisation made their traditional craft obsolete. Wagon makers had difficulty convincing their colleagues to form a national trade association. World War I made that possible for five years, then it took the economic crisis to re-establish a national association. In the meantime, local and provincial associations and RND mobilised and supported wagon makers to learn how to make bodywork for motorised vehicles. Then, the wagon makers associations and RND fulfilled several roles during the innovation process. The case study illustrates that wagon makers could access

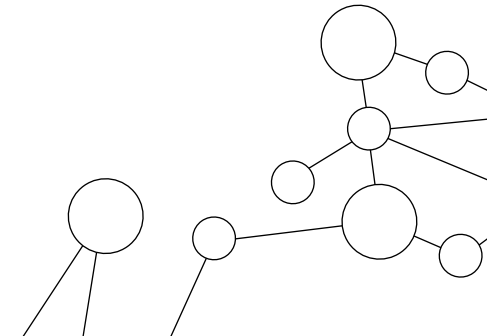
a variety of information sources themselves, but many of them needed personal support and explanations from RND as they hardly had any formal education. The trade associations created a network that enabled RND to link up with the wagon makers.

In chapter 4, I examine the development of the Dutch bicycle industry alongside the parallel development of the bicycle and its use. It started with mainly individual entrepreneurs acquiring knowledge from France and Britain and diffusing this to Dutch manufacturers. The Dutch users' activities embedded the bicycle in the Netherlands, making it a utility vehicle for all classes. The case demonstrates RND's roles in supporting bicycle manufacturers with knowledge transfer and development. In contrast, trade associations did not fulfil a very active role in in knowledge transfer. Their main function was to protect the sector and the Dutch market against national and international competition, resulting in a cartel.

Chapter 5 presents an analysis of the multiple-case study data with an overview of the roles and activities found in the three cases. Next, I use the research results to develop a categorisation with four specific roles of intermediary organisations in knowledge transfer and knowledge development which also include flow directions and relational aspects.

Chapter 6 follows RND's evolving roles and relationships. Once RND was established, the consultants fulfilled its roles in a different way than what the original proponents had envisaged. Circumstances had changed with limited resources and the outbreak of World War I. Additionally, the RND consultants identified new challenges such as the relationships with private consultants and other knowledge institutes, and the importance of asserting their own expertise. They extended their original mandate of knowledge transfer with several other roles. This chapter reviews RND's challenges and how they brought about changes in roles, relationships and capabilities.

Chapter 7 is the final chapter. It begins by reflecting on how the Dutch industries in the multiple-case study compare with global industrial developments in mechanisation and knowledge. Then I reflect on the multiple-case study results to understand why and how the trade associations and RND's roles differed in each of the three cases. For that purpose, I analyse the cases using historical, business and social factors. The evolving roles of RND are my next consideration along with the case study results on RND's roles. All these reflections result in conclusions, in which I will also assess the significance of trade associations and RND for firm-level innovation in SMEs. After that, I present some contributions to literature, implications for present-day innovation agencies, policy recommendations and suggestions for further research.



‘Is this baker justified in calling it unfair competition if a rival baker can label his loaves “milk bread” just because they officially comply with all the specifications? … Surely customers expect to pay only a reasonable extra amount for milk bread but assume it is made with full milk and is therefore nutritious.’

A.L.Th. van der Does, association secretary, Dutch Bread Bakers Association, 1910

‘… bearing in mind the circumstances, the bread can be of good quality … however, the current results pose a serious health risk, caused indirectly by the bakers’ incompetence.’

George Enzlin, bread baker, 1917

2 How Dutch Bread Bakers Modernised, 1900-1930

2.1 Introduction[1]

When Remijn began his own bread bakery in the Dutch village of Ovezande around 1908, he did not need much equipment. He had his wood-fired vaulted oven built with bricks and bought a stove to heat water, a trough, a work bench, an ash bucket and a few utensils.[2] This farmer's son from the southern province of Zeeland had learned his trade by working for two bakers. He determined the composition of his bread himself, kneading and shaping the dough with his hands. The work was labour-intensive and time consuming. The end result varied, depending on the weather and the quality of the raw ingredients. Unlike the bakers in towns, Remijn had no competition from the bread factories.[3] Along with three other bakers, he supplied bread to the thousand villagers.

Remijn's situation is typical of many small Dutch bakeries in the early twentieth century. In the following decades, their traditional, manual and relatively autonomous working methods would change because of mechanisation, standardisation and legislation as demonstrated by the Oude Weernink bakery. This baker in Hilversum purchased his first electric dough-kneading machine around 1920. In addition, he had a hand-press dispensing machine, a manually operated rusk-cutting machine as well as machines for confectionery. The vaulted oven had been replaced by a convection oven, which enabled him to bake bread faster in the mornings.[4] After 1927 he had his bread monitored by the *Station voor Maalderij en Bakkerij* (Institute for Milling and Baking) in Wageningen, to ensure it complied with the *Warenwet* (Consumers Goods Act).[5] His son could learn his trade at the trade school located at the Institute or attend the local master baker courses run by the *Bakkersbond* (Dutch Bread Bakers Association) and the Institute.

The differences between Remijn and Oude Weernink illustrate the modernisation process that began in small bread bakeries in the early twentieth century. The process changed radically, so that by the 1930s, the composition of the bread was completely different than back in 1900. The same applied to the requirements for good bread and a good baker. Looking at the entire sector, however, we notice one remarkable continuity, namely the existence of small bread bakeries. Also thanks to their ability to modernise, they survived alongside bread factories and bakeries that only sold bread. This article examines how small bread bakers acquired the knowledge they needed to innovate and modernise. We will attempt to show that trade associations, especially the Dutch Bakers Association and the associated Institute for Milling and Baking, played a pivotal role in encouraging and facilitating innovation in the bread making industry.

In order to depict the transformation of small and medium-sized enterprises (SMEs), we had to consult a very wide range of sources. Two series of interviews give insight into the life and work of Dutch bakers in the 1900s, but further company archives are scarce.[6] However it was possible to reconstruct the innovations the bakers accomplished by consulting publications and archives at the Institute for Milling and Baking in Wageningen, the Bakers Association, regional associations, the *Rijksnijverheidsdienst* (RND, Government's Technical Information Agency) and the available volumes of the trade journals *De Bakkerij* and the *Bakkers-Bondscourant*.[7] For example the latter featured visits to bakeries, demonstrations and exhibitions. The minutes of the association board meetings sketch a picture of the various changes, the discussions held by the bakers and the associations' activities.

First of all we will review the various mechanisation processes in the bread making industry and the role of the trade associations in transferring knowledge. We then examine the typical production methods in the early 1900s and the subsequent challenges faced by the traditional bread bakeries up till 1930. The final section highlights the role of the Bakers Association and the Institute for Milling and Baking in facilitating innovation and mechanisation in this period.

2.2 Research on the Modernisation and Mechanisation of Bakeries

Studies of modernisation in the Netherlands highlight the large industrial firms rather than the small ones. For example, the emergence of bread and milling factories in the nineteenth century has been extensively analysed, yet there is scarcely any focus on the remarkable developments in the small bakeries between 1900 and 1930.[8] The same can be said for the way millers, tailors, painters, carpenters and other craftsmen renewed and adapted their trades to the demands of that era.[9]

The few studies on small Dutch bakeries concentrate on the competition with the bread factories or explaining mechanisation.[10] According to economic historian Jan Pieter Smits, the *Arbeidswet* (Labour Act) of 1919 stimulated investments in labour-saving technologies, while the fast electrification in the Netherlands facilitated the purchase of electromotors and thereby mechanisation in SMEs, including bakeries.[11] Moreover, the higher wage costs for workers after World War I hit the bread factories harder than small bakeries. These small bakeries were run by the owners and their family members, who did not demand an increase in wages.[12]

Studies have been conducted on the technological changes in bakeries in Germany and Belgium. They show an obvious link with other renewal processes. In his dissertation, historian Hans Münstermann describes the inter-dependency between mechanisation, the development of raw materials and consumables and consumer preferences in Germany. He sees the application of the dough-kneading or mixing machine as the first step in the transformation from manual methods to

entirely automated bread production.[13] From 1925, the dough mixer broke through to Germany's small and medium sized bakeries. This time-saving device lightened the work load considerably. As a result of the increased kneaded dough production, bakeries needed additional workers for the ensuing manual processes. In this way the mechanisation of kneading stimulated the mechanisation of further processing steps. To be able to invest in such machines, a baker had to have sufficient revenue. This could be achieved by enticing customers from other bakers or came as a result of the population growth.[14]

According to Münstermann, an inhibiting factor in the mechanisation process was that the dough had to be machine-friendly, meaning that its properties and composition could vary only slightly. This was easier said than done due to the natural origin of the raw ingredients. Additives and other processes gradually reduced the variation, however they did have an effect on the flavour of the bread. As long as consumers showed their preference for the specific taste of the small bakeries' bread, these bakeries could afford not to further automate.[15] In her study of bakeries in Belgium, historian Annick Detremmerie points out that the mechanisation of Belgian bread bakeries was inextricably linked with other developments. Since the 1930s, Belgian bakers had dough mixers and indirect-fired ovens. Just like in Germany, small bakeries could survive thanks to mechanisation and by retaining a recognisable bread flavour.[16] Detremmerie sees this as a typical European situation. In the United States, small bakeries lost out to the bread factories due to extensive up-scaling and growing distribution networks between 1914 and 1930. By 1930, twelve percent of the American bakeries were producing two-thirds of the turnover.[17]

Detremmerie's research shows that the progress in innovation processes did not just depend on the bakers and their customers. Firstly, the bread factories and cooperatives had a test function for new technologies; secondly, suppliers demonstrated their new machines at bakery exhibitions; and finally by publishing information on innovation, the trade associations had a motivational role.[18] This article builds on these insights by examining what role the intermediary organisations played in innovating Dutch bread making businesses from 1900 to 1930. On the one hand, the theme is broader than Münstermann's and Detremmerie's studies that highlight mechanisation. Here the focus is on a wider innovation process, not just the implementation of mixing machines, convection ovens and other equipment, but also the emergence of standards for flour and the changing demands on bread and bakeries. On the other hand, the scope of this article is more limited due to the specific focus on the transfer of knowledge during this innovation process, specifically concentrating on the trade associations' central role. Contrary to Detremmerie's findings, the role of the Dutch Bakers Association and the Institute was not merely restricted to stimulating mechanisation and reporting this in their publication *Bakkers-Bondscourant*, but their activities covered a wide range of areas.

2.3 Trade Associations and the Transfer of Knowledge

The actions undertaken by the trade associations to encourage innovation processes are termed as mediation activities. These activities can take place between producers and consumers of technology. Historians of technology Ruth Oldenziel and Adri Albert de la Bruhèze illustrate how the relationships between both groups are redefined during innovation processes and in what way these are influenced by consumer preferences and product applications. Intermediaries perform numerous activities: they define standards and conduct quality control, inform and educate users. They are also involved in creating images: the image that consumers have of products and the image producers have of consumers.[19]

While previously the focus was on the end user, historian of technology Frank Veraart concentrates on SMEs in the graphics sector as users of new technology. Their decisions regarding automation of the type-setting process were influenced by the activities of intermediary organisations, one of which was the *Koninklijk Verbond Grafische Ondernemingen* (Royal Association of Printing Companies). Intermediaries played a crucial role in the transfer of knowledge regarding innovation.[20] Studies published after the 1990s strongly emphasise the importance of these intermediary organisations for innovation in SMEs, as SMEs' knowledge base was certainly less specialized and varied compared to the big enterprises. SMEs conduct fewer knowledge-generating activities and have a smaller knowledge network. They lack the financial means, time and personnel for adjustments.[21] Many innovation studies describe how intermediary organisations were able to remedy these shortcomings.

The two roles that intermediary organisations most frequently fulfil are linked to knowledge and information transfer for specific innovations: 'gathering, processing and transferring information' and 'processing knowledge and utilising it in a new context'.[22] They thereby adapt the knowledge to specific requirements and potential. They also reinforce a company's knowledge and skills through training and advice. Intermediary organisations bridge gaps and develop learning networks to take entrepreneurs out of their isolation and facilitate their access to specific knowledge.[23] Intermediary organisations translate the needs of entrepreneurs into demands for new knowledge, such as standards. From their neutral position, intermediary organisations can in addition determine standards and test new products or processes, thus reducing the uncertainty for entrepreneurs.[24]

Although only a few innovation studies focus on the intermediary role of trade associations, these organisations do appear to be important for innovation processes. For example they were mentioned more often as source of knowledge or collaborative partner than state laboratories or universities in a survey carried out among 2,000 Canadian companies.[25] Despite the lack of comparable historical research, more is known about their origins and wider role. According to business historians Bram Bouwens and Joost Dankers, entrepreneurs set up trade associations in response to

external threats.[26] Especially for smaller companies, collaboration can reduce the competition and is a means of survival. Trade associations do this by engaging in four types of activities: lobbying, negotiating with third parties, self-regulation and providing information to support companies.[27] So what role did these associations fulfil in innovating Dutch bakeries in the period from 1900 to 1930?

Before investigating their role, we should first look at the typical production methods used by bakeries at the start of this period to fully appreciate the challenges they would have to deal with in later decades.

2.4 Bakeries in 1900

According to the earliest known statistics, the Netherlands counted just over 13,000 bread bakeries in 1909 (Table 2.1). They were nearly all small firms, with only 127 employing more than ten people.[28] These had a higher production level: a flour turnover per person that was 70 to 115 percent higher than the small companies.

Bakers did not need much equipment, which made the trade attractive for newcomers; nor did they have to invest very much. One of the consequences was that the baker's trade had little status.[29] Yet baking bread required a variety of skills that had to be well synchronized. Firstly the baker heated up the oven by lighting fire-wood in the baking area. While the oven was heating up, he filled the trough with a mixture of flour, yeast, salt and water or milk. The trough could hold enough for eighty to ninety loaves. Kneading the dough was hard work and made the baker perspire a great deal. Sometimes he would knead the dough with his feet. The baker determined how much water the flour needed, felt how well the water was being absorbed, if the gluten became soft quickly and the dough hardened, then assessed how the fermentation process was going. 'Making dough is definitely not a purely mechanical operation. What the baker feels is usually the best measurement'.[30] Once the dough had risen, it had to be kneaded again to reduce the expansion of the carbon dioxide bubbles. After a second rising time, the baker divided the dough into pieces and formed the loaves. After the third rising time, the dough was stretched out and each piece rolled flat to distribute the bubbles in the dough, after which it was rolled up and the sides folded over. Then the dough was left to rise a fourth time.[31]

Table 2.1 Dutch bakeries in 1909: number, size of company, workers on night shifts from Tuesday to Saturday (from 9 pm to 5 am) and flour revenues

No. of workers in each bakery	total	1	2-3	4-10	more than 10
No. of bakeries	13,121	3,870	7,956	1,168	127
No. of people	29,406	3,870	17,354	5,425	2,757
No. of people working nights	17,126	1,637	8,778	4,098	2,613
Percentage of people working nights	58	42	51	76	95
Flour revenue per bakery (kg)	811	371	665	1,800	14,284
Flour revenue per person (kg)	362	371	305	387	656

Source Departement, *Onderzoek*, 69-71.

In the meantime the oven had become hot enough, which the baker could tell by the colour of the oven's dome. He removed the ashes and cleaned the floor of the oven with a long-handled mop. Then he shut the oven door briefly to let the heat draw. The loaves were then slid one by one on a paddle into the oven where they baked in half an hour. After the first loaves had cooled completely, they were sold in the shop or given to the deliverer or hawker. The time it took from heating the oven to the first fresh loaves was roughly four hours. One disadvantage of the vaulted oven was that the temperature dropped during baking, which meant it had to be fired up again for a second bake.

Furthermore bakers had to cope with the fluctuating quality of raw ingredients. Suppliers neither delivered a standard quality nor gave any quality guarantees. The rising depended on the quality of the flour, the yeast and the weather conditions. Likewise, the firing-up of the oven as well as the kneading process were dependent on the weather. Bakers, unlike the bread factories, used no analysis or weighing equipment. They relied on their experience and intuition.

The majority of the bakers (58 percent, see Table 2.1) worked at night: the workers in the bread and milling factories relatively speaking the most, while bakers in the countryside probably the least. The emergence of night working was linked to industrialisation. In the past, bakers baked bread in the morning because their customers did not eat fresh bread until lunch-time. When factory workers started working further from home, they wanted to buy fresh bread early in the morning. Bread factories began to bake at night and supply bread from four o'clock in the morning. In response to this, the small bakeries also began working at night. Thereafter the custom of having fresh bread at breakfast gradually spread to the middle classes and from the towns to the countryside. Consequently, rural bakers began to work at night as well.[32]

2.5 Three Areas of Tension

Small bakeries in the early twentieth century faced three areas of tension: the competition from mechanised bread factories, wages and working at night, and the quality of bread. The main issue for them was the competition from the bread and milling factories, which had been the case since the 1850s already.[33] However, by 1900 the tide turned more in favour of the bakeries. Bread factories benefitted less from having their own flour mills because since 1890, bakers were able to buy flour from abroad at lower prices.[34] At the same time the urban population had grown to such an extent that the market was big enough to accommodate both the bread factories as well as the small bakeries.[35] Bread factories mostly sold bread to the working classes. The middle and upper classes preferred the smaller bakeries.[36] When machines and equipment finally became available to the small companies, they too were able to mechanise. The lack of new technologies for large-scale production also contributed to improving the situation for the smaller bakeries.[37]

The second area of tension concerned wages and night shifts. While consumers were able to enjoy fresh bread in the morning, the bakers, their apprentices and factory workers suffered the hardship of working at night. That led to protests because the bakery and factory workers no longer wanted to work at night or on Sundays and holidays for low wages.[38] Alongside wage policies, they demanded a government ban on night-time working. The protest and strikes caused unrest in both the factories and the bakeries, thus bringing the factory owners and bakers closer together. Nevertheless the bakers were divided on the issue of the ban. The adversaries were against state interference, fearing that this would lead to loss of customers. On their side they had the bread factories that did not want their machines standing idle at night. The supporters felt the working conditions were degrading. Moreover the trade would become more attractive without night work and bakers would have more time for their families.[39] In 1909, Talma, the Minister for Agriculture, Trade and Industry, decided to investigate night working in all the Dutch bakeries.[40] He introduced a *Bakkerswet* (Bakers Bill) to parliament in 1912 to regulate working hours. The Liberals and Conservative Confessionalists, however, did not want to restrict the freedom of working practice and rejected the Bill. Working at night was finally forbidden by law in 1919. This law introduced the 45-hour working week and abolished working at night as of 24 October 1920.[41] Bakers with workers were not allowed to work from Tuesday to Friday between 8 pm and 6.00 am (later put back to 5.00 am).[42] Every baker was forbidden to deliver bread before 9.00 am and sell bread in the shop before 10.00 am. This gave bakers less time to bake their first loaves, which they partially compensated by reducing the required leavening time for the dough.

The third area of tension was the quality of the bread. The government became increasing more involved in the quality of food products.[43] Town and County

Councils had begun controlling the quality of foodstuffs for example in Rotterdam (1893), Leiden (1901), Dordrecht (1909) and Drenthe (1916). For this purpose they instigated inspection services.[44] Local health commissions and health services had controlled food products since the late nineteenth century and frequently dished out fines.[45] Organisations such as the *Nederlandse Vereniging van Huisvrouwen* (Dutch Housewives Association) (1912) were also involved. This association regularly sent letters to councils if it felt that foodstuffs should be inspected by the local inspection service.[46] Consumers and authorities complained about bread flavour, poorly baked bread and unhygienic conditions in bakeries. One test by the Rotterdam inspection service revealed a huge variance in composition. The amount of milk in milk loaves varied considerably and the amount of flour in the investigated milk and water loaves sometimes differed by as much as thirty percent.[47] With the enforcement of the *Broodbesluit* (Bread Act) of 1925, the composition of bread was legally established.

The period from 1900 to 1930 was in many ways pivotal for the modern history of Dutch bakeries. In these three decades, the bakeries that had survived the competition from the bread factories in the nineteenth century faced many uncertainties and challenges. Was mechanisation desirable from a competitive point of view? And what was the best way to achieve this? How could they cope with the ban on working at night? How should they deal with the changing demands and quality regulations? The Bakers Association and the Allied Institute provided guidance at this time. The SMEs proved to be able to transform their product and practices. By 1930, mechanisation has penetrated the majority of the bakeries. The foundations for this transformation were mostly laid in the period 1900 to 1930 and as we will show in the following section, the Bakers Association and the Institute played a key role.

2.6 The Bakers Association

In the final decades of the nineteenth century, bakers had begun to form associations at a local and regional level. They were not the only ones to do so. Around 1900, nearly every SME was affiliated with a local trade association, a sort of reincarnation of the guilds that were abolished in 1796.[48] In their wake, national trade associations emerged. In 1881 eleven bakers took the initiative to start up the *Nederlandsche Brood-, Koek- en Banketbakkersbond* (Dutch Bread Bakers and Confectioners Association, hereafter Bakers Association).[49] The national bakers association in Germany was their inspiration. In the late nineteenth century, German bakers had also reinstated local bakery guilds, which then took on the additional role of education and regulation.[50] The first chairman of the Bakers Association, S.W. Siemons, saw the association as combining forces to stand up to the bread factories and cooperatives: 'We must form an army, stand shoulder to shoulder and attack anyone who threatens our wonderful craft'.[51]

Figure 2.1 The laboratory at the Institute for Milling and Baking.

Initially only a few were interested. The number of members grew from 460 in 1885 to 1,100 in 1912. World War I marked a significant change, because when grain supplies were halted, the price of flour rocketed. The flour mills cancelled the existing supply contracts and credits. The Bakers Association subsequently prosecuted the flour mills, but to no avail. Then in 1915 the association took matters into its own hands by purchasing a flour mill in Den Bosch on behalf of 4,000 bakers.[52] Supported by an influx of new members, the association bough a second and a third flour mill. The membership rose to about 7,000.[53] In 1917 the association established the *Nederlandsche Bakkerij Centrale* (Dutch Bakers Purchasing Association), which purchased raw materials and machines for members of the Bakers Association.[54] The Bakers Association had also set up the Institute for Milling and Baking in 1909 with a trade school for bread bakers and millers. From 1920, bakery teachers connected to the Institute gave master baker courses and travelled around the country providing information.

The Bakers Association and the Institute played a pivotal role in the process of modernising the bakery sector, which was closely linked to the three earlier mentioned areas of tension. Two aspects are covered here: the Bakers Association and the Institute in relation to mechanisation and in relation to standardising and controlling raw materials and bread.

2.7 Mechanisation of the Bakery Sector

In 1909, twenty bakers travelled to Ferwerd, an old village in the north of Friesland. There they visited a historic building located on Havenstraat. At the front it was a pub and the back was a bakery.[55] At a talk organised by the *Friesche Bakkersbond* (Friesian Bakers Association) they had been advised to visit this bakery because it housed the first dough-kneading machine in Friesland.[56] It is not known why this baker in Ferward had bought the machine and how he had acquired it. No doubt he would have an interesting tale to tell.

The Friesian bakers probably felt 1,200 guilders was too expensive for a kneading machine with a petroleum or petrol motor. Bakers did not have much money, they struggled to get credit and the machine yielded little savings on account of the apprentices' low wages.[57] Furthermore the bakers doubted if the bread from a machine would be as airy and tasty as bread kneaded by hand.[58] For that reason kneading machines were not very popular before World War I, neither in Friesland nor in the rest of the Netherlands. But the kneading machine would come into its own after the war. By that time there were certainly plenty of incentives to purchase a mixing machine. Kneading dough was heavy work, which the machine could lighten. Some bakers pointed out the improved hygiene: thanks to the machine, less sweat and dirt would get into the dough. Besides, the large towns had an electricity grid, to which the baker could connect his mixer with its electric motor.

Adopting new machines, however, required know-how and information. How did the bakers gain their knowledge of the kneading machine? There were three important sources. Bakers sought advice from their pioneering colleagues. They acquired information from the supplier. And they got experience working the machine themselves. Traditionally these three sources fulfilled a significant role in the innovation process. One new element in the early twentieth century was that the bakers had set up a structure whereby their trade associations contributed to the knowledge transfer and innovation processes. What previously took place in informal bakers' networks, became an association's formal task. In the case of the visit to the innovative baker in Ferwerd, the Friesian Bakers Association was responsible. It was founded in 1893, one of its aims being '… to do everything in its power to advance the theoretical and practical skills of its members.'[59] The Friesian Bakers Association kept in close contact with the national Association, which had advocated mechanisation of the bakery sector right from the start. The Bakers Association published its own newspaper, organised exhibitions and undertook study trips to observe the situation in bakeries abroad.

The kneading machine was an innovation that demanded a considerable investment by the baker. Another was purchasing an oven that could be fired up continuously. Buying and installing a convector or hot water oven was a risky business as any teething problems meant a bakery could not bake bread. It was

therefore usual to first inspect a new oven at another bakery. The bakers could find the addresses of the oven builders in the advertisements published in the *Bakkers-Bondscourant*. They could also read the articles and letters about ovens and their use. The Bakers Association advised them on contracts with oven suppliers.[60] At exhibitions there were demonstrations of model bakeries where bakers could not only view the production process but even taste the result.

The mixing machine and the new ovens set off a chain reaction. All types of machines appeared on the market for further process steps, including the dough moulder or loaf shaper.[61] These moulded the dough and rounded it off. Such machines had been used abroad for some time, but were initially not suited to the loose, airy dough that was common in the Netherlands.[62] The dealers proudly advertised the names of the first purchasers, mainly bread factories and large bakeries in towns. Bakers could read up about the new machine in the *Bakkers-Bondscourant*, in a report two bakery teachers had written after a visit to baker P. de Heus in Amsterdam.[63] Their conclusion was that the dough shaper produced loaves of a smaller volume, because the machine required a certain stiffness of the dough and did not allow for regional variances. That was a disadvantage, because they felt that a machine should be suited to the dough and not vice versa.

After World War I, the small bakeries began their transformation from manual to mechanised production. This depended on a number of factors. A significant and fundamental aspect was the electrification of the Netherlands, a process that was completed – also in the countryside – by the end of the inter-war period. The *Arbeidswet* (Labour Act) of 1919 banning working at night also had a huge impact. In addition, both the dough mixing machine and the convector oven had reduced production times. Purchase prices dropped because machines imported from Germany were cheaper under the foreign exchange rate resulting from the economic crisis in Germany. Suppliers were even happy to offer credit.[64] The rising wages in the Netherlands also played in the hands of mechanisation, an argument which the Bakers Association used to extol mechanisation explicitly as a solution: 'The labour costs will force us to lose as little valuable time as possible; or even better: have as much of the expensive manual work replaced or supplemented with mechanised labour', according to G.J. Bokhorst, Secretary of the Bakers Association.[65] Bakers could read this message in the advertising slogans for dough mixers: 'It is in the interest of every baker … to … have what can be carried out by machines, not done by human hands'.[66]

Figure 2.2 'Stop unhealthy and exhausting trough labour. Your mind needs to stay fresh in order to properly manage your business in these difficult times. Buy a Record kneading machine.' Advertisement in the *Bakkers-Bondscourant* (1920).

The degree of mechanisation was reflected in the high level of electrification in the bakery sector. The first Dutch business census of 1930 showed that 60 percent of the bakeries had one or more electric motors compared to the 26 percent average among Dutch companies.[67] Mechanisation and the pressure to prepare bread quicker had yet another effect on the bakery sector, namely standardisation. Mechanised production operated optimally if all the characteristics of the raw materials and the composition of the dough conformed to certain demands and showed as little variation as possible.[68] Bearing in mind these demands, the Institute for Milling and Baking instigated by the Bakers Association would play an important role.

2.8 The Institute for Milling and Baking

To achieve an optimally mechanised production, the bakers required a suitable, standardised work method. Consequently the need arose for raw material and product control, standards and training. Control was also a major factor for guaranteeing the reputation of the baker's trade. The latter motivated bread manufacturer Dr. Jacob Roeters van Lennep to propose to the Bakers Association committee in 1905 that they set up a national office.[69] The office would examine

flour and solve any disputes. It would also test the bread samples submitted by consumers. This initiative was comparable to the existing agricultural laboratories and institutes, but would only be partially state-funded. Later the proposal was extended with a trade school for bakers and millers.[70]

The association's department in The Hague supported the proposal, feeling pressurised by the government. When the fat content in milk was regulated in 1908, milk bread was also subjected to random sample checks. Consequently, a proposal was submitted to The Hague City Council to publish the names with the test results. The city's bakers wanted to prevent this because skilled bakers, who had unwittingly used poor quality raw materials in good faith, would have their reputation unjustly damaged.[71] Indeed some members doubted the need for an Institute, like baker A. Papenhuijzen from Schiedam, who felt that the bakers themselves could determine the quality of the flour. Roeters van Lennep compared Papenhuijzen's resistance to the farmers' wives not wanting to use a thermometer when preparing butter and so the quality never improved. He saw the same phenomenon with bakers not using a thermometer to prepare dough, a practice that the Institute was about to change through education.[72] The differences of opinion caused such a tumultuous association meeting, that the board had difficulty in persuading the representatives to approve the proposal.[73] Afterwards the Institute was soon established with the help of F.F. Bruyning jr., who as director of the *Rijksproefstation voor Zaadcontrole* (Government Research Institute for Seed Control) had investigated the properties of domestic wheat. Bruyning's assistant, A. Boonstra, became the first director of the Institute for Milling and Baking in Wageningen, which opened in 1909.[74]

Boonstra began by laying down the requirements for milk bread. He used his own analysis and existing research outcomes, taking into account the types of milk in the various regions and the way bakers heated and cooled milk. This enabled him to stipulate a fat content of 2.8 percent for milk. Bakers could determine their own fat content or take controlled milk. They also had to determine the maximum water content of flour, but many bakers thought they could still rely on their touch. In order to change this attitude, Boonstra held many talks and courses and regularly published articles in the *Bakkers-Bondscourant* and the *Nederlandsche Bakkers Courant*, reminding people that 'Research is the only accurate method'.[75] He also developed a baking test to enable bakers to determine the quality of flour. By following a strict bread baking protocol, bakers were able to compare the effects of various types of flour and amounts of yeast enhancers. Thus Boonstra translated the scientific requirements into concrete and systematic practices.[76]

From 1910 bakeries as well as milling and yeast factories could have their products tested by the Institute. The association's leaders set a good example by being the first to have their bakeries controlled. Participating bakeries were allowed to put a protected trade mark on their milk bread, consisting of an M in a circle.[77] The Institute also carried out analyses for local health committees.[78] According

to Boonstra, great improvements in quality would only be accomplished if the nutritional requirements were enforced by law. That is why the Institute strove to make bakers aware of the importance of quality improvement. If adulterated ingredients or poor quality loaves were found, they were highlighted extensively in the *Bakkers-Bondscourant.*

Two events supported the Institute's right to exist. First of all the outbreak of World War I, when the government took over the price fixing and distribution of flour and bread. The government ordered the Institute to test the quality of flour at 400 mills. Later the Institute determined the standards for state wheat and conducted the necessary tests.[79] The Institute paid particular attention to the maximum water content in the flour.[80] Due to the shortage of grain and flour, bakers also had to adapt their methods. The Institute's experiments showed that maize was the best replacement for wheat.[81] The method required was published in the *Bakkers-Bondscourant*, along with advice on how to process state wheat, as its composition often varied.[82] The second significant boost for the Institute came from the *Warenwet* (Commodities Act) of 1919. The number of firms that requested monitoring rose from 104 in 1919, to 275 in 1930. In the same period, the number of Institute members rose from 310 to 1210.[83] The Commodities Act was framework legislation which came into force for bread bakeries as the 1925 *Broodbesluit* (Bread Act). This act regulated equipment installation, hygiene and the composition of the bread, which had to comply with a minimum dry weight content. The disadvantage was that the bakers could not measure the dry weight content themselves. They needed a laboratory such as the Institute, or had to bake overweight loaves to avoid a fine from the *Keuringsdienst van Waren* (Inspection Service).[84]

The Institute's tasks consisted mainly of controlling raw materials and products, developing standards and research into baking methods. Additionally it had a significant role in providing information. The knowledge acquired at the Institute featured in *Bakkers-Bondscourant* articles and talks held by the Bakers Association. The Institute would also be increasingly more involved in the training and education of bakers.

2.9 Bakery School

In 1908, two bakers from Arnhem attended the members meeting of the *Bakkerspatroonsvereniging Zutphen* (Master Bakers Association Zutphen) to outline their plans for a three-year bakery school in Arnhem and to raise funds: 'We want theoretical development yet men of practice.' Afterwards they received a huge applause from the members. One of them said it was scandalous that the Bakers Association gave the Institute a grant of six hundred guilders, yet the bakery school only fifty. The government was setting up agricultural schools and subsidising them, but gave no support to the work in the bakeries.[85]

The bakery school was established, but in Wageningen, located at the Institute. In 1909 the bakery school began with seven students, who after one year's training would become master bakers.[86] It was a select group, because the eighty guilders tuition fees were considerably high. In addition, the bakers' families did not like the idea of their sons living and studying far from home. Moreover the admission requirements reflected the school's elite character: only pupils with a three-year high school or secondary school diploma received exemption for the entrance examination. The curriculum was similar to schools abroad and included theoretical subjects such as physics and chemistry, knowledge of goods, health education, engineering, accounting, business management and commercial correspondence. The practical learning took place in the Institute's bakery: making dough by hand and with the machine, firing up the oven and sweeping. After 1915, confectionery was added. The literature list included Birnbaum's book on bread baking and other Dutch, German and French works.[87] The number of students was rather low in the first two decades, about ten a year. After completing their training, 44 percent of them set up their own business or went to work in the family bakery.[88]

The existence of the bakery school enabled the Bakers Association departments to organise training activities. The *Hanzegilde der Broodbakkerspatroons Sint Honoratus* (Hanseatic Guild of Master Bakers St. Honoratus) in Den Bosch wanted to hold master courses, just like abroad. Boonstra and his co-workers were prepared to give these. The first course was in October 1910 and consisted of six sessions, each lasting three and a half hours. The bakers could hear and see how to examine milk, butter, yeast and grain themselves. They were given explanations about the analyses the Institute conducted and the assessment of grain, flour, leavening, yeast enhancers and the nutritional value of bread. They learnt about the flour manufacturing process; during the practical lessons they learnt how to use a thermometer when forming the dough. In order to inform other members, the reports of these sessions were published in the *Bakkers-Bondscourant* and thereafter could be bought in volumes. The master baker course was such a success that it was held in other places. After 1910 the Institute held twelve courses in three years with 25 to 40 master bakers on each course.[89] Thanks to this course, bakers decided to joint-purchase equipment, join the Institute together, set up a purchasing association or go on trips to the Institute, bread or grain factories.

The Institute also took on regional bakery teachers to give courses and information. The initiative for this came from baker George Enzlin. During World War I, he realised that although the Institute's testing did make it possible to bake reasonable bread despite the shortages, bakers were insufficiently trained to put this advice into practice. Consumers complained about undercooked, dry and sour bread. In 1917 Enzlin approached the Minister of Agriculture, proposing the government provide financial support to appoint bakery teachers.[90] On request, the Institute's director Boonstra confirmed Enzlin's findings. Additionally, he emphasised that the

bakery teachers should work under the expert academic guidance of the Institute, to prevent them making allegations that were insufficiently substantiated by theory.[91]

Consequently the minister granted funding to train ten bakery teachers at the Institute. As of February 1920, they would provide two-year master baker courses in bakeries, supported by the Bakers Association.[92] Between 1920 and 1925, almost 1500 bakers attended these courses consisting of fifty three-hour lessons.[93] One of the subjects was practical bookkeeping so that bakers could set up and keep their own accounts. This was a move that bakers praised highly in the *Bakkers-Bondscourant*. During the courses, the bakers also learned from one another by exchanging information and by tasting and discussing each other's bread, biscuits, cake and rye-bread before and after the sessions. The courses also led to other communal activities such as trips to the Institute, a rusk factory or mechanised companies with chain or hot water ovens.[94] After two years, the number of courses declined because some bakery teachers left the Institute and the subsidy was stopped. The remaining teachers continued to give courses, demonstrations, advice and information on the changing product demands and methods. Not until the *Vestigingswet-Kleinbedrijf* (Establishment of Small Enterprises Act) came into force in 1937 and the *Vestigingsbesluit voor de Broodbakkerijen* (Act for Bread Bakeries) in 1938, did the bakers need to acquire sufficient knowledge to conduct and manage their trade.

2.10 Conclusion

People's opinions on what they thought was good quality bread and how a good baker made it, changed radically in the Netherlands between 1900 and 1930. The new quality bread demanded new working methods, whereby bakers could not fall back on their earlier experience. Having bread mealtimes earlier in the day and then the ban on night working forced bakers to reduce the preparation and baking time. Mechanisation, standardisation and attention to hygiene were all regarded as modern. The Bakers Association and certainly the Institute for Milling and Baking played their part with a coherent set of activities: defining and stipulating specifications for quality bread and work processes, providing information via lectures and articles or reports in the *Bakkers-Bondscourant*. The courses given by bakery teachers taught solid working methods, including the baking test. Alongside transferring knowledge, the courses led to new contacts and bakers exchanging know-how among themselves. As unenthusiastic bakers were still given speaking time at meetings, they remained involved. What is more, the Association could reach less interested bakers who were only members because they wanted to get access to cheap flour or purchasing deals.

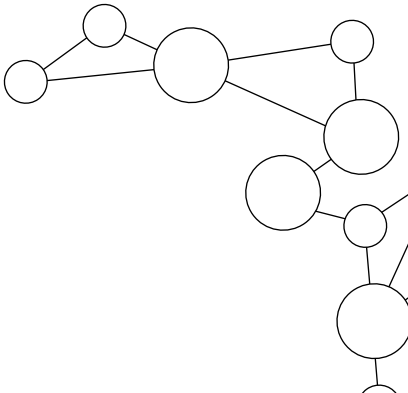
The transfer of knowledge provided by both the Bakers Association as well as the Institute played a considerable role in the modernisation of Dutch bakeries

around the early twentieth century. Without their development and dissemination of knowledge and information and education activities, the threshold to mechanisation and change in products would have been too high for many bakeries. Moreover they contributed to the liaison between the bakers themselves and suppliers. Equally important as the direct transfer of knowledge was their active participation in promoting modernisation. Whereas the Institute fulfilled more the role of knowledge centre, the Bakers Association took on the relationships with members, local departments and other stakeholders. The association was also mainly responsible for providing knowledge on mechanisation by organising exhibitions and demonstrations, reporting on them and placing advertisements. In this way the association also had a signalling function, forming a bridge between machinery suppliers and small or medium sized bakeries. The Institute's activities were of interest to the majority of the sector. In fact the incentive to set up the Institute had come from the large as well as the small and medium enterprises. A bread manufacturer would argue in favour of monitoring activities, while bakers wanted professional training and bakery teachers. The dissemination of information was not just aimed at bakers but also at the public and the government. The Institute functioned as a knowledge centre for the state, monitoring for example raw materials and products, whereas the association pushed for funding the monitoring and education as well as regulatory quality requirements and checking compliance. Thus we see how the development of knowledge went hand in hand with its dissemination and lobbying.

Bakeries are portrayed in this article as users of new technology. At the same time, however, they are producers delivering to end users and their relationship with consumers could also be influenced by the Bakers Association and the Institute. By defining standards and monitoring the quality of bread, the Institute in particular helped to change the relationship between consumers and producers. The quality stamp on milk bread will have led to some customers adopting a more critical attitude towards bakers. To gain more insight in the Institute's role in this change in attitude, further study of other intermediaries is required, such as the Dutch Housewives Association.

Due to the lack of specific research in the existing literature, we do not know to what extent such involvement of a Bakers Association and Institute in the transfer of knowledge is a typical Dutch phenomenon. Just as in Germany and Belgium, the mechanisation of one process in the Dutch bakeries led to others being mechanised, thus encouraging the use of standardised dough. It is remarkable that unlike in the quoted German and Belgian studies, the flavour of bread is not discussed in great detail. Neither the Bakers Association nor the Institute focussed on this. The reason is still not clear. One possible explanation is that low prices and efficient bread production were more important in the Netherlands than in other countries, factors that emerged during the bread wars of the 1930s.[95]

Another characteristic of the bakery sector in the Netherlands and neighbouring countries is that despite standardisation and mechanisation, the small enterprises did not disappear. After modernisation and the ban on night working, the small bakeries were able to survive alongside bread factories thanks to their lower labour costs. This is in sharp contrast with large sections of the food industry. To what extent the trade associations played a part and whether this also applied to other trades, should be the subject of further studies. For bread bakers we have shown that trade associations have an important role to play in the modernisation and survival of small enterprises. Established in the late nineteenth century to stand up to the bread factories and cooperatives, the Bakers Association, in its attempt to develop and transfer knowledge, contributed to accomplishing sector-wide changes as well as enhancing the reputation and status of the bread bakeries *vis-à-vis* bread factories and raw material suppliers.




CARROSSERIE
MET. ALKMAAR

‘In 1922, a customer ordered a “box on a chassis” from wagon maker Bartele Hainje. Although he had never done this before, Hainje decided not to refer him to the local vehicle body manufacturer and put the “box” on the chassis himself.’

Leeuwarder Courant, 1957

‘There is a complete lack of theoretical knowledge … hence the many weird, rickety, often highly dangerous and moreover very ugly vehicles they dare to call buses.’

Rijksnijverheidsdienst, 1923 Annual Report

3 Building Carriage, Wagon and Motor Vehicle Bodies in the Netherlands: The 1900-1940 Transition

3.1 Introduction[1]

In 1944, wagon maker Jan Van Peet junior, who worked in a village in the Dutch province of South Holland, completed a handmade farm wagon with beautiful wood- cut ornaments. It was a decorative wagon that farmers only used to impress each other. His father, Jan Van Peet senior, felt proud that he had managed to pass the traditional wagon making skills to the next generation.[2] However, by 1944 motorisation had removed the demand for horse drawn wagons on wooden wheels. Farmers wanted wagons with rubber tyres, for which wooden wheels were unsuitable, and since the 1920s, local businessmen had been buying motorised vans and trucks in preference to animal-hauled wagons. Accordingly, thirty-four year old Van Peet junior learnt body making for motorised vehicles by studying drawing at the local vocational school and following the body-making course organised by the national wagon and body makers association. Then, he accepted commissions for body making. First, he made a construction for a vegetable delivery van, then the body of a simple truck. Finally, when he felt sufficiently experienced, he made an all-metal bus body.[3]

During Van Peet junior's process of retraining and innovation, he was able to access new knowledge and skills via external parties. Small and medium sized enterprises (SMEs) need external parties during innovation because their resources in time, money, people and knowledge are more limited than larger firms.[4] The external parties that SMEs preferably turn to are close to them, like customers, suppliers and advisers.[5] Other available external parties are intermediary organisations which enable innovation in SMEs as one of their explicit objectives, for example trade associations and government agencies.[6] According to research by historian of technology Frank Veraart, and business historians and historians of technology Mila Davids, Harry Lintsen and Arjan van Rooij, during innovation, Dutch SMEs obtained information from various parties, ranging from suppliers, customers and competitors, to intermediaries.[7] In the twentieth century, SMEs required more codified knowledge, so some trade associations established laboratories and schools, and organised courses.[8] In his paper on ideas and policies concerning crafts in the Netherlands, historian Dick van Lente posed the question why the government tried to help crafts which seemed bound to disappear. One of the examples he gives is the case of the wagon makers. This is a brief review of the wagon makers' situation, the impact of motorisation and the activities of a government agency for SMEs, *Rijksnijverheidsdienst* (RND, Technical Information Agency), to retrain wagon makers

to build motor vehicle bodies. Van Lente concludes that RND justified this support for wagon makers because of the opportunities in the new automobile industry. Lastly, he observes the lack of detailed statistics on this transition and the lack of knowledge about how wagon makers made the transition from wood to metalwork.[9]

Historical research into American wagon makers during motorisation concludes that the majority of wagon making firms did not transition to the automobile industry because they were not able to switch to metalwork and the production of engines.[10] In Germany, carriage and wagon makers in the cities had disappeared before motorisation already as a result of mechanised carriages and wagons being produced in factories. In the 1930s, country wagon makers were not able to invest in the machinery required for automobile body making.[11]

So far, there has been no study of the transition process of Dutch wagon makers and the available knowledge flows, nor about the intermediary organisations which fulfilled a role in this process. This paper investigates the changes in knowledge and skills during the wagon makers' retraining and innovation processes, thereby focusing on the roles of the trade associations and government agency RND. It will review their roles in knowledge transfer, with activities including personal advice, training, demonstrations, and promotion activities, and their roles in knowledge development, with activities in testing technology and standardisation.[12] Thereby, it contributes to our understanding of innovation of craftsmen in response to motorisation and the roles that intermediary organisations can fulfil.

This paper studies the effects of motorisation on the craft of wagon making. This profession involved skilled handicraft work and produced and maintained a relatively small number of animal-drawn vehicles. Motorisation, defined as the process during which horse-drawn vehicles like carriages and farm wagons were replaced by automobiles, trucks, buses, and tractors, took several decades.[13] In the Netherlands, it started around 1900, when the first Dutch users bought automobiles.[14] The rise of utilitarian motor vehicles occurred between 1920 and 1940.[15] Around 1960, motorisation made the last farm horses obsolete, which marked the end of the traditional wagon makers trade.[16] The effects of this period on wagon makers are apparent in scarcely available quantitative data. In 1930, the Dutch census of industries counted 1618 wagon makers and 209 body-making plants.[17] In 1950, the same survey did not count wagon makers as only a few appeared to be left.[18] However, trade association data shows that in 1957 there were still 620 wagon makers. The number of body-making firms had increased to 640, and 475 of these firms combined vehicle body and wagon making.[19]

The transition from wagon making was a gradual process. The statistics show that from the 1920s, many wagon makers combined body and wagon making. Furthermore, not all wagon makers transitioned to body making and not all body makers were ex-wagon makers. Some wagon makers started producing other machines or products, like furniture for hospitals.[20] Others continued with their

side-line businesses, such as house painting or the lumber trade. Many older wagon makers continued wagon making until they retired.[21] There were also young entrepreneurs who started body making, as they were attracted by the opportunities in the new and growing automobile sector.

This article studies two historical periods: the start of motorisation between 1900 and 1920, and the rise of motorisation between 1920 and 1940. In each period, motorisation, wagon makers' activities, knowledge, and the roles of trade associations and RND are analysed. A concluding section reflects on changes in knowledge and skills and the roles of intermediary organisations in the wagon makers' transition to building motor vehicle bodies.

3.2 The Start of Motorisation, 1900-1920

When the first automobiles appeared in the Netherlands, they were not considered serious competition for carriages. In contrast, it was thought that motorisation would result in the obsolescence of horse-traction for freight and transport vehicles.

3.2.1 Mechanisation and Motorisation

In the early 1900s, the major change that wagon makers experienced was mechanisation, as machinery enabled significant reductions in production time. Until then, the only machine that wagon makers owned was a hand or foot powered lathe. After 1900, wagon makers who believed in mechanisation and who could afford it installed more machines, like a hand or foot powered band saw and circular saw. Then, electrification stimulated further mechanisation, with planers, drilling and grinding machines. This resulted in a reduction of production time: with hand tools it took four to six weeks to complete a farm wagon, whereas this took only about two weeks with machines.[22]

After the first automobile was introduced in the Netherlands in 1896, motorisation was mainly seen as a threat for commercial and transport vehicle makers.[23] In 1903, a Dutch trade journal for carriage and wagon making wrote that horse traction would not disappear: for short distances the automobile would remain too expensive and missed the gracefulness of a horse-drawn carriage. In contrast, the journal expected that horse-traction could not compete with motorised vehicles in freight and transport, because motors were much cheaper for long distances. Likewise, it saw a great future for buses, especially in the countryside.[24]

The government sponsored national SME survey of 1908 identified motorisation as an opportunity instead of a threat. It concluded that, in contrast with other crafts, there were no major concerns for wagon makers, but it had several recommendations

for the sector. First, wagon makers needed better education. Second, they needed credit facilities for mechanisation. Third, their customers should pay them more frequently than once a year. Fourth, wagon makers needed to improve their cost calculation skills for more profitable business. Last, they should take the opportunities in metalwork and the new automobile and motor sector.[25]

Carriage making firms were the first to be affected by motorisation, because their upper-class customers were the first buyers of horseless carriages.[26] For that reason, some carriage makers, such as Spyker and Veth, started manufacturing automobiles. Others stayed close to their core skills and switched to making automobile bodies. This worked well, as early automobile manufacturers were concentrating on developing and manufacturing engines with chassis, transmission, and braking and suspension systems.[27] Furthermore, customers wanted their automobiles to look as stylish as carriages. At first, automobile bodies were mainly made of wood and designed similarly to carriage bodies, so carriage makers could easily transition to making automobile bodies. However, it was only a temporary opportunity for carriage firms, because in the late 1920s, body making became part of automobile mass production.[28]

So, motorisation impacted differently on wagon makers, depending on their clientele. Two groups could be distinguished: carriage makers and wagon makers.[29] Carriage makers had upper-class customers for whom they produced and repaired fashionable and expensive vehicles. In the Netherlands, there were only a few of them, about twenty-four in 1912.[30] Carriage makers had medium-size firms, whereas most wagon makers had small firms. There were two types of wagon makers: in the cities and in the countryside. City wagon makers made and repaired various types of vehicles and tools, often for other small businesses, such as dray carts, delivery vans, handcarts, dogcarts, wheelbarrows and ladders. Rural wagon makers made and repaired vehicles, wooden tools and equipment for farming, including farm wagons, carts, wheelbarrows, ploughs, harrows, rakes, spades and shovels (Figure 3.1). In addition, they made other wooden products, like drying frames and milking stools. Rural wagon makers' work was seasonal, so they often had side-line businesses like the lumber trade, house painting, carpentry, or cooperage.

3.2.2 Wagon Making Knowledge

The wagon makers had many different skills which they learnt during apprenticeships. Training took place in the workshop, and since the abolition of the guilds in the Netherlands in 1818, there was no formal examination or accreditation. Apprentices started when they were about twelve years old, and it would take them about ten years to become a master wagon maker. Often the craft passed from father to son. Owners of bigger carriage making firms sent their sons abroad for an

internship, preferably in French firms, which were trendsetters in carriage building.[31] Wagon maker apprentices had to learn how to use and maintain various tools and equipment, like chisels, saws, drill bits, gouges, adzes, drawknives and a variety of planes. They learnt to make numerous wagon parts, how to prepare and work with various types of timber like elm, oak, lime, ash, beech, and poplar. Wheel making was the most challenging and important skill to learn. For metalwork, wagon makers worked with the local blacksmith. Painting and woodcutting would normally be done by others. Bigger firms employed their own blacksmiths and painters.

Traditionally, wagon makers' knowledge was experiential and informal, as they worked without drawings or books. They stored the shape and dimensions of product parts in thin wooden patterns. These patterns represented their trade secrets, which they passed to their sons. In exceptional cases, patterns were shared: when a wagon maker in Zeeland lost his patterns in a workshop fire, he was allowed to copy his colleagues' patterns.[32]

Figure 3.1 Wooden farm wagon in the beet-lifting season, Walcheren, between 1928 and 1941.

To improve production efficiency, a drawing methodology for carriages and wagons was created, which was circulated via trade journals. In the 1850s, three French carriage makers developed the 'French rule', a scale drawing system with standards and rules that enabled carriage makers to create much more detailed and exact representations of their products. The drawing method was then distributed via

the school for carriage makers in Paris, which was established in 1858 by one of the French rule developers. Furthermore, the drawing method was published in trade journals.[33] These journals were read by major Dutch carriage and wagon making firm owners, who had subscriptions to keep track of international trends and developments. Some Dutch wagon makers must have been aware of the French rule.[34]

In the early 1900s, the average Dutch wagon maker's way of working was based on tacit and experiential knowledge, as there were hardly any formal education opportunities for wagon makers in the Netherlands. In other countries, the situation was different. There was at least one carriage making school in France, and in the USA a school for wagon and carriage makers was established in 1880.[35] From the 1860s, the first Dutch vocational schools were established, but courses were limited to building and construction crafts. Nevertheless, wagon makers signed up to study construction drawing, or they learnt drawing in evening schools. Around 1912, carriage drawing could be studied in Amsterdam, in a course that lasted ten winters. Few apprentices completed the course, which was not due to its length, but because their masters gave them few opportunities to use their new skills.[36]

3.2.3 Wagon Makers' Associations

Like many other Dutch crafts around 1900, wagon makers needed collective action to survive, but it was not until World War I that a national association was established. The trade needed to improve quality standards and profitability. However, as the Dutch government was a proponent of a liberal economy, it did not organise education for the crafts or support specific policies for crafts. In Germany, by contrast, city wagon makers were organised in guilds, and the market for rural wagon makers was regulated.[37] In the USA, the wagon making sector consisted of many mass-producing, highly profitable firms and there were several wagon makers' trade associations.[38]

In the Netherlands, wagon makers established local and regional associations from the early 1900s. However, many wagon makers refused membership, as their work in small and isolated firms made them distrust other wagon makers. It took until 1909 before the first national association was established, but it was small, having about twenty carriage makers as members.[39] Only extreme pressure resulted in the establishment of a national association of carriage and wagon makers. When material shortages and price increases during World War I made it urgent and necessary to organise a collective lobby with governmental committees and offices, this resulted in the establishment of *Centrale Bond van Rijtuig- en Wagenmakerspatroons Verenigingen in Nederland* (CBRW, Central Association of Dutch Carriage and Wagon Makers Associations) in 1918.[40]

After the war, CBRW continued its activities, but these were not very successful. The association tried to organise wagon maker training in vocational schools in several towns and cities, but did not succeed. CBRW also started initiatives for price regulation, because price-cutting threatened the survival of wagon makers, but only some regional associations accepted standard local price lists.[41] Members resisted being public about their business profitability: '. . . better to close the books than to open these for every Tom, Dick and Harry who keep their books hermetically closed.'[42]

3.2.4 Technical Advice – *Rijksnijverheidsdienst*

The establishment of RND was initiated by Dutch upper-class citizens who were concerned about the status and quality of the crafts. Since the late nineteenth century, concerned citizens saw the application of modern science and technology in SMEs as vital for their survival. Therefore, they lobbied for the establishment of an agency that would transfer knowledge and technology to SMEs to support their mechanisation and modernisation. As a result, the Dutch government established RND in 1910.[43] It was a hesitant gesture, which was visible in the limited budget that was approved for RND's activities. RND started with only one industrial consultant, an academically qualified mechanical engineer. In 1913, he was joined by two consultants.[44]

RND was the first intermediary organisation in the Dutch industrial sector.[45] As the Dutch government minimised interventions in business and education, the Dutch knowledge infrastructure consisted of few education, technology and research institutes in the early 1900s.[46] This was also the reason for RND's existence: it was to bridge gaps and liaise between the available experts, laboratories, the technical university, and the SMEs. In addition, the consultants collaborated with civic organisations which tried to stimulate and modernise the Dutch industries. Thereby, RND followed a model which had already been applied in the modernisation of the agricultural sector. According to the consultants, the crafts could survive next to large industries, as suppliers of semi-finished articles, or as producers of small product series.[47] For that purpose, craftsmen needed to mechanise, to work in an organised and efficient way, and to use cost calculations to ensure profitability.[48] In 1911, the RND consultant observed that craftsmen needed a hands-on and personal approach, and not necessarily expert advice based on the latest scientific research. During his first project with blacksmiths, he observed how limited their education was, and concluded that they needed practical assistance, preferably in their workshops. As a result, RND appointed a technical assistant in 1917, to educate and advise blacksmiths in modernising their trade. This caught the interest of a wagon makers trade journal, which observed a similar need for wagon makers:

'... especially in the countryside, gross errors are being made in this craft, and the practical consultancy of an expert could be very useful.'[49]

3.2.5 Knowledge and Mediation

Around 1900, wagon makers' knowledge was mostly tacit and informal and its circulation was based on lengthy apprenticeships. This situation continued for the majority of wagon makers, although some took evening classes in drawing, read trade journals or were sent on an internship abroad. The few major Dutch carriage makers were the first to make the transition to body making for automobiles. This was easy, because early automobile bodies were mainly made of wood.

In 1918, wagon makers finally succeeded in forming a national association, and CBRW mainly functioned as a representative to governmental bodies. RND had few resources and did not offer specific activities for wagon makers.

3.3 Utilitarian Motor Vehicles, 1920-1940

In the 1920s, automobiles became popular as utilitarian vehicles, which resulted in a growing demand for custom body making for automobiles, trucks and buses. In parallel, body specifications and materials were developed further, which finally resulted in all-metal bodies.

Figure 3.2 Truck body made by wagon maker Jan van der Roest, IJsselstein, 1927.

3.3.1 Motorisation and Mechanisation: Opportunity and Threat

In the 1920s, the growth of utilitarian automobility created numerous body making opportunities for wagon makers. In those years, automobiles became cheaper and more affordable for small business owners. Because of this, motorised commercial transport and freight in the Netherlands increased, while it also created new sectors, like bus and truck transport and carrier services. From 1921 until 1928, there was a boom in bus companies: every year the number of buses increased by several hundreds, from about 2,000 buses in 1924, to 3,200 in 1928 and 4,500 in 1939.[50] In the early years, many of these buses were converted Model-T Fords.[51] Compared to buses, the number of trucks increased exponentially: from 511 in 1918, to 35,040 in 1929 and 54,000 in 1939.[52] Ford was especially popular: by 1929 the Netherlands had 20,488 Ford trucks.[53] Naturally, these developments impacted heavily on traditional wagon makers, who wondered what would come next: 'Farmers still use carriage and wagons, greengrocers their vegetable cars, and bakers and milkman their handcarts. But will this continue? . . . Who will make cars, bicycles, side-cars, farming equipment: all those products which have replaced work that was done by wagon makers?'[54]

So, wagon makers needed to change their products. This was feasible, because the increasing demand in buses, trucks, delivery vans, and vehicles like hearses, refuse lorries and tankers, created opportunities for city and rural wagon makers, as many of these vehicles were bought as chassis (Figure 3.2). About ninety percent of trucks was bought as chassis, whereas for automobiles this had decreased to six percent by 1923.[55]

Figure 3.3 Bus built by wagon maker Bartele Hainje for Hendrik Dragstra and Ynze Kalsbeek in 1922.

Wagon makers did not necessarily need a lot of training to start body making. Izaäk Verhulst first took a drawing course and then built his first body: an ice-cream sales booth on a Model-T Ford chassis.[56] Several wagon makers started making motor vehicle bodies because their customers asked them to, like wagon maker Bartele Hainje, who in 1922 built his first bus body on a Ford chassis. As these chassis consisted of a simple and sturdy construction, they were excellent enablers for customised body making. Hainje's design was a wooden body very similar to that of a carriage (Figure 3.3). Thereafter, he received more orders for bus bodies and eventually specialised in bus body production. Similarly, other body makers decided to specialise in bus bodies or other utility vehicle bodies.[57]

Figure 3.4 Lengthening a Model-T Ford chassis to convert it into a transport vehicle, by Jacob Met in Alkmaar, 1910-1920.

As there were hardly any regulations, wagon makers had a lot of freedom in construction: 'Sometimes we just sawed bodywork in half to insert a piece', Hainje recalls.[58] Ford engines were strong enough for loads of two tonnes, but the standard chassis was not, so, carriage and wagon maker Jacob Met strengthened it by adding a construction around it.[59] For a transport vehicle, Met lengthened the chassis and added extra blade springs for the longer body (Figure 3.4).[60] Other body makers bought converted or lengthened Ford chassis from specialists.[61]

Motorisation of the agricultural sector was slower than the transport sector, so some rural wagon makers continued their work long after World War II, but not without being impacted by mechanisation and motorisation. First, wagon makers could not compete with factories that produced cheap metal farming equipment and tools. Besides, these products were sold and repaired by blacksmiths.[62] Second, traffic regulations in the 1920s that specified the design of motorised vehicles impacted on the design of horse-drawn farm wagons whose wheels then required a broader rim width in relation to its axial load. Third, initiatives for rationalisation and standardisation changed the design of farm wagons. Around 1932 a standard farm wagon was developed for the newly reclaimed Wieringermeerpolder to support rational farming.[63] It had pneumatic tyres which influenced the design and construction of farm wagons, as they had a lower and larger wagon box. The result was a more efficient use of horse traction, because these wagons could carry higher loads.[64]

3.3.2 Motorisation and Knowledge - Continuously Changing

The transition of wagon makers was not like a change from one craft to another: it was a step from a centuries-old craft in which wheel making fulfilled a central role, to a less visible niche in a fast developing industrial sector based on engines.[65] In the early twentieth century the automobile sector continuously changed in terms of technology, production, regulations and customer needs. When wagon makers started making bodies for automobiles, trucks and buses, they needed new skills, but they also needed to update their skills and knowledge regularly to keep up with the automobile industry.

Wagon makers had a wide range of information sources available. From the early 1900s, trade journals published articles about automobile repair, because owners would approach local wagon makers for this work.[66] This way, wagon makers became acquainted with automobiles which prepared them for body making. For further information, they could rely on other trade journal publications, like drawings of bodies for automobiles and utility vehicles, and articles about drawing and body work methods.[67] To get access to metalworking knowledge, wagon makers hired metalworkers on a temporary or permanent basis.[68]

Initially, wagon makers constructed both cabins and bodies for trucks and commercial vehicles.[69] However, in the 1930s, American truck manufacturers started to produce simple cabins on chassis.[70] So, body makers specialised in customising the exterior and interior of cabins and bodies, adapting standard trucks and vans, building trailers, and painting bodies. Furthermore, cabin design changed and fittings became more luxurious: a hard bench in the open air gave way to an enclosed cabin with heating and sleeping facilities.

Construction materials changed from wood to metal, so that eventually body makers were skilled metalworkers. The first step, in the 1930s, involved cladding wooden frames with metal panels. Bus body maker Hainje went even further and started using square metal profiles from the early 1930s: 'As far as I know, we were the first in the world to do that.'[71] In the late 1930s all-metal bodies were introduced widely, and light metal was used for frames. After that, body makers started using modular constructions.[72] Furthermore, metal bodies required different painting methods, so body makers installed spraying cabins or sent the bodies to an external painting firm.[73] The changes also impacted on the workshops: as early as 1927 body maker G.J. Van Koppen decided to add a smithy to his firm so that he did not have to depend on the local blacksmith.[74]

3.3.3 Trade Associations – Difficulties in Mobilisation

Despite increasing motorisation, the trade association had a hard time mobilising wagon makers. For that reason, CBRW members acted as change agents to counter the distrust and conservatism of their fellow wagon makers. In the winter of 1921, wagon maker Johan de Groot in Leiden organised evening sessions to share his knowledge.[75] Carriage and wagon manufacturer Marten Oostwoud in Franeker bought several copies of a German book with models of carriages and wagons and offered these for sale to interested colleagues.[76] Around 1926, his son Jacob studied body making for luxury automobiles and buses in Germany. When Jacob returned, he shared the course material with a teacher at the vocational evening school in Leeuwarden who used it for drawing courses in body making.[77]

The threats of motorisation and mechanisation were important topics on CBRW's agenda. The Dutch trade association repeatedly made the case for change and tried to mobilise its members to mechanise and broaden their skills. These messages were published in its monthly journal to stimulate members' receptiveness to technical, business and management articles. For example, in July 1922, during the boom in Dutch motorisation, a special issue was published to convince wagon makers that they now had to compete in an industrialised economy, in which customers expected high quality and low prices. The editorial stressed the need for professional training, economical methods, and a business-like approach to

satisfying customers – and for reading the journal to get help in this regard.[78]

The issue marked the start of many subsequent articles about technical and business topics like drawing, strength calculations, body making, machines, technology developments and trends in motorisation. In contrast, German guilds prioritised the status of their craftsmen, so they ensured that wagon maker work areas in automobile and carriage plants were separated from unskilled labourers. Furthermore, their rules forbade wagon makers to start metalwork.[79] In the USA, the main trade association was so blinded by the huge size of the American carriage trade, that they did not regard the automobile industry as a serious threat.[80]

In the Netherlands, between 1923 and 1936, there was no national association for wagon makers. Around 1923, CBRW broke up, as its members did not want to pay anymore for a national association.[81] It took until January 1936 before the *Federatie der Organisaties van Carrosserie- en Wagenbouwers en aanverwante bedrijven* (FOCWA, Federation of Organisations of Body and Wagon Makers and related firms) was established.[82] It consisted of twenty-three regional wagon makers associations, the association of firms in automobile coating and spraying, and the association of Dutch body manufacturers.

After CBRW fell apart, the regional and local associations continued, and communicated through a monthly trade journal. This journal, originally published by CBRW, also supported wagon makers' activities. One of these was the *Practische Hulpdienst* (Practical Service) which the journal started in 1923 in cooperation with RND. Via this service, wagon makers who had difficulties building the first bodies, could get assistance from a skilled body maker.[83]

The economic crisis and a new Dutch law strengthened the position of FOCWA to regulate price and entry into the sector. FOCWA established a national body and wagon makers' price list in 1939.[84] From 1937, Dutch law required all SMEs to prove their skill levels in order to obtain a business permit.[85] This law regulated entry into business sectors, and would thereby help firms to survive during the economic crisis. To operationalise the law, the Dutch Ministry of Economic Affairs cooperated with trade associations. At first, FOCWA maintained a list of approved members. Then, FOCWA developed the minimum requirements for professional skills that body and wagon makers needed to prove, and it organised courses.[86] However, it took until 1948 before FOCWA organised the first exams for master wagon makers and master body makers, and not until 1952 was the wagon and body maker sector protected by law.[87]

3.3.4 RND - Mediating for Wagon Makers

The blacksmiths' appreciation for RND's technical assistance made RND approach CBRW. RND noted that for wagon makers there were hardly any courses in vocational schools and that they needed better skills and equipment: '... wagon

makers in villages still work in very primitive and old fashioned ways and with inadequate tools…'[88] Correspondence with CBRW chairman confirmed the wagon makers' interest in assistance, so that in 1920 RND appointed the first technical assistant for wagon makers. In March 1921, this assistant was succeeded by Jan Bernardus van de Pavert who fulfilled this role until his death in October 1940.[89] The RND assistant conducted several activities to support wagon makers in making bodywork for motorised vehicles. An overview of activities from 1920 to 1940 (Table 3.1) shows lectures, workshop visits and knowledge development activities.[90] The maximum number of attendees and workshops was reached between 1923 and 1927, which coincides with the boom in motorised commercial transport and freight. The lack of wagon makers' knowledge in producing the requested bodies became visible in the weird looking vehicles on the road, so wagon makers welcomed RND's assistance. The RND assistant shared knowledge during formal lectures and courses about body making: a photo of a course around 1926 shows twenty-two male participants, all wearing suits.[91] The assistant also helped wagon makers to put this into practice in their workshops. For example, he visited wagon makers in Vlaardingen five times between 1930 and 1932 to help beat out curved panels and styles, and to design and construct a body for a delivery van.[92] In 1929 and 1930, he travelled three times to Heerenveen to give advice about bus design and construction, quite likely to bus body maker Hainje.[93]

Table 3.1 Overview of the RND assistant's activities, 1920-1940

Year	Lectures	Attendees	Workshop visits	Other
1920	4	52	124	
1921	26	461	129	
1922	25	338	226	
1923	55	1096	210	
1924	83	1618	221	
1925	82	1516	224	
1926	78	1350	209	
1927	54	932	221	(a)
1928	49	786	215	
1929	39	711	206	
1930	63	970	187	(b)
1931	51	820	185	
1932	41	644	204	(c)

1933	34	492	154	
1934	39	568	158	
1935	38	542	159	(d)
1936	39	558	162	
1937	36	482	177	(e)
1938	27	391	168	(f)
1939	29	352	179	
1940	11	97	145	
Total	*902*	*14776*	*3863*	

Source Nationaal Archief (NA, Dutch National Archives), RND, Annual reports, 2.06.083, inv. no. 17. NA, RND, Monthly reports from the assistant for wagon makers, 1926-1940, 2.06.083, inv. no. 118.
(a) Assisting standardisation of farm wagon in Zeeland
(b) Survey of non-productive hours: 15 participants.
(c) Assisted Wieringermeerpolder management in design and procurement of new farm wagons.
(d) Assisted in design of a three-year course for body and wagon makers.
(e) Jury member for vehicle design contest. Committee member to determine requirements in technical and business skills and solvency in relation to the law for business permits. Prepared axial load tables for the trade association's journal
(f) Member of Central Committee for Normalisation for wagon on rubber tyres (tyres, rims, axles).

The wagon makers' eagerness for technical and business knowledge peaked in the 1920s but continued in the 1930s, as an overview of lecture topics shows (Table 3.2).[94] This was due to changes and innovations and new wagon makers who started body making. Thirty-six of the sixty-three lectures were on technical topics, such as 'designing, beating out and making of a wheel encasing, arches, etc.' Business and organisational topics included cost calculation, cooperative purchasing and commercial problems. Lectures about new developments were very popular. In 1928 and 1929, the assistant lectured fourteen times about the new Model-AA Ford chassis, attracting 257 participants. Other topics that kept wagon makers informed about technology were: use of rubber tyres, gluing panels, demonstrating beating out of metal panels, new farm wagons, making streamlined bodies, using light metal frames, and axial load calculations. In addition, wagon makers could find drawings and articles by the RND assistant in their trade journal.

RND fulfilled a role for the whole sector by conducting knowledge development activities. From 1932 to 1937, the assistant reviewed a new machine for making wheels.[95] The assistant also participated in standardising a farm wagon in Zeeland province and in normalising wagons with rubber tyres (Table 3.1). Furthermore, in 1937, he was involved in determining the technical and business skills that wagon makers and body makers would need for the new business permit.

Dutch wagon makers also benefited from RND marketing initiatives by being

represented at the collective booths during the *Jaarbeurs* (National Fair). In the early 1930s, wagon makers found out that they needed to market their capabilities, as customers tended to buy foreign made cabins and bodies via automobile dealers. According to their trade journal, wagon and body makers were too modest and needed to advertise their merits to the general public. Otherwise, they might disappear like luxury automobile body makers had.[96] In 1932, eighteen wagon makers participated for the first time in a booth at the *Jaarbeurs*. The booth showed a cabin, cabin doors, a milk carrier, a wheelbarrow, and other products. Some wagon makers were also present in person, and profited from increased product sales and new business contacts.[97]

Table 3.2 RND lectures: topics and frequency in 1930

Topics	Frequency
Interests of body and wagon makers	6
Cooperative purchasing	6
Calculation and implementation of general costs in our firms	12
Productive and indirectly productive hours	3
Technical and commercial problems in body making	2
Equipment and installations in our firms	1
Demonstration of designing, beating out and making corner girders	3
Designing, beating out and making of: a wheel encasing, corner styles, arches, etc.	7
Designing and making products: delivery van, cabin, wheel housing, etc.	11
Beating out and making out of: rear doors or a sloping wheel housing	2
Various topics: production of Chevrolet bodies, introduction to body making, etc.	10
Total	*63*

Source NA, RND, Monthly reports by the assistant for wagon makers, 1926-1940, 2.06.083, inv. no. 118

RND's activities and publications were not only to transfer knowledge, they were also used to mobilise wagon makers to learn new skills. This is illustrated by wagon maker Cees Luteyn from Zeeland who won the third prize for his design of a vegetable delivery van in 1937. Luteyn's drawing was published in the wagon makers journal, which mentioned that he had learned body design and drawing by taking the RND course and subsequent self-study of drawing course articles in the journal.[98] The wagon makers trade associations also relied on the assistant as a trusted

adviser for their sector. They invited the assistant to give lectures during meetings, after which he was then allowed to attend the rest of the meeting as well. There, he would repeat his message that the wagon makers' sector needed to be organised as their situation was worsening. For instance, in 1929, when wagon makers tried to re-establish a national association, he expressed his regret about the liquidation of CBRW in 1923. He stressed that during the boom in motorisation, wagon makers needed an organisation to provide a social network for both practical and moral support.[99]

RND facilitated social networking through lectures and demonstrations, but also by organising excursions which underpinned RND's message of modernisation. In 1931, the assistant organised a visit to the General Motors automobile assembly plant in Antwerp, and in 1934 to the Ford automobile and truck plant in Amsterdam.[100] In his journal article about the visit to General Motors, the assistant pointed out how much each wagon maker could learn from the plant's efficiency. He admired the drawings and scale models which ensured precision, and stressed how special instruments saved production time. Furthermore, the economical organisation of this large-scale firm was a useful example for wagon makers' workshops. He concluded: 'This experience is a stimulus to not rest on our laurels and daily ask ourselves how we can implement efficiency in our firms in a practical way.'[101]

3.3.5 Mediation and Knowledge

In the 1920s the impact of motorisation could not be ignored anymore. Wagon makers who wanted to transition to body making needed new skills and formal knowledge, and because of their lack of formal education, the associations and RND based their knowledge transfer activities on a combination of personal contacts, demonstrations and lectures.

When there was no national association between 1923 and 1936, local and regional associations, the trade journal and the RND technical assistant fulfilled roles in knowledge transfer. The associations mobilised members and provided the network. The trade journal was a central channel, and RND ensured that knowledge was continuously updated, standardised and circulated via lectures, courses and personal advice. RND was also involved in knowledge development activities, like standardisation and normalisation. The roles of intermediary organisations overlapped, so that some association members were also involved in knowledge transfer, whereas RND also used its activities to mobilise wagon makers for modernisation. The new Dutch law in 1937 was the final stimulus for sector regulation, while it also strengthened the position of the new national association FOCWA.

3.4 Conclusion

Between 1900 and 1920, during the start of motorisation, the few major Dutch carriage makers had to make the transition to body making for automobiles or production of automobiles. In contrast, the majority of Dutch wagon makers continued their business as before, which was to use their tacit and experiential knowledge to produce traditional wooden business and farm wagons, carts and equipment.

During the rise of motorisation from 1920 to 1940, knowledge transfer and development activities of the wagon makers' trade associations, the trade journal and RND enabled the transition of Dutch wagon makers into body making by forming a bridge from a traditional craft to niches in the modern, continuously innovating automobile sector. The trade associations created the network and mobilised their members, the trade journal was a knowledge channel, and RND was both knowledge source and channel. Together, they ensured that their activities were suitable for wagon makers, who had little formal education.

The emphasis of RND's activities was providing knowledge. RND was also involved in influencing, generating knowledge and standardisation. Promotional activities at fairs, testing and the standardisation of farm wagons and rubber tyre dimensions had a lower priority because the wagon makers needed training. Consequently, RND's activities would help wagon makers to catch up with the trends in the automobile industry. Only a few activities were proactive and tried to adapt the new technology for Dutch users and producers: one of these was the design of the new farm wagon for the new polder, around 1932.

Access to knowledge mattered for several reasons. Wagon makers had to absorb tacit and formal knowledge. Furthermore, the required knowledge was prone to change, as a result of continuing innovations in the automobile industry. Lastly, in addition to technical knowledge, body and wagon makers also needed business and management knowledge. As niches moved and knowledge needs changed, the trade associations, the journal and the RND filled the gaps with updated knowledge.

The knowledge transfer and development activities of the associations, the journal and RND were especially suitable for wagon makers who needed personal attention and support while learning new skills. This paper shows how the need for knowledge and support differed amongst carriage and wagon makers, as some were able to use other sources as well, like trade journals, internships and training abroad, and metalworkers. The first carriage makers who started motor vehicle body making were able to access knowledge resources themselves. Some city and rural wagon makers were able to transition to body making themselves, as they were sufficiently skilled and had business acumen.

The Dutch case shows two major differences with the American and German wagon makers. In comparison with the American wagon makers association, the

Dutch trade associations had no vested interests in mass production of wagons and as the situation of small wagon makers clearly needed improvement, it took the threat of motorisation seriously and responded. Furthermore, in contrast with German guilds, the Dutch trade associations allowed wagon makers to extend their skills with metalwork.

Nevertheless, the Dutch wagon makers had challenges as well. It took until the rise of motorisation before the trade associations' efforts to modernise their sector really took off. Furthermore, for a long time, they lacked organisation at a national level, so they depended on the journal and RND to bridge this gap via local and regional wagon makers associations.

The case of the Dutch wagon makers is an example of how a sector can renew itself in the face of technological progress by organising and innovating. It shows the roles of intermediary organisations in creating a network, and distributing and updating body making knowledge and skills to wagon makers. Additionally, by introducing formal knowledge and modern business methods to wagon makers, the intermediary organisations established knowledge and training institutes that the aspiring vehicle body makers needed to survive in the automobile industry.

‘Bicycle production is now an established industry in the Netherlands … No more tinkering in dingy sheds with parts procured from obscure sources abroad.’

Dutch Cyclists Union (ANWB), 1894

‘Standardisation and specialised production of parts … has enabled bicycle assembly outside the major manufacturers … resulting in “cheap machines” … Bicycles made by reputable Dutch manufacturers have an almost unlimited life, whereas cheap ones have to be discarded after a few years of heavy pedalling.’

Algemeen Handelsblad, 1933

4 How the Netherlands Became a Bicycle Nation: Users, Firms and Intermediaries, 1860-1940

4.1 Introduction[1]

In 1935, a British journalist was impressed by Dutch bicycle traffic: 'It was interesting to notice in the streets of The Hague recently that the bicycle became everybody's vehicle. In a flock of cyclists hurrying to lunch I counted three clergymen, a top-hatted civil servant . . . three army officers . . . and any number of more ordinary people. . . . All of them were riding ordinary straight-up bicycles, and they had not the hideous overworked look of British cyclists with arched backs and low handle-bars'.[2] Many of these bicycles were made in the Netherlands, as the New York Times wrote: 'A few years ago only 58 percent of the bicycles were Dutch-made, but the percentage rose to 99 in 1931'.[3] Ownership statistics illustrate the diffusion of the bicycle in the Netherlands: by 1939, 38 percent of the Dutch population of 8.7 million owned a bicycle, which was equal to 3.3 million bicycles.[4]

So, from 1925, the Netherlands was a nation of cyclists and cycle producers. However, there is the question of how this happened, especially because of four factors. First, the bicycle was not a Dutch, but a French invention and major innovations came from Britain.[5] Second, in countries like Britain and Germany, cycling was seen as a working class activity.[6] Third, for decades, the Dutch preferred to buy foreign products, as their national industry was seen as backward.[7] Fourth, the Dutch had an open economy, and even when import tariffs were imposed, they were low.[8]

Therefore this article investigates how the Netherlands became a bicycle nation. The four factors above identify several interlinking research areas, like diffusion, usage, product and production capacity. Business historians Francesca Carnevali and Lucy Newton show how the development of a new sector takes many interactions between several actors, like producers, retailers and consumers.[9] Science and technology researcher Wiebe Bijker illustrated the role of users and how their needs influenced bicycle design and its use.[10] Furthermore, Dutch bicycle firms had to compete with imported products, which were of better quality. To improve, they needed knowledge, about bicycles, production, and sales.[11] Lastly, the role of intermediaries matters, as these organisations and individuals can fulfil an important role in the process of developing mass-scale production in which consumers, firms, producers, and the state are involved.[12]

Intermediaries can fulfil different roles and functions in innovation processes.[13] Examples of these functions are 'knowledge processing, generation and combination', 'training', 'accreditation and standards', 'regulation and arbitration', 'intellectual

property' and 'commercialisation'. Whereas innovation researcher Jeremy Howells looks at product and process innovation as well as the exploitation of new markets, mediation quite likely also occurs in two other types of innovation as defined by economist Joseph Schumpeter: new sources of supply and new ways to organise business.[14]

Furthermore, Howells stresses the need to research mediation by business interest associations, trade associations and cartels, including how their activities change over time. Business interest associations fulfil several types of activities for their members economic and business interests, like lobbying, negotiations, and self-regulation.[15] It is recognised that they also circulate information about innovatory activities, but the importance of their role as intermediaries in innovation processes is underestimated.[16] In addition, business historian Alain Cortat concludes that cartels are not necessarily slowing down innovation.[17]

This article aims to make a theoretical and an empirical contribution. Its theoretical contribution consists of extending the knowledge about how activities and interactions of users, firms and intermediaries influence the development of a new sector, including knowledge flows and specific roles of intermediaries. Its empirical contribution is that it results in a better understanding of how the Netherlands became a bicycle nation between 1860 and 1940.

This study is both different and similar to the work of business historians and historians of technology Mila Davids, Harry Lintsen and Arjan van Rooij.[18] The latter studied the interaction between innovating firms and knowledge infrastructure in the Netherlands in the twentieth century. This article focuses on a specific, new sector, and traces from its start how users, firms and intermediaries were involved in developing this sector. This article is different as it also includes users' activities, whereas it specifically studies changes in the roles of intermediaries. There is an overlap, as it also studies knowledge flows and the roles of intermediaries.
So far, historical studies have focused on the invention, development and diffusion of the bicycle, on national bicycle industries or well-known bicycle manufacturers like Raleigh.[19] National bicycle histories especially studied the visible part of cycling, which consists of the users.[20] Some interdisciplinary research was conducted, which studied users, producers and non-users and took different perspectives into account.[21]

The question 'why is the Netherlands a nation of cyclists?' was studied by historian Anne-Katrin Ebert.[22] She concluded that the Dutch Cyclists Union (ANWB) developed an extensive infrastructure for everyday use and touring. The ANWB also stimulated bicycle use for citizens of all classes as a way to learn and show civilised behaviour and to get to know the country by touring. All this transformed cycling into an activity of nation building for the Netherlands, as a way to create political stability.

However, the Netherlands does not have an academic study of its development as a nation of cycle producers, nor about the history of its bicycle sector.[23] Existing

literature on Dutch bicycle firms is limited to memorial books and publications of the Dutch veteran bicycle club '*De Oude Fiets*' (The Old Bicycle).[24] So, whereas Ebert focused on users, the ANWB and bicycle use until 1940, this article will also study how Dutch bicycle firms developed.

This article studies how the Netherlands became a bicycle nation from 1860 to 1940, by reconstructing its history and analysing knowledge flows and activities and interactions of users, firms and intermediaries. The intermediaries that are studied are two business associations in the bicycle industry (RAI and BRHN), the Dutch Cyclists Union (ANWB) and the *Rijksnijverheidsdienst* (RND, Technical Information Agency). The research is based on literature research and archival research at the ANWB, RAI, RND and bicycle museum Velorama.

Table 4.1 Dutch bicycle history from 1860-1940

	1860-1900 The start	**1900-1920 Changing character**	**1920-1940 A cartelised market**
Product design	Several changes: from velocipede to penny farthing to safety and from wood to steel.	From customised bicycles to standard versions. Utilitarian bicycles developed via experiments.	From standard high quality to high quantity, low priced products.
Production	Start and maturation of the first bicycle manufacturers.	Growth and development of bicycle industry. Improved reputation of Dutch manufactured bicycles.	Many bicycle and bicycle parts manufacturers. Bicycle assembly as well.
Users and diffusion	First only by young, upper class users, then also sportsmen.	Slow diffusion to lower classes as well.	Mass use by all classes.
Representation of user practices	Showing off, modern, adventurous. Cycle racing. Start of promotion for civilised touring.	Civilised touring by all classes to support nation building. Useful for personal mobility and transport.	Everyday, robust and reliable means of personal mobility and transport for everyone.

To describe the history, four periods are distinguished, of which the first two are combined in the overview table (Table 4.1). The Dutch bicycle sector began in the first period, from 1860 to 1880. In the second period, from 1880 to 1900, the first Dutch bicycle organisations were established and Dutch manufacturing matured. In the third period, from 1900 to 1920, the Dutch bicycle sector changed character. In the last period, from 1920 to 1940, the Dutch bicycle market became cartelised. For each period, the developments of the bicycle, it use, bicycle firms, and the role of knowledge and intermediaries have been analysed.

The conclusion will reflect on changes in the activities and interactions of actors and organisations, knowledge flows and the role of intermediaries during the development of the Netherlands as a bicycle nation.

4.2 Starting Up, 1860-1880

In 1867 the bicycle was introduced in France, in a world with neither specific bicycle firms nor organisations. The Dutch slowly became familiar with bicycles and cycling sports. Several Dutch import firms and bicycle manufacturers were established with mostly local clientele.

4.2.1 The Pedal Driven Velocipede, the Latest Fashion from Paris

In 1867, the Parisian blacksmith and carriage maker Pierre Michaux placed a small advertisement in *Le Moniteur Universel du Soir*, which presented his latest product: a velocipede with pedals.[25] The introduction of Michaux's velocipede was to become the starting point for a revolution in transport and mobility, including the start of a new industry sector.

The vehicle caught the attention of foreign visitors, who were in Paris for the Universal Exhibition of 1867. Several visitors purchased a bicycle and shipped it home, which spread the pedal driven vehicle in Europe and the United States.[26] One of them was Dutchman Otto F. Groeninx van Zoelen. The 29 year old baron bought a velocipede from Michaux, which he then introduced in the Rotterdam area.[27]

4.2.2 The Bicycle Enters the Netherlands

Before the pedal driven velocipede appeared in the Netherlands, Dutch wagon makers and blacksmiths already experimented with human powered vehicles, such as draisines and tricycles.[28] The vehicles were used in races, which were organised by local pubs.[29]

The introduction of the pedal driven vehicles started off the Dutch bicycle sector. Enthusiastic users brought the bicycle from Paris to the Netherlands and showed the velocipedes at exhibitions. In 1866, the first Michaux velocipede was displayed at a physics exhibition in the province of Friesland.[30] Local craftsmen copied the vehicle and in the same year the bicycles were used in races. In 1868, J.T. Scholte imported Parisian velocipedes to Amsterdam. One of his retailers, H.H. Timmer, hired and sold the expensive bicycles and founded a bicycle riding school to promote this new activity in the Dutch capital. By setting up a riding school he also contributed to the establishment and diffusion of cycling as an activity.

Table 4.2 Early cycling clubs in the Netherlands 1869-1883

	Club name	Location	Membership	Region	
1869	Amsterdamsche Velocipede-club	Amsterdam		Urban Holland	(West)
1871	Immer Weiter	Deventer	51 (1872)	Gelderland/ Overijssel	(East)
1872	Voorwaarts	Apeldoorn/ Brummen	25 (1885)	Gelderland/ Overijssel	(East)
	De Zwaluw	Rotterdam	18 (1885)	Urban Holland	(West)
1874	Leeuwarder Velocipede Club	Leeuwarden	39 (1885)	Northern provinces	(North)
1877	La Sylphide	Amsterdam		Urban Holland	(West)
	Groninger Velocipede Club	Groningen		Northern provinces	(North)
1880	La Vitesse	Apeldoorn	7 (1885)	Gelderland/ Overijssel	(East)
1881	Vires acquirit eundo	Zutphen	11 (1885)	Gelderland/ Overijssel	(East)
1882	Celiritas	Zwolle	13 (1885)	Gelderland/ Overijssel	(East)
	De Ooievaar	The Hague	18 (1885)	Urban Holland	(West)
	Haarlemmer Velocipede Club	Haarlem	27 (1885)	Urban Holland	(West)
1883	Bredasche Velocipede Club	Breda	7 (1885)	Southern provinces	(South)
	De Zwaluw	Arnhem	16 (1885)	Gelderland/ Overijssel	(East)
	De Voorwaarts	Wageningen	13 (1885)	Gelderland/ Overijssel	(East)

Sources Middelburgsche Courant, 19 January 1869; *Stadsarchief en Athenaeumbibliotheek Deventer* (Deventer City Archives) ID 1019, Deventer vélocipède-club *Immer Weiter*; ANWB Archives, *Maandblad*, February 1885.

Dutch blacksmiths and wagon makers simply copied the French machine. This was done in every country except the USA, where the bicycle's basic design was patented.[31] One of the entrepreneurs who started by copying the velocipede, was Henricus Burgers (1843-1903).[32] Burgers was already renowned in the east of the Netherlands as an all-round blacksmith who produced carriages and wagons as well.[33] In 1869, Burgers started producing wooden velocipedes based on Michaux's

design. In 1873, Burgers' works produced 122 bicycles.[34] At that time, the machines had an iron frame, wooden wheels without bearings and a saddle connected to a blade spring. The price of a machine was 48 guilders, about twice the monthly wage of an agricultural labourer.[35]

Burgers' bicycle factory prospered as his products attracted local attention. It was therefore no coincidence that in 1871, sons of the local elite founded 'Immer Weiter' (German for 'Always Forward'), one of the first Dutch bicycle clubs. All members owned a wooden Burgers bicycle.[36]

In the 1870s more clubs were founded in the areas where the first French bicycles were introduced. Membership remained limited, consisting mainly of local upper class youngsters (Table 4.2). The club activities were an expression of the riders' control over their machines. This was often displayed in the names of the clubs and certainly in the activities that resembled equestrian sports such as racing, dressage, tilt at the ring and touring. These bicycle clubs, which also organised races, contributed to the diffusion of cycling as a sport.

4.2.3 Mediation and Knowledge

Potential users and manufacturers were introduced to bicycles and cycling via exhibitions and demonstrations. Pioneering users and firms organised races, established riding schools and local bicycle clubs, which were important because this new activity had to be learned and developed. As a result of these activities, users and society became acquainted with cycling. Cycling as a sport mainly attracted rich youngsters. The French velocipedes, which were the most important knowledge sources for the manufacturers, were displayed at exhibitions then tested and demonstrated by their first users.

4.3 Organising and Maturing, 1880-1900

Cycling became more popular in the late nineteenth century. Moreover, utilitarian cycling opened new markets. More trade and production firms were established, which made the acquisition of product and production knowledge more important. Furthermore, the need for repairmen increased.

4.3.1 Cycling Wins Ground

In the 1880s cycling became more popular, but was still limited to a select group of people. The cost of new, imported bicycles varied from 130 to 225 guilders, about

four to six times a labourer's monthly median income.[37] Cycling was mainly a club activity. Clubs organised tours, races and exhibitions. Some cyclists felt rather isolated in their local clubs. That is why cyclists of the Velocipede Club '*De Ooievaar*' (The Stork) in The Hague were pleasantly surprised when they met members of the Velocipede Club of Haarlem on one of their spring tours. Inspired by the British Bicycle Touring Club, which was established in 1878, this meeting resulted in the establishment of the national Dutch Cyclists Union (*Nederlandsche Vélocipèdisten-Bond*) on July 1st, 1883. From 1885 the name was changed to *Algemeene Nederlandsche Wielrijders-Bond* (ANWB).

Until then, cycling and commercial activities mixed easily in an informal way. The first ANWB board members, however, soon found out that they could not mix different interests, when alongside their board membership, they enthusiastically started their own bicycle firms. For example, in 1884, Englishman D. Webster, second chairman and one of the founding members, became an agent for Singer, Rudge and Bayliss Thomas bicycles. These commercial activities threatened ANWB's reputation, as existing bicycle manufacturers and retailers protested unfair competition, and outsiders saw the ANWB as a club promoting the commercial interests of its board.[38] Not until January 1885, when influential persons refused to financially support the ANWB, did the organisation prohibit board membership for members who earned a living from bicycle sales, manufacturing, repair or related activities.[39]

Improvements in regulations and infrastructure for cycling contributed to the growing popularity of cycling. The activities of the ANWB in developing a cycling infrastructure and mediating between users and firms were of prime importance.[40] The ANWB realised that cyclists needed local infrastructure for eating, accommodation and bicycle repair. Therefore, one of the earliest ANWB projects was to compile a handbook, which was first issued in May 1884. It literally opened up the cyclists' world, by providing cyclists with information about safe and suitable routes, addresses of coffee houses and reliable hotels. It included a list of recognised repair workshops, which were allowed to call themselves ANWB repairshops. In 1894, the ANWB erected the first signposts, so that cyclists could tour independently. Nevertheless, when their bicycle broke down, cyclists had to improvise. There were hardly any bicycle repairmen in the country, so cyclists depended on local blacksmiths. To cater for this need, the ANWB board proposed in 1895 to start an experiment with the installation of bicycle aid boxes in pubs and restaurants in the countryside, just as had already been implemented in Belgium (Figure 4.1).[41]

Figure 4.1 Cyclists fixing a flat tyre at Hotel 't Kromhout, note the ANWB aid box sign (HULPKIST A.N.W.B.) above the door.

The ANWB installed the initial bicycle aid boxes in 1895. Their contents reflected the expected capabilities of early cyclists to repair their machines (Table 4.3). These were quite extensive, as users had to be able to perform rather sophisticated repairs, such as fixing problems with ball bearings and chains. By making these tools and repair items available, the aid box bridged the gap between cyclists and bicycle parts suppliers.

The ANWB also organised cycle races, which were very popular, and which also promoted bicycle sales. However, as races became associated with betting and corruption, the ANWB decided to stop any involvement in cycle racing in 1898. Instead it decided to only stimulate cycle tourism, as this was a civilised activity. For this purpose, the ANWB tried to improve railway transport for bicycles, offered legal support and insurance against accidents, improved road conditions, encouraged cyclists not to let farmers and villagers get away with maltreatment, and educated cyclists to behave responsibly. It also lobbied with authorities to abolish tolls and import taxes. Furthermore, the ANWB published the magazine *De Kampioen* (The Champion), with advertisements, news about bicycle use and the bicycle industry.[42]

Table 4.3 Contents of the bicycle aid box

Free items	Repair items for sale	Dressings
- Lubricant - Reel of string - Copper wire Fixed inventory - Pneumatic pump with connectors to 'ordinary Dunlop' and 'American Dunlop' tyres - Two types of adjustable spanners - Pipe wrench, with one handle that could serve as a screwdriver and another as a tyre lever	- Chain bolts - Bearing balls (various sizes) - Tyre repair kit, including canvas, rubber, solution, sand paper and valve rubber - Chain links - Nuts (unhardened metal) - Packings	- Cotton wool - Iodoform gauze dressing - Cambric bandage - Ferric chloride cotton wool - Box of adhesive plasters - Safety pin - Scissors

Source De Kampioen, 21 January 1898.

4.3.2 Dutch Bicycle Traders and Manufacturers

One of the topics in *De Kampioen* was the capability of the Dutch bicycle industry, whose products were of lower quality than the British, due to the lack of production knowledge. As a result, Dutch manufacturers could only compete by producing second grade, cheaper bicycles.[43]

So, Dutch cyclists mostly bought British bicycles, and the ANWB was critical about the Dutch bicycle industry. According to *De Kampioen*, the Dutch needed experienced engineers and craftsmen. Instead, 'blacksmiths in obscure workshops ordered parts and assembled, enamelled and nickel plated bicycles without understanding how to deliver quality'.[44]

New entrants started, who had to learn how to trade and manufacture bicycles. Most of these entrepreneurs were younger than thirty, had an affinity with the new cycling sport or were active in cycling clubs. Some entrepreneurs first started trading and then expanded their business with production, like H.W. Bayer. In 1880, only 19 years of age, he started an import firm in Rotterdam for British high wheeled bicycles.[45] From 1890, he also produced bicycles. Another example of such a trader was H.A. Samuels. He started his business in 1886 importing Hilleman Herbert & Cooper bicycles from Coventry.[46] In 1887, Samuels' agency expanded and represented no less than twelve British bicycle industries, including Humber, Singer, Coventry Machinist, Starley & Sutton and Rudge, which were well-established brands. With his knowledge of British bicycles and the industry, Samuels started a bicycle factory in Amsterdam in April 1887.[47]

As well as traders also blacksmiths, wagon makers and metalworkers started a bicycle factory by buying bicycle parts and copying bicycles. These manufacturers innovated by using their skills and experience while learning how to construct bicycles. For example, in 1883, Albert Fongers, a blacksmith and wagon maker in the north of the Netherlands, bought a high bicycle from England for his son, who attracted the attention of his peers with it. When asked if he could build one for them, Fongers made his first bicycle in 1884, using parts from British manufacturers.[48]

For specific product and production knowledge manufacturers and traders now relied on British products and manufacturers. After France lost the war with Prussia in 1871 and suffered an economic crisis, Britain had taken over as the centre of bicycle production. British engineers and craftsmen with metalworking skills had improved the bicycle's roadworthiness.[49] In 1870, the first all metal bicycle, Ariel, was developed by James Starley. It set the standard for the high wheelers that were to be used for cycle sport activities.[50] As British firms were far away, Dutch manufacturers also needed creativity to make functional high wheelers. This happened when in the early 1880s, Burgers experienced that 'no parts could be expected from England'. So, he made the backbone of his high wheeler from gas piping and even made ball bearings.[51]

Dutch manufacturers not only copied, but also tried to improve bicycles. Burgers improved the Facile bicycle by adding Aeolus ball bearings which were absent in the original design.[52] The Facile bicycle was a British, patented design, operated by levers instead of pedals.[53]

Production expertise was also acquired from Britain. Before starting a repair workshop in 1886, J.W. Koopman worked for four years in British manufacturing plants. From 1889 he produced Sint Bavo bicycles, using American and British machinery.[54] To enhance his reputation, his advertisements referred to his experience in Britain. Likewise, H.A. Samuels advertised that British craftsmen, who were apparently living in Amsterdam, made his bicycles. The machines won awards at several Dutch exhibitions. Moreover, in 1890 Samuels was the first Dutch company to show bicycles at the Stanley bicycle club show in London's Crystal Palace, the world's leading bicycle exhibition. There he surprised the British with unexpected high quality products.[55] Unfortunately, in 1891, Samuels went bankrupt.[56] Still, Samuels' setback created an opportunity for his competitor Simplex, which immediately employed the best of Samuels' employees.[57]

The Samuels example also illustrates the uncertainties and risks in this new and booming sector. Despite such bankruptcies, the first Dutch bicycle manufacturers matured in the 1890s; 1894 and 1895 were top sales years, which allowed Dutch bicycle manufacturers to invest in expansion and new facilities (Table 4.4).[58] This increased Dutch production capacity by thousands of bicycles per year.

Table 4.4 Investments by major Dutch bicycle manufacturers, 1896-1897

Year	Firm	Investment	Location	Production capacity per year
1896	Burgers ENR	Expansion & new facilities	Deventer	5000 – 6000 bicycles
1896	Simplex	Expansion & new facilities	Amsterdam	5000
1896	Hinde*	New factory	Amsterdam	
1897	Eysink	New factory	Amersfoort	
1897	Fongers	Expansion & new facilities	Groningen	2000 – 3000
1897	Gruno	New factory	Winschoten	

* bankrupt in 1900
Sources Hogenkamp, 1939; http://www.rijwiel.net; *De Kampioen*, 3 July 1896; Van der Vinne, 2001; Brusse, 1920.

The increasing maturity of Dutch bicycle production was confirmed by the ANWB's editor. In 1894 he declared the Dutch bicycle industry to be modern, as it used American and British machinery, and worked with engineers in plants with experienced craftsmen.[59] However, true to its liberal and neutral ideology, the ANWB refused to recommend its members to buy Dutch. It felt that as Dutch manufacturers had lower overhead costs than the British, they should be able to compete by delivering the same quality for much lower prices.[60] So, despite the modernisation of domestic bicycle plants, Dutch demand for bicycles was mainly met by imports from Britain. In the late 1890s, bicycles were also imported from the USA and Germany.[61] From 1895, when the end of a bicycle boom resulted in overcapacity of American plants, US producers started exporting low-priced mass-produced bicycles.[62]

4.3.3 From Sport to Utilitarian Cycling

In 1896, the first car was introduced in the Netherlands. Then, upper class youngsters switched their attention from bicycles to automobiles and motorcycles. However, cycling continued to be popular as utilitarian cycling and touring for all classes increased. In the early 1890s, the safety bicycle became popular – the low mounted, chain driven bicycle with two equally sized wheels which is still in use.[63] The bicycle with newly invented pneumatic tyres was introduced in 1890, and attracted a new and wider customer base, including many women.

The ANWB wanted to attract utilitarian cyclists as members as well, as they were seen as having similar interests in a good bicycle infrastructure.[64] This was important for lobbying purposes, as the government was preparing nationwide legislation for bicycles.[65] In 1891, the ANWB asked its members for names of utilitarian cyclists,

so that these persons could be approached for membership. The resulting list shows a variety of occupations like doctors, merchants, traders and craftsmen (Table 4.5). However, labourers were not mentioned.

Innovations were irrefutably changing bicycle use. Nevertheless, bicycles were still too expensive for mass utilitarian use. This was confirmed when the Dutch government introduced bicycle taxes in 1899. It revealed that less than 2 percent of the Dutch population owned a bicycle.[66]

The adoption of the bicycle for utilitarian functions developed slowly. Not only individual users, but also government agencies needed time to introduce cycling for communication and transport.[67] While the Dutch Postal Services had used bicycles since 1885, in the army, cyclists were originally volunteers, as the ANWB organised a civilian corps of military cyclists in 1889.[68] Only in 1909 was it replaced by a military corps.[69]

These government agencies did not automatically buy Dutch products. The army purchased bicycles from Dutch manufacturers Simplex (1897-1904) and Fongers (1904-1908), until 1915, when they needed more robust bicycles and started in-house production.[70] The Dutch Postal Services started buying bicycles from Burgers. However, in 1901, they decided to rent bicycles in order to save maintenance costs. Apparently this resulted in waiving the preference for Dutch bicycles, as German manufacturer Brennabor won the tender.[71]

Table 4.5 Top 20 occupations of ANWB members in 1891

Occupation	Number of members	Occupation	Number of members
Merchant	101	Student	44
Doctor	84	Shopkeeper	42
Factory owner	64	Wine and beer trader	41
Teacher	62	Trade agent	40
Nurseryman	58	Bicycle trader	38
Building contractor and architect	56	Cigar trader	37
Clerk	54	Grain and flour trader	35
Salesman	47	Cheese and butter trader	30
Manufacturer	47	Butcher	29
Carpenter	47	Other	594
Forger	46	*Total*	*1596*

Source De Kampioen, 19 December 1891, 8.

4.3.4 The First Bicycle Manufacturers and Traders Organisation

One of the consequences of the increasing popularity of cycling in the 1890s was that in December 1893 bicycle manufacturers and traders established RI, the Dutch business association 'The Bicycle-Industry' (*Vereeniging De Rijwiel-Industrie*, RI).[72] It was a response to the numerous exhibitions that local bicycle clubs organised to stimulate cycling. As bicycle manufacturers and traders were expected to attend all of these, the participation fees resulted in a financial strain for the young Dutch bicycle entrepreneurs. In November 1893, bicycle manufacturer H.W. Bayer wrote to De Kampioen, the Dutch Cyclists Union magazine, suggesting that bicycle manufacturers and traders should form an organisation with their own exhibitions. At that time, already three exhibitions, in Amsterdam, The Hague and Arnhem, were planned for early 1894. Six bicycle manufacturers (Burgers, Fongers, Simplex, Eysink, Bayer and Hinde) and twelve traders responded positively to Bayer's letter, resulting in the establishment of the RI.

Although manufacturers and traders now had a separate organisation, they had a good relationship with the ANWB, as some of them were ANWB members, and they were of the same generation. The RI decided that its members would only publish advertisements in ANWB's *De Kampioen*, which would save them money. In exchange, *De Kampioen* would only accept advertisements from RI members. The RI's first exhibition in 1895 was a financial failure, after which the RI became a sleeping association and the exhibition policy started to fade away. However, from 1899 the organisation replaced bicycle club exhibitions with their own exhibition.

The RI cooperated with the ANWB to improve the trade's reputation. From 1895, ANWB members who bought bicycles from an RI member could count on a six-month guarantee period, during which they would not have to pay for any defects due to production or repair failures.[73] Although this period was six months shorter than the usual guarantee period, customers could now approach an ANWB-RI guarantee committee if there were any disagreements, so the guarantee was more reliable. In 1899, the RI and the ANWB agreed that for a small fee, the bicycle guarantee was also available to non-members.[74]

While motorised vehicles were gaining popularity, the RI wanted to promote bicycles as modern products. Therefore, in March 1900 the organising committee of the third RI exhibition showed a 'live' bicycle plant. It consisted of lathing machines and other machines for bicycle parts production and was powered by a gas motor.[75] As envisaged, the bicycle plant attracted considerable attention from the public.[76] Some bicycle traders and manufacturers diverted their business to motorised vehicles, like Burgers, Gruno, Hinde and Simplex. For that reason, the RI decided in 1900 to rename itself the Dutch Association 'Bicycle and Automobile Industry' (RAI), to reflect the changes in mobility technology.[77]

4.3.5 Mediation and Knowledge

In the late nineteenth century, most bicycles were imported from Britain, however, domestic production of bicycles developed further. Bicycle manufacturers imported production knowledge mainly from Britain through artefacts (bicycles and bicycle parts), through travel (visiting and working in British plants) and, through people (British craftsmen). They were able to apply this production knowledge by relying on their existing knowledge and experience. Knowledge about products, production and markets circulated in a small network, consisting of a mixture of users, traders and manufacturers, who met during races, exhibitions and club meetings. Knowledge transfer was direct and without intermediary organisations.

Exhibitions continued to play an important role in spreading product knowledge and cycling as a fashionable practice for upper class youngsters. In the 1880s the number of cycling clubs increased. Cooperation between them led to the establishment of the Dutch Cyclists Union (ANWB), which supported cyclists and stimulated further diffusion of cycling. Consequently, mediating activities for innovation were conducted by users, who bought bicycles and developed user practices, and by manufacturers and traders, who imported bicycles and knowledge and learned to produce and market bicycles. The ANWB was involved in mediation by organising races and building a touring infrastructure.

The ANWB wanted good quality bicycles for the Dutch, and was therefore critical of the capabilities of Dutch manufacturers, but also supportive. Together with the RI it initiated activities to upgrade the trade's reputation. The RI had been established in response to the increasing number of exhibitions organised by bicycle clubs, however, at first, it was not very successful.

To conclude, users and the ANWB were most influential and active in the development of the bicycle sector in this period and their membership overlapped manufacturers and traders. However, in the new century, business pressures would change these dynamics.

4.4 The Dutch Bicycle Sector Changes Character, 1900-1920

In these decades, competition increased and prices dropped. During World War I, imports stopped and the number of producers increased further. More users could now buy a bicycle and they also helped in developing the bicycle as a transport vehicle. The bicycle lost its upper class and sports image and became a more accessible and utilitarian vehicle.

4.4.1 More Cycling

In the early twentieth century, the popularity of cycling in the Netherlands continued to grow and the number of bicycles increased further, from 113,000 in 1900 to 861,000 in 1919. Bicycle ownership rose from 2 percent in 1900 to 12 percent 19 years later.[78] However, this growth was not a smooth and linear development. While some of the upper class clientele who purchased high-priced bicycles were lost to automobiles and motorcycles, the bicycle was not yet a mass product. Although lower bicycle prices attracted more users, they were still too expensive for the working classes. For example, in 1910, the cheapest bicycle was about 55 guilders, which equalled the monthly median income.[79]

Besides being an attribute for sport and leisure, the bicycle was increasingly considered as a utilitarian product. During World War I, the Dutch army started using more bicycles in an effort to replace horses.[80] Individuals used bicycles for transport and delivery, as civilian cycling became easier, also thanks to the endeavours of the ANWB. From 1900 to 1920, the organisation continued developing a bicycle infrastructure for touring and utilitarian purposes.[81] The ANWB studied how to prevent dust on cycle paths and the construction of new paths. It worked as building contractor and consultant for local authorities. Anything that could possibly hinder cyclists on their trips was a topic for the ANWB: legal advice, cycle storage at railway stations, hotel cleanliness, road signs and maps. Often, the ANWB needed to cooperate with other organisations and authorities. The ANWB also stimulated relationships, subsidising clubs and associations that were actively enabling cycling and tourism, unless they had a political or religious affiliation.

During World War I, the ANWB marketed cycle tours as patriotism. Touring not only enabled people to become acquainted with the attractive Dutch landscape and countryside, it was also a wholesome and healthy pastime. This was supported by local bicycle path associations of upper class citizens who wanted to stimulate healthy behaviour and local trade. The ANWB only subsidised those who followed the ANWB's advice on path construction and maintenance.[82]

The ANWB, renamed the Royal Dutch Touring Club in 1904, also represented motorised tourism, which had the advantage that it took the interests of various user groups into account. For this purpose, ANWB initiated several activities. For example, cyclists and hikers were educated to keep the Dutch countryside clean. Another example was the proposal for driving permits to ensure that automobile drivers would be responsible traffic participants. This started after noticing that the number of women cyclists increased in wartime. It appeared that women dared to take to the streets with their bicycles again when all the dangerous automobile drivers disappeared.[83]

4.4.2 Bicycle Repairmen and Retailers Unite

The increase in the amount of cyclists, bicycles and cycling offered possibilities to start a bicycle business, like a repair workshop. As a result, in the early 1900s, there were repairmen almost everywhere in the country. Consequently, the need for one of the first ANWB cycling support services, the aid box, vanished. J.C. Redelé, the manager of the boxes, explained this in 1914, when writing to the ANWB executive board: 'The exploitation of aid boxes has run for 17 years. Meanwhile, cycling has grown up. Initially, it was an infant that needed careful pampering, since then it has become more independent. Our aid boxes used to fulfil a great need. Now, they are not really useful anymore, they are advertisements. . . . There is a bicycle repairman in every village.'[84] The number of aid boxes was gradually reduced. Whereas the number of aid boxes was 1000 in 1910, it was about 500 in 1920, and only 84 in 1934.[85]

As competition between bicycle repairmen was fierce, in 1903 they linked up with retailers to form the Dutch Association of Bicycle Repairmen and Retailers (BRHN).[86] The BRHN was to ensure their survival and to improve their reputation, so BRHN united its members against bicycle price dumpers, bicycle auctions and unreliable repairmen. It also stimulated craftsmanship.[87]

To fight unfair competition, the BRHN also wanted to stop wholesale traders from supplying bicycles to any interested buyer, like mailmen who started bicycle selling as a side-line. Otherwise, the BRHN would blacklist them. In order to convince their suppliers, the BRHN invited them for a meeting on 13 November 1905 in Amsterdam. The meeting was not successful, as most of the suppliers were RAI members (formerly RI). They saw the BRHN decision as a way to lower wholesale prices. Furthermore, they were put off by the threat of blacklisting. After unsuccessful discussions, the RAI decided in 1906 to forbid its members to have any relationship with the BRHN. This lasted until 1910, after which the BRHN changed its strategy, and it agreed to cooperate with the RAI. As a result, both associations would publish an official list of bicycle retailers, with the objective to regulate bicycle trade and to protect its reputation.[88]

BRHN and RAI cooperated more easily against their common enemy, the travelling salesmen who organised bicycle auctions. Both associations viewed the practice as unfair competition, so to oppose this, they set up a joint committee in 1909. After four years, the committee concluded that bicycle auctions had virtually disappeared as a result of its actions.

BRHN's initial relationship with ANWB was also tense. In 1905, the BRHN provoked the ANWB, by suggesting that bicycle repairmen would find BRHN recognition more honourable than ANWB recognition. This conflict was settled in 1913, when both parties agreed on ANWB recognition for BRHN members. Members used their BRHN membership as a mark of craftsmanship and charged

standardised prices for their services, to encourage customers to choose them rather than non-members. Price standardisation was easier after 1900, because bicycle parts were more standardised so that bicycle repairmen were not confronted with many different types of wooden and steel rims, different tyres, spokes, handlebars, brakes, wheels and chains.[89]

In order to ensure good craftsmanship, the BRHN wanted to organise vocational training, but its members did not like the idea of BRHN training future competitors, even though poor craftsmanship gave the trade a bad name. In 1917 the BRHN, the Association for Directors of Vocational Schools (VDN), the ANWB, RAI, and several other associations set up a committee with the objective to organise vocational training. However, it only resulted in some local initiatives for training sessions, which were partly subsidised by the ANWB.[90]

4.4.3 Dutch Bicycle Producers Survive Difficult Times

Dutch bicycle manufacturers were confronted with fierce international competition and new entrants. From 1896 till 1900 Europe was overwhelmed with low-priced American bicycles.[91] This set in motion a process of price cutting and increasing production efficiency in the bicycle industry, where the demand for high-priced bicycles had already decreased. Lower prices meant new users could afford bicycles. Despite the Dutch production capacity increase in the 1890s, the Dutch bicycle market still depended on imports, mainly from Germany. In response to American price cutting, British bicycle producers hesitated to lower prices, whereas German bicycles were already cheaper.[92] So from the early 1900s, German imports of complete bicycles exceeded British imports: in 1907 the Netherlands imported 26,723 German bicycles and 4,203 British bicycles, and in 1913 49,056 German bicycles and 6,416 British bicycles.[93]

Dutch manufacturers using artisan production methods, who had previously served upper class clientele, were not able to survive this period. At the same time, however, expanding bicycle sales and the halt on imports during World War I, encouraged and helped new Dutch entrants to this industry. Their motivation and backgrounds were quite similar to their predecessors and they too had similar learning needs. One of the new entrants was Union, founded by Berend-Jan van den Berg (1877-1936).[94] At first, he worked as a salesman in his father's building materials business. He became fascinated by bicycles, bought one and learnt to ride. Then, he organised tours for local youngsters in order to boost demand, so by 1904 he was selling Dutch and German bicycles. As his business flourished, he started producing bicycles with Gazelle frames in 1911. The first bicycle series was a disaster due to the lack of production knowledge and skills. Loose crank axles were tightened with a metal strip and on the first ride, the frame would lose its ball-head

plate, as it was only fastened with small wooden pins. To improve production quality, Van den Berg managed to hire production managers from Burgers, Gazelle and Gruno. While in an earlier period Dutch manufacturers had to rely on British experts, Union could recruit from experienced Dutch manufacturers. In 1913, a new facility was built, which was soon expanded. Around 1917, Union also produced bicycle parts, like rims and crankshafts. In 1918 Union produced 5000 bicycles per year.

In the first two decades of the twentieth century the Dutch bicycle industry became more diverse. Burgers, Fongers, and Gazelle produced many parts in-house, although the majority of the bicycle manufacturers depended heavily on external supplies of bicycle parts (Figure 4.2).[95] Great Britain and Germany were the most important suppliers of bicycle parts and fittings, like frames, cranks, handlebars, bells, rims, hubs, chains, pedals, and saddles.[96] In 1907 the value of the import of cycles and parts from Germany was £ 285,600 and from the UK £ 129,773, and in 1913 these values were £ 220,850 and £ 254,589.[97]

Figure 4.2 Fitters in Fongers bicycle factory, Groningen, 1929.

Before the 1920s, imported parts were partly replaced by domestic products. Furthermore, some of the new bicycle parts manufacturers introduced new products, like bicycle locks, tools or storage racks.[98] One of them was Klaas de Vries, who developed a bicycle lock in 1917, as there was an increase in bicycle thefts during the war.[99] It consisted of a U-shape with two clocks at the ends, which connected a horizontal bar.[100] De Vries patented the design and started the Hopmi firm in 1917 to produce and sell his locks. The new lock was so popular, that many Dutch

bicycle manufacturers, including Burgers and Fongers, applied it. The successful start enabled Hopmi to diversify its production with other bicycle parts, like carriers, carriers combined with standards, saddles, and foldable handlebars, for better bicycle storage and transport.[101]

More domestic production also had an effect on marketing and created a Dutch style bicycle. For bicycle manufacturers it became easier to standardise and specify the design of their bicycle parts so that it would reinforce their brand.[102] An example of a typical Dutch product was the standard carrier for the front or the rear of the bicycle. Durabo, established in 1898, was one of the early Dutch bicycle parts manufacturers that produced carriers.[103] Its front and rear carriers were mainly made of recycled steel belts from Dutch East Indies' tea boxes.

World War I stimulated Dutch bicycle production. The Netherlands declared its neutrality and continued production using British parts up till 1916. German imports were not possible anymore, so existing manufacturers expanded their production, and new entrants took the opportunity to produce parts and fittings.[104] Bicycle prices increased, due to material shortages. After the war, in September 1919, when bicycle manufacturer Gruno was asked whether he expected that high priced Dutch bicycles could survive the expected flood of cheap imports, his response was that material prices had increased for everyone. Then he added: 'Our objective is to be highly competitive, because we are able to do so, in terms of producing robust and good bicycles, and price wise'.[105]

World War I also had the effect that manufacturers and firms depended more on the RAI and the BRHN. In order to continue imports from Britain, Dutch manufacturers needed to deposit a bank guarantee, to ensure that these imports would not be sold to Germany. For this purpose, the Dutch government established a trust organisation (NOT) in November 1914.[106] The RAI and the BRHN mediated between manufacturers, wholesalers and the NOT, and thereby became more important for the Dutch bicycle sector.[107] When the import of tyres stopped completely in July 1916, a government committee for maximum prices was set up to prevent speculation. The committee was chaired by ANWB secretary Steffelaar. However, he resigned in 1918 – retailers and manufacturers opposed his appointment, because they saw a conflict of interests.[108]

After the war, the bicycle market became again very competitive. German manufacturers sold bicycles at extremely low prices, which attracted many individuals to sell bicycles as a side-line. For this reason, RAI and BRHN established a bicycle cartel in 1919, together with the association of wholesale traders of bicycles and parts (NEVGRO).[109] The cartel started in 1920 and was managed by the CBR (Central Bicycle Trade Bureau).[110] The CBR controlled bicycle production and its members' sales. It managed a list of recognised suppliers and sellers, sales quota and prices. Members who did not comply were fined, or could not get supplies from any other members.

The cartel was heavily opposed by the ANWB, whose liberal values supported a free market. In their eyes, cyclists should have unregulated freedom of choice. ANWB chairman Bergsma, who was also a member of the Senate in the Dutch parliament, voiced his opposition in March 1921.[111] The Minister was not impressed, as he did not believe the government was able to stop cartels, in or outside the Netherlands. Furthermore, he did not see retailers making high profits, and he saw advantages for the general public who could buy bicycles from retailers with a good reputation.[112] After that, the ANWB did not take any further steps.[113]

4.4.4 Technical Advice for the Industry – the *Rijksnijverheidsdienst*

From 1900 to 1920, the Dutch bicycle industry expanded into a variety of firms for bicycle and bicycle parts production, which prolonged the need for knowledge. Most Dutch bicycle manufacturers continued to follow British developments. Fongers' policy was to apply the latest bicycle innovations from Britain like the freewheel (1901) and Bowden rim brakes (1904) to the most expensive models.[114] The larger bicycle manufacturers, whose expansion had started around 1890, also copied British bicycle production methods with machines and labour differentiation.

From 1910, bicycle manufacturers and repairmen could also approach a government agency for help in acquiring product and production knowledge, the *Rijksnijverheidsdienst* (RND, Technical Information Agency). Responding to an initiative of upper class citizens, the Dutch government decided to stimulate the application of modern science and technology in small and medium enterprises. It thought these business owners could help stabilise Dutch society which was in turmoil due to modernisation and industrialisation. This decision was a change in policy, as for decades the government had preferred to pursue a liberal economic course.[115]

RND was inspired by German and Austrian governmental institutions, but as its resources were minimal, it could only help a small percentage of Dutch firms.[116] In 1910, RND started with one industrial consultant, a mechanical engineer, who was joined by two colleagues in 1913. To minimise the barrier for small and medium enterprises, RND's services were free of charge.[117]

To be able to advise businesses, RND developed and maintained a knowledge base consisting of addresses of British and American agents and manufacturers. Furthermore, in addition to the general technical library, the consultants collected information about special melting and soldering furnaces and other production equipment, materials and methods.[118] To understand the bicycle business, the consultants visited bicycle factories, like Fongers in 1914.

When firms approached the RND for help, the consultants used several sources of information to prepare their advice. They would use their knowledge base, advice

from the RND laboratory, their experience, and often, a personal visit to the firm.[119] Bicycle manufacturers did not consult RND frequently. The RND consultant for the north and the east of the Netherlands, where most of the bicycle manufacturers were based, received the first requests in 1916. Until 1920, he advised eight firms almost twenty times, mostly about production, energy supply and factory construction.

RND also received questions about the VNF hallmark. In addition to consulting, RND staff supported marketing efforts for the Dutch industry. This was helpful for Dutch bicycle manufacturers as well. One of the reasons why their customers preferred bicycles and other products from countries like Britain and Germany was that, unlike the Netherlands, these countries were seen as having a modern industry which produced high quality products. That is why RND consultants became involved in the establishment of the Association 'Made in the Netherlands' (*Vereeniging 'Nederlandsch Fabrikaat'*, VNF) in 1915. VNF was established by upper class citizens to promote Dutch products as replacement for products that were imported until World War I.[120] RND consultants carried out audits to check whether products had been manufactured in a Dutch firm, then the VNF committee decided whether the products qualified for the VNF hallmark. In the bicycle industry, the Adek factory was the first to pass the inspection, and other bicycle manufacturers followed.[121]

RND was also involved in an initiative to assist manufacturers in patenting innovations. After its abolishment in 1869, a new Dutch patent law became effective in 1912. Patents were seen as a way to stimulate innovation and industrialisation, so a wealthy Dutch entrepreneur established the Agency for Inventors (*Bureau voor Uitvinders*), which subsidised patent requests and stimulated implementation. This agency cooperated with RND. Its consultants coached inventors and evaluated their inventions, like a bicycle lock (1919), a bicycle pump (1919), and a crankshaft (1920).[122]

4.4.5 The Utilitarian Bicycle: Bicycle Ambulances and Transport Cycles

From 1900 to 1920, development of utilitarian bicycles continued. After the invention of pneumatic tyres in the 1890s, further improvements in brakes and gears made utilitarian cycling more popular. In 1906, Dutch authorities influenced bicycle design by making the front light and the bell compulsory. Furthermore, experiments were conducted to use the bicycle for transport.

For innovations in utilitarian cycling, manufacturers needed to understand user needs, which might explain why they did not approach RND for advice. The examples of the bicycle ambulance and transport cycles illustrate how users developed new models individually or in cooperation with manufacturers.

Experiments to use the bicycle as a means for transporting patients were first

conducted by armies, and coincided with the development of first aid and care of wounded soldiers in the early twentieth century. In those days, the Red Cross and the Dutch army exercised regularly together and this included experiments with bicycle transport.[123] Dutch army doctor G.W. Boland developed a bicycle stretcher, which transported the patient in a construction on the handlebars, covered in cloth. In 1907, he was awarded a prize for this bicycle at the International Red Cross exhibition in London.[124] In the same year, Menno Huizinga, director of Amsterdam's new municipal medical service (GGD), approached the Simplex bicycle factory with the request to develop a bicycle ambulance.[125] The resulting bicycle ambulance was a three-wheeler with the stretcher between the two front wheels. The model was quite popular, so Simplex sold it to medical services in the Netherlands, Dutch East Indies, Britain, France, Germany and Sweden. Its success may have inspired other bicycle firms to copy the Simplex bicycle, as around 1910, Van der Lely & Co supplied a similar model.

During World War I, Red Cross exercises in the Netherlands resulted in other variations, like multi bicycle constructions, easy to carry constructions and small, flexible constructions. Some of these were developed together with local bicycle repairmen. However, most of these vehicles did not survive the experimental phase. In the early 1900s, transport and carrier cycles were custom made. This enabled the manufacturer to include specific user requests and to learn from user experiences to make cycles more suitable for utilitarian purposes. The first transport and carrier cycles, usually tricycles, were already for sale in the 1880s.[126] When bicycle prices dropped, it allowed the further development of bicycles as a means for small shop owners to transport goods. Dutch manufacturers developed their own products, with many British examples available for inspiration.[127] The Fongers catalogue showed carrier bicycles for the first time around 1900. These bicycles were driven with two or three wheels, custom made and only delivered on order.[128]

The transport and carrier cycles produced by bicycle manufacturer and retailer Bergreijer shows how user needs were translated.[129] Around 1915, their bicycles had a larger front carrier, a more robust construction and more flexibility in steering. If necessary, a very soft spring system was used for the transport of fragile goods. Similarly, to transport heavy goods on the front carrier of a transport cycle, Bergreijer built a robust construction consisting of split V-shaped handlebars which formed a triangle with a horizontal beam.

4.4.6 Mediation and Knowledge

Between 1900 and 1920, the characteristics of the Dutch cycling and bicycle sector changed. The bicycle became accessible to more people and was not only used for sports or touring. The development of the utilitarian bicycle was accompanied by

production expansion and an increasing number of domestic manufacturers. Dutch bicycle manufacturers experimented together with users to develop bicycles for transport and services. The ANWB developed the bicycle infrastructure together with the authorities and other associations. The result was a larger domestic knowledge base, even though the Dutch bicycle sector continued copying British trends and innovations. For knowledge and experience, established Dutch bicycle firms were important.

Market turbulence had resulted in another business association, the BRHN. Initially, the new organisation had to find its position in relation to the existing ANWB and RAI. BRHN's role was at first limited to market protection, so it did not yet contribute to enhancement of the general knowledge base. The importance of associations increased during World War I. This paved the way for the cartel to protect Dutch production against German imports. In this period, the government's RND advised firms. More important than the limited consultancy role, was RND's support of the 'Made in the Netherlands' hallmark for individual firms, including the bicycle industry. More domestically produced bicycles were available on the Dutch market.

To summarise, this was a fluid period. The bicycle sector and the bicycle transformed in response to changes in user groups and their preferences, competition, cost pressures and World War I. Ultimately, the bicycle sector was structured to manage the Dutch market, and the ANWB was the driver and creator of the bicycle infrastructure and a cycling culture in which the bicycle was a civilised vehicle for all Dutch citizens. From this configuration, the utilitarian bicycle started diffusing into the lower classes. However, it would take two more decades before the bicycle was a vehicle for the masses.

4.5 A Cartelised and Dutch Bicycle Market, 1920-1940

In the 1920s, the Dutch bicycle cartel managed to minimise imports. As the Dutch bicycle industry was expanding as well, by 1925 almost all bicycles sold to the Dutch were made in the Netherlands. Bicycle prices continued to fall, so that the bicycle became a mass consumption product for all Dutch people, for touring and utilitarian purposes. Incremental innovation in bicycles, parts and fittings continued, while a typical Dutch bicycle developed.

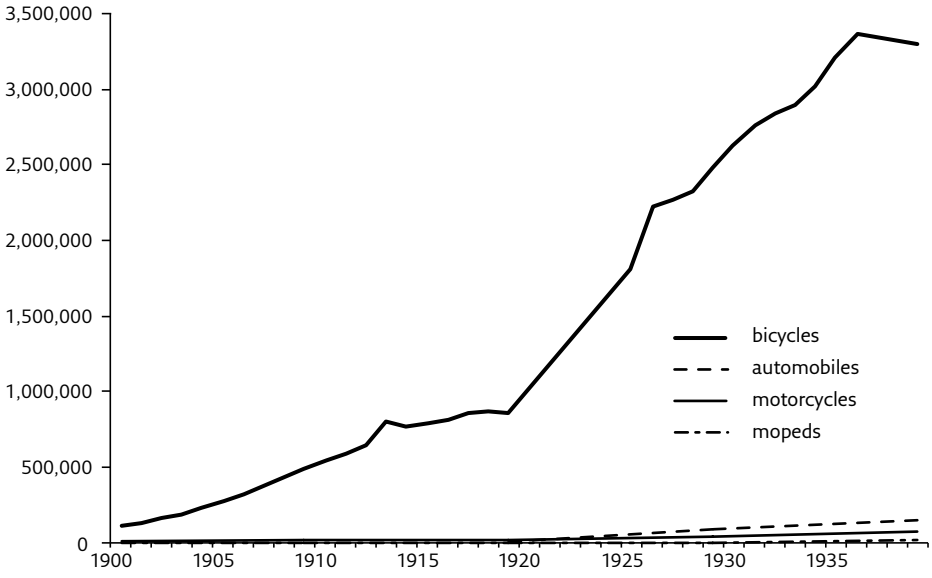


Figure 4.3 Dutch vehicle ownership from 1900 to 1939.

4.5.1 Towards Mass Use and Mass Production, 1920-1940

Bicycles for Everyone

Between 1920 and 1940, the bicycle became a mass product. Despite the economic crisis, the number of bicycles in the Netherlands rose from 861,000 in 1919 to 3,300,000 in 1939, in a population of 8.7 million.[130] In other words, the percentage of the population that owned a bicycle increased from 12 percent to 38 percent. The bicycle was a much more common possession than other vehicles (Figure 4.3). In 1939, compared to 3.3 million bicycles, there were 15,000 mopeds, 60,000 motorcycles and 150,000 cars.[131]

In these years, millions of bicycles were bought by the working classes who could afford these when prices fell. The cartel did not stop price pressures, so the bicycle industry continued low cost production. According to Statistics Netherlands the major manufacturers' average bicycle price was 89 guilders in 1922, when an agricultural worker's monthly income was 120 guilders.[132] In 1935 the bicycle price was 28 guilders, with hardly any change in income due to the crisis.[133] Whereas in 1924, 139,000 bicycles were produced per year (Figure 4.4), this almost trebled to 374,000 bicycles per year in 1928. The result was that the Dutch bicycle industry could at last meet domestic demand.

The increasing number of cyclists could still rely on the ANWB, although in the 1920s and 1930s the organisation was very much involved in the rise of

motorised traffic. Thus members ensured that the ANWB continued stimulating bicycle touring and lobbying for cyclists' interests. For example, thanks to ANWB's status, the authorities would first consult them when considering policy changes. So, when the Dutch government intended to re-establish bicycle taxes in 1924 after the abolishment in 1919, it first consulted the ANWB. The ANWB was then able to have the proposal modified, so that taxes depended on personal income. In addition, bicycle and vehicle taxes were funnelled into a road fund, which was used to plan and construct an integrated road infrastructure.[134] After that, the ANWB continued to be a critical stakeholder. When the government intended to increase automobile, motorcycle and bicycle taxes, and to abolish the road fund in 1934, chairman Bergsma organised a public meeting with automobile and motorcyclists unions KNAC and BBN.[135] This time, the ANWB was not able to convince the government. Although bicycle taxes were not increased, the road fund was abolished.

Figure 4.4 Dutch bicycle production per year from 1920 to 1939.

Dutch Bicycles for Everyone

Domestic production and sales were managed by the cartel, which from 1925 succeeded in minimising bicycle imports, despite recurring conflicts between RAI and BRHN. Although in late 1923 the German measures to stop hyperinflation halted German price-cutting, the cartel still needed to protect the Dutch bicycle market, as Dutch import tariffs were relatively low, around 10 percent.[136] Despite lobbying by bicycle manufacturers, the Dutch government did not approve quota until 1935.[137]

Import of bicycle parts continued and even increased, as in 1927 the value of 19,306 bicycles imported from Germany was 675,000 RM, whereas the value of imported parts was 8,951,000 RM.[138] Furthermore, Dutch bicycles were not competitive in the world market, as the Dutch production scale was smaller than in Britain and Germany.[139] The result was that the Dutch bicycle market became inward focused, as is illustrated by its low import and export in 1925.

The victory over imports finally made the Dutch proud of their bicycle industry: '. . . against all this import, the Dutch industry had to fight and develop itself. Nowadays, it is hard to imagine how foreign products were preferred above Dutch products . . . the public has experienced that first class produced Dutch bicycles are the best in every way.'[140] Production expansion was partly made possible by new bicycle firms. Production statistics of 1929 show that there were 35 manufacturers (average number of employees 52.8) and 58 assemblers who produced more than 500 bicycles a year.[141] In 1929, 405,000 bicycles were produced in the Netherlands, of which 51 percent by the larger manufacturers and 22 percent by the larger assemblers, which was on average 3216 bicycles per large producer. In addition, it was estimated that there were at least 200 smaller firms who produced the remaining 105,900 bicycles. These small firms were often repair shops who presented themselves as bicycle manufacturer as well. They either assembled bicycles or constructed these from packages. It was a competitive way of producing bicycles, as parts were standardised and cheap. However, it was suggested that these bicycles were not as reliable in the long term, due to low coating quality and insufficient production control.[142] Between 1925 and 1939 the percentage of assembled bicycles varied between 41 and 56.[143]

4.5.2 Increasing Competence

Although the knowledge base of the Dutch bicycle industry was growing, British and German developments remained important. For example, Durabo bicycle manufacturer Meerbeek visited England in 1933, where he noticed the new lighter frames with narrow 26-inch wheels. He then decided to also produce these himself. As the Dutch were used to wide 28-inch wheels, it took a while before these cycles sold.[144] Another example is that Dutch manufacturers used pedal brakes from Fichtel and Sachs in Germany, which were easy to use in the flat Dutch landscape.[145] Furthermore, some domestic production replaced imports, such as electric bicycle lamps. Around 1920, carbide lighting was slowly replaced by electric lighting, which was imported from Britain, Germany and Switzerland. But by the 1930s, Dutch manufacturers could purchase lighting from Dutch firms like Philips, Leko and Unigro.[146]

Dutch firms also continued copying each other. In 1937, Simplex followed Durabo's example in copying British sports cycles. An example of copying

construction innovations happened in the late 1930s, when small bicycle manufacturer Mulder adapted the mudguard so that there was space to fit wiring for the newly required electric rear lighting. After a while Mulder discovered that Gazelle had patented his construction, because his supplier could not produce these for him anymore.[147]

Unsurprisingly, the number of patents for bicycle and bicycle parts from Dutch investors was modest (Figure 4.5). From 1913 till 1940, 487 patents were obtained, of which 273 were given to Dutch inventors, whereas 214 had foreign inventors. Of the 273 Dutch owned patents, 83 were from recognisable bicycle or bicycle parts firms.

Figure 4.5 Number of bicycle patents published in the Netherlands from 1910 to 1940.

Firms continued to approach RND, sometimes several times over a number of years, for advice on technical, management and organisational issues. The variety of businesses that contacted RND was substantial. From 1916 to 1934, the consultant for the north and east received advice requests from thirteen different small, medium and large bicycle manufacturers (Table 4.6). In addition, he received requests from bicycle parts manufacturers, bicycle traders, and several related organisations. With 35 requests between 1920 and 1934, RND's consulting role in the bicycle industry was small.

Table 4.6 Requests for advice from bicycle manufacturers in the East of the Netherlands

Factory or director name	Location	Period	Number of requests
Batavus	Heerenveen	1928-1934	6
J. Bronda	Groningen	1922	2
Drusus	Doesburg	1917-1930	4
Empo	Vorden	1931	1
Fongers	Groningen	1918-1921	2
Gaasterland	Nijemirdum	1916-1923	8
Gruno	Winschoten	1917-1921	3
Phoenix	Leeuwarden	1918	1
Joh. Tedinga & Co	Emmen	1918	2
Union	Dedemsvaart	1916-1930	11
Veeno	Bedum	1923	2
F. & J. van Werven	Meppel	1913-1931	12
W. Wittkampf & Co	Apeldoorn	1921	2

Source Brabants Historisch Informatie Centrum (BHIC, Historical Information Centre Brabant), 169, inv. no. 93, Monthly reports consultant Deventer 1914-1935.

Bicycle manufacturers asked RND for help in a range of problems, as illustrated by the descriptions of the advice requests from Frederik and Jan van Werven's bicycle firm (Table 4.7). Frederik van Werven, son of a blacksmith, began a wholesale trade in bicycles and bicycle parts in 1893. He was joined by his brother Jan, and they started producing bicycles under the brand 'Germaan' in 1905. In 1915, they built a new plant and in 1916, they requested the VNF hallmark. After World War I, their firm continued to flourish, so it moved to a new production location in 1927.[148] The brothers experienced various production problems. From 1920, these were mostly related to material selection, corrosion and wear resistance and product quality.

Repairmen and retailers were able to increase their knowledge and skills. After almost twenty years, BRHN could finally organise training, as BRHN members now supported this initiative. Until then, repairmen and retailers could find technical and business knowledge in the BRHN journal and in general trade journals.[149] In 1930, there were 1408 bicycle repair workshops and 4749 workshops combined with a store.[150] Some of these also produced bicycles.

Table 4.7 Topics of advice requests from Frederik & Jan van Werven

Date	Description
November 1913	Advice about gas installation and insulation of enamelling furnaces
January 1916	Advice about electrical installation
June 1916	Certificate 'Made in Holland' (VNF hallmark)
March 1917	Unsatisfactory performance of installation for central heating
September 1917	Cost agreement for casting cokes
January 1920	Selection of steel for the production of shafts and cones for bicycles
February 1920	Usage of wrought iron to produce cones and cups for bicycle shafts
December 1924	Procurement of a soldering furnace
May 1925	Sandblast apparatus
October 1926	Testing various metals and analysis of chemical preparations
November 1926	Testing metals and chemicals
May 1928	Testing bicycle parts for tensile strength, etc.
July 1931	Information about the Coslett-process (coating to prevent rusting and wear)

Source BHIC, 169, inv. no. 93, Monthly reports consultant Deventer 1914-1935.

The BRHN cooperated with RND. In 1923, the BRHN approached RND to support training for bicycle frame production.[151] After a meeting with RND in June 1923, the BRHN organised the first and only frame construction training in the winter of 1923.[152] The BRHN was more successful in training for repairmen. In 1928, with support from RND, the first training was conducted for bicycle repairmen.[153] According to the RND consultant, this training should supplement the repairman's working experience with technical knowledge about working with new tools and new materials. Furthermore, in contrast with plant workers who had specialised work, bicycle repairmen had to be able to solve a variety of problems in a reliable way.[154] In the years after that, the training was further developed and conducted in two other cities.[155] In 1929, the BRHN organised exams for 38 repairmen to become a master or a fellow in the trade. These training activities were institutionalised when certification in trade and business skills became obligatory by Dutch law in 1937. Certification then became a prerequisite for a business permit, which limited entry to the sector.

4.5.3 The Dutch Style Bicycle

The interaction between Dutch users, user organisations, Dutch manufacturers, government regulations and actual bicycle use, resulted in the gradual development of a bicycle with a typical Dutch look, despite its many imported parts. It was utilitarian cycling by all Dutch classes, as stimulated by the ANWB, which created a need for bicycles which enabled civilised riding and were robust, reliable, yet affordable.[156]

Manufacturers translated these user needs in bicycle design and marketing by adding safety constructions and corrosion resistant coatings, or changing standard fittings. For example, in the early 1900s, carriers were not a standard item on new bicycles. Users had to buy these separately, like other accessories. As user preferences changed, Dutch manufacturers' practices changed, as is illustrated by Fongers 1929 catalogue, which shows bicycles fitted with carriers (Figure 4.6).[157]

Figure 4.6 Fongers bicycle model BDG for women, 1929.

As a result, a typically Dutch style bicycle evolved, with specific parts and fittings from Dutch manufacturers. The bicycle had the standard black British cycle frame of the early 1900s, a diamond frame for men and a loop frame for women. The frame was high, so that to ride it, an upright elegant position was required. Bicycle wheels were 40 mm wide, for a comfortable ride on bumpy country roads. Bicycles had a moleskin chain cover, which was typically Dutch, as British bicycles did not have chain covers, or had an oil filled chain box. For Dutch cyclists, the moleskin chain cover made cycling more comfortable, as it protected clothing from damage and also looked good.

The lightweight, lower-built and coloured sports cycle, which in the 1930s superseded the heavy black frames in Britain, hardly influenced the typical Dutch look.[158] Most likely, this was due to the continuing Dutch demand for the familiar low cost heavy black frames.

Bicycle design was simplified in the drive for efficient production and lower

cost. Parts were standardised and normalised. To ensure efficient production, fork ends were more roughly finished, material preferences changed (tin instead of nickel plate), and customised rim brakes were replaced by standard rim brakes.[159]

Government regulations continued to influence bicycle details. For instance, in 1935, rear mudguards had to be white. When rear lighting became obligatory in 1938, several manufacturers devised a way to lead the electrical wiring in the bicycle construction.[160]

4.5.4 Mediation and Knowledge

The developments in the 1920s and 1930s continued the earlier trend in which domestic production, government regulations and Dutch user preferences shaped the originally British bicycle model into a Dutch style bicycle. It evolved into a low cost bicycle from the Dutch bicycle industry, suitable for users in the Dutch cycling infrastructure and culture. Mass demand for bicycles was stimulated by the transition to low cost production, which required product and process innovations. Product innovations, mostly incremental, came from individuals and firms and were often inspired by developments abroad. User influence was more implicit than in previous decades and built on earlier decades of utilitarian cycling, so bicycles had to be low cost, robust, and reliable and had to facilitate respectable cycling. Bicycle specifications were also influenced by government policies on traffic safety. Production knowledge was now also available within the existing bicycle sector, and could also be acquired from an intermediary service like RND. Nevertheless, a considerable percentage of bicycle parts and fittings continued to be imported. With regard to bicycles, from 1925 onwards, Dutch manufacturers managed to meet the needs of the internal market.

The bicycle cartel regulated and stabilised the highly dynamic bicycle market in order to enable its members to survive. This was further supported by initiatives from the BRHN to improve the quality and position of repairmen through training. In conclusion, in this period mediating activities were dominated by business interest associations of manufacturers, traders and repairmen, while the ANWB continued its activities for cycling infrastructure. The intermediary RND played a modest role.

Mediation continued, by RND for production knowledge, the BRHN to improve the quality and position of repairmen through training, and the ANWB for cycling infrastructure, although the ANWB's role was less important than in previous periods. Mediation was less direct and included many others, for example, while educating various traffic participants. On specific subjects, intermediary organisations worked together, like the RAI and the BRHN in the cartel and the BRHN with RND for vocational training.

4.6 Conclusion

This article shows how in the Netherlands, decades of activities and interactions with users, producers, suppliers and intermediary organisations resulted in a huge demand for utilitarian bicycles and the capacity to produce these. From 1860 to 1940, the Netherlands became a bicycle nation with its own industry producing typical Dutch bicycles, with bicycle related firms, organisations and a cycling culture.

It illustrates how during the development of the bicycle nation, user practice knowledge and production knowledge were interlinked and dependent on each other. In the early days, users were also traders and manufacturers, and Burgers supplied bicycles to the local club. For the utilitarian bicycle, users and manufacturers experimented together. For the bicycle infrastructure, a much wider network was involved, consisting of ANWB, authorities, firms and many organisations.

Similar to other countries that built up their bicycle sector, the first entrepreneurs and manufacturers looked abroad for product and production knowledge, copied and learnt from it. There were no Dutch intermediary organisations involved. Knowledge import continued, also when there was a much larger knowledge base. Dutch innovations continued to be incremental, as the main bicycle innovations came from Britain. Furthermore, the combination of cartel, low cost production and minimal export limited the development of Dutch innovation capabilities.

Table 4.8 Intermediary roles from 1860 to 1940

Actor	Knowledge	1860-1900	1900-1920	1920-1940
Users	User practices	Bring bicycle to the Netherlands. Transition to sports organisers, traders, manufacturers.	Experiment with manufacturers for new uses.	Utilitarian cycling creates more need for facilities in public space.
Clubs	Local network	Collectively develop user practices, demonstrate, tour. Organise exhibitions.	From sports clubs to touring clubs. Bicycle path and traffic associations.	Touring clubs. Bicycle path and traffic associations.
ANWB	National network	Connect local cycling clubs. Build and maintain touring infrastructure. Lobby for suitable legislation. Representation of new user and user practices.	Maintain touring infrastructure. Lobby for suitable legislation. Representation of new user and user practices.	Maintain cycling infrastructure and integration with general road planning. Lobby for suitable legislation. Representation of new user and user practices.

Manu-facturers	Trade skills and experience, user practices	Produce foreign product in the Netherlands. Import product and production knowledge via people and travel.	Experiment with users for new purposes. Improve bicycle design and production and adapt bicycle to new legislation. Produce bicycle parts.	Adapt bicycle design for low cost production and new legislation. Acquire knowledge for low cost production.
Traders	Sales and marketing	Import and distribute bicycles and bicycle parts and distribute to agents and manufacturers. Bicycle riding schools.	Import and distribute bicycles and bicycle parts and distribute.	Import and distribute bicycles and bicycle parts and distribute.
Retailers and repair men	Sales, user practices, repair bicycles	-	Fill gap between supplier and user during touring. Small scale bicycle production and customisation.	Fill gap between supplier and user. Small scale bicycle assemblage.
RI (RAI)	Bicycle production and sales	Regulate marketing and sales activities	Regulate and organise marketing and sales activities. Exhibitions. Distribute materials (WW I).	Regulate and organise marketing and sales activities. Exhibitions.
BRHN	Bicycle sales, repair and small scale production	-	Protect and standardise trade. Establish position against RAI and ANWB. Organise training. Distribute materials (WW I).	Protect and standardise trade. Organise training.
CBR	Bicycle production and sales		Established as cartel by RAI, BRHN and NEVGRO.	Control and manage production and sales of bicycles.
RND	Production and business knowledge	-	Technical and business advice, VNF hallmark.	Technical and business advice, VNF hallmark, evaluation of inventions, general industry support.
Govern-ment	Legislation	-	Establish legislation for bicycle use, bicycle design. Bicycle tax. Distribution (WW I).	Establish legislation for bicycle use, bicycle design. Bicycle tax. Regulate Dutch economy (1930s).

When the bicycle was transformed from an expensive, fashionable sports vehicle into a lower priced, utilitarian vehicle around 1900, this corresponded with changes in intermediary activities (Table 4.8). The ANWB changed its focus from sports to touring, and business associations became more important, which resulted in the cartel. The changes also had an impact on bicycle manufacturers – their clientele

changed, and so products and production methods had to be adapted accordingly. At the same time, this created opportunities for new firms.

Users established the first intermediaries and organisations. After that, firms followed. When the government finally established knowledge intermediary RND, its consulting role was limited, but auditing firms for the 'Made in the Netherlands' (VNF) hallmark, enhanced the reputation of the Dutch bicycle industry. Nevertheless, many activities were conducted without intermediaries. Individual users, agents, manufacturers and citizens would travel, lobby, experiment and cooperate. Using Howells typology to review intermediary activities shows that these changed from 'commercialisation' of the velocipede and the utilitarian bicycle, to 'regulation and arbitration' by the ANWB in road infrastructure and traffic regulations, and by business associations in the cartel.[161]

Dutch politics was an important factor in several ways. First, the liberal, *laissez faire* policy of the state created the space in which ANWB, RAI, BRHN, and other organisations could lobby, self-regulate, negotiate and cooperate. Second, the neutral status in World War I and the Dutch open economy resulted in huge German bicycle imports after World War I, which created the urgency for firms' organisation and self-regulation. Third, World War I created an opportunity for the Dutch bicycle sector to expand capacity, despite material shortages and price increases. This laid the groundwork for further expansion in the 1920s, for a bicycle industry that could fully meet domestic demand.

In comparison to other countries, the Dutch cartel was organised very early. In addition to World War I and its aftermath, this can also be explained by Dutch bicycle firms not being very different in size, and mainly producing bicycles. Manufacturers' cartels in Britain had difficulties, because some firms with a very large share refused to cooperate.[162] In Germany, the resistance came from manufacturers who had a diverse product range, including typewriters, sewing machines and automobiles.[163]

The Dutch bicycle industry also had symbolic value. The ANWB transformed cycling into a common good for Dutch society, while during World War I, RND, VNF and the bicycle firms made the Dutch appreciate domestic products. So, after the war, the label 'made in the Netherlands' mattered more than the origin of its parts. As a result, the fact that the Dutch were able to produce all their bicycles not only made cycling more Dutch, it also made the bicycle industry represent the Netherlands as a modern industrialised country.

To conclude, the Dutch bicycle nation developed in interaction with changes in the bicycle, bicycle use, its users, and in response to external events. Through imported knowledge and products, it started copying sports bicycles for the upper classes. By the 1930s, while still depending on imported knowledge and products, the Netherlands produced low cost utilitarian bicycles that were affordable, desirable and used by all the Dutch people.

‘Although people still ask, just they as did in the past “what is the point of an association?” joining forces was inevitable and this form of organisation has enabled us to achieve much more.’

C.D. van Noppen, association secretary, Dutch Bread Bakers Association, 1931

5 Roles of Intermediary Organisations in Three Sectors

In the early twentieth century, Dutch bread bakers, wagon makers and bicycle firms faced different challenges. The case studies in the three preceding chapters investigated how these SMEs innovated, while also exploring the roles and activities of trade associations and RND. This chapter focuses on the roles of these intermediary organisations by consolidating the results of the preceding exploratory research. It explains what roles intermediary organisations conducted in these case studies. Chapter 7 will take the results further by reflecting on how these roles depended on specific sector, market and product characteristics, on the importance of individual SMEs versus intermediary organisations' activities and how roles changed through time. This also lets us include the results of the separate RND study where applicable.

This chapter starts with an overview of the roles and activities that trade associations and RND conducted in each of the sectors. Then I use this overview to categorise the intermediary organisations' roles in innovation through knowledge transfer and knowledge development. Finally, this chapter draws conclusions regarding the type of roles found in the multiple-case study.

5.1 Roles and Activities of Trade Associations and RND in Three Sectors

The trade associations and RND fulfilled several roles and conducted a range of activities in the three sectors. This section first reviews the activities and how these activities fit in the basic outline of roles that was prepared for this research (chapter 1). Then, observations about knowledge flow directions and relationships are added to gain further insight in the roles and their relational aspects.

The trade associations and RND had different activity levels in each of the cases, as shown in Table 5.1. The trade association was important and influential for bread bakers but conducted fewer activities for the wagon makers and in the bicycle sector. RND advised very few bread bakers because bakers had their own knowledge institute to fulfil that role. For wagon makers, the RND assistant personally guided many of them in the transition to making bodywork for motorised vehicles, while also conducting courses and lectures for that purpose. In the bicycle sector, RND advised several manufacturers and played an especially important role by auditing them for the *VNF* (Vereeniging Nederlandsch Fabrikaat, *Association 'Made in Holland'*) hallmark, which proved the Dutch origin of their products.

The review focuses on the roles and activities relating to knowledge, in line with

the research question in this thesis. Activities like cooperative purchasing (bread bakers), price regulation (wagon makers), marketing regulation and cartelisation (bicycle sector), lobbying the government in World War I (all) are not included, although the case studies showed that these were some of the trade associations' important activities.

Table 5.1 The activity levels of trade associations and RND in the case studies

Activity level	**Bread bakers (1900-1930)**	**Wagon makers (1900-1940)**	**Bicycle sector (1860-1940)**
Trade associations	++	+	-
Rijksnijverheidsdienst (RND)	-	++	□

Key to activity levels: ++ very high + high □ average - low

Table 5.2 summarises the case study results by presenting which activities each intermediary organisation conducted in knowledge transfer and knowledge development, following the basic outline of roles (developed in chapter 1). As the overview illustrates, trade associations and RND conducted a range of activities for SMEs. The trade associations as well as RND performed knowledge transfer and knowledge development activities, but this did not happen to the same extent and in the same way in all three sectors.

The results clearly show that trade associations can conduct knowledge transfer activities to support and stimulate their members' innovation. This is most visible in the case of the bread bakers, and to a lesser extent for the wagon makers. More importantly, these activities were integrated in the associations' efforts to build a network. Thereby, the results illustrate that associations can build their networks to also support innovation activities, not only for lobbying the government or self-regulation. This is also demonstrated by the way these associations communicated. They wanted their members to survive and to do so, firms had to adopt new technologies and processes. So, not only did associations distribute new knowledge, they also spread the message that firms needed to change and innovate.
The table shows that knowledge transfer happened in two directions. Trade associations and RND transferred knowledge and information about technologies, products, processes, business and management from external sources to SMEs.
In the opposite direction, trade associations and RND (for wagon makers) spread information and knowledge from SMEs and their needs to other parties. Their efforts included sales exhibitions, sector promotion and organising training for SMEs with other parties.

To some extent, trade associations also performed knowledge development. This mainly happened in an enabling role, whereby associations stimulated the

development of new knowledge, for example by making available a distribution channel (journal) for publishing drawings, articles and evaluations of new technology. These activities were in line with their efforts to stimulate SMEs to innovate and their realisation that SMEs needed information and knowledge tailored to their business context. Thus the trade associations enabled information and knowledge collection from various parties and transformation into suitable formats for their members.

The recognition and understanding of the needs of SMEs is also visible in the case of standardisation and accreditation activities (bread bakers, wagon makers). For this purpose, associations fulfilled a mediating role. They understood the SMEs' needs and capabilities and translated these into specific standards and government regulations. In addition, they had to ensure alignment with all parties. Finally the two types of networking activities in knowledge development confirm the findings of the literature review results in chapter 1.

The bread bakers association had its own knowledge institute. This organisation was very influential in knowledge transfer and development. It trained bread bakers in using instruments and standard recipes. It devised recipes during the wheat shortage in World War I. It tested suppliers' products to prove the need for quality standards, and it carried out quality control of milk bread. The importance of these activities was reinforced by ever-increasing government regulations, and so this knowledge institute also fulfilled a mediating role between government and bread bakers. As the other two cases show, not all trade associations had their own knowledge institute. Chapter 7 will reflect further on this difference.

Table 5.2 Activities carried out by the trade associations and RND

Type	**Activities**		
	Case 1 **Bread bakers**	**Case 2** **Wagon makers**	**Case 3** **Bicycle sector**
Trade associations			
Knowledge transfer	Network building and outreach program for change (meetings, lectures, study tours, journal); exhibitions; contractual advice; sector promotion	Network building and outreach program for change (meetings, evening sessions, lectures, excursions, journal, books, training); ask support for training; support for sales exhibitions	Sales exhibitions; journal; initiatives to stimulate bicycle repairman education; training

Knowledge development	Enabling development of new knowledge (evaluation of machinery, recipes, standards); support accreditation (*Vestigingswet*)	Enabling development of new knowledge (evaluations of technology, drawings); support accreditation (*Vestigingswet*)	Not applicable
Trade association's knowledge institute			
Knowledge transfer	Training, demonstrations and advice; lectures and publications; excursions	Not applicable	Not applicable
Knowledge development	Translate knowledge for courses and advice; testing and evaluating ingredients and technology; standardisation (need for standards, develop standard); quality control (M-hallmark)	Not applicable	Not applicable
***Rijksnijverheidsdienst* (RND)**			
Knowledge transfer	Advice on efficient energy use of ovens in war-time; technical advice	Technical assistance and advice (personal, meetings); training; demonstrations; excursions; lectures (technical and business); sales exhibitions	Advice on production and energy; support training initiative
Knowledge development	Develop advice on efficient energy use of ovens	Translate and develop knowledge for courses, lectures, articles, advice; developing drawings; standardisation (norms, standard wagon); accreditation (*Vestigingswet*); monitoring developments; testing and evaluating technology	Advice about patents; audits for VNF ('Made in the Netherlands') hallmark

RND's original mandate was to provide information and advice, which is illustrated by the results. The scope and breadth of these activities indirectly show that RND had only limited resources. The need and the number of SMEs were much greater than a handful of consultants could manage in a satisfactorily way. Interestingly, the results show that despite this lack of resources, RND did more than its original

mandate. For wagon makers it fulfilled a crucial role in bridging the gap between wagon makers and the automobile industry via training and advice from its technical assistant. This assistant was also involved in sector promotion through organising sales exhibitions. He conducted various knowledge development activities, which were similar to the bread bakers' knowledge institute. Furthermore, he prepared courses, lectures, drawings and articles and was also involved in standardisation and accreditation activities. In addition, he tested and evaluated new machinery and production methods. RND's knowledge transfer and development activities showed the same differences in flow directions and types of relationships as the trade associations.

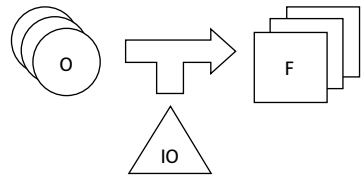
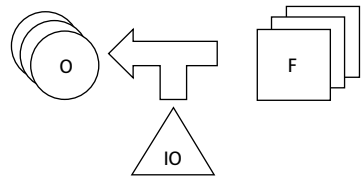
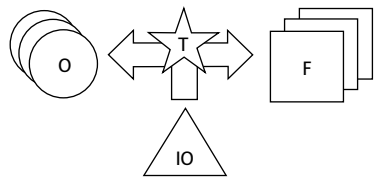
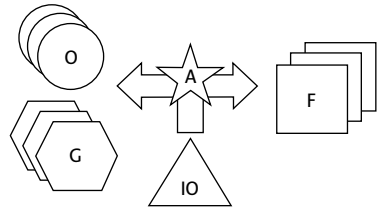
In the two other cases, RND also conducted some knowledge development activities. It advised bread bakers on efficient energy use in ovens at the end of World War I. In the bicycle sector, RND evaluated and supported patent requests and audited firms that wanted a VNF hallmark to show their products were made in the Netherlands. Chapter 6 will show that RND participated in establishing this VNF hallmark.

The intermediary organisations in the three cases were most active in knowledge transfer. They did conduct some promotional activities, and to a lesser extent, they articulated innovation needs, such as for training and education. The cases show that these organisations were also developing knowledge, specifically to stimulate and enable firm-level innovations. In contrast, the literature mentioned activities like developing new technologies in-house or with partners, defining technology roadmaps and supporting Intellectual Property development and management, which are activities that are more relevant for innovation that is new to a sector or a country. The case study results show that developing knowledge for firm-level innovation involved preparing drawings and courses, writing articles, evaluating technology, etc.

The findings confirm that the activities can be grouped into four roles with different flow directions and relationships. Table 5.3 presents these four different roles and visualises these in order to include knowledge aspects as well as networking. Thereby, it builds on Dalziel's categorisation and visualisation and the previous literature review.[1] The first two are knowledge transfer roles. The largest role of intermediary organisations is transferring knowledge from several sources to one or more firms. In the second role, an intermediary directs knowledge and information from firms to other parties, for promotional and influencing purposes. In the third role, an intermediary organisation develops technology. To do so, it forms links with firms and several organisations and also transforms existing knowledge into new formats and new knowledge. In the fourth role, an intermediary develops standards. This is very similar to the third role, but it also links with governmental and regulatory bodies. Furthermore, to ensure the implementation of standards, these need to be aligned by all parties.

The diagrams in Table 5.3 also include knowledge flows from the intermediary to the other parties, unlike Dalziel's visualisation. For example, intermediaries bring in their own knowledge of SMEs' context or their own expertise. Thus intermediary organisations do more than brokering; they not only bring information from one party to another. They are also one of the knowledge sources in the mediation process, alongside their supporting and facilitating role.

Table 5.3 Visualisation of four roles including networking

	Role
	Knowledge transfer to firms
	Knowledge transfer from firms to other parties – for promotion and influencing
	Knowledge development
	Development of standards

Key: IO – intermediary organisation, F – firm, O – other organisation or individual, G – government and regulatory bodies, T – transformation of knowledge, A – alignment of standards

To conclude, the case studies illustrate that the trade associations and RND did conduct roles and activities in knowledge transfer and knowledge development, however, not to the same extent in each sector. Unsurprisingly, a difference with the literature review is that the resulting knowledge development activities are

typical for firm-level innovation (according to the research design). The cases also support the different knowledge flow directions and types of relationships that were distinguished in chapter 1. In the next section I will use these results to develop a categorisation of roles.

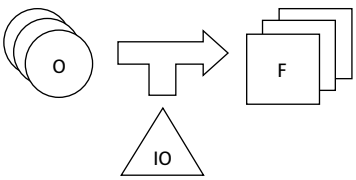
5.2 To a Categorisation of Intermediary Organisations' Roles

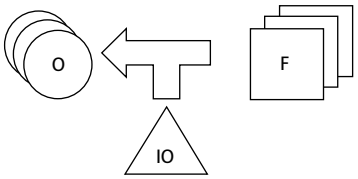
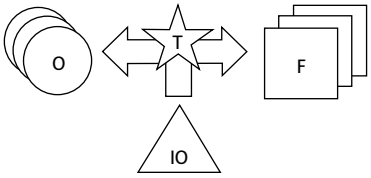
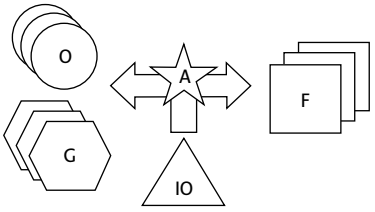
The case study results show that the basic outline consisting of roles in knowledge transfer and knowledge development was relevant. Furthermore, they show different flow directions (to and from SMEs) and different relationships depending on the activity.

To apply these results for a categorisation of intermediary organisations' roles, I took into account two observations. First, current literature mainly tries to identify the specific activities and roles of intermediary organisations. Consequently, there is an abundance of articles, whereas there is a distinct lack of useful and applicable categorisations for studying intermediary organisations. Second, as concluded in chapter 1, Dalziel's categorisation provides a good starting point as it was not limited to knowledge transfer. To some extent her categorisation integrates activities, flow directions and relational aspects. Therefore, this dissertation can contribute by developing a categorisation which is less time-dependent, elaborates knowledge mediation and consists of a few roles that each take into account knowledge flow directions and relational aspects.

To obtain a categorisation of the roles, the basic outline with 'knowledge transfer' and 'knowledge development' roles was further developed using Tables 5.2 and 5.3, which resulted in the categorisation as presented in Table 5.4.

Table 5.4 Categorisation of intermediary organisations' roles in innovation

Types	**Roles (including networking)**	**Activities**
Knowledge transfer	Providing knowledge – transfer of knowledge flows from a range of sources to the intended firm(s) 	Conducting and supporting knowledge provision activities for firms: – *Giving personal advice to firm(s); organising and supporting training, demonstrations, excursions, study trips and exhibitions for firm(s); writing and supporting publications for firms; other activities*

	Influencing - transfer of knowledge flows from firm(s) towards a range of recipients 	Conducting and supporting promotion activities for firms and sectors; articulating firms' innovation needs
Knowledge development	Generating knowledge - transforming knowledge from several sources to make it suitable for local firm(s) 	Translating and adapting knowledge; testing and evaluating technology; developing technology; supporting intellectual property management
	Standardisation - generating and translating knowledge and aligning this with firm(s) and other stakeholders 	Defining specifications and norms for firms; preparing and conducting accreditation for firms; defining and conducting tests and quality controls for firms

Key: IO – intermediary organisation, F – firm, O – other organisation or individual, G – government and regulatory bodies, T – transformation of knowledge, A– alignment of standards

The resulting categorisation consists of four roles of two types (Table 5.4). Under the 'knowledge transfer' type, the two roles are 'providing knowledge' and 'influencing'. Under the 'knowledge development' type, the two roles are 'generating knowledge' and 'standardisation'. In the descriptions of roles and activities below I will use 'firms' instead of 'SMEs', because the suggested roles also apply to large-sized firms.[2] The first role is 'providing knowledge'. When intermediary organisations provide knowledge, they enable a flow of knowledge from a range of sources to the intended firm(s). They need to build and maintain relationships with sources and firms.[3] These sources include suppliers, government officials, experts, and research and technology institutes.

The second role is 'influencing', which consists of communication in the opposite direction than 'providing knowledge'. 'Influencing' an intermediary

organisation enables knowledge flows from a firm (or firms) towards a range of recipients. In order to influence successfully, an intermediary organisation has to build and maintain relationships with firms and recipients. The objective is to promote the interests of firms to other parties in order to influence changes in other parties. These other parties include customers, suppliers, firms in other sectors, governmental bodies and knowledge institutes.

When intermediary organisations develop knowledge, they do this by processing, generating or combining knowledge, which all lead to the transformation of existing to new knowledge.[4] Naturally, these roles involve communication, provision of knowledge and influencing, but the main purpose is to develop new knowledge. They link different types of knowledge (or actors) to facilitate innovation.[5] These links are quite similar to the ones they use when they transfer knowledge.[6] However, in this case their mediation between several parties consists of two-way influencing activities with several parties and the necessary networking activities.[7] The intersection of the links is also named the mediation junction.[8]

The third and fourth roles belong to the 'knowledge development' type. The third role is called 'generating knowledge'. It involves transforming existing knowledge in order to supply the required knowledge or information. This includes all the ways of generating knowledge, except 'standardisation'.

The fourth role is 'standardisation'. This role usually involves governmental and regulatory bodies in addition to firms, suppliers, customers, etc. Standardisation consists of developing new knowledge for shaping standards, regulations or contract frameworks and also requires alignment between producers, users and other parties for successful implementation.[9]

Finally, the boxes in the right hand column of Table 5.4 give examples of activities for each of the four roles. They are defined in a rather generic way, making them less time and context specific. The first activity in the 'generating knowledge' role is 'translating and adapting knowledge'. A typical example of this in the early twentieth century is 'developing product drawings for wagon makers and blacksmiths', whereas a present-day example would be 'developing templates for webshops'.

The next section will apply this categorisation to the case study results and reflect on these.

5.3 Reflection and Conclusion

In order to reflect further on the multiple-case study results, I will use the categorisation of roles to understand and analyse what roles the trade associations and RND conducted. Table 5.5 shows the activity levels of trade associations and RND in each of the four roles in the different cases. I will use this overview to identify

what roles these organisations performed and how they performed them. The analysis of contextual factors that determined the differences between the cases will be presented in chapter 7.

Reviewing the case study results in Table 5.5 leads to the following conclusions. First, the multiple-case study resulted in a simple categorisation with four different roles, two in knowledge transfer and two in knowledge development. The role definitions include knowledge flow directions and different types of relationships. Thereby, they show the possible breadth of different roles and relationships in which intermediary organisations may be involved.

Second, most of the activities are concentrated in two roles: 'providing knowledge' and 'influencing'. This relates to the observation that almost all the activities found in the case studies are typical of firm-level innovation: drawings, training, excursions, publications, advice, standards and quality control. These were conducted to support the implementation of machinery, processes and standards in SMEs. Thus most activities involved knowledge transfer. Knowledge development mainly consisted of developing drawings, trainings, publications, etc. that were provided to SMEs. Two activities that were not related to firm-level innovation are the VNF hallmark and advice about patents. The VNF hallmark was to stimulate customers to buy Dutch products instead of imports. RND's provision of advice about patents was to stimulate bicycle firms to develop their own intellectual property. As chapter 4 shows, the actual number of patents was quite low. Finally, the activities of the bread bakers knowledge institute and the RND assistant for wagon makers show the importance of standardisation in firm-level innovation. In both cases these reduced uncertainty for SMEs. For bread bakers, standardisation ensured the quality of their raw materials, for wagon makers it set norms for wagon design.

Table 5.5 Overview of roles fulfilled per intermediary organisation per case study

Type	**Roles**	**Case 1 Bread bakers**	**Case 2 Wagon makers**	**Case 2 Bicycle sector**
Trade associations				
Knowledge transfer	Providing knowledge	+	+	-
	Influencing	□	□	□
Knowledge development	Generating knowledge	Enabling	Enabling	NA
	Standardisation	Enabling	Enabling	NA

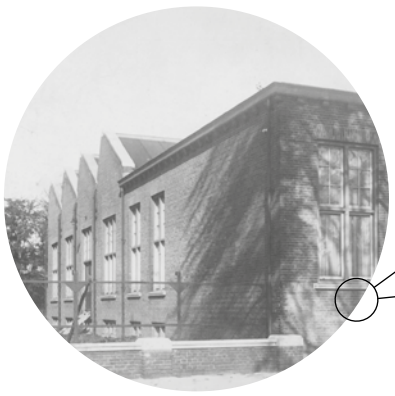
Trade association's knowledge institute				
Knowledge transfer	Providing knowledge	++	NA	NA
	Influencing	+		
Knowledge development	Generating knowledge	++		
	Standardisation	++		
***Rijksnijverheidsdienst* (RND)**				
Knowledge transfer	Providing knowledge	-	++	□
	Influencing	NA	+	NA
Knowledge development	Generating knowledge	-	□	-
	Standardisation	NA	□	□

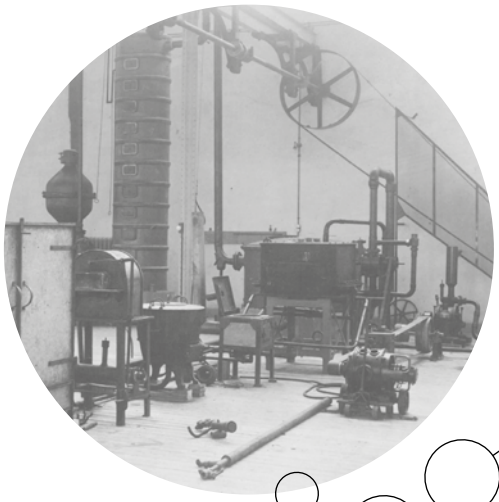
Key to activity levels: ++ very high + high □ average - low
Key: NA - not applicable

Third, the character of the trade associations' roles in innovation seem to be mostly enabling. The bread bakers and wagon makers' cases illustrated that trade associations did transfer knowledge during meetings, lectures and excursions, and by providing advice. However, on the whole, it was especially the network they created that was important for knowledge transfer, both among SMEs and for influencing activities to external parties. The case of the bread bakers showed that a trade association can enable and delegate knowledge development by establishing its own knowledge institute. The latter is not a straightforward task, as the wagon makers and the bicycle sector show. This will be further discussed in chapter 7. The cases showed only a few 'influencing' activities with regard to innovation: trying to organise education, sector promotion and sales exhibitions.

Fourth, the multiple-case study shows that RND was in principle able to undertake all four roles, as illustrated by the wagon makers case (and also chapter 6). Their lack of visibility in other sectors was partly on account of limited resources, and partly on other circumstances, see chapters 6 and 7.

Last, the overview illustrates why it was necessary to investigate the cases from an SME perspective. This overview cannot show to what extent other intermediary organisations or external parties were relevant to SMEs. Nor does it show what other events or circumstances were challenging SMEs. I will reflect on this in chapter 7.





'... instead of a demonstration, the consultants propose conducting an experiment. This was not what the *Rijksnijverheidsdienst* Laboratory was set up to do ... we must avoid giving the industry the impression that we are amateurs.'

Professor Isaac Pieter de Vooys, Laboratory Advisory Board, 1916

6 Evolving Roles and Dynamic Capabilities of an Innovation Agency: The Dutch *Rijksnijverheidsdienst*, 1910-1940

6.1 Introduction[1]

Innovation studies show that gaps in market and innovation systems are bridged by intermediary organisations.[2] Examples of gaps that firms experience are barriers to knowledge, lack of advisers or lack of relationships with access to knowledge sources.[3] Firms and knowledge suppliers experience difficulties in closing these gaps themselves, because their goals and perspectives are incongruent.[4] Therefore, intermediary organisations enable innovation in firms by performing roles in brokering and knowledge transfer.[5] Often, these intermediaries are publicly financed, because the perceived lack of short-term results prevents firms from hiring private consultants.[6] While all firms may find it difficult to create the necessary connections due to market and innovation system failures, small and medium-sized enterprises (SMEs) face additional challenges, as they are more limited in their resources and scanning abilities than large firms.[7]

Nowadays, a considerable part of Dutch businesses still consists of SMEs, however, SMEs dominated the economy in the late nineteenth century. Then, relatively late in comparison with neighbouring countries, SMEs were confronted with industrialisation.[8] Around 1860, the first wave of industrialisation took place in the metal and food sector. From 1890, large manufacturing plants swept away small firms in other sectors as well.[9] In contrast with countries like Germany and Belgium, Dutch SMEs did not seem to be concerned about their fate. They scarcely protested, nor lobbied the government for supportive policies, partly due to the lack of trade associations.[10] Instead, civic organisations with members of the elite and upper middle classes, later joined by confessional parties and organisations, expressed concerns about the impact of industrialisation on SMEs. These organisations took various initiatives to support SMEs and one of these resulted in the establishment of a government agency for technical information in 1910: the *Rijksnijverheidsdienst* (RND, Technical Information Agency). The publicly financed RND was the first Dutch intermediary organisation in the industrial sector and is the topic of this paper.

We have, however, not only studied the establishment of RND. Our main goal was to analyse the evolution of its roles between 1910 and 1940 as a result of challenges and changing circumstances. This paper illustrates that RND's dynamic capabilities in mediation and knowledge development explain how it could evolve its roles. By 1940, its roles were different from the initial design, because over time, RND had adapted to several external changes. However, its reaction to external

opportunities and threats is not the most remarkable aspect. The analysis also shows a distinctive feature of an intermediary organisation. While the newly established organisation started out with the roles its founders had in mind, as soon as the intermediary organisation appeared, it began to formulate and change its own roles, not necessarily in keeping with its founders' aims and ideals.

This paper consists of seven sections. First, a section on intermediary organisations, roles and the historical background and theory. Second, a section about the analytical approach based on dynamic capabilities. The third section explains the methodology. This is followed by an analysis of RND's activities, then sections describing the establishment of RND and the evolution of its roles. Finally, a section with conclusions.

6.2 Background: Definition and Research Focus

Our definition of intermediary organisations is based on a review of contemporary studies on intermediary organisations. As researchers from a wide variety of disciplines have studied intermediary organisations, there is no consensus on what an intermediary organisation is, nor is there agreement about the name, as a long list of synonyms shows (e.g. broker, bridging organisation, innovation intermediary).[11] Therefore it is necessary to articulate the selected definition.

Firstly, this paper focuses on intermediary organisations which support innovation of firms as one of their explicit objectives. Therefore, it does not study parties which support innovation incidentally, like customers who may suggest product changes, or suppliers who may supply knowledge to improve product quality. Secondly, this paper studies roles in knowledge circulation.[12] For that reason it will not examine activities relating to the coordination of markets or prices, which may be defined as innovation as it ensures the survival of firms.[13] Summarising, this leads to the following definition: 'an intermediary organisation enables innovation in firms as one of its explicit objectives by connecting, translating and facilitating flows of knowledge.'

Contemporary studies of intermediary organisations also informed our research on the evolution of roles. This shows that the research is limited to organisations in the last twenty-five to thirty years.[14] Most researchers analysed intermediaries at a specific moment, for example by studying staff competencies and performance measurements.[15] Some studies noted that intermediary organisations adapt their approach to cater for variations in sector, region and period, which also led to the conclusion that there is no one-size-fits-all solution.[16] So, intermediary organisations seem to function best when they adapt to their environment, but how this happens and how this is influenced has not been investigated yet. Moreover, the time dimension is lacking. Researchers observed that intermediary organisations had

changed in response to challenges and opportunities.[17] But, they did not conduct research on how an intermediary organisation adapts to changes in its environment over several decades.

Lastly, the debate in SME policy studies is about how innovation intermediaries for SMEs can be designed and organised most effectively.[18] This raises the question how effective original design rules are after a specific period of time. Naturally, intermediary organisations will change as they respond to challenges and opportunities.[19] Furthermore, innovation intermediaries also change because of the organisation's own preferences. When it is established, an intermediary's design will reflect the goals, ideas and ideals of its initiators. Once the intermediary organisation is in place and starts to function, it becomes an actor that reinterprets, changes and optimises its roles.[20]

This paper reviews roles from the intermediary organisation perspective. A role is defined as consisting of function and position, where function refers to the useful thing that an organisation does or intends to do, and position refers to where an organisation is in relation to others.[21] The literature review of contemporary studies on intermediaries and a historical multiple-case study of three sectors provided four roles in knowledge circulation (Table 6.1). Thereby, it enlarges an early view of intermediary activities that focused only on knowledge transfer.[22] Lastly, science and technology dynamics researchers Barend van der Meulen, Maria Nedeva and Dietmar Braun suggest that performance and change in intermediary organisations depend on the relationships they mediate and the changes in these relationships.[23] Therefore, this paper studies the evolution of roles by studying changes in functions and relationships.

Table 6.1 Roles of intermediary organisations[24]

Types	Roles	Activities
Knowledge transfer	Providing knowledge – transfer of knowledge flows from a range of sources to the intended firm(s)	Conducting and supporting knowledge provision activities for firms: – *Giving personal advice to firm(s); organising and supporting training, demonstrations, excursions, study trips and exhibitions for firm(s); writing and supporting publications for firms; other activities*
	Influencing - transfer of knowledge flows from firm(s) towards a range of recipients	Conducting and supporting promotion activities for firms and sectors; articulating firms' innovation needs

Knowledge development	Generating knowledge - transforming knowledge from several sources to make it suitable for local firm(s)	Translating and adapting knowledge; testing and evaluating technology; developing technology; supporting intellectual property management
	Standardisation - generating and translating knowledge and aligning this with firms and other stakeholders	Defining specifications and norms for firms; preparing and conducting accreditation for firms; defining and conducting tests and quality controls for firms

The subject of this paper is also rooted in historical research. The proponents of RND were found among those who embodied and propagated the modernisation of the Netherlands. Historian Thomas Misa and philosophers of technology Philip Brey and Andrew Feenberg show that in America and Europe 'The tie between modern technology and social progress was much in the minds of "modernists" in the early twentieth century.'[25] Historians of technology Johan Schot, Harry Lintsen and science and technology researcher Arie Rip illustrate for the Netherlands how from 1890 onwards, various proponents of modernisation articulated the 'demands of the modern era' and promoted the development and use of specific technologies. However, this did not imply that they always agreed on how it was to be done. By stressing this idea of contested modernisation, the authors provoked 'discussion of alternative paths to modernisation'.[26] Our actor driven approach will be in line with that. The establishment and development of RND highlights differences in opinion on how small businesses and craftsmen should cope with industrialisation.

The unfolding of the contested modernisation process is inextricably bound with the specific national context. Schot et al. stress 'the specific role of Dutch governments and their reliance on intermediary actors that helped to manage the relationships between public and private spheres and between products and consumers'.[27] New acquisition methods and diffusion of knowledge and technology developed during the second wave of industrialisation in the late nineteenth century. While large industrial firms established research laboratories, it took much longer for the Dutch government to adopt an active role in fostering a public knowledge infrastructure for SMEs.[28] The Netherlands was a liberal economy in which the government was not expected to intervene, neither for the survival of firms, nor for the education of craftsmen.[29] These two interrelated features of the Dutch context – government involvement and their reliance on intermediary actors - also played a role in the establishment and development of RND. We will illustrate how these influenced RND's roles from 1910 until 1940. This research period enables insight in the effect of two major external events that impacted Dutch businesses: World War I and the economic crisis, which both led to greater government intervention.[30]

6.3 Analytical Approach

While historical and intermediary organisation studies guided our definition and research focus, our analysis is based on insights from dynamic capabilities studies. This perspective gives us an insight in dynamics by focusing on how organisations evolve or can be changed over time and how advantages are achieved or sustained. Business and organisational researchers David Teece, Gary Pisano and Amy Shuen were the first to stress the importance of dynamic capabilities in coping with external circumstances.[31] According to the authors, the ability to integrate, build and reconfigure internal and external competences is essential for responding to rapidly changing environments. By altering the resource base, dynamic capabilities open new strategic alternatives or paths for the organisation.

Since then, numerous scholars have added to the body of dynamic capability literature, so a group of researchers decided to define this concept more precisely while using the accumulated insights. This led to the definition of dynamic capabilities as 'the capacity of an organisation to purposefully create, extend, or modify its resource base'.[32] The term capacity in the definition implies that a dynamic capability is repeatable, as 'it consists of patterned and somewhat practiced activity'. The definition further incorporates the search, selection and learning aspects of dynamic capabilities. The resource base includes tangible, intangible, and human assets as well as capabilities which the organisation owns, controls or has access to on a preferential basis. The authors consider capabilities to be resources that the organisation can draw upon to accomplish its aims. A capability involves the integration of tangible assets, knowledge, and skills in order to perform a task. Because capabilities incorporate the knowledge and skills of individuals and teams in performing tasks, people are essential for capabilities.

This paper is a contribution to empirical dynamic capabilities studies. So far, dynamic capabilities studies tend to be abstract and focus on defining the core concepts, resulting in only a few empirical studies, for example strategy researchers Gregory Ludwig and Jon Pemberton's study of the Russian steel industry.[33] Moreover, these studies mostly focused on firms. By studying an intermediary organisation, this paper investigates how well this approach works in another type of organisation.

6.4 Methodology

Research for this paper started with a literature review and archival research (see Appendix 1). The collected data consisted of annual reports (see Appendix 1), minutes of meetings, design notes, public discussions, letters, articles, etc. The research methodology consisted of two analyses. Firstly, we conducted a quantitative analysis of RND's core activity, advice to SMEs between 1910 and

1940. Next, we undertook a qualitative analysis of nine cases of challenges and external changes that RND had to cope with, the effects on RND's resource base and corresponding changes in roles and relationships. For that purpose, we defined two dynamic capabilities: mediation and knowledge development (see Table 6.4). We selected the cases by reviewing the available literature and archival documents, resulting in an analysis that covered the period from RND's establishment up till 1940.

6.5 Analysis of RND's Advice Activities

From 1910, RND was a small agency whose core activity consisted of responding to advice requests from firms, the majority of which were SMEs.[34] These requests and responses were in written format, and often supported by a personal visit of the RND consultant to the firm to ensure good understanding of the situation. The number of responses increased from an unknown amount in the first years, to about 400 per year in 1915 to almost 1400 per year by 1939 (Figure 6.1). The topics ranged from electrification and mechanisation, supplier addresses, bookkeeping, new laws and regulation. In addition, RND also conducted various activities for governmental bodies. As there were about 390,000 Dutch SMEs, this justifies the conclusion that RND could only be a token agency.[35]

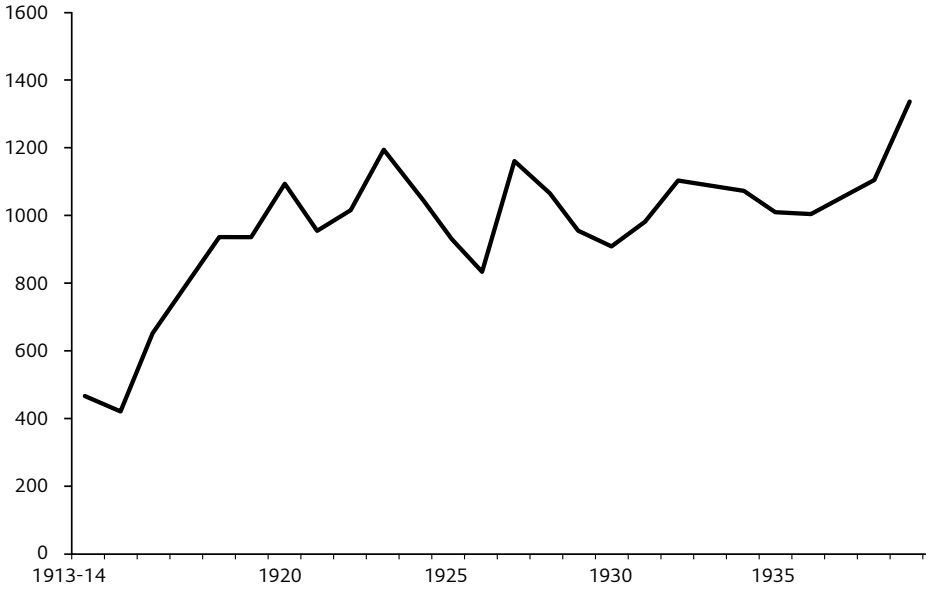


Figure 6.1 Number of RND responses to SME requests, 1913-1939.

Available data on the period between 1920 and 1940 shows that the majority of the advice requests originated from three sectors: metal, textile and laundry, and food (Table 6.2). The interest from the metal sector was further enhanced by RND's decision to specialise in metal production from 1937.[36]

Further analysis indicates the four most popular areas of advice: production equipment, suppliers, process and recipes, and energy up till 1935 (Table 6.3). Additionally, the type of advice requests followed technical developments and economic trends. In the late 1920s there was a need for advice in business economics, especially to save labour costs, whereas during the economic depression in the 1930s, many SMEs requested advice about sales and markets.

Table 6.2 Origins of RND advice requests per five years, 1920-1936[37]

	1920-1924	**1925-1928**	**1930-1934**	**1935-1936**
Wood, cork, straw sector	382	262	279	234
Metal sector	944	732	1221	621
Textile, laundry sector	680	667	703	241
Food sector	528	420	464	145
Other[38]	714	908	1342	376
Other organisations[39]	1310	804	869	409
Total	*4558*	*3793*	*4878*	*2026*

Table 6.3 Types of RND advice requests per five years, 1920-1939[40]

	1920-1924	**1925-1929**	**1930-1934**	**1935-1939**
Energy, power supply	683	769	641	363
Process and recipes	662	624	433	623
Production equipment	793	791	785	933
Suppliers	765	519	596	598
Other[41]	1694	1201	1596	2177
Total	*4597*	*3905*	*4051*	*4694*

6.6 Establishing *Rijksnijverheidsdienst*

Before *Rijksnijverheidsdienst* was established, two proposals were developed for its organisation and resource base. Each proposal represented the interests of its proponents, while each also had its critics.

In 1900, the civic organisation *Vereeniging tot bevordering van de Fabrieks- en Handwerksnijverheid* (VFHN, Association to promote Industry and Crafts) concluded that there was a need for a neutral, independent consultancy that provided firms with technical advice.[42] So far, firms had to rely on their own engineers or resort to technical advice from suppliers, so that especially SMEs were at a disadvantage. Therefore, the VFHN decided to fill this gap and asked G.A.A. Middelberg, a mechanical engineer and former director of the South African Railway Company, to draft a proposal for a technical information agency.

Middelberg's design consisted of an agency that brokered between firms and professors at Delft Technical University or other expert civil servants.[43] It would be staffed by a technically capable secretary. Information requests were expected to include technical issues and supplier addresses. Middelberg thought that consultancy would help professors in educating their students and it would help students develop relationships with future employers. The independent agency would have to be subsidised, as there would be high costs and uncertainty about the number of requests. Funding ought to be made available by civic societies, large firms or the government.

When the VFHN consulted professors at Delft Technical University about its initiative, they received critical and positive reactions about the need and the feasibility of the agency.[44] Some professors doubted the need for a subsidised agency, as they expected that graduates would find work in private consultancies. Professors claimed they were already consulted regularly, and were not interested in answering requests for addresses. They also had doubts about the secretary's position, as he would get access to confidential information. The professors who were enthusiastic about the proposal mentioned that the agency would need a laboratory as well. Laboratories would give the university and its students the opportunity to develop industrial technology while being close to firms. Furthermore, they did not expect issues about competition with private consultants, as the agency could refrain from design work. They saw the proposal as promoting the need for university laboratories and government funding.

A round of comments from the general public in December 1901 only resulted in a reaction from two engineers, who saw the suggested agency as unfair competition and not feasible.[45] Furthermore, they could not envisage why firms would pay a public agency for advice, as they would risk that if a competitor requested similar advice, this competitor would receive it at a lower price, as the knowledge had already been paid for.

After the establishment of the *Nederlandsche Middenstandsbond* (Middenstandsbond, Dutch Association for SMEs) in 1902, SMEs became involved in the initiative for a technical agency. In 1906, the Middenstandsbond approached the *Maatschappij van Nijverheid* (MvN, Society of Industry) to establish a joint committee to develop a proposal for an exhibition with modern technology for SMEs.[46] In the meantime, the VFHN had merged into the MvN in 1903. The joint committee broadened its purpose and decided to develop the most effective initiative for SMEs.[47] As a result, the plan for a technical agency resurfaced, quite likely because committee chair Dirk Bos and Middelberg were both members of parliament.[48] Furthermore, J.S. Meuwsen, the *Middenstandsbond* chairman, became acquainted with the Austrian institute for SMEs during a study tour. He published an article in one of the major newspapers about how the Austrian government institute for SMEs demonstrated modern tools and equipment, organised courses in technical, administrative and commercial skills, organised exhibitions and trade contests, held lectures, published magazines, offered credit facilities, and operated a test laboratory.[49] According to Meuwsen this had resulted in the revitalisation of SMEs on the brink of liquidation.

The committee presented its proposal for an agency in 1909, which turned out to be an extension of the original VFHN initiative inspired by the Austrian institute.[50] The agency's activities were positioned as education for SMEs, who needed independent and impartial advice about new machinery. The agency would have five consultants. In each region, they were to have their own facilities, where they would stimulate exhibitions, give lectures, and organise training. As the estimated costs were high, about 50,000 guilders a year, the government would have to finance it, with the advantage that the consultants would have a neutral position. The consultants had to have a technical education and take a pragmatic approach. The MvN approved the proposal but made two stipulations: The consultants had to have an academic degree, and the consultants should maintain relationships with the MvN and other associations that stimulated the industry.[51]

The new cabinet, which was supportive of SMEs, approved the new proposal. According to the government's plan, the agency was to transfer knowledge to firms, especially to SMEs.[52] It would collaborate with the few existing schools and laboratories for the trades. However, to ensure the approval of Parliament members who were critical of financing agencies, the budget was only 10,000 guilders, which meant that only one consultant could be appointed.[53] Finally, the first RND consultant, Floor C. Kist, a 31-year old mechanical engineer, started his activities on 15 August 1910.[54] He reported to the chief civil servant of the Department of Trade and Industry of the Ministry of Economic Affairs.

Summarising, RND's organisational design and resource base depended on its proponents. The VFHN proposed transfer of technology knowledge, whereas the Middenstandsbond added additional activities for stimulating SMEs. Lastly, the

Parliament members' reluctance to spend money on supporting businesses resulted in an agency that started with one consultant.

6.7 Evolving Roles of *Rijksnijverheidsdienst*

Once RND was in operation, its roles changed in response to challenges and changing circumstances. This section describes nine examples.

6.7.1 Extension

Three years after RND was established, the government extended this organisation. The first consultant was apparently able to fulfil the demand by conducting a study for SME policy, responding to advice requests, creating a database with supplier and machinery information, and helping SMEs in crisis, like blacksmiths in the West of the Netherlands.[55] In 1913, the government appointed two new consultants.[56] From then on, each consultant worked in his own region. Furthermore, the RND was extended with a laboratory to demonstrate equipment and to support consultants in collecting information and addresses. The laboratory was to be built on the Delft Technical University campus to stimulate good working relationships with the lecturers.[57]

Figure 6.2 The *Rijksnijverheidsdienst* (Dutch Government's Technical Information Agency) Laboratory building located at 76a Nieuwe Laan, Delft, 1930s.

6.7.2 World War I

As a result of the outbreak of World War I, RND changed and extended its activities.[58] As SMEs had difficulties in continuing their operations, RND responded by advising SMEs how to replace and conserve raw materials. Furthermore, as the government had taken control of distribution, SMEs needed representation of their needs within these new distribution offices and governmental committees. However, not all the sectors had well-functioning national trade associations. RND responded by building relationships with these new offices and committees, either by representing SME interests, or by becoming a committee member. Thus World War I impacted RND's scope of advice and led to its new role representing SME interests.

6.7.3 Working with Civic Organisations

By collaborating with civic organisations as MvN requested, RND was able to partly compensate for its lack of resources. For example, when consultant Begemann observed that Amersfoort's local industry needed to grow, he planned to establish an MvN department in this town.[59] In other cases, RND consultants were board members or advisers for civic organisation initiatives. In 1915, a group of well-to-do and noble citizens established the *Vereeniging Nederlandsch Fabrikaat* (VNF, Association 'Made in the Netherlands'), to promote products that were manufactured in the Netherlands as replacement for products imported up till World War I.[60] RND was involved in the establishment of the VNF and then audited firms that wanted to qualify for the VNF hallmark.[61] Another initiative was the *Bureau voor Uitvinders* (BvU, Agency for Inventors), which was established in 1917 by the MvN and a wealthy manufacturer to financially support inventors' requests for patents.[62] Consultant Steketee was a board member and the RND laboratory reviewed the inventions.[63] However, the RND consultants were initially wary, as they did not want to be managed by civic organisations. Late 1913, when consultant Steketee started his work, he did not want to give presentations for MvN departments yet. First, he wanted to have his work scope better defined, as his impression was that the MvN in Groningen had designs on managing the RND consultants.[64]

Thus collaboration with civic organisations resulted in a useful extension of RND's resource base.

6.7.4 The RND Laboratory and Delft Technical University

When the RND wanted to initiate new laboratory activities to respond to new SME needs, they first had to convince the Delft Technical University professors on the

Laboratory advisory board. This board had been established to ensure good working relationships. Its members were three mechanical engineering professors who were expected to review requests and decide how to deal with requests that the consultants could not answer.[65]

The discussions between RND and the advisory board began in late 1915. As a result of the war, firms had approached RND for assistance in using generator gas for heating purposes. Therefore, the consultants proposed to organise a demonstration and more tests. As they did not receive a response from the professors, the consultants felt that their proposal was not taken seriously.[66] Furthermore, they questioned whether the board had to be in charge of the laboratory.[67] Finally, a meeting was arranged in March 1916, when RND convinced the board of the feasibility of its proposal and the need to extend the laboratory's activities with testing.[68] Firstly, it appeared that the professors were unaware of the range of applications and the need for further tests to make it suitable for implementation in firms. Secondly, the board had to be convinced of the laboratory's capability to conduct tests. Finally, when consultant Steketee mentioned examples of requests he had received over the past few years from metal works, printing offices and tin manufacturers, the professors were convinced. The RND lab organised the demonstration at the end of 1917, after some delays because of the war. After that, conflicts were a thing of the past because the board was disbanded.[69]

Thus, in order to respond to SME requests, RND took the initiative to extend its laboratory activities, thereby also amending the original role of the board as RND laboratory supervisor.

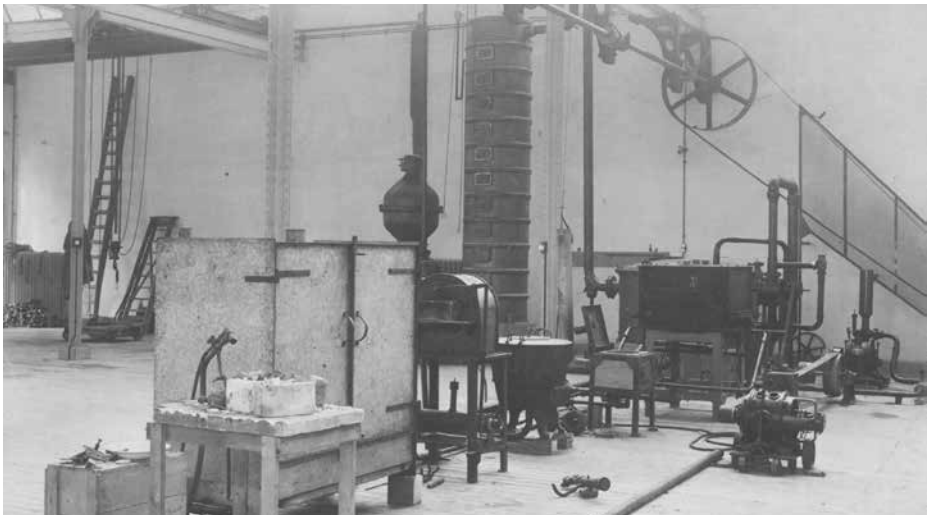


Figure 6.3 Interior of the *Rijksnijverheidsdienst* Laboratory: equipment for demonstrations and tests, 1930s.

6.7.5 Establishing ONRI, the Dutch Association for Consulting Engineers

When starting its activities, RND faced two challenges. Firstly, to ensure that firms would have access to reliable private engineering consultants who would further develop RND's general advice.[70] This profession was new and not yet regulated, so RND could not refer to a professional association. Secondly, to forge good relationships with engineers, who considered RND as unnecessary and also as unfair competition.[71] These challenges resulted in RND's initiative to establish an association for consulting engineers.

At first, RND tried to arrange cooperation with the two MvN associations which gave their members advice on how to use steam boilers economically, prevent smoke and on general technical matters.[72] However, RND and the associations could not agree on how to organise this cooperation, so RND decided to give two engineers the task of establishing an association for consulting engineers.[73] It would set standards for independent consulting engineers and its members would be approved by RND. The association's members and RND would also agree their scope of work: RND consultants would only give outline technical advice, which consulting engineers would then develop in more detail.[74] Consequently, the *Vereeniging "Orde van Nederlandsche Raadgevende Ingenieurs"* (ONRI, Dutch Association for Consulting Engineers) was established on 4 January 1917. [75]

Summarising, to ensure the standard of private consultants and to build good relationships with consulting engineers, RND initiated the establishment of the ONRI and agreed to limitations in the scope of RND's activities.

6.7.6 Technical Assistants

What Kist, the first RND consultant, noticed right from the start, was that many SMEs needed very basic support as they lacked proper training. He advised the appointment of technical assistants who were experienced craftsmen with up-to-date vocational training.[76] It took until 1917 before the first technical assistant was appointed, for blacksmiths.[77] It was a success, so assistants in other sectors followed: for wagon makers, clog makers, plumbers and fitters.[78] As RND's resources were limited, assistants were placed in those sectors which had the highest need or which lacked vocational schools.[79]

RND decided that in order to be effective, these assistants would communicate with the craftsmen in an informal way, by meeting in their workshops for personal advice and to demonstrate advice on-the-job. As these craftsmen were not used to having outsiders in their firms, RND worked with local trade associations to be introduced. Once the assistants had shown their practical value on the workshop floor, the craftsmen trusted them and asked many questions.[80]

The technical assistants also conducted several knowledge development activities.[81] To improve product quality, they initiated a trademark stamp for Dutch clogs and were jury members at trade competitions. To support business improvements, they standardised cost calculation methods for blacksmiths and wagon makers, made product drawings and developed standard workshop drawings. To stimulate sector learning, they published examples of good cost calculations and organised time studies. So, the original idea of transferring the latest results from science and technology was not helpful for many of the SMEs. RND changed its approach and cooperated with trade associations to successfully transfer and develop knowledge via technical assistants.

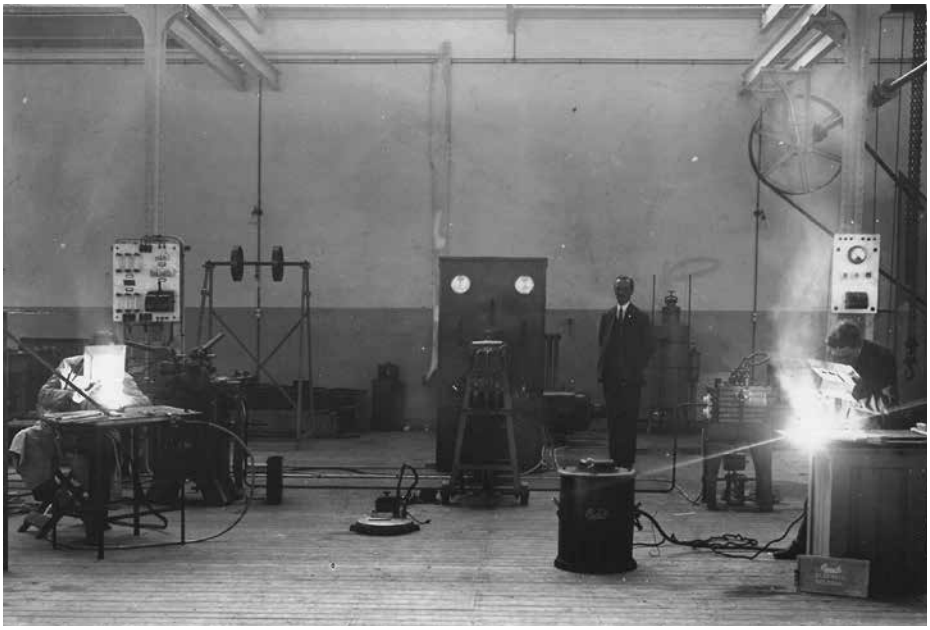


Figure 6.4 Welding demonstration in the *Rijksnijverheidsdienst* Laboratory, 1930s.

6.7.7 The Sector Approach

Originally, the *Middenstandsbond* wanted RND to also organise courses, exhibitions, demonstrations, and to support sectors in their modernisation as in Austria. However, as RND's resources were limited, this was not possible. Then, in the early 1920s, RND met with non-religious and Catholic trade associations in the laundry sector. The meeting resulted in a successful series of lectures, articles and services for the sector, based on existing RND capabilities. Consultant Steketee conducted a comparative cost study that resulted in a benchmark for laundry exploitation costs,

which laundry firms could use to improve their business. His colleagues developed advice to improve laundry machines and technology.[82]

RND's expertise was then presented at lectures and published in the associations' magazines, which increased the number of advice requests from laundries, from 48 in 1922, to 94 in 1923 and 122 in 1924.[83] To provide these, RND also cooperated with other intermediaries. After that, the laundry associations asked the consultants to design a course, based on their knowledge. The success was a breakthrough for RND, as until then, it had felt limited in its ability to help SMEs.

Then RND wanted to replicate the laundry approach in other sectors, as the sector approach was proactive, visible and less shallow than responding to various industry requests. Therefore, in its 1923 annual report, RND wrote 'our aim is to support sectors where there is a lack of skill and methods are obsolete or which suffer from threatening economic circumstances.' Examples of such sectors were woodworkers, plumbers and pipefitters, small beer breweries and bicycle and motorcycle repairmen.

However, most of its attempts to replicate this approach in other sectors failed, because RND lacked the staff and knowledge and because some sectors were hesitant to involve external support.[84] For example, the cabinetmakers sector was divided into manufacturing plants and small workshops, so it was difficult to start with one assistant. From 1930, RND tried to help foundries, but suggestions to finance an assistant were treated with suspicion, and were only agreed when the sector was severely hit by the economic crisis.

So, RND's new knowledge development activities for the laundry sector were very successful. However, replication of this approach to other sectors appeared to depend on the internal relationships in a sector.

6.7.8 Working with New Institutes

In the 1930s, the government adapted its policy to meet the challenges of the economic crisis. This led to new industrial policies and several new governmental institutes in technology development with the result that RND had to reposition itself.

One consequence was that RND had to hand over its scope of work to new institutes, which also resulted in new collaborations. This is what happened when the *Economisch Instituut voor den Middenstand* (EIM, Economic Institute for the Trades) was established in 1930, to conduct economic statistical research for SME sectors. First, RND's cost studies and benchmarks for laundries and blacksmiths had to be handed over to the EIM.[85] After that, RND supported the EIM by making its relationships with SMEs available to this new institute. Together, they initiated efficiency studies in foundries and time and motion studies in laundries.[86]

Another consequence was that RND had to reposition itself in the field of intermediary organisations. For example, the government established provincial economical-technical institutes from 1931, to which RND responded by physically changing position. RND co-located on a part-time basis in the provincial institutes. Furthermore, during meetings with these institutes, RND positioned itself as the knowledgeable representative of SME experiences.[87]

To summarise, RND responded to changes in its institutional environment by collaborating with the new institutes and by taking on the role of representing SME interests to these institutes.

6.7.9 Machinery Credit

When RND consultant Kist began in 1910, he recognised that SMEs were also in need of low-barrier credit facilities to buy new machinery.[88] The market did not provide these, nor did the government, but this changed as a result of the more active government policies in the 1930s.

From 1939, SMEs could apply for *Werktuigencrediet* (Machinery Credit), which resulted in a new role for RND.[89] After SMEs had applied for a loan to buy machinery, the RND consultant would visit the firm for an appraisal. He reviewed the firm's situation and prospects, assessed the owner's personality and technical and business skills, the firm's organisation and business results, and the impact of the new machinery on the business. Then, he submitted his advice to the committee, after which the loan application would be reviewed at a committee meeting. RND consultants regularly attended these meetings to clarify their reports. Although these reports meant more work for RND consultants, they saw these activities also as opportunities to form long-term relationships with SMEs.[90]

The changes in government policy had therefore resulted in a new role for RND as a technical assessor of credit applications.

6.8 Discussion and Conclusions

Before and after its establishment, RND and its roles as innovation agency evolved. Whereas the founders expected RND to transfer knowledge to SMEs, RND's position as a government agency made the consultants also support large firms, other organisations and governmental bodies. Furthermore, the consultants created, modified and extended their capabilities through interaction with their external environment. This resulted in RND consultants fulfilling other roles as well, like representing SME needs to others and various roles in generating knowledge and standardisation. RND responded to technology developments, war, economic

crises, and changes in government policy. Besides these, the consultants were also confronted with other situations and challenges that its founders had not taken into account, like the importance of good relationships with consulting engineers, the actual needs of craftsmen, and lack of resources. The examples also show that the consultants claimed their expertise and if necessary challenged others, like in the case of the RND laboratory versus Delft Technical University professors.

All in all, the examples illustrate how RND's dynamic capabilities in 'mediation' and 'knowledge development' resulted in role changes (Table 6.4). Mediation was the dynamic capability that enabled the consultants to search, select and learn about SME needs.[91] Knowledge development was the dynamic capability that enabled them to support their capabilities: they started testing technologies for SMEs, and they developed knowledge for the sector approach. The original capability of 'transfer of technology knowledge' was modified and extended several times. Likewise, the three other capabilities (cooperation with civic organisations, testing technologies, appraising SMEs) underwent changes. The examples show that new resources were hired to take up new activities, like technical assistance to craftsmen or running the laboratory.

The examples show that RND needed good relationships with private consultancies and other institutes. However, the latter is not unique for intermediary organisations: some firms may be in a similar position, as they collaborate with other firms to produce complex products or systems.

Table 6.4 Summary of RND's dynamic capabilities and impact

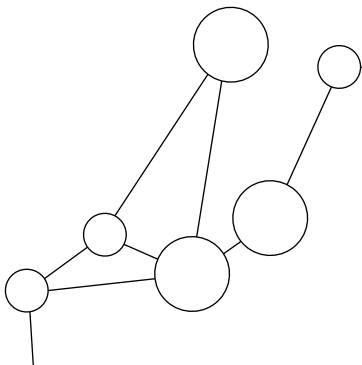
Dynamic capability	**Mediation for knowledge transfer**		**Knowledge development**	
↓ Development of specific capabilities over time	Transfer of technology knowledge (1900)	Cooperation with civic organisations (1909)	Testing technologies (1913)	Appraise SMEs (VNF) (1915)
	Education and technical advice (1909)	Represent SMEs (1914)	Basic support to SMEs (1917)	Technical assessment (machinery credit) (1939)
	Demonstrating technologies (1913)	Cooperation with new institutes (1930)	Sector approach (1921)	
	Outline technical advice only (1917)		Cooperation with new institutes (1930)	
	Basic support to SMEs (1917)			
	Sector approach (1921)			
	Cooperation with new institutes (1930)			

It is typical that six of the nine examples originate from RND's first ten years. More examples do exist in the period between 1920 and 1930, but these are variations of earlier examples, such as new government policy. This does raise the question whether dynamic capabilities matter more when an intermediary organisation starts, or whether this observation is related to fact that after 1930, active government intervention in the innovation infrastructure restricted the consultants' scope to modify and extend its capabilities.

The latter points to a difference in the dynamic capabilities of intermediary organisation and firms. As an intermediary, RND's roles and dynamic capabilities were interlinked with RND's relationships. The case of RND illustrates how changes in founders and new government policies influenced the establishment of RND, its envisaged and actual capabilities and successive changes. In contrast, entrepreneurs define capabilities themselves in response to market opportunities. Thus, further theory development in dynamic capabilities for intermediary organisations needs to take into account the typical influence of governments and financial supporters, and especially the effect of *laissez-faire* versus active governments.

RND's experiences in an industrialising country have resulted in several recommendations for contemporary innovation agencies. For example, this paper shows that an innovation agency needs to be neutral and can avoid being perceived as unfair competition by private or existing parties. Furthermore, an innovation agency must be able to act in a flexible way, so that it can focus on working in sectors where associations show an interest in innovation. Alternatively, an innovation agency can try and stimulate an interest in innovation. Lastly, an innovation agency will be more effective if it is part of a greater innovation policy, consisting of education, credit facilities, knowledge and technology infrastructure. Such an infrastructure did not exist when RND started, but it was able to compensate this by working with other organisations, following a Dutch tradition in which the government relies on a network of intermediary organisations to achieve its aims.

Currently, governments in industrialised countries privatise innovation agencies because of pressure on public funding and the abundance of knowledge and training institutes and private consultancies. This trend will inevitably impact the roles, relationships and dynamic capabilities of these organisations. Therefore, it is recommended to repeat the study in this paper for contemporary innovation agencies. This will provide more insight into the ensuing changes and to what extent these are similar to RND's evolving roles and dynamic capabilities nearly a hundred years ago.




KAASFABRIEK

'For implementing existing innovations ... the trade associations helped some SMEs to form a network whereby they could acquire knowledge, maintain relationships with external parties and initiate lobbying, training, standardisation, and quality control activities.'

'*Rijksnijverheidsdienst* helped to fill gaps in the knowledge infrastructure for wagon makers, laundry firms and blacksmiths.'

7 Conclusion

When I began this project, other researchers had already studied the roles of some trade associations and *Rijksnijverheidsdienst* (RND, Technical Information Agency) for innovation in SMEs, yet a systematic study of what roles they performed in the innovation process and how they fulfilled these was missing. Moreover, only a few studies deal with innovation in Dutch SMEs in the early twentieth century. These histories are either simply neglected or the SMEs did not leave enough suitable company archives. More problematically, current research neglects SMEs' tendency to innovate by implementing existing technologies. Therefore, a detailed study of the roles of trade associations and RND through a historical study of firm-level innovation in SMEs also helps to better understand how SMEs innovated and responded to industrialisation and other changes.

In this concluding chapter, I will reflect on the results of the multiple-case study and the separate RND study in order to draw conclusions and present recommendations. This conclusion has three sections. Section 7.1 presents the research results and conclusions, including an assessment of the significance of trade associations and RND for firm-level innovation in SMEs. Section 7.2 reflects on the contributions of this dissertation to literature. Section 7.3 contains implications for present-day innovation agencies, policy recommendations and suggestions for further research.

7.1 Research Results

The research consisted of two main parts: a multiple-case study of three sectors and a separate study of RND. First, to examine the roles of trade associations and RND in knowledge transfer and knowledge development over time, I conducted three case-studies: the mechanisation of Dutch bread bakeries (1900-1930), the transition of Dutch wagon makers to body making for motorised vehicles (1900-1940) and the development of the Dutch bicycle industry (1860-1940). In each of these cases the SMEs faced different circumstances, while the activities and the activity level of the trade associations and RND varied as well. Second, a separate study of RND investigated how its roles evolved between 1900 and 1940. I will present the results and the overarching reflections and conclusions in five subsections.

Section 7.1.1 assesses how the Dutch industries in the case studies, including its SMEs, compared to global industrial developments in mechanisation and knowledge in these decades. Section 7.1.2 presents the results of the multiple-case study. It shows what roles trade associations and RND conducted. Furthermore, it analyses

the influence of context characteristics (sector, market, product) on the results and reviews the differences between the cases. Section 7.1.3 consists of conclusions about specific contributions of trade associations for firm-level innovation of SMEs. Section 7.1.4 draws conclusions about RND's specific contributions. The final section, 7.1.5, features concluding remarks on the government's role in stimulating innovation in SMEs.

7.1.1 Dutch Industries and SMEs versus Global Developments, 1900-1940

In this section I will review how the Dutch industries compared to global industrial developments in mechanisation and knowledge.[1] First, the Dutch bread-baking sector in comparison with the American bread-baking industry. Second, the Dutch vehicle body makers (formerly wagon makers) and their place in the global automobile industry. Third, the diverse Dutch bicycle industry compared to foreign bicycle industries. The comparisons show that these Dutch industries had to rely more on codified knowledge and could survive thanks to their specific niches and cartelisation (bicycle industry).

Compared to the American bread-baking industry, the Dutch bread-baking sector mechanised at a much lower pace between 1900 and 1940. Partly, this was because the Dutch bread market remained local as its distribution networks covered smaller areas. Another reason was the state's restriction in night work after 1919. This hindered factories' mechanisation because the labour regulation led to expensive machinery standing idle overnight. Consequently, the percentage of Dutch SMEs in the sector remained relatively high. In 1909, only 127 of 13,121 bread bakeries had more than 10 employees. By 1930, this figure had increased slightly to 553 of 13,813 bakeries. The restriction in night work spurred small bakeries to buy kneading machines to speed up their production time in the morning. This was also stimulated by electrification. Other machines followed later. This development, coupled with the government introducing bread regulations, meant that bread bakers became more receptive to the use of codified knowledge. In bread factories, this knowledge was in the hands of engineers and scientists combined with the work of unskilled workers. However, small bakery owners had to be able to use and share this knowledge with their employees in a flexible way, because they did not have such a strict division of labour as in factories.

In the Netherlands, there were no major automobile manufacturers between 1900 and 1940. Some entrepreneurs did produce automobiles, but these were mainly luxury and customised vehicles, in small series. Dutch firms only filled niches in the global automobile industry. They provided transportation and repair services. They produced and customised bodies for luxury and utility vehicles, including buses and trucks. Wagon makers who became body makers for the automotive

industry needed new skills and knowledge to be able to break through and find a niche. In particular, they needed codified knowledge: reading and making drawings, materials, knowledge about production and specialised automobile knowledge. This knowledge originated mainly from foreign automobile industries that first needed to be translated and adapted for the Netherlands. As their work was mainly customised and produced in small series, they used general-purpose machines in contrast with the specific machines used in mass-production.

In the late 1930s, the Dutch bicycle industry consisted of major industrial manufacturers with mechanised production, a few bicycle parts and accessory producers, assembly firms of different sizes, traders, retailers, and repair workshops. This industry was the result of a diffusion process, in which Dutch users and producers relied on knowledge, machines and materials from France, Britain, the United States and Germany. Bicycle production relied on codified knowledge stored in bicycles, parts and accessories. Factories had mainly low-skilled workers and on the job trained employees, led by formally educated staff.[2] The Dutch industry was not only the result of diffusion. It also thanked its existence to market protection after local industry failed to compete with competitively priced bicycles from Germany. To beat the competition, the Dutch cartelised the bicycle market after 1920. This cartelisation transformed the import of fully assembled German bicycles into Dutch assembly firms importing German parts. Dutch firms badly needed production knowledge and the skills to repair bicycles.

Summarising, compared to the American bread-baking industry, Dutch bread-baking firms were smaller and mechanised at a lower pace. Furthermore, their market was local and small firms could compete with factories because of government night work regulations. Dutch vehicle body makers survived in a local niche of the global automobile industry. They produced small batches or customised vehicle bodies. The Dutch bicycle industry had manufacturing firms with different degrees of mechanisation and various sizes of assembly firms. It survived thanks to its cartel. All three sectors relied on engineers and scientists for their codified knowledge, which mainly originated from other countries. These three Dutch industries were typically implementing existing innovations, or in other words, firm-level innovation was important for Dutch firms in these sectors.

Next, the case study results will help us to understand the significance of trade associations and RND for these sectors.

7.1.2 Three Sectors: Bread Bakers, Wagon Makers and the Bicycle Sector

First, I will summarise the results of each case. Then I will make comparisons and consider the influence of sector, market and product characteristics on the results.

Each of the case studies led to different conclusions about the roles of trade

associations and RND. Such an outcome was expected because in the multiple-case design, variation in the trade associations and RND activity level was a criterion for selection. You can see the original case definitions in Table 7.1 (see also Table 2.2). The categorisation of roles in Table 7.2 resulted from the multiple-case study (Chapter 5, Table 5.4). Table 7.3 shows the results of the case studies. It presents all the activities categorised according to the roles presented in Table 7.2 and also the activities conducted by individual SMEs. To interpret Table 7.3, note that between 1900 and 1940, RND was one of the few government agencies which conducted activities for SMEs despite its limited resources. In this period, the maximum number of staff was twelve, thus severely limiting the activities RND could undertake.

The case of the Dutch bread bakers illustrates how a trade association and its knowledge institute could make a difference for a sector.[3] Individual bread bakers were able to mechanise their bakeries through trial and error combined with advice from suppliers and colleagues as well as friends and family in the Netherlands and abroad. However, most bakers needed the support network created by the Dutch bread bakers' association. Through this network, bakers acquired various types of knowledge, in particular codified knowledge like tests and standard recipes, which the bread bakers' *Proefstation voor Maalderij en Bakkerij* (Institute of Milling and Baking) developed. This Institute was a driving force for the sector's innovation. It brought individual bakers into contact with new knowledge through advice, courses, publications, demonstrations, exhibitions, excursions, and quality control. Forward-looking bread bakers, in turn, convinced their colleagues to follow their example to mechanise and improve their business. These leading bread bakers also started several other initiatives to improve their sector in response to the industry's crises: in meetings and publications they pushed the idea with fellow bakers that change was needed.

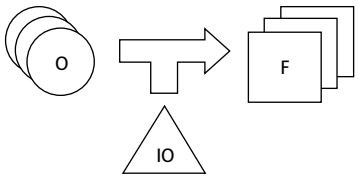
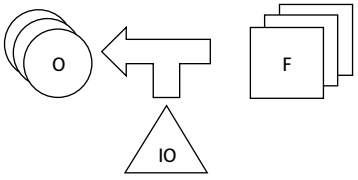
Despite the efforts of these activist bakers, the bread bakers association only gained momentum in the aftermath of World War I. Because flour prices had increased tremendously, the bread bakers' association decided to alleviate the pressure by buying milling factories to supply their members with flour at reasonable price levels. This made the majority of bread bakers decide to join the association as members. During the war, the government similarly found the association useful because it had to rely on the bakers association's lnstitute for quality control, specifications and recipes for making bread with alternative ingredients to cope with the emergency war situation. The bread bakers maintained relationships with RND through their association and Institute; at the same time, their own knowledge infrastructure allowed them some independence. As a result the government directly funded the new bakery teachers at the bakers' Institute rather than at RND.

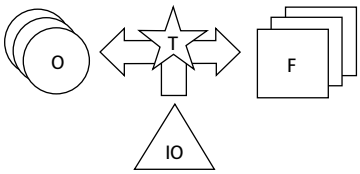
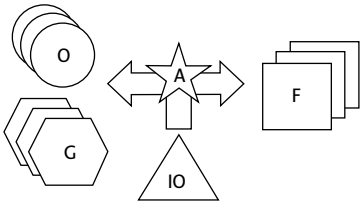
Table 7.1 Comparison of the three case studies

	Bread bakers (1900-1930)	**Wagon makers (1900-1940)**	**Bicycle sector (1860-1940)**
Threats	Bread factories	Motorisation	Import (quality and price)
Challenges	Improve bread quality and survive economically	Facilitate transition of artisan crafts to industry	Develop a new sector interacting with users
Developments	Mechanisation, standardisation, and quality control	Retraining and improving production efficiency of making bodywork for motorised vehicles	New firms, infrastructure for Dutch bicycles and cartel formation
Activity level			
Trade associations	++	+	-
Rijksnijverheidsdienst (RND)	-	++	□

Key to activity levels: ++ very high + high □ average - low

Table 7.2 Categorisation of roles in intermediary organisation innovation

Types	**Roles (including networking)**	**Activities**
Knowledge transfer	Providing knowledge – transfer of knowledge flows from a range of sources to the intended firm(s) 	Conducting and supporting knowledge provision activities for firms: – *Giving personal advice to firm(s); organising and supporting training, demonstrations, excursions, study trips and exhibitions for firm(s); writing and supporting publications for firms; other activities*
	Influencing - transfer of knowledge flows from firm(s) towards a range of recipients 	Conducting and supporting promotion activities for firms and sectors; articulating firms' innovation needs

Knowledge development	Generating knowledge - transforming knowledge from several sources to make it suitable for local firm(s) 	Translating and adapting knowledge; testing and evaluating technology; developing technology; supporting intellectual property management
	Standardisation - generating and translating knowledge and aligning this with firm(s) and other stakeholders 	Defining specifications and norms for firms; preparing and conducting accreditation for firms; defining and conducting tests and quality controls for firms

Key: IO – intermediary organisation, F – firm, O – other organisation or individual, G – government and regulatory bodies, T – transformation of knowledge, A – alignment of standards

Table 7.3 Categorised multiple-case study results

		Activities		
		Case 1 **Bread bakers**	**Case 2** **Wagon makers**	**Case 3** **Bicycle sector**
SMEs				
		Trial-and-error learning; requesting contacts abroad and suppliers	Internships and schools abroad; self study; trial-and-error learning; hiring metalworkers	Study tours; training and trade schools; self study; trial-and-error learning; hiring skilled craftsmen and production managers
Trade associations				
Knowledge transfer	**Providing knowledge**	Network building and outreach program for change (meetings, lectures, training, study tours, journal); contractual advice	Network building and outreach program for change (meetings, evening sessions, lectures, excursions, journal, books, training)	Journal; training
	Influencing	Exhibitions; sector promotion	Ask support for training; support for sales exhibitions	Sales exhibitions; initiatives to stimulate bicycle repairman education

Knowledge development	**Generating knowledge**	Enabling development of new knowledge (evaluation of machinery, recipes)	Enabling development of new knowledge (evaluations of technology, drawings)	Not applicable
	Standardisation	Enabling development of standards; support accreditation (*Vestigingswet*)	Support accreditation (*Vestigingswet*)	Not applicable
Trade association knowledge institute				
Knowledge transfer	**Providing knowledge**	Training, demonstrations and advice; lectures and publications; excursions	Not applicable	Not applicable
	Influencing	Supporting trade association	Not applicable	Not applicable
Knowledge development	**Generating knowledge**	Translate knowledge for courses and advice; testing and evaluating ingredients and technology	Not applicable	Not applicable
	Standardisation	Standardisation (need for standards, develop standard); quality control (M-hallmark)	Not applicable	Not applicable
***Rijksnijverheidsdienst* (RND)**				
Knowledge transfer	**Providing knowledge**	Advice on efficient energy use of ovens during war; technical advice	Technical assistance and advice (personal, meetings); training; demonstrations; excursions; lectures (technical and business)	Advice about production and energy; support training initiative
	Influencing	Not applicable	Sales exhibitions	Not applicable
Knowledge development	**Generating knowledge**	Develop advice on efficient energy use in ovens	Translate and develop knowledge for courses, lectures, articles, advice; developing drawings; monitoring developments; testing and evaluating technology	Advice about patents
	Standardisation	Not applicable	Standardisation (norms, standard wagon); accreditation (*Vestigingswet*);	Audits for VNF ('Made in the Netherlands') hallmark

Among the Dutch wagon makers, similarly forward-looking entrepreneurs as in the bread-baking sector saw the need to organise their sector to secure their future. Whereas bread bakers faced the threat of large-scale production in bread factories and the back-breaking working conditions at night ever since the late nineteenth century, wagon makers were confronted with threats to their industry only around World War I. It took until 1918 before the wagon makers finally agreed to support the establishment of a national association. This organisation had to lobby government bodies about distribution and other war regulations. After the war, most traditional wagon makers faced the threat of motorisation. In the first instance, the wagon makers association was not a united front, in part because motorisation impacted urban wagon makers differently than their rural colleagues. Like the bread bakers association, the national wagon makers' association bridged the gap between its members and the experts.

The national wagon makers association faced difficulties: after five years, it collapsed in 1923. The collapse resulted in a loose network of regional and local associations that took over the national association's mediation role between 1923 and 1936. These local associations developed a wagon makers' network to help members acquire knowledge about building bodies for motorised vehicles. This network also shared knowledge with others wagon makers and acquired knowledge from other parties. For example, in 1919 RND used this network when it sought to support wagon makers with a technical assistant. First, RND approached the association, which welcomed RND's initiative because it had tried in vain to organise training at vocational schools. The association made the RND assistant available to its members through their regional and local associations. The assistant retrained wagon makers, assisted them in vehicle body making, and updated them regularly on business and technological topics, especially developments in the automobile industry. Not only did he teach and advise, he also facilitated sales exhibitions at the National Fair (*Jaarbeurs*), was a committee member for normalisation activities and designing modern farmers wagons, and tested new technology and equipment. A comparison with American and German wagon makers shows that it was easier for Dutch wagon makers to make the transition, because of RND's assistance and lack of strict guild rules (as in Germany).

Like in the case of the bread bakers, some wagon makers learned body making without the assistance of a Dutch knowledge institute. These wagon makers learned new skills through self-study; hired metalworkers to start body making; or went abroad for internships and education in automobile technology. They turned to the association for other forms of support, however, such as reading its journal to stay abreast of the trends, designs and developments. They also found the association useful in representing their sector's interests during the economic crisis and *vis-à-vis* other sectors.

The case of the bicycle industry differs from the first two cases. The study

did not examine an existing but an emerging sector. The case study of the bicycle industry describes the development of a new sector. Bicycle entrepreneurs utilised their existing skills, knowledge and expertise as bicycle users or their previous roles of salesmen, blacksmiths or wagon makers.[4] The sector differed from bread making in its competitiveness. The bicycle manufacturers competed both against each other and with foreign bicycle manufacturers from France and Britain. After 1900, bicycle imports from Germany became substantial. By contrast, bread bakers and wagon makers competed mostly in local markets. The first manufacturers starting up a bicycle business copied the original velocipedes, high-wheelers, and safeties from France and Britain. The quality of their products depended on their ability to copy new products combined with their previous training. Alternatively, they learnt their new skills by making bicycles with imported bicycle parts or by hiring skilled craftsmen and experienced production managers. Study tours to Britain, trade exhibition visits and activities in bicycle clubs and races were other ways these entrepreneurs learned about market trends, manufacturing developments and user needs. Understanding user needs was an essential activity because bicycle use was new and not yet stable, but changing quickly. The bicycle started off first as a luxury good before becoming a utility.

In the early twentieth century, the association of retailers and repairmen (BRHN) began training repairmen and assemblers. Between 1860 and the 1930s, bicycle entrepreneurs depended mostly on generic mechanical training in trade schools, internships, study tours, and their own sales and marketing skills. RND activities mainly consisted of advice about production methods, saving energy and the audits for the VNF (*Vereeniging Nederlandsch Fabrikaat,* Association 'Made in the Netherlands') hallmark, which proved the Dutch origin of products. Until World War I, the two business associations in the cycling sector, the RAI (the association of bicycle manufacturers and traders) and the BRHN, mainly regulated marketing and sales activities; the BRHN also standardised its prices for bicycle repair. Then, World War I created the opportunity for Dutch entrepreneurs to replace German and British bicycle imports. They jumped at the opportunity. After the war, the window of opportunity closed when German bicycles reappeared on the Dutch market at extremely low competitive prices. In response, the three business associations (RAI, BRHN, and NEVGRO) representing bicycle manufacturers, traders, retailers, repairmen, and wholesalers, established a cartel in 1920 to protect the Dutch market against imported bicycles. The cartel created a market for a national product: the well-known Dutch bicycle. It was a cheap mass-produced vehicle based on a British model, made from imported bicycle parts from Germany and Britain, and adapted to Dutch user preferences.

The three cases share one common characteristic: in each case, most firms initially hesitated to become members of trade associations voluntarily because they

cherished their entrepreneurial independence.[5] Despite difficult circumstances, they preferred to continue struggling on their own. Major threats like competition from bread factories, the automobile sector, foreign bicycle manufacturers, and new firms did encourage small firms to become members. However, only the radical impact of World War I convinced them they had no choice but to unite in large numbers. Another commonality is illustrated by the bread bakers and the wagon makers. In both cases, the majority of SMEs only latched on to innovations in times of urgent need. The kneading machine broke through in bread bakeries when they needed it after World War I because of the restricted night work and higher labour costs. Many wagon makers started building vehicle bodies when motorisation broke through after World War I.

A sector's division between small and large firms and the type of product are typical factors that influenced the willingness of firms to form a collective association.[6] Both homogeneity in firm size and similarity in product type stimulated organisation. Over ninety percent of the bread-baking sector consisted of small businesses with one main product: bread. In the Netherlands, sector organisation was further encouraged when the bread baker associations belonging to the three social pillars (non-religious, Catholic and protestant) agreed to have one national umbrella association.[7] On the other hand, many of the 10,000 firms had no interest in organising. The association therefore needed quite a few members before it had sufficient support in the sector to take a firm stand.[8] In the wagon makers sector, the degree of homogeneity was also high, yet there was less similarity in activities compared to the bread bakers. There were carriage makers and wagon makers in the cities and in the countryside. Although the product names suggest overlap, their actual products ranged from luxury carriages, utility wagons and carts to farm wagons, wooden tools and other farm products. Another factor counteracting organisation was that motorisation also brought new trades for wagon makers: car dealers and repair workshops. It is likely, therefore, that some wagon makers who had specialized skills in the automotive sector joined other associations. The bicycle sector, however, had a low degree of homogeneity: a small group of mainly large-scale manufacturers versus a large group of small bicycle repair shops and retailers. The division resulted in two national business associations: RAI for major bicycle manufacturers and traders and BRHN for retailers and repairmen (including small bicycle factories and assemblers). Furthermore, there was NEVGRO for wholesalers.

To get a quantitative impression of the relative firm homogeneity of these three sectors, see Table 7.4, based on the 1930 Dutch Census of Industries. In the case of the bread bakers, associated trades and suppliers are added. For the wagon makers' case, the number of car repair shops is added. The table shows the great number of bread bakers (13,813) and small number of confectionaries (1,610), which also tended to be small-scale firms. The latter had formed a separate confectioners association. Bread bakers worked with various suppliers, for example, grain millers.

The table shows that despite mechanisation and scale increase, there were still 2,177 grain millers in 1930. Most were small-scale firms, who milled grain for bread bakers located in their vicinity. This close geographical and intimate working relationship may explain why the association of bread bakers and the millers set up a joint laboratory. With respect to larger suppliers, the table shows that the seventeen flour factories and nine yeast and alcohol manufacturers were mostly medium and large firms. As the bread bakers' case shows, some supplier factories supported the bread bakers association; others did not. To illustrate the latter: skyrocketing flour prices during the war prompted the bread bakers association to buy their own flour factories.

Table 7.4 Number of Dutch firms per trade and percentage of small firms in 1930

	Number of firms	**Percentage of firms with 1-10 persons**
Bread bakers' case		
Bread bakeries	13,813	96
Confectioneries	1,610	95
Rusk factories	206	59
Grain mills	2,177	98
Flour factories	17	6
Yeast and alcohol manufacturers	9	22
Wagon makers' case		
Wagon makers	1,618	100
Body making factories	209	74
Car repair workshops	491	94
Bicycle industry case		
Bicycle manufacturers	84	42
Bicycle repair shops and retailers	6,157	100

Source Centraal Bureau voor de Statistiek. *Bedrijfstelling 31 december 1930*. Den Haag: Centraal Bureau voor de Statistiek, 1935-1937.

Compared to bread bakers, the number of wagon makers was much lower. Even when you include body making factories and car repair workshops, the total number of firms is only seventeen percent of the number of bread bakeries. This may explain why the wagon makers struggled to raise joint funding. Not only did they

lack donations from suppliers, they also had a smaller pool of potential members, whereas the cost of a sharing a knowledge institute was probably quite similar to that of the bread bakers.

There were only 84 bicycle manufacturers in the Netherlands. The relatively low number partly explains why these manufacturers were less inclined to establish a knowledge institute for their sector. On the other hand, a small group also allows members to cooperate more easily, as illustrated by the establishment of RI (or RAI, for bicycle manufacturers and traders). In contrast with the manufacturing sector, the repair sector was large: the number of bicycle repair shops (6,157) was very high, even taking into account the threefold increase of cycle owners between 1920 and 1930, to 2.6 million. Repairing bicycles was an essential part of the industry.

The bread baking case differed from both wagon making and bicycle manufacturing regarding the government's role. Strict government regulations for bread and flour encouraged bread bakers to become members of the bread bakers association and increased the importance of the bread bakers' Institute for Milling and Baking. During World War I, the Dutch government commissioned the bakers' Institute to check the flour quality and define the government specifications for wheat. After the war, the laboratory's regular inspections helped bread bakers to ensure that their bread was baked according to the government specifications in the 1925 Broodbesluit (*Bread Act*). In contrast, the wagon makers and bicycle manufacturers' products were less regulated. These products did not have the same public health and social stability impact as bread.

The trade associations in these three cases differed in their initiatives and activities in knowledge circulation as well as in their access to financial resources. The bread bakers association managed to convince its members to finance the Institute for Milling and Baking. However, the association only managed to establish the Institute with the help of government subsidies and donations from suppliers. Conversely, the wagon makers could hardly be persuaded to pay contributions for a national association, let alone for training facilities or a knowledge institute. In the bicycle sector, members were initially not very interested in training facilities nor a knowledge institute. Bicycle repairmen resisted initiatives to start training activities because they thought these would encourage competitors. Why bread bakers were less deterred by this argument is not entirely clear. The willingness to organise the sector may simply have been the availability of critical mass. Furthermore, small bakers were already united against the common threat of bread factories.

The three cases also show that each sector had different gaps in its knowledge infrastructure. Bread bakers needed education so that they could implement codified knowledge. They had to learn how to use standards and test protocols. Furthermore, the laboratory first had to develop this codified knowledge. Wagon makers needed retraining in making bodywork to serve the automotive industry in the manufacturing of motorised vehicles. Once part of this high-tech sector, wagon

makers needed regular updates to keep up with the developments in the automobile industry. Later, wagon makers needed qualified and experienced craftsmen and staff. In the bicycle sector, early bicycle manufacturers mainly needed to maintain network relationships with French and British manufacturers and train abroad. Bicycle repairmen needed specialised training.

These types of knowledge gaps were bridged in different ways. The bread bakers were able to start filling these gaps with their own training initiatives and an Institute thanks to government subsidies. Some wagon makers were able to fill these knowledge gaps on their own terms; their association introduced many wagon makers to RND's support in the form of a technical assistant. In the bicycle sector, manufacturers and repairmen were generally able to fill these knowledge gaps by themselves by learning on-the-job and through other sources. Available trade school training also helped the sector. Only by the 1920s, did BRHN play a significant role in organising training for repairmen.

The cases also show that knowledge is not neutral. In all three cases, SMEs needed to use more codified knowledge that engineers and scientists developed: in specifications, standards, drawings, production technologies, machines and products. Due to the formal nature of this knowledge, many of these engineers and scientists were far removed from the shop floors of SMEs, in the American bread-baking industry, the British bicycle industry and in the American automobile industry. Dutch engineers and scientists introduced, translated, and transferred this type of foreign knowledge to Dutch firms. For example, Jacob Roeters van Lennep, founder of a bread factory in Zutphen, who had a PhD, suggested the bread bakers association should establish a laboratory.[9] A. Boonstra, who was trained in scientific wheat research, headed this Institute of Milling and Baking. RND, staffed with mechanical engineers and technical assistants, fulfilled similar roles for all Dutch SMEs, whether it was in retraining wagon makers, improving clog makers businesses or advising SMEs in production efficiency. SMEs did not necessarily welcome this change. It took a lot of patience from people like Boonstra and the RND consultants, and years of repeating the same message over and over again to convince the SMEs they needed to organise their business better, use tests and specifications to improve their production, and get training. At the same time, Boonstra and the RND consultants had an advantageous position because their opinions were taken more seriously by authorities. In World War I, baker George Enzlin wrote to the Ministry, saying that bread bakers lacked the education to use the Institute's recipes. Enzlin mentioned that customers complained about undercooked, dry and sour bread. To address the problem, he said the Ministry should subsidise bakery teachers. Because of his experience in teaching bakers, he offered to head such a school. Institute director Boonstra agreed when the Ministry asked him for advice. Additionally, he strongly suggested stationing the bakery teachers at his own Institute because he found that the experienced Enzlin was weak on theory.[10]

Finally, the introduction of education was based on status. The first bread bakers school, housed at the Institute, expected its students to have at least three to four years secondary school education; 44 percent of its graduates owned a bakery or worked in the family owned bakery. Later, bread bakers established schools that were more accessible and less expensive. At the same time, these schools lacked the elite character of the Institute school. Most bread factory workers lacked specialised training because their work was low skilled and undemanding.[11]

Between 1900 and 1940, the roles of the trade associations, their knowledge institutes and RND evolved for several reasons. Their roles changed as a result of government policies and regulations, World War I shortages, changes in technology, availability of other knowledge suppliers, and price-cutting imports. From the beginning, the bread bakers association wanted to have a test laboratory. The threat of government food regulation created the momentum to set up their own laboratory, the Institute for Milling and Baking. On top of government regulations, World War I prompted a need for the test and quality control function of the bread bakers' Institute because of the shortage of wheat and flour. The war-time experiences also convinced the government to fund ten bakery teachers at the Institute. For wagon makers, the main changes were visible in RND's role. In his first years, the assistant was mainly providing training to wagon makers to teach them how to build bodies. After that, his role consisted of keeping wagon makers up to date, while also being involved in various other activities. From the late 1920s, schools and private institutions offered courses for body making as well. This voided the role for RND to offer basic training. During World War I, the trade associations in the bicycle sector formed a cooperative; after the war, the impact of German imports prompted the establishment of a bicycle cartel. For all three sectors, a new law in the 1930s instated mandatory training. Such training created a barrier for anyone wanting to enter the sector yet was meant to help firms survive the economic crisis.

After reviewing the case study results, the question is how do the above reflections inform the results of chapter 5 on what roles in innovation did trade associations and RND conduct for SMEs? They give more depth. The bread bakers case demonstrated how well a sector can organise and stimulate innovation through a trade association and its knowledge institute. At first glance, this could be considered a recipe for success for other sectors. However, the comparison with the two other cases and the specific sector, market and product characteristics illustrate why this recipe is not so easy to replicate. Therefore, it is appropriate to conclude that the bread bakers' example worked well given the circumstances, which include: the product characteristics with public health and social stability impact, the sector composition, the sector's ability to establish a trade association, forward-looking members, supporting government regulation, financial resources, time and severe threats. The bread bakers case shows that it took almost thirty years before they were able to establish the knowledge institute and a similar length of time before the

majority of bread bakers joined. For RND the findings show that although they could only help a small percentage of the SMEs, their value in those days lay in general advice, influencing and in-depth support for a few sectors, including the wagon makers. For the latter sector, RND started as a retraining organisation and thereby filled a gap in the knowledge infrastructure. When RND started in 1910, the bread bakers had just established their Institute, so there was no gap anymore. In the bicycle sector, there was a gap, but RND did not see it as a high priority to train and educate bicycle repairmen and small manufacturing firms. Possibly, this was because the bicycle sector was not a traditional craft.

The next section will reflect on what the findings about the various organisations' roles and their context signify for innovation in SMEs.

7.1.3 Trade Associations

The multiple-case study and the analysis of its results illustrated the roles that trade associations performed. What are the conclusions with respect to the specific contributions of trade associations for innovation in their members' firms? What was their significance?

First and most importantly, trade associations created networks that supported SMEs. These networks helped SMEs to access codified knowledge and learn from each other. In addition, networks helped intermediary organisations and knowledge suppliers to offer their services to individual SMEs while also defending the sector's interests against external parties. Second, trade associations stimulated innovation by making members more receptive to change. The trade associations, for example, repeatedly communicated the message through meetings, trade journals and in personal contact, that members needed to mechanise or change their businesses as the best tactic to survive. The organisation thus created a sense of urgency for SMEs to take action. Third, trade associations represented the sector's various interests in several ways, sometimes in collaboration with their knowledge institute or RND. They lobbied suppliers, customers, government agencies and standardisation committees for standardisation and simplification of regulations. Trade associations represented their members in several fora to ensure the translation of new knowledge and technology, for example in standards. They also represented their sector's interests by taking initiatives or conducting activities. Examples are the establishment of a knowledge institute, responding to crises through mitigating actions and organising exhibitions to demonstrate new technology.

The cases show that trade associations had one major barrier to overcome: SMEs tended to avoid membership because they cherished their entrepreneurial freedom. Although the challenges were severe and they possibly could not handle these themselves (huge competition, many new entrants, low product prices, low product

quality, lack of education, reputation issues), most SMEs only joined when the external threats were so severe that these left them with hardly any other option. The cases indicated that there are stimulating factors for organisation, for example the amount of financial resources available, either via many small firms or via a couple of larger firms; furthermore, trade associations were more successful if they could deploy initiatives in an area that they could control with their members, for example, a local or regional market. The cases also show that collective organisation not only consists of alignment and agreement, but also of heated debates and conflicts. Sufficient authority of association leaders and the presence of external threats often persuaded members into agreeing and adhering to the suggested policies, regulations and activities to ensure their businesses survived.

Summarising, the research in this dissertation indicates that trade associations were able to contribute to firm-level innovation in SMEs, especially in creating support networks and in encouraging SMEs to innovate. Additionally, they stimulated initiatives such as the establishment of a knowledge institute, sales exhibitions, standardisation, etc. Trade associations can also help the diffusion and implementation of technology or knowledge in a sector. This was best illustrated by the bread bakers case and to some extent by the wagon makers case. Their trade associations supported adaptation of knowledge, standards and specifications to the local context. These cases also illustrate that the trade association did not perform these tasks itself, but delegated these to another organisation. The bread bakers had a sector knowledge institute (Institute of Milling and Baking) and the wagon makers had a sector specialist (RND assistant for wagon makers). These were able to work in close and direct contact with SMEs, for example via personal and practical advice and assistance, lectures, courses, and demonstrations. In order to gain sufficient support and momentum in the diffusion process, trade associations needed progressive entrepreneurs as leading organisers in their sector.

7.1.4 *Rijksnijverheidsdienst* and its Evolving Roles

The case studies of the three sectors and the separate study of RND illustrate that this agency was far too small for the number of Dutch SMEs and their needs. Given the low political support around 1900 for government intervention in the economy and the resistance to use taxpayers' money for agencies, this insufficient size is quite understandable. What the research does show is that despite the lack of visible quantitative effects on SMEs as a whole, RND was seriously developing and performing the activities it could manage.

The separate study on *Rijksnijverheidsdienst* (RND, Technical Information Agency), a government agency for SMEs, resulted in three findings of how its roles evolved. First, even before its establishment, RND's mission evolved, following the

interests of the various stakeholders who founded this agency. It was first designed as a knowledge broker between small firms and Delft Technical University. Then, the design was changed to copy the Austrian institutes' methods of training and mechanising small firms. Finally, the Dutch government established an agency which was a slimmed down version, starting with only one consultant, later extended to three consultants, a laboratory and some technical assistants. Furthermore, this agency served SMEs, larger firms and governmental bodies and institutes.

Second, once established, RND's consultants became stakeholders who were shaping the agency's roles. From the beginning, these stakeholders did not support the civic associations' idea that SMEs needed to develop an artisanal niche as a strategy to survive industrialisation.[12] Instead, these stakeholders translated the best practices of large firms to SMEs (like laundry firms, blacksmiths) into a body of expertise. These best practices included modern technology, mechanisation, efficient work organisation and planning, cost calculation, benchmarking, and time-and-motion studies. RND consultants also responded to changing circumstances. In response to World War I, they participated in government distribution committees and war offices; to manage relationships with private consultants, they decided to establish the ONRI (Dutch Association for Consulting Engineers); they took charge of their laboratory instead of having the advisory board manage it; when they found out that SMEs needed basic advice, they extended the agency's human resources with technical assistants; they developed a sector approach to reach SMEs in a more effective way. In defining these changing roles, RND actively set the tone for its scope and direction. In contrast, when the economic crisis led the Dutch government to establish new institutes and a machinery credit policy, RND adapted. The agency conformed to the new institutional landscape by handing over activities to the newly established institutes; by collaborating with these organisations and representing SMEs' interests in meetings; and by playing a role in the machinery credit application process.

Third, by using insights from dynamic capabilities studies, the separate study shows how RND was able to adapt its roles and relationships. It was RND's dynamic capability in mediation which enabled it to ascertain SMEs' needs and thus adapt its roles and competencies. Additionally, RND's dynamic capability in knowledge development complemented its activities in stimulating SMEs to innovate.

RND started in knowledge transfer before taking on the role of developing new knowledge to cope with changing circumstances. RND's founders expected the agency to provide knowledge to SMEs. Once established, however, RND consultants extended its original mandate by lobbying for the interests of SMEs externally in meetings with other organisations. In the first ten years of the agency's existence, RND consultants also extended their scope to include activities in generating knowledge and standardisation, through the laboratory, technical assistants and a sector approach.

Using the categorisation of roles to analyse what roles RND conducted (in the multiple-case study and the separate study) results in the following conclusions. RND's main role was providing knowledge. It also conducted three other roles: influencing, generating knowledge and standardisation, however in a different way – only in some sectors was RND very active in these roles, for example, blacksmiths, wagon makers, clog makers, laundry sector, in other sectors much less. This depended both on resource availability as well as the relationship with the sector (i.e. trade association). Furthermore, the analysis shows mainly knowledge transfer and development to support firm-level innovation. This consisted of very practical and pragmatic activities to stimulate SMEs to mechanise and improve their businesses. RND filled the needs of these SMEs very well. This observation is not only on account of the scope of the research question. RND conducted these roles and activities because the Dutch knowledge infrastructure was in a very early phase, so the need was highest for education and retraining.

RND contributed in three ways to innovation in SMEs. First, RND bridged the gap between the SME knowledge base and other knowledge and skills. It also reached out to other organisations. Expertise often consisted of codified knowledge, which the consultants provided through personal advice and training. RND developed SMEs' skills through instructions and personal assistance on the workshop floor. The consultants also assisted SMEs in implementing new knowledge and skills, for example, in marketing activities and in implementing new regulations and standards in their business. RND bridged SMEs' gap with the external world by building and maintaining relationships with other trade organisations and governmental agencies. Second, RND also filled gaps in the knowledge infrastructure in a flexible way. Consultants went beyond transferring knowledge on an incidental basis, but were instead attuned to the broader and long-term needs of SMEs. For example, RND developed knowledge in drawings, specifications, guidelines, and benchmarks. Third, because of its advisory and implementation efforts, RND consultants were well positioned to shape regulations and articulate the needs of SMEs. Consequently, RND consultants participated in a number of standardisation and normalisation committees, thus communicating SMEs' needs in meetings with other organisations.

RND's main challenge was maintaining good relationships with a wider circle beyond the relationships with knowledge suppliers and SMEs.[13] It established relationships with trade associations to discuss SME needs and to gain access to these SMEs. The agency needed to build trust with independent commercial consultancies, which tended to view the government-subsidized RND as unfair competition. For that purpose, it established ONRI. During the 1930s economic crisis, RND was forced to engage with the newly established and government-supported institutes. In creating its position, RND also struggled with others to set its boundaries. For example, the consultants carefully claimed their knowledge

domain to avoid intervention from civic associations; they unintentionally crossed the agreed boundaries with private consultants, who were organised through the ONRI. Another example was when the agency defended its position as a capable consultancy and test laboratory *vis-à-vis* the advisory board consisting of Delft Technical University professors.

In summary, the research results show that RND had difficulty completing its mission due to insufficient resources. Its contributions were most visible in the sectors for which it prioritised activities. RND carried out its mission to diffuse innovation in SMEs most effectively when working closely with SMEs in specific sectors, as illustrated for wagon makers, laundry firms and blacksmiths. Applying this approach, RND cooperated with the trade associations. The agency bridged knowledge and knowledge development gaps and represented SME needs through lobbying efforts outside the sector.

7.1.5 Concluding Remarks

Both trade associations and RND played their roles in encouraging innovation in SMEs. The question is, what do the research results suggest about the government's role in supporting and stimulating innovation in SMEs? Do the results indicate that SMEs can manage innovation without government support? The results illustrate that government support is needed to stimulate firm-level innovation in SMEs. This complements the natural inclination of governments to invest in innovations that are new to sectors or countries, as these are seen as more prestigious and seem to get a better head-start. The multiple-case study shows that for many activities in firm-level innovation, SMEs were able to find knowledge providers themselves. For collective activities, SMEs needed other organisations and their own association. Furthermore, for collective activities like standardisation, the bread bakers' case demonstrates that SMEs were capable of forming a trade association, which established an effective knowledge institute. This was a private initiative, but, not without government support. The bread bakers association depended on government subsidies for its Institute and its teachers, and government regulation helped the Institute get the message to bread bakers and suppliers to improve product quality. Furthermore, for more than thirty years the bread bakers association only covered a minority of the bakers. Membership of the bakers association only increased after the impact of World War I left individual bread bakers with no other alternatives. Last, the two other cases further confirm that sectors find it difficult to organise training and standardisation activities themselves, so government support is needed.

In conclusion, the dissertation shows that for some firm-level innovation activities, SMEs could not rely on the network of relationships they had as individual entrepreneurs, but needed to act collectively through the trade associations and

RND to help fill these gaps. In those instances, they needed to collaborate with external parties as well as rely on government support, subsidies and regulation. Trade associations helped some SMEs form a network, whereby they could acquire knowledge, maintain relationships with external parties and initiate lobbying, training, standardisation, and quality control activities. RND helped to fill gaps in the knowledge infrastructure for wagon makers, laundry firms and blacksmiths. For sectors where the agency did not have resources for technical assistants or other specialist support, RND consultants played a more general role in advising on an individual basis, referring SMEs to other knowledge sources, lecturing, conducting lab tests, auditing for the VNF-hallmark, and helping out with machine credit.

This historical study thus shows that an innovation agency is useful in supporting firm-level innovation in SMEs, but what advice can we give the government when deciding to establish such an agency? What is a good and effective approach, based on the results of this dissertation? The historical study covering more than three decades showed that the agency's activities were continually evolving, as challenges appeared and disappeared and the knowledge infrastructure evolved. For that reason, I conclude that an innovation agency needs to be a long-term commitment that acts as intermediary to bridge gaps on a temporary basis and in a flexible way, depending on the sector's and SME's need. Activities and content (knowledge) need to be adapted to the context of SMEs and preferably take place in direct contact. An innovation agency can work closely with a knowledge institute to fulfil roles in knowledge transfer and in knowledge development. This knowledge institute can either be linked to the agency or to one or more sectors. Finally, such an agency needs to ensure continuing financial and political support from its stakeholders, so it needs to spend sufficient time and energy maintaining durable relationships with them.

7.2 Reflections on the Theoretical Contributions of this Research

7.2.1 Reflections about Roles of Intermediary Organisations

In the previous section, I concluded that trade associations and RND did carry out roles to increase the innovation capacity in SMEs, especially in adapting knowledge, standards and specifications to the local context and in diffusing and implementing technology or knowledge into a sector. Trade associations were important in creating networks then stimulating innovation and needed a sector knowledge institute or specialist for knowledge development. RND worked best with sectors through trade-based associations by bridging the gap to knowledge, temporary filling gaps in knowledge development and representing SME needs.

The following section discusses how this dissertation contributes to the current

literature on the roles of intermediary organisations. This section first reviews how the results relate to the existing scholarly literature. Second, it reviews what the results suggest about role changes. Third, it reflects on the definitions.

The dissertation contributes to the existing literature in several ways. It offers a categorisation of roles of intermediary organisations in knowledge transfer and knowledge development. These roles each relate to different flow directions and to different relationships with the intermediary organisation. Furthermore, I investigated the roles of trade associations and RND in a multiple-case study of three sectors and a separate study of RND's role and its evolving roles over several decades. In parallel, the multiple-case study also gave insight in firm-level innovation in SMEs. This research led to conclusions about the contributions of trade associations and RND for innovation in SMEs, as presented in the previous section.

The results show that the basic outline of roles in innovation based on earlier work by economy and organisation researcher Margaret Dalziel and references to other researchers was a suitable analytical tool for my explorative study of intermediary organisations' roles. In addition to the distinction between knowledge transfer and knowledge development, the basic outline looked for different knowledge flow directions and relationships.

The dissertation results are an extension of management and organisation researchers James Winch and Roger Courtney's paper.[14] These authors identified the roles that intermediary organisations can play in independently validating new ideas and creating a neutral space for activities in standardisation, accreditation and regulation. In my categorisation, I represented these in the roles of 'generating knowledge' and 'standardisation'. Furthermore, their evaluation of several intermediary organisations indicated that three of these organisations also had their own research and development facilities, however, these departments were organised separately from the mediation department. The dissertation results confirm that these are two separate roles, and highlight that SMEs need an intermediary organisation and an appropriate knowledge institute or specialist. In the case of the bread bakers, this was the Institute for Milling and Baking. In the case of the wagon makers, RND conducted this role (through its technical assistant and its laboratory).

This dissertation aimed to investigate roles in firm-level innovation in SMEs. I showed that for some types of innovation, SMEs did not always need trade associations, RND, or the affiliated knowledge institutes. For example, many SMEs bought new machines themselves, they arranged training and study tours for themselves and they hired people with new skills. This confirms recent research by innovation researcher Jeroen de Jong, who reported that supplier driven innovation (new machines including training etc.) covers the majority of innovations in SMEs. Furthermore, it also confirms De Jong's observation that intermediary organisations like RND seem to be most active in two types of innovation: knowledge implementation and system usage. During 'knowledge implementation'

entrepreneurs acquire new knowledge and start using this in their firm. In 'system usage' several parties are involved, including intermediary organisations which define new standards and request permits and subsidies.[15]

The analysis of the case studies in combination with the categorisation resulted in four findings. First, it showed that most of the identified activities took place in 'providing knowledge' and 'influencing'. Whenever 'generating knowledge' and 'standardisation' took place, the activities were typical of firm-level innovation and mostly consisted of developing drawings, trainings, publications and translating existing knowledge to the local context. Second, trade associations' contribution was in enabling knowledge transfer and knowledge development, not so much in conducting these. Their contribution was creating networks and stimulating SMEs to innovate, mechanise and improve their businesses. The cases of the bread bakers and wagon makers show that trade associations can delegate these roles to another actor (knowledge institute or sector specialist). Third, RND was able to conduct all four roles, but it could only do so in a very few sectors, due to its limited size and resources. Last, the case studies and the historical analysis shows that collective activities in sectors depended on sector organisation, including the composition of a sector and a sector's internal relationships. Furthermore, product and market characteristics also determined the extent of the trade associations' influence. So, it was easier for trade associations to have an impact on local markets, and more difficult on international markets, especially with mass products.

The case results showed that SMEs are more easily persuaded to adopt innovations when presented by someone who relates well to their firm context, at a minimal distance and in a way they can easily comprehend. For example, through courses, demonstrations, and personal advice in their workshops. Historian of technology Frank Veraart observed this phenomenon also in his case of the printing industry. He distinguished direct mediation activities (personal advice, training, and demonstrations) and indirect mediation activities (publications).[16] Although he did not explicitly conclude that direct mediation activities had more impact, he illustrated that courses (offered by suppliers) were influential in adopting desk top publishing.[17]

SMEs' exposure to technology may encourage further innovation. The wagon makers case illustrates that, with training and knowledge transfer, wagon makers were able to transition to the automotive body making industry in the 1920s. After that, they continually updated their skills to keep abreast of rapid changes in the automobile industry. To some extent, this was also visible in the bicycle industry case. Bicycle manufacturers continually copied innovations from abroad or they started as entrepreneurs on the basis of their experience in bicycle riding. These case results are similar to the research by business researcher Marijke van der Veen who concluded that SMEs adopt e-business applications (e-mail and internet) more easily when entrepreneurs are already users of more conventional information technology.

Such user experience helps entrepreneurs recognise the new business opportunities that e-business can bring.[18]

If intermediary organisations communicate with SMEs in a way that is easily understandable for their context, this supports trust building. Several authors point out the importance of trust.[19] Winch and Courtney view neutrality and independence as important ways to build trust: these support a neutral position during standardisation activities and technology evaluations.[20] The dissertation results confirm this insight, showing that SMEs needed trade associations and RND especially for standardisation and implementation of new technologies.

In considering the most effective ways of mediation for SMEs and the importance of trust, I conclude that in mediation activities for SMEs, knowledge transfer, knowledge development and relationship building are closely linked. As illustrated, intermediary organisations succeed best when communicating directly with SMEs in cases that are easily recognisable for participating businesses. It requires relevant and intimate sector and business knowledge. Furthermore, neutrality and independence also create trust. In order to build relationships with SMEs, intermediary organisations need knowledge and neutrality. Currently, a new type of intermediary organisations is developing, enabling systemic innovations to transition into more sustainable technology. These organisations focus on brokering activities rather than using or circulating knowledge.[21] The dissertation results demonstrate the need to differentiate between these new systemic intermediaries geared towards transitions, and the intermediary organisations intending to transfer firm-level innovations to SMEs.

With respect to evolving roles, this dissertation shows how roles evolve over time in response to rapid changes in the knowledge and innovation infrastructure, technology changes, government policies and regulations, and other external events, like wars and economic crises. Reviewing how these changes affected mediation junctions, as historians of technology Ruth Oldenziel and Adri Albert de la Bruhèze originally defined them for consumer technologies, leads to several observations. In their role of technology users, SMEs found the mediation junctions initially rather open, without intervention from state or market (suppliers). As the bread bakers case showed, there was enough negotiation space for their trade association and their knowledge institute. Before the government regulated the sector, individual bakers did not need trade representation and found it relatively easy to access this mediation junction themselves as individual entrepreneurs. The easy access, however, also resulted in little agreement on standardisation and quality improvements in the sector overall. Once the government occupied a place at the junction when it took on the role to protect citizens, the negotiation space changed: individual bakers now became members of their association to be more effective. For wagon makers, as producers of technology, the change took place much later, during the economic crisis in the 1930s. For the bicycle sector, user organisations were rather influential

at the mediation junction from 1860 to 1900. In general, government interventions in firms started in World War I and were reinforced during the economic crisis, while its efforts to protect workers and consumers began in the late nineteenth century. Oldenziel and Albert de la Bruhèze observed how in the early twentieth century consumers had to organise themselves in order to be represented at mediation junctions. In a similar fashion, SMEs organised themselves in these decades through trade associations.

The dissertation results also identified a number of struggles at the mediation junctions. It showed how alignment of interests between SMEs, trade associations and engineers stimulated knowledge transfer and development. Oldenziel and Albert de la Bruhèze studied similar struggles for consumers. The case studies show that engineers and scientists introduced a new type of knowledge that SMEs had to absorb later on. Other challenges and struggles were taking place in parallel: in labour relations, economics and regulations. The cases show that Dutch engineers and scientists acted as mediators between Dutch SMEs and knowledge that often originated from abroad. When the interests of SMEs, their associations and engineers were well aligned, this stimulated knowledge transfer and development. However, when this alignment was missing, or if associations within sectors distrusted each other, this restrained knowledge flows.

Studying evolving roles also showed how intermediaries appear and disappear, as stated by Veraart.[22] It showed how trade associations started with knowledge transfer activities, and handed these over to training institutes once these were established. RND conducted several activities, like retraining and sector studies, which it handed over to trade schools and the EIM (Economic Institute for the Trades). Trade associations and RND responded to the challenges as a result of World War I by deploying new activities. Studying roles with a temporal perspective deepened the understanding of the character of intermediary organisations and their roles, as proposed by Oldenziel and Albert de la Bruhèze, and science and technology dynamics researcher Barend van der Meulen et al.[23] Their functions and positions are by definition in flow, as the gaps they aim to bridge are temporary. Furthermore, both mediation and knowledge development appeared to be dynamic capabilities for RND to adapt its roles and competencies.

Reflection on the original definition of 'trade association' and the way this thesis uses 'intermediary organisation' and 'innovation agency' results in the following. First, I defined trade associations as organisations which conduct a wide variety of activities, according to Lanzaloco: a trade association represents the interests of specific groups of producers and firms, not only (do they) provide all those services needed by firms, such as marketing, fiscal and financial advice, research and innovation, regulation of competition, etc., but they also act as pressure groups or lobbies for defining, promoting, and defending the interests of their membership in the political arena *vis-à-vis* government authorities, public administrations, and state

agencies.[24] Basically this is still correct, however, based on the case study results and Dalziel's paper, I suggest an additional definition for the contributions of trade associations in their members' innovation: 'A trade association can enable innovation for firms by creating networks of firms and external parties, mediating between firms and other parties, organising networking activities, facilitating joint actions through network closure and stimulating firms to innovate. It can also enable and conduct knowledge transfer and development roles, preferably in cooperation with a sector knowledge institute.'[25]

Second, the quite generic way this thesis refers to an intermediary organisation can be made more specific. Originally, in chapter 1, this consisted of: 'an intermediary organisation enables innovation in SMEs as one of its explicit objectives by connecting, translating and facilitating flows of knowledge'. As illustrated by the results, intermediary organisations can manage four different types of flow directions with different relationships. Therefore, I suggest the following revision: 'an intermediary organisation enables innovation in SMEs as one of its explicit objectives by connecting, facilitating and transforming flows of knowledge, therefore it networks with various parties and switches between different positions.'

Third, based on the previous changes, I suggest an adaption for how the term innovation agency is used. So, 'a publicly financed intermediary organisation which enables innovation in firms as its main objective' becomes: 'a publicly financed intermediary organisation which enables innovation in SMEs as its main objective, which bridges distances to knowledge, temporarily fills gaps in knowledge development, and represents the needs of these SMEs to others. To support these roles, it may also have its own knowledge institute.'

7.2.2 Reflections on Historical Research of Innovation in SMEs

The historiographical review showed that so far, studies in business history and history of innovation and technology mainly tried to understand innovation in large firms, mostly in knowledge and capital-intensive sectors. The review presented several studies of historians who did study how small firms tried to survive during the early 1900s. As this dissertation aimed to add to these studies, this section assesses its contributions.

Historians Philip Scranton, Mansel Blackford, and social scientists Charles Sabel and Jonathan Zeitlin all concluded that small firms were able to survive by flexible custom or batch production and specialising in products for niche markets.[26] The multiple-case study in this dissertation partly supports this, as illustrated by the wagon makers, who started making custom bodies for their customers' motorised vehicles. The case of the bread bakers is a case of mechanisation and standardisation. Although their product was not for a niche market, they could

survive because large industrial bakeries were not able to cover the entire market. The case of the bicycle industry is different, as it is not so much a story of survival as one of developing new small firms. For example, bicycle repair shops were service providers for new technology, which was one of the ways to survive for small firms, as concluded by historian of technology Ulrich Wengenroth.[27] Some bicycle manufacturers and assemblers were probably conducting flexible batch production, but from the 1920s, the bicycle was not a niche product as such, as the cartel protected it against competition from large foreign industries.

As historian Dick van Lente observed, the RND consultants wanted SMEs to transform their workshops into small industrial firms with the potential to grow into medium or large firms.[28] They succeeded to some extent, as they enabled many small firms to mechanise and implement efficient production methods, so that these firms had the potential to grow further. However, a characteristic of SMEs is that the majority of them does not have the desire to expand.[29] Furthermore, the case results showed that small firms were able to survive industrialisation in several ways: by flexible custom or batch production, specialisation in niches where large firms could not compete, and as service providers for new technologies. So, in order to survive, SMEs did not have to expand, but they needed to ensure that their firm was competitive in offering value to its customers, for which several methods of firm-level innovation were available. In that respect, history proved RND consultants partly wrong. Small firms needed to mechanise and update their ways of working, but there was no necessity to expand in size as these firms could survive in niches that larger firms did not fill.

The studies by Scranton and by Sabel and Zeitlin concluded that entrepreneurs took many initiatives to survive: they established trade schools, industrial bureaus, and organisations for quality assurance, managing competition, standardisation, and technology updates. The dissertation cases confirm that SMEs needed organisations and collective activities to survive. Bread bakers established a laboratory, wagon makers agreed on standard price lists and benefited from training through RND's technical assistant. The bicycle sector managed a cartel and had standard price lists for bicycle repair shops. However, where the cases differ, is that they show that these initiatives are taken by trade associations, whereas Scranton and Sabel and Zeitlin studied firms in industrial districts or networks.[30] Furthermore, the cases were based on firm-level innovation by 'following' SMEs, whereas these researchers refer to more proactive firms, which were probably more like the progressive Dutch bakers and wagon makers who took the lead in their sectors.

Economic historian Johzen Takeuchi defined the process of Japanese craftsmen who used their skills in order to produce foreign technology in their own country as 'localising'.[31] This is recognisable in the bicycle sector case, where bicycle manufacturers were able to teach themselves how to produce bicycles, mostly by trial and error and by copying bicycles. Thereby, they tried to 'localise' the bicycle.

Takeuchi saw localising as a way to catch up with industrial production, which is also applicable in the case of the Dutch bicycle sector.

Comparing the multiple-case study to Veraart's study of innovation in the Dutch printing industry in the 1980s in which he concluded that the trade associations were reactive with respect to shaping computer technology, leads to a mixed result.[32] The main reason is that only the bread bakers' case can be compared, because Veraart's case is about printers using new technology, similar to how bread bakers started to use kneading machines, standard recipes and processes. For the bread bakers' case it can be concluded that the trade association and its Institute were mainly proactive in adapting existing standards and specifications for mechanisation; they did not influence machinery design. The standards and specifications already existed abroad and the trade association and the Institute adapted these to the Dutch context and advocated their use. The cases of the wagon makers and the bicycle industry mainly studied the diffusion of the production of new technologies (bodies for motorised vehicles, bicycles), and to a lesser extent the diffusion of new machinery to produce these. For the latter, it can be concluded that the trade association was positive but not so active for the wagon makers and that insufficient information was available about the bicycle industry. In both cases, RND supported diffusion of new products and processes with personal advice and the assistant for the wagon makers.

To conclude, studying the roles of trade associations and RND in innovation in SMEs enabled unravelling these roles further into roles and activities in knowledge transfer and knowledge development. It also contributed to historical research by confirming earlier research while also adding contextual distinctions, and by creating a link with contemporary and historical mediation studies.

7.3 Recommendations for Policy and Research

7.3.1 Innovation Agencies – Past and Future

Although RND was studied in a period more than half a century ago, its challenges, opportunities and threats are very well recognisable for contemporary times.[33] For that reason, this section summarises the implication of the research findings for current and future innovation agencies that support firm-level innovation.

An innovation agency has three challenges. First, it has constrained resources, which will therefore limit its scope, for example, through a limited number of sectors it can work in, or have specific knowledge about. Knowledge, whether codified or tacit, is relevant, because an innovation agency needs this to build trust from SMEs and sectors. Second, the case study results show that an innovation agency that makes clear choices about which sectors it supports will be able to make more

impact. However, the case studies also show that this implies consistent political choices for at least a decade, which is difficult to achieve in the Dutch polder economy. Last, every sector is different and will change, so an innovation agency needs to be able to deploy a flexible and evolving approach. Not only do challenges and knowledge needs evolve and differ per sector. Also, the sector infrastructure and the relationships between organisations in sectors differ and evolve, which will all impact an innovation agency's activities.

An innovation agency also has opportunities. First, general and easily accessible consulting activities are a good way to keep in touch with SMEs and their situations. Thereby, an innovation agency builds up a dynamic capability in mediation which enables adapting its roles and competencies to changing circumstances. Second, not only do innovation agencies bridge gaps in the knowledge chain between knowledge suppliers and SMEs, they also have opportunities to deploy other activities, often on a temporary basis. For example, as the cases illustrate: in knowledge development, implementation of new standards and retraining. Once these activities are embedded, they can be handed over to the market or to new schools and knowledge institutes. Last, through conducting their activities, an innovation agency builds up a knowledge base, which can be fed back to governmental bodies who are designing policies, regulations or standards.[34]

Finally, one weakness that an innovation agency focusing on sectors may face, is that this sector approach is designed for firm-level innovations. Therefore, it is not clear to what extent it can enable innovations which are new to the industry or which are based on cross-sector networks.[35]

7.3.2 Policy Recommendations

How can policy makers use the results of this dissertation in policies for firm-level innovation in SMEs? First, the findings indicate that a sector specific policy based on relationships with trade associations is more likely to be successful. An indicator for policy success is the existence and performance of the knowledge and innovation infrastructure for that particular sector. On one hand, an existent infrastructure makes it easier to diffuse innovation, on the other hand, the absence of it is actually an opportunity for policies.[36] Second, the results show that a sector analysis is needed. What are the challenges for the sector, to what extent are these recognised by SMEs and the trade association? What are the gaps? Who can fill these gaps, temporarily or for a longer term? By answering these questions, a sector strategy and an action plan can be defined. Based on these, possible roles and activities of an innovation agency can be identified, in knowledge transfer or knowledge development.

These recommendations are based on a number of assumptions. First, the

assumption that the government makes choices, as scarcity of resources makes it impossible to support all sectors. Second, it assumes the existence of a trade or business association in a sector. Where this is lacking, a government may seriously consider stimulating the establishment of trade associations, similar to how RND kept repeating to wagon makers that they needed a national association. The third assumption is that the existing trade associations actively support innovation activities. Otherwise government sponsored activities will probably become a waste of time and money, as lack of support from trade associations hinders effective connections with SMEs and the sector, and trade association support is needed for activities in standardisation, specifications and quality control.

As the cases show, innovation does not only involve access to knowledge. SMEs also need good basic education and access to capital, and they need regulation to reduce innovation risks. Governments can make basic education available and compulsory, they can facilitate and support credit facilities for SMEs, and instigate regulations that stimulate adoption of innovations, and possibly consider whether temporary trade protection is needed.[37] These policies have the advantage that they will benefit firm-level innovations as well as more visible innovations which are new to a sector or a country.

7.3.3 Suggestions for Further Research

Further research will enable more insight in how intermediary organisations and other external parties fulfilled roles for innovation in SMEs and to what extent these roles were similar or different to the ones in this dissertation. One question to be studied further is to what extent the role of 'providing knowledge' (traditionally seen as the central role of intermediary organisations), is the primary role of intermediary organisations and how that depends on the context. The cases illustrated that intermediary organisations also conduct three other roles (influencing, generating knowledge, standardisation), but mostly in a supporting way. A similar question is the importance of technological knowledge over other knowledge types in the case studies. In the early twentieth century, Dutch SMEs especially lacked up-to-date technical knowledge. Was this a temporary matter, or did it also depend on the context, for example, on a lack of other institutions? Further research can result in identification of other roles and activities, like in commercialisation or culture change.[38] Last, further research can show whether relevant activities of trade associations, RND, or other parties were inadvertently missed or ignored during data collection.

Further research is chiefly needed in three dimensions: in time, with different actors, and in other geographies. First, further studies are needed in the period between 1940 and the present. Between 1900 and 1940 the Netherlands evolved

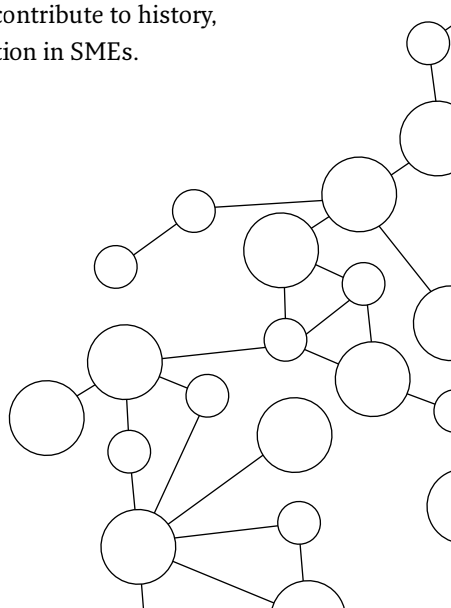
from a liberal economy to a coordinated economy. As a result, membership of trade associations changed from voluntary to a necessity, whereas in the 1990s, this necessity disappeared as these associations were not allowed anymore to make agreements on prices, markets and products.[39] At the same time, the number of intermediary organisations and other actors for SMEs increased, resulting in a dense field. Whereas in the early twentieth century there was a lack of intermediary organisations, actors and consultants for SMEs, a hundred years later there is an abundance of these parties, so SMEs find it difficult to know where to go to. So, these changes, in addition to other political, economic and technological developments suggest the need for further research of 1940 to the present.

Second, further studies are needed with different actors. This dissertation focused on trade associations and RND. However, what were the roles of suppliers, engineering consultants, private training institutes, and commercial exhibitions for innovation in SMEs? What other parties fulfilled roles as well? What was their influence, their interest and their impact?[40]

Third, further research in other geographies can show to what extent the results of this dissertation are typical for the case of the Netherlands. For that purpose, roles of trade associations and innovation agencies in other industrialising countries are interesting, for example, in Germany, Belgium and France: how did these organisations fulfil roles in innovation in SMEs and what were their roles? What other organisations were involved?

Fourth, varying time and geography, further research can enable more understanding about whether this dissertation studied a typical case of catch-up with industrialisation.[41] For example, by investigating the roles of trade associations, innovation agencies and the government in industrialising countries in the later twentieth century, like Korea, Taiwan, Ireland and Portugal.

This dissertation has given more insight into how trade associations and an innovation agency can fulfil roles in innovation in SMEs, based on a historical study of firm-level innovation in the Netherlands. Extending this research in time, with different actors, and over various geographies, will give more insight in how external parties can enable innovation in SMEs. Thereby this will contribute to history, technology and innovation studies and especially: innovation in SMEs.



Notes

Chapter 1 – Introduction

1 http://www.rijksoverheid.nl/ministeries/ez/nieuws/2014/12/11/meer-geld-en-betere-dienstverlening-voor-innovatieve-ondernemers.html?utm_source=twitter&utm_medium=social&utm_content=op_nederland&utm_campaign=tweets [accessed 28 January 2015]; 'Meer geld en betere dienstverlening voor innovatieve ondernemers', Nieuwsbericht Ministerie van Economische Zaken, 11 december 2014. The programme is called *MKB Innovatiestimulering Topsectoren (MIT)* (SME Stimulation of Innovation in Top Sectors).

2 Ibid.

3 https://ec.europa.eu/programmes/horizon2020/en/area/smes [accessed 14 September 2014]; https://www.sbir.gov [accessed 14 September 2014].

4 Meuwsen, article about his visit to Austria, Telegraaf, 11 November 1908.

5 Kirkels and Duysters, "Brokerage," 26, 49-57; Sapsed, Grantham and DeFillippi, "A Bridge over Troubled Waters."

6 Kirkels and Duysters, "Brokerage."; McEvily and Zaheer, "Bridging Ties."; Nauwelaers and Wintjes, "Innovating SMEs."

7 Howells, "Intermediation."; Klerkx and Leeuwis, "Establishment and Embedding."

8 Dalziel, *Why Do Innovation Intermediaries Exist*; Howells, "Intermediation."

9 Boldrini, Schieb-Bienfait and Chéné, "Improving SMEs' Guidance."; Howells, "Intermediation."; Winch and Courtney, "The Organization."

10 Lintsen, *Made in Holland*.

11 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur,* 38-39.

12 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 13.

13 Eekels, Christiaans and Kaasschieter, *Ondernemen en vernieuwen,* 13-15; Lente, *Techniek en ideologie,* 138-139.

14 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur*. I mainly use the term 'trade associations', whose members are in a specific trade or craft. For a further definition, see 2.2. In some cases I use 'business associations' as it is more appropriate for associations that cover a sector or industry. Another synonym is 'industrial association'.

15 Lente, "The Crafts."; ---, *Techniek en ideologie*.

16 Veraart, *Vormgevers,* 202.

17 Boersma, *Inventing Structures*; Faber, *Kennisverwerving*; Hounshell and Smith Jr., *Science and Corporate Strategy*

18 Segmentation of contemporary SMEs in the Netherlands shows that a minority are leaders and developers who develop or implement technologies which are new to their sector or country. Only some of these leader and developers have their own R&D facilities. See: Gibcus and Jong, *Innovatiepiramide,* 5.

19 Hargadon and Sutton, "Technology Brokering," 747-748; Howells, "Intermediation," 721; Winch and Courtney, "The Organization," 757-758.

20 Howells recommends researching how intermediaries have evolved over time: Howells, "Intermediation," 725. For a study of roles evolving due to the privatisation of governmental agencies, see: Klerkx and Leeuwis, "Establishment and Embedding."

21 Blackford, *A History,* 5.

22 Ibid.; Sabel and Zeitlin, eds., *World of Possibilities*, 2-3. See, for example: Hounshell, *From the American System.*

23 Chandler Jr., *Strategy and Structure*; Lamoreaux, Raff and Temin, "Economic Theory," 38-43.

24 Blackford, *A History,* 5; Gerwen and Goey, *Ondernemers in Nederland,* 272; Sabel and Zeitlin, eds., *World of Possibilities*, 3.

25 Gerwen and Goey, *Ondernemers in Nederland,* 145-151, 176, 245-247.

26 Blackford, *A History,* 5-6. Historians are also critical of the assumption that SMEs are the engines of economic growth, see: Gerwen and Goey, *Ondernemers in Nederland,* 13.

27 Odaka and Sawai, *Small Firms,* 6.

28 Ibid.
29 Wengenroth, "Small-scale Business," 123-124.
30 Ibid., 125-126.
31 Ibid., 126-127.
32 Ibid., 127-128.
33 Lescure, "Small- and Medium-size Industrial Enterprises," 140-145.
34 Ibid., 149-153.
35 Takeuchi, "Historical Features," 207-208.
36 Arnold, *Everyday Technology*.
37 Blackford, *A History,* 200.
38 Scranton, *Endless Novelty,* 9, 17-24.
39 Sabel and Zeitlin, eds., *World of Possibilities*, 4-9.
40 Ibid., 12.
41 Ibid., 23-27.
42 Ibid., 27.
43 Forster and Inwood, "The Diversity of Industrial Experience."
44 Blundel and Tregear, "From Artisans to "Factories"."
45 Panschar, *Baking in America,* 69.
46 Ibid., 94-96.
47 Ibid., 99.
48 Detremmerie, "De mechanisering," 40; Panschar, *Baking in America,* 122-124. Note that Panschar's book is from 1956 and does not recognise concerns about bread's taste or nutritional value. He does refer to food faddists who have extravagant claims about the nutritional value of whole wheat versus white bread (p. 108).
49 ---, *Baking in America,* 127-143.
50 Ibid., 125-126.
51 Detremmerie and Deseyn, *'t Is voor de bakker,* 39-40.
52 Ibid., 40.
53 Schulte to Bühne, *Das Bäckerhandwerk,* 57.
54 Ibid., 2, 81.
55 Münstermann, *Bäckerei- und Technikgeschichte,* 118-124; Schulte to Bühne, *Das Bäckerhandwerk,* 113, 124.
56 Gerwen and Goey, *Ondernemers in Nederland*.
57 Ibid., 63.
58 Ibid., 48, 55, 64.
59 Sluyterman, *Dutch Enterprise,* 36.
60 Zanden, *De industrialisatie,* 56-62, 68-70. About the importance of electrification for SMEs, see also: Davids, "Van stoom naar stroom," 279; Lente, *Techniek en ideologie,* 125-126.
61 Verkuylen, *Brabantse klompenmakers,* 17-23, 48-49.
62 Lente, "The Crafts," 111-112.
63 Verkuylen, *Brabantse klompenmakers,* 21, 23.
64 Jonge, *De industrialisatie in Nederland,* 79.
65 In 1911, the province of North-Brabant had 338 tanneries with 771 employees, while in 1930, the Netherlands counted 179 SMEs in the tanning sector with 1,657 employees and 13 large tanneries with 2,039 employees, see: Centraal Bureau voor de Statistiek, *Bedrijfstelling 1930*; Seelen and Vogel, *De geschiedenis van het leerlooien,* 9.
66 Eillebrecht, Grimbergen and Schipper, *De sigarennijverheid in Culemborg,* 31-67; Jonge, *De industrialisatie in Nederland,* 63-64.
67 Sluyterman, "Mechanisatie en werkloosheid." This is also illustrated by the electrification rate in 1930. Of the 2360 cigarmaking firms, of whom 87 percent were SMEs, only eight percent used electromotors, see: Centraal Bureau voor de Statistiek, *Bedrijfstelling 1930*.
68 Eillebrecht, Grimbergen and Schipper, *De sigarennijverheid in Culemborg,* 58.
69 Sluyterman, "Mechanisatie en werkloosheid," 23.
70 Nijhof, *De Nederlandse grafische industrie,* 51-64, 113.
71 Ibid., 63.

72 Lente, "The Crafts," 110-112.
73 See the MSc thesis of: Koorenhof, *De kleine nijverheid in Nederland*, 50.
74 Ibid., 53.
75 Lente, "The Crafts," 109-110.
76 Hooff, *In het rijk van de Nederlandse Vulcanus,* 286-287.
77 Hall, "Innovation and Diffusion," 459-465.
78 Contemporary literature shows that the majority of current Dutch SMEs can be characterised as implementers or followers, who implement technologies or innovations which are new to their firm, but not for their sector or country. Around 2008, the leader and developer segments, who develop or implement innovations which are new for their sector or country, comprised about 5 percent and 17 percent of the total number of Dutch SMEs, see: Gibcus and Jong, *Innovatiepiramide,* 5. For an evaluation of contemporary segmentations of SMEs (by Syntens, AWT, VNO-NCW, EIM, and Dialogic), see: ibid., 24-28. For a taxonomy of technological innovation and small firms, see: Rizzoni, "Technological Innovation." For a report on innovative firms, so-called 'growing diamonds', see: Adviesraad voor het Wetenschaps- en Technologiebeleid, *Briljante bedrijven*. A similar type of firm is referred to in 'small scale for the world market' by: Wengenroth, "Small-scale Business," 130.
79 Hall, "Innovation and Diffusion," 459-460.
80 This definition is from: Oerlemans, *De ingebedde onderneming*, 35-36, 39.
81 This diffusion of products or processes can also result in economically significant innovations. This is because introducing products or processes in a new context often implies some degree of adaption, see: Fagerberg, "Innovation," 8. Pavitt found a number of industries that receive most technology from other sectors, see: ibid., 16; Pavitt, "Sectoral Patterns." See also: Hall, "Innovation and Diffusion."
82 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur,* 15-17; Fagerberg, "Innovation," 5, 11, 16; Hall, "Innovation and Diffusion," 473-475.
83 Fagerberg, "Innovation," 11.
84 About the challenges of knowledge transfer, see: Kerste and Muizer, *Effective Knowledge Transfer.* The authors explain that SMEs need customised products, knowledge and services; because time and money are their bottlenecks, they have to minimise their search costs (p. 60).
85 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur,* 111-112.
86 Ibid., 63-64.
87 Ibid., 83-84.
88 Ibid., 52-59.
89 The other cases are the introduction of apple must by manufacturer Hero, washing without detergent, stocking manufacturer Hin, and syrup production, see Chapter 3 in: ibid., 111-112. With the exception of syrup production, these cases involve medium and large-size firms (more than 10 employees).
90 Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism*.
91 Oldenziel and Albert de la Bruhèze, "Theorizing the Mediation Junction," 20, 29, 37.
92 Veraart, *Vormgevers,* 301-302.
93 Ibid., 301-302, 311.
94 Howells, "Intermediation."; Veraart, *Vormgevers,* 298-300.
95 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 13.
96 Lanzaloco, "Business Interest Associations," 294-295. Business interest associations consist of trade associations and employers' associations. The latter tend to represent non-sector-specific, like local or regional interests, see: ibid., 294. Other work may use 'business associations' or 'industrial associations' to refer to organisations which are very similar to trade associations.
97 Feldman and Nocken, "Trade Associations."; Park, "Cooperation between Business Associations."
98 Carnevali, "Social Capital."
99 Lemercier, "Looking for "Industrial Confraternity"."
100 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 27; Waarden, "Regulering en belangenorganisatie," 228.
101 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 21-27; Waarden, "Regulering en belangenorganisatie," 232-233.
102 Read about the blacksmiths in: Koorenhof, *De kleine nijverheid in Nederland*, 53.
103 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 12; Waarden, "Regulering en belangenorganisatie," 239.

104 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 26, 49-57.
105 Ibid., 54-55.
106 Lanzaloco, "Business Interest Associations," 293-300.
107 Waarden, "Regulering en belangenorganisatie," 239-249, 259-260.
108 Gerwen and Goey, *Ondernemers in Nederland,* 48-51; Waarden, "Regulering en belangenorganisatie," 250-259.
109 Schmidt, Toren and Wal, *Ondernemende brancheorganisaties.*
110 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 14.
111 According to Bouwens and Dankers, the adviser role became more prominent after World War II, see: ibid., 264.
112 Ibid., 262-263.
113 Soltow, "Small City Industrialists."
114 Waarden, "Regulering en belangenorganisatie," 245.
115 Sabel and Zeitlin, eds., *World of Possibilities*, 25.
116 Murmann, *Knowledge and Competitive Advantage*.
117 Gaggio, "Pyramids of Trust."
118 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur,* 86.
119 Veraart, *Vormgevers,* 202.
120 Lente, *Techniek en ideologie,* 131-136, 144. Also, see: ---, "The Crafts," 109.
121 ---, "The Crafts," 109-110.
122 For an evaluation of the performance and added value of the Innovation Centres, established in 1988 as successor to RND, see the dissertation: Coehoorn, *The Dutch Innovation Centres*.
123 Eekels, Christiaans and Kaasschieter, *Ondernemen en vernieuwen,* 19-22.
124 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur,* 81.
125 Dalziel, *Why Do Innovation Intermediaries Exist?*, 3; Howells, "Intermediation," 718-719.
126 Sinclair, ed., *Cobuild Advanced Learner's English Dictionary*.
127 Meulen, Nedeva and Braun, *Intermediaries Organisation and Processes: Theory and Research Issues*, 3. In his study of intermediaries in the printing industry, Veraart concludes that they exist in relation to specific products and user demands, see: Veraart, *Vormgevers,* 297.
128 Howells, "Intermediation," 718.
129 Dalziel, *Why Do Innovation Intermediaries Exist?*, 4.
130 Chesbrough, *Open Business Models*; Howells, "Intermediation," 720; Lente et al., "Roles of Systemic Intermediaries," 248; Winch and Courtney, "The Organization," 747.
131 Dalziel, *Why Do Innovation Intermediaries Exist?*, 3-4; Howells, "Intermediation," 720; Lente et al., "Roles of Systemic Intermediaries," 248; Winch and Courtney, "The Organization," 747.
132 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 26.
133 On the funding paradox of publicly and privately funded intermediary organisations, see Klerkx and Leeuwis, "Establishment and Embedding," 857-858.
134 About the other four types: for supplier innovation and customer driven innovation the number of relationships is low and mostly limited to suppliers or customers. For garage innovation, several informal parties fulfil roles. For chain innovation, in which firms adapt their products or process, especially financial consultants fulfil an important role in addition to suppliers and customers. See: Jong, *De bron,* 35-40.
135 Hall, "Innovation and Diffusion," 461-465; Kerste and Muizer, *Effective Knowledge Transfer,* 64; Mantel and Rosegger, "The Role of Third-parties," 132-133; Rogers, *Diffusion of Innovation.*
136 Mantel and Rosegger, "The Role of Third-parties," 133.
137 Bessant and Rush, "Building bridges," 100; Dalziel, *Why Do Innovation Intermediaries Exist?*, 8-12; Geenhuizen, *Technology Transfer,* 35-36; Oldenziel and Albert de la Bruhèze, "Theorizing the Mediation Junction," 34-36; Veraart, *Vormgevers,* 300-301.
138 Klerkx and Leeuwis, "Establishment and Embedding," 851.
139 Hassink, "Technology Transfer Infrastructures," 354; Kirkels and Duysters, "Brokerage," 376; McEvily and Zaheer, "Bridging Ties," 1152.
140 Rothwell, "The Changing Nature," 268-269, 276-277.
141 Around 2008, the leader and developer segments of SMEs comprised about 5 percent and 17 percent of the total number of Dutch SMEs. Only some of the leader and developer firms have their own research

and development facilities. See: Gibcus and Jong, *Innovatiepiramide,* 5.

142 Dalziel, *Why Do Innovation Intermediaries Exist?*, 10-12.

143 Nauwelaers and Wintjes, "Innovating SMEs," 203-205.

144 See also: Dekker et al., *Innovatie door samenwerking,* 42.

145 Dalziel, *Why Do Innovation Intermediaries Exist?*, 9.

146 Winch and Courtney, "The Organization," 757-758.

147 Ibid., 756-757.

148 Recent research concluded that the combination of knowledge and brokering activities is typical for intermediary organisations involved in diffusing innovations. In systemic innovation, there are intermediary organisations which act solely as brokers, see: Klerkx and Leeuwis, "Balancing Multiple Interests," 368; Lente et al., "Roles of Systemic Intermediaries," 257-260.

149 These parties include firms, suppliers, research institutes and specialists, see: Dalziel, *Why Do Innovation Intermediaries Exist?*, 5.

150 Kolodny et al., "Design and Policy Choices," 216-217. In his study of intermediaries in the printing industry, historian Veraart concludes that their influence depended on the trust they built with user SMEs, see: Veraart, *Vormgevers,* 297.

151 Kolodny et al., "Design and Policy Choices," 217-220.

152 Winch and Courtney, "The Organization," 758.

153 Ibid.

154 Klerkx and Leeuwis, "Balancing Multiple Interests," 857.

155 Ganzevles and van Est, *Collaborative Project,* 13. This made Coehoorn suggest a framework with six different types of collaborations that the Innovation Centres need to manage, see: Coehoorn, *The Dutch Innovation Centres,* 113-139.

156 Dalziel, "The Impact."

157 ---, *Why Do Innovation Intermediaries Exist?*, 5-6; Howells, "Intermediation," 724.

158 Meulen, Nedeva and Braun, *Intermediaries Organisation and Processes: Theory and Research Issues*, 7.

159 Klerkx and Leeuwis, "Establishment and Embedding," 852.

160 Oldenziel and Albert de la Bruhèze, "Theorizing the Mediation Junction," 12.

161 Veraart, *Vormgevers,* 287, 311.

162 Oldenziel and Albert de la Bruhèze, "Theorizing the Mediation Junction," 12; Veraart, *Vormgevers,* 297, 309-311.

163 Oldenziel and Albert de la Bruhèze, "Theorizing the Mediation Junction," 26-27.

164 Ibid., 16.

165 For example in the article by Howells, see: Howells, "Intermediation."

166 Sinclair, ed., *Cobuild Advanced Learner's English Dictionary*.

167 '...much more research needs to be undertaken into the nature of the *relationships* that intermediaries exist in', see: Howells, "Intermediation," 725. Conceptualisation of the intermediary organisation needs to account for both the relationships in which it is involved, and the organisation, see: Meulen, Nedeva and Braun, *Intermediaries Organisation and Processes: Theory and Research Issues*, 3.

168 Howells, "Intermediation."

169 Meulen, Nedeva and Braun, *Intermediaries Organisation and Processes: Theory and Research Issues*, 3.

170 Howells, "Intermediation," 721.

171 Dalziel, *Why Do Innovation Intermediaries Exist?*

172 Winch and Courtney, "The Organization."

173 Dalziel, *Why Do Innovation Intermediaries Exist?*, 6.

174 Transferring specialised knowledge, see: Bessant and Rush, "Building bridges." Diffusing information and best practise techniques, see: Grindley, Mowery and Silverman, "SEMATECH." For contractual advice, see: Howells, "Intermediation." Giving advice related to sales and marketing activities, see: Bessant and Rush, "Building bridges."; Howells, "Intermediation." Scanning and information processing, see: ibid.

175 ---, "Intermediation," 721-722.

176 Ibid., 721; McEvily and Zaheer, "Bridging Ties," 1139.

177 Kerste and Muizer, *Effective Knowledge Transfer,* 64. According to the authors, Syntens can demonstrate these successes, and trade associations can distribute these examples among their members.

178 Dalziel, "The Impact." This study is based on an evaluation of Statistics Canada data.

179 ---, *Why Do Innovation Intermediaries Exist?*, 6.

180 Human and Provan, "Legitimacy Building."; Sapsed, Grantham and DeFillippi, "A Bridge over Troubled Waters," 1328.
181 Bessant and Rush, "Building bridges," 102.
182 Ibid., 101-102; Howells, "Intermediation," 722.
183 ---, "Intermediation," 721.
184 McEvily and Zaheer, "Bridging Ties," 1139; Winch and Courtney, "The Organization," 757-758.
185 Bessant and Rush, "Building bridges," 101-102; Howells, "Intermediation," 722.
186 Dalziel, *Why Do Innovation Intermediaries Exist?,* 7-8.
187 Helping clients assess their ideas for intellectual property protection, see: Howells, "Intermediation." Other activities associated with the commercial evaluation of inventions, see: Markman et al., "Entrepreneurship."; Siegel, Waldman and Link, "Assessing the Impact."
188 Winch and Courtney, "The Organization," 757-758.
189 Howells, "Intermediation," 721-723; Mantel and Rosegger, "The Role of Third-parties," 127; Winch and Courtney, "The Organization," 757-758.
190 Howells, "Intermediation," 721-723; Winch and Courtney, "The Organization," 757-758.
191 Meulen, Nedeva and Braun, *Intermediaries Organisation and Processes: Theory and Research Issues,* 3.
192 Howells, "Intermediation," 725.
193 Lente et al., "Roles of Systemic Intermediaries," 254.
194 Changes in environment and mandate, see: Klerkx and Leeuwis, "Establishment and Embedding," 853. Clients' needs and their strategies, see: Howells, "Intermediation," 723-724. New requirements, see: ibid.
195 Klerkx and Leeuwis, "Establishment and Embedding," 853; Winch and Courtney, "The Organization," 752.
196 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 21-24, 79-81, 93-95.
197 Oldenziel and Albert de la Bruhèze, "Theorizing the Mediation Junction," 12, 16.
198 Ibid., 21-29.
199 Yin, *Case Study Research,* 8-9, 25-60.
200 Centraal Bureau voor de Statistiek, *Bedrijfstelling 1930*.
201 In 1904, only 67 electromotors were counted in all the small firms in the Dutch food sector (9870 firms with 1-9 employees. Note these statistics excluded firms without employees), see: Rijksverzekeringsbank, *Ongevallenstatistiek 1904*. 1930 statistics from: Centraal Bureau voor de Statistiek, *Bedrijfstelling 1930*.
202 Electrification rates of bicycle manufacturers and wagon makers in 1930 were also high, see: ---, *Bedrijfstelling 1930*. Of the 86 bicycle manufacturers (42 percent small firms), 75 percent had electrification. However, only 7 percent of the bicycle repair workshops (6157, of which 100 percent small firms) had an electromotor. Among the 209 body making firms (74 percent small firms). 88 percent used an electromotor. Of the 1618 wagon makers (100 percent small firms), 58 percent had an electromotor. See: ibid.
203 See the contextual approach of the history of technology which studies technology (equipment, products, processes and infrastructures), the knowledge and skills to apply and develop technology, and society (behaviour, and social and economic trends), see: Schot, Lintsen and Rip, eds., *Technology and the Making of the Netherlands*; Schot et al., eds., *Techniek in Nederland.*
204 Yin, *Case Study Research,* 38-39, 141-144.
205 Ibid., 61.
206 Lente, *Techniek en ideologie,* 124. See also note 58 of: Gerwen and Goey, *Ondernemers in Nederland,* 22.
207 Bond van Rijwiel- en Motorhandelaren in Nederland, *Een kwart eeuw organisatie,* 47; Jong, *Geschiedenis eener Nederlandsche vereeniging,* 40-41, 45.
208 An example of a wagon maker praising the RND course and the journals: 'Zeeuwsche Groentenwagen', De Rijtuig-, Wagen en Carrosseriebouw, 20 December 1937, 89. Read an article identifying two groups of wagon makers, 'old' and 'new', in which the old wants to continue in a traditional way, whereas the new wants to improve efficiency and start making bodywork for motorised vehicles: 'Waarom Ge Uw Vakblad Leest', De Rijtuig-, Wagen en Carrosseriebouw, 1 July 1922, 2.
209 Gerwen and Goey, *Ondernemers in Nederland,* 25-27. See also: Bouwens and Dankers, *Tussen concurrentie en concentratie,* 21-24.
210 Gerwen and Goey, *Ondernemers in Nederland,* 27.
211 Ibid., 68. See also: Zanden, *Een klein land in de 20e eeuw,* 24-25.
212 Gerwen and Goey, *Ondernemers in Nederland,* 36, 78.

213 This period resulted in six Dutch multinationals which still exist: Van den Bergh en Jurgens (Unilever), Hoogovens (Tata Steel Europe), DSM, AKU (Akzo Nobel), Philips, and Shell, see: Zanden, *Een klein land in de 20e eeuw,* 50-58.

214 As mentioned above, there are no consistent industry statistics available for this period, therefore this table is based on an article by Scheffer, who compared various statistics: the Dutch Occupational Censuses of 1889, 1909 and 1930, the Accident Statistics of 1909, and the Dutch Census of Industries 1930. He used these to determine the number of employees in small, medium and large firms. I compared Scheffer's percentages over 1930 with the first Dutch Census of Industries in 1930 and concluded that Scheffer's results work well: the 1930 Census shows slightly fewer employees than Scheffer's result: 1,031,064 and the distribution over the firm sizes is 34.2, 17.6, and 48.2 percent. See: Scheffer, "Ontwikkeling van de ambachts- en fabrieksnijverheid."

215 Centraal Bureau voor de Statistiek, *Bedrijfstelling 1930*; Rijksverzekeringsbank, *Ongevallenstatistiek 1905*.

216 Lente, *Techniek en ideologie,* 124-126.

217 Davids, "Van stoom naar stroom," 272-273.

218 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur,* 84-85; Gerwen and Goey, *Ondernemers in Nederland,* 54-56.

219 ---, *Ondernemers in Nederland,* 55, 71, 102, 272. Before 1914, the entire Dutch manufacturing industry could best be described as small-scale and family run, see: Sluyterman, *Dutch Enterprise,* 23-26.

220 Gerwen and Goey, *Ondernemers in Nederland,* 118.

221 Ibid., 274.

222 Ibid., 47, 63-67, 106., P47, 63-67, 106

223 Davids, "Van stoom naar stroom."; Lente, *Techniek en ideologie,* 125-126.

224 Gerwen and Goey, *Ondernemers in Nederland,* 49-50.

225 Ibid., 49; Sluyterman, *Dutch Enterprise,* 68-91.

226 Gerwen and Goey, *Ondernemers in Nederland,* 93-95; Sluyterman, *Dutch Enterprise,* 111-113.

227 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 136-138. Bouwens and Dankers' study overlaps the study by Van Gerwen and Van Goey. Bouwens and Dankers typically do not indicate new technologies as the reason for firms to form associations but increased market pressure and competition.

228 Ibid., 54-56.

229 Detremmerie and Deseyn, *'t Is voor de bakker*; Hounshell, *From the American System*; Münstermann, *Bäckerei- und Technikgeschichte*; Panschar, *Baking in America;* Schulte to Bühne, *Das Bäckerhandwerk*.

230 Epperson, "Failed Colossus."; Herlihy, *Bicycle*.

231 Utterback, *Mastering the Dynamics of Innovation,* 80-101.

232 Epperson, "Failed Colossus."; Norcliffe, "Popeism and Fordism."

233 Hounshell, *From the American System*; Kinney, *The Carriage Trade*; Mende, "Verschwundene Stellmacher."

234 This is a translation of the original article written and published in Dutch.

Chapter 2 – How Dutch Bread Bakers Modernised

1 This chapter is a translation of the original Dutch article, which is published as: Tjong Tjin Tai, Sue-Yen, Mila Davids and Harry Lintsen, "Hoe moderniseerden bakkers aan het begin van de twintigste eeuw? De betekenis van de Nederlandsche Bakkersbond en het Station voor Maalderij en Bakkerij." *Tijdschrift voor Sociale en Economische Geschiedenis* 10, no. 3 (2013): 55-79. We are grateful to the anonymous referees and the TSEG editors for their comments on an earlier version of this article. The translation is by Val Kidd.

2 Brummelen and Leijten, *Tussen trog,* 22-23.

3 Lintsen et al., *Geschiedenis van de techniek,* 46.

4 Brummelen and Leijten, *Tussen trog,* 19-20.

5 Jaarverslag Station voor Maalderij en Bakkerij (hereafter Institute Annual Report) (Wageningen 1930), (1931) 9.

6 For the life and work of bakers till around 1940, see: Voskuil, *Twaalf bakkers*. Regarding changes in bakeries, especially mechanisation, see: Brummelen and Leijten, *Tussen trog*.

7 *Brabants Historisch Informatie Centrum*, Den Bosch (BHIC, Historical Information Centre Brabant), Rijksdienst voor Nijverheid in Tilburg, 1913-1965 (RND), 169; *Nationaal Archief* (National Archives) in The Hague (NA), Ministry of Economic Affairs (further EZ), access 2.06.001; NA, Rijksnijverheidsdienst, 1945-1963; Nijverheidslaboratorium, 1913-1962 (further RND), access 2.06.083; Tresoar,

Fries- Historisch en Letterkundig Centrum (Friesian Historical and Literary Centre), Leeuwarden (further Tresoar), Provinciale Friesche Bakkersbond (FB), access 153-22; Volumes of the *Bakkers-Bondscourant* and *De Bakkerij* are in the *Nederlands Bakkerijmuseum* 'Het Warme Land' (Dutch Bakery Museum), Hattem.

8 Lintsen and Bakker, "Meel."
9 On the Rijksnijverheidsdienst's activities for wagon makers and blacksmiths, see: Lente, "The Crafts."
10 Goudriaan jr., *De doelmatigheid,* 58-60; Zanden, *De industrialisatie,* 66-68.
11 Smits, "Technology, Productivity and Welfare."
12 Verhaegen, *Rationeele broodvoorziening,* 22.
13 Münstermann, *Bäckerei- und Technikgeschichte,* 118-120.
14 Ibid.
15 Ibid.
16 Detremmerie, "De mechanisering," 18-43.
17 Panschar, *Baking in America,* 125-126.
18 Detremmerie, "De mechanisering."
19 Albert de la Bruhèze and Oldenziel, eds., *Manufacturing technology*.
20 Veraart, *Vormgevers*.
21 Howells, "Intermediation."; Kerste and Muizer, *Effective Knowledge Transfer*; Nauwelaers and Wintjes, "Innovating SMEs."
22 Howells, "Intermediation."; Veraart, *Vormgevers*.
23 Boldrini, Schieb-Bienfait and Chéné, "Improving SMEs' Guidance."; Nauwelaers and Wintjes, "Innovating SMEs."
24 Winch and Courtney, "The Organization."
25 Dalziel, "The Impact."
26 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 13-14, 26-27, 57-59.
27 Ibid., 13-14.
28 In 1909, those conducting the survey visited within five weeks all but 46 of the Dutch establishments (*warme bakkers*, bakeries which baked their own bread instead of selling bread that was baked elsewhere) in connection with the *Bakkerswet* (Bakers Bill): Departement van Landbouw Nijverheid en Handel, *Onderzoek,* 68.
29 *Bakkers-Bondscourant* (hereafter *BC*) (1922) 420-421.
30 This description is based on: Birnbaum, *Het broodbakken*; Efdée, *Bakker*; Spil, *Vakbekwaamheidskennis*.
31 Birnbaum, *Het broodbakken,* 178.
32 Departement van Landbouw Nijverheid en Handel, *Onderzoek,* 77-84.
33 According to Harry Lintsen and Martijn Bakker, the competitiveness began in 1856, when the first bread factory in Amsterdam offered bread far below the normal price. This broke through the millers and bakeries' existing price cartel. Dick van Lente describes how the keen competition from the bread factories in the late nineteenth century forced many bakers to close. See: Lente, *Techniek en ideologie,* 125; Lintsen and Bakker, "Meel."
34 Zanden, *De industrialisatie,* 66-68.
35 Goudriaan jr., *De doelmatigheid,* 58-60.
36 Departement van Landbouw Nijverheid en Handel, *Onderzoek,* 96-97.
37 Zanden, *De industrialisatie,* 66-68.
38 Efdée, *Bakker,* 73-74.
39 Ibid.
40 Minderaa, "Talma."
41 Gerwen and Goey, *Ondernemers in Nederland,* 48-49.
42 Starting work at 6 am appeared to be too late for rural bakers and so from 1922 they were allowed to start at 5 am. By 1933 this applied to all bakers. See: Efdée, *Bakker,* 77-78.
43 Otterloo, "Voeding."
44 Vledder, Homburg and Houwaart, "Particuliere laboratoria."
45 'Gezondheidscommissie', *Algemeen Handelsblad*, 19 Sept 1905.
46 Jonker, *Huisvrouwenvakwerk,* 37.
47 BC (1908) 53. See also: Volksvoeding. Weekblad voor wetenschappelijke en practische kennis van levensmiddelen en hygiëne (1922), (1923).
48 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 26-27.

49 *De Bakkerij. Goedkoop orgaan voor brood-, koek-, en banketbakkerij. Jubileumnummer 6 jan. 1928*; Nederlandsche Bakkersbond, *Jubileumnummer*; Schoep, *100 jaren Nederlandsche Bakkersbond*. See also: BC (1922) 406, 420, 423.
50 Schulte to Bühne, *Das Bäckerhandwerk,* 27-28, 35-36.
51 *BC* (1922) 406.
52 *De Tijd* (1914) 11 Aug; *Algemeen Handelsblad* (1914) 1 Sept, 4 Sept, 13 Oct, 7 Nov, (1915) 13 Jan, 23 Mar, 25 June; *BC* (1916) 5, (1919) 22 Dec.
53 Schoep, *100 jaren Nederlandsche Bakkersbond,* 48.
54 *BC* (1916) 5, (1919) 22 Dec.
55 This building 'Stienstrahearehuzinge' is still at No 1 Havenstraat. Around 1900 it housed a bakery, presumably with the dough-mixing machine. See also chapter 2 of: Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur.*
56 Tresoar, FB, inv. no. 1, Meeting 28 April 1909; *De Bakkerij. Goedkoop orgaan voor brood-, koek-, en banketbakkerij. Jubileumnummer 6 jan. 1928.*
57 Brummelen and Leijten, *Tussen trog,* 20, 43.
58 Meurs, *Meel- en broodfabrieken*.
59 Nederlandsche Staatscourant (1897) 22 and 23 Aug.
60 *BC* (1921) 9, 110, 112, 120; *Institute Annual Report* (1926).
61 *BC* (1920) 136, 346.
62 Departement van Landbouw Nijverheid en Handel, *Onderzoek,* 47; Everwijn, ed., *Beschrijving van handel en nijverheid in Nederland*, 670.
63 *BC* (1920) 656, 657, 660.
64 Brummelen and Leijten, *Tussen trog,* 43.
65 *BC* (1920) 366.
66 *BC* (1920) 739.
67 Centraal Bureau voor de Statistiek, *Bedrijfstelling 1930*.
68 Birnbaum, *Het broodbakken,* 177.
69 Roeters van Lennep (1848-1920) founded Zutphen's Bread Factory and was then director of The Hague's Bread Factory. He had already put forward this proposal at the annual meeting of the *Vereeniging tot bevordering van de Fabrieks- en Handwerksnijverheid* (VFHN, Association to Promote Industry and Crafts) in 1890. See: *40 jaren Station voor Maalderij en Bakkerij, 1909-1949*; Nederlandsche Bakkersbond, *Jubileumnummer,* 46-47.
70 *BC* (1908) 211.
71 Ibid.
72 Ibid., 110.
73 *Ibid.,* 211.
74 *40 jaren Station voor Maalderij en Bakkerij, 1909-1949,* 14.
75 Institute Annual Report (1910) 8.
76 *Ibid.* The baking test is also described in the fifth *Codex Alimentarius*. F.F. Bruyning jr. was one of the committee members. *Institute Annual Report* (1911) 16; *Algemeen Handelsblad* (1905) 18 Sept.
77 Institute Annual Report (1911).
78 Institute Annual Report (1913).
79 Institute Annual Report (1915).
80 Institute Annual Report (1915); BC (1916) 590-591.
81 NA, Crisisvoorzieningen, access 2.06.079, inv. no. 782, Articles regarding advice on experiments in baking bread using various raw materials by the Institute in Wageningen, 1915.
82 Institute Annual Reports (1915 and 1916).
83 Institute Annual Reports (1920 and 1930).
84 Efdée, *Bakker,* 79-81.
85 Stadsarchief Zutphen, Bakkerspatroonsvereniging Zutphen, access 202, inv. no. 3, Minutes 2 July 1908.
86 Initially the idea was to offer a two-year course.
87 *BC* (1910) 235, (1917), 734.
88 See the Institute's address list of alumni: Bond van Oud-Leerlingen van het Station voor Maalderij en Bakkerij (Wageningen), *Jaarboek*.
89 *BC* (1910) 391, 471, 494; *Institute Annual Reports* (1911), (1912), (1913), (1914).

90 They were also called *wandelleraren* (peripatetic teachers).
91 NA, EZ, inv. no. F5043, Letter N.G. Enzlin, 16 April 1917; Letter J.Ph. Peters, 8 May 1917; Letter A. Boonstra, 16 May 1917.
92 *BC* (1919) 436-437. *BC* (1921) 520, 521, 523. BHIC, RND, inv. no. 26, Minutes of meeting of RND consultants on 12 March 1919.
93 *Institute Annual Reports* (1921), (1922), (1923), (1924), (1925).
94 *BC* (1920) 347, 640, 705.
95 Verhaegen, *Rationeele broodvoorziening,* 70-72.

Chapter 3 – Building Carriage, Wagon and Motor Vehicle Bodies in the Netherlands

1 This article has been accepted for publication in the Journal of Transport History, December 2015.
2 'Daar kan geen moderne, gladde carrosserie tegenop. Van een oud stiel', *Het Vrije Volk*, 19 January 1951, 3.
3 Braber, ed., *Van klep tot krat*, 180. Nederlands Openluchtmuseum (hereafter NOM, Dutch Open Air Museum), 674.32, Map 1, Wagenmakerij, Eerste vragenlijst wagenmakerij, Jan van Peet, 1959.
4 Rothwell, "The Changing Nature," 268-269, 276-277.
5 Jong, *De bron,* 45-47.
6 Dalziel, *Why Do Innovation Intermediaries Exist?*, 3-4; Howells, "Intermediation," 720; Winch and Courtney, "The Organization," 747.
7 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur,* 64; Veraart, *Vormgevers,* 200-202, 218-220.
8 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur*.
9 Lente, "The Crafts," 110-112.
10 Kinney, *The Carriage Trade,* 285-292.
11 Mende, "Verschwundene Stellmacher," 96, 105.
12 Dalziel, 'Why Do Innovation Intermediaries Exist?,' 6; Dalziel, *Why Do Innovation Intermediaries Exist?*, 6; Howells, "Intermediation," 720-722; Winch and Courtney, "The Organization," 757-758.
13 For a history of motorisation in the Netherlands, see: Mom and Filarski, *Van transport naar mobiliteit*.
14 Ibid., 11.
15 Ibid., 117-121, 203-204.
16 Renaud, *Wagens & Karren,* 69.
17 It is not known how the census differentiated between wagon makers and body making firms. Nor do we know how many wagon makers also made bodies. Centraal Bureau voor de Statistiek, *Bedrijfstelling 1930,* staat I.
18 Centraal Bureau voor de Statistiek, *Tweede bedrijfstelling, 1950,* 18.
19 Nationaal Archief, Den Haag (hereafter NA, National Archive in the Hague), Ministry of Economic Affairs: SME and Tourism, hereafter ME, 2.06.073, inv. 649, Commissie Adviezen Vestigingsregelingen, Advies vestigingsbesluit, 6 May 1959.
20 Oostwoud, *Van rijtuig tot ziekenhuisbed,* 83.
21 One of the last Dutch wagon makers died in 1986. See Heijbroek and Mönnich, *De Leidse wagenmaker,* 1.
22 Renaud, *Wagens & Karren,* 64.
23 Mom and Filarski, *Van transport naar mobiliteit,* 60.
24 Het Geïllustreerd Vakblad voor Zadelmakers, Rijtuigfabrikanten, Rijtuigschilders, Wagenmakers, Wagensmeden en Koffermakers, 4 September 1903, 3-4.
25 Commissie voor de Middenstandsenquete, *Verslag,* 188-190.
26 Kinney, *The Carriage Trade,* 271-272.
27 Oliver, *Cars and Coachbuilding,* 36.
28 Kinney, *The Carriage Trade,* 289.
29 This section is based on Renaud, *Wagens & Karren,* 59-77.
30 *De Rijtuigbouw*, hereafter RB, 1 July 1912, 1-2.
31 Vlijmen, *Rijden en omzien,* 31.
32 NOM, 674.32, Map 1, Wagenmakerij, Notes, version 1, Cornelis Lansen, Biezelinge, 1959. Museum Rotterdam has several patterns for wheels in its collection, see: www.museumrotterdam.nl (accessed 8 February 2015), search in 'mal uit wagenmakerij'.

33 Kinney, *The Carriage Trade,* 91-92.
34 RB, 1 July 1912, 10.
35 Kinney, *The Carriage Trade,* 32-33.
36 RB, 1 July 1912, 9.
37 Mende, "Verschwundene Stellmacher," 96.
38 Kinney, *The Carriage Trade,* 29-35.
39 RB, 1 July 1912, 1.
40 *Rijnbode,* 6 February 1918, 2. The founding meeting was on 16 January 1918.
41 Statuten en Prijslijst voor de Afdeling Leiden en Omstreken van de Wagenmakers-patroons-vereeniging, Afdeeling van de Nederlandsche Rijtuig- en wagenmakers-patroons-vereeniging in Nederland (1917).
42 *De Rijtuig- en Wagenbouw*, hereafter RW, 1 June 1922, 36.
43 Lente, "The Crafts," 102-107.
44 Eekels, Christiaans and Kaasschieter, *Ondernemen en vernieuwen,* 15.
45 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur,* 58-59.
46 Ibid., 27-28, 62-65.
47 Tijdschrift der Maatschappij van Nijverheid, 1916, 249-255.
48 Rijksvoorlichtingsdienst ten behoeve van Handel en Nijverheid, *Verslagen van de werkzaamheden over het jaar 1925,* 14-15.
49 Vakblad voor Wagen-, Rijtuig- en Auto-carrosseriemakers 1, September 1917, 2. My translation.
50 Brouwer, Kesteren and Wiersma, *Berigt aan de heeren reizigers,* 450; Centraal Bureau voor de Statistiek, *75 jaar statistiek,* 101.
51 Mom and Filarski, *Van transport naar mobiliteit,* 207.
52 Wallast, *100 jaar trucks,* 42, 54-55.
53 Ibid., 54.
54 RW, 1 June 1922, 40.
55 Mom and Filarski, *Van transport naar mobiliteit,* 163.
56 *Tijdschrift van de Historische Vereniging Vlaardingen*, June 2002, 1-13; http://www.conam.info/carrosseriebouwers-beschrijvingen/verhulst-vlaardingen
57 Mom and Filarski, *Van transport naar mobiliteit,* 206-209. Some wagon makers who became successful manufacturers of autobus bodies: Hainje in Heereveen, Smit in Joure, Verheul in Waddinxveen.
58 *Friesche Koerier,* 1 November 1957, 3; Wallast, *100 jaar trucks,* 49.
59 http://www.conam.info/carrosseriebouwers-beschrijvingen/jac-met-heerhugowaard-alkmaar-1806-197.
60 Ibid.
61 From 1917 Ford also produced heavier one tonne Model-TT Ford chassis for trucks. Chassis converter specialists included: Broshuis in Muiden, Van de Meulen-Ansems in Tilburg and Helmond, Bakkeren in Rotterdam. See: advertisement Broshuis, *De Rijtuig-, Wagen- en Carrosseriebouw*, hereafter RWC, 11; Wallast, *100 jaar trucks,* 49-50.
62 Renaud, *Wagens & Karren,* 67.
63 'Efficiency in de Wieringermeer', *De Tijd*, 9 November 1933, 2.
64 Renaud, *Wagens & Karren,* 65-66.
65 Kinney, *The Carriage Trade,* 285-291.
66 *Het Geïllustreerd Vakblad voor Zadelmakers, Rijtuigfabrikanten, Rijtuigschilders, Wagenmakers, Wagensmeden en Koffermakers*, 6 March 1903, 3; Vlijmen, *Rijden en omzien,* 26.
67 See the yearly overview of articles published in RWC in 1923-1924 and 1924-1925.
68 Vlijmen, *Rijden en omzien,* 36.
69 Mom and Filarski, *Van transport naar mobiliteit,* 211-214.
70 Wallast, *100 jaar trucks,* 67-68.
71 *Leeuwarder Courant*, 9 January 1975, 15.
72 FOCWA, *1936-1976 FOCWA 40 jaar,* 70.
73 'Een Model-spuitcabine', RWC, 20 December 1938, 90.
74 Archives of Delft, Wagon Maker, later vehicle-body maker Van Koppen, archive no. 791, no. 32, Financial report 1927.
75 'In Memoriam', RW, 1 June 1922, 35.
76 RW, 1 June 1922, 36.
77 Elzinga, *Van wagenmakerij tot carroseriebouw,* 2; Oostwoud, *Van rijtuig tot ziekenhuisbed,* 81.

78 RW, July 1, 1922, 1. My translation.
79 Mende, "Verschwundene Stellmacher," 120.
80 Kinney, *The Carriage Trade,* 299-301.
81 This is visible in the heading of the trade journal *De Rijtuig-, Wagen- en Carrosseriebouw.* In July 1922 it appears as the CBRW journal, but not in May 1923. No issues of the interim period were archived. See also the minutes of meetings to re-establish a national association: RWC, March 1928, appendix.
82 FOCWA, *1936-1976 FOCWA 40 jaar,* 7.
83 RWC, 15 May 1923, 9-10.
84 Centraal Bureau Wagenbouw, *Kostprijzenboekje* (1939).
85 FOCWA, *1936-1976 FOCWA 40 jaar,* 7.
86 NA, ME, 2.06.073, inv. 649, Letter from FOCWA to Ministry of Economic Affairs about minimum requirements for professional skills, 24 November 1947.
87 Renaud, *Wagens & Karren,* 68.
88 NA, ME, Trade and Industry, hereafter ME-TI, 2.06.001, inv. 4528, Letter from the RND to the Ministry, 12 February 1919. My translation.
89 *De Eenheid*, November 1940, 98.
90 NA, RND, 2.06.083, inv. 17, Annual reports.
91 Photo of participants in a course for body making for motorised vehicles, conducted by RND assistant J. B. van de Pavert, Leeuwarden, 1926-1928. Collection Nederlands Openluchtmuseum, AA98795.
92 NA, RND, 2.06.083, inv. 188, Monthly reports from the assistant for wagon makers, 1926-1940. Report of 27 January and 28 April 1930, 2 and 16 September 1932, 13 December 1932. The reports do not indicate the name of the wagon makers.
93 Ibid., Reports of 24 December 1929, 7 November and 16 December 1930.
94 NA, RND, 2.06.083, inv. 118, Monthly reports from the assistant for wagon makers, 1926-1940.
95 Ibid., Reports of 11 November 1932, 13 November 1936, 10 September 1937, and August 1938, wheel pressing machine Mr. Sommen or Somers, Princenhage.
96 RWC, 1 November 1932, 100.
97 NA, ME-TI, 2.06.001, inv. 4527, Report about collective booth wagon makers at the Jaarbeurs, 15-24 March 1932.
98 'Zeeuwsche Groentenwagen', RWC, 20 December 1937, 89.
99 RWC, 15 June 1929, 36.
100 RWC, 15 October 1931, 70-71; Ibid., 15 August 1934, 42-43.
101 RWC, 1 December 1931, 106.

Chapter 4 – How the Netherlands Became a Bicycle Nation

1 This article was published as: Tjong Tjin Tai, Sue-Yen, Frank Veraart, and Mila Davids, "How the Netherlands became a bicycle nation: Users, firms and intermediaries, 1860-1940." *Business History* 57, no. 2 (2015): 257-289. The article in this dissertation contains some editorial changes compared to the published version. Earlier versions of this article were presented at the 23rd International Cycling History Conference, the Bicycle History Workshop at Eindhoven University of Technology in 2012 and the 40th ICOHTEC Symposium. The authors would like to thank participants at the events for their comments, the anonymous reviewers for their helpful suggestions and the funding bodies for their support.
2 The Manchester Guardian, March 13, 1935.
3 *New York Times*, January 15, 1933.
4 Centraal Bureau voor de Statistiek, *Tweehonderd jaar statistiek*; Jong, *Geschiedenis eener Nederlandsche vereeniging*.
5 Herlihy, *Bicycle*.
6 Cox, *Modelling Bicycle History: Users and Non-users*; Ebert, *Radelnde Nationen*.
7 Lintsen et al., eds., *Geschiedenis van de techniek*.
8 Gerwen and Goey, *Ondernemers in Nederland*.
9 Carnevali and Newton, "Pianos for the People."
10 Bijker, *Of Bicycles, Bakelites*.
11 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur*.
12 Oldenziel and Albert de la Bruhèze, "Theorizing the Mediation Junction."; Veraart, *Vormgevers*.
13 Howells, "Intermediation."

14 Fagerberg, "Innovation," 6-7.
15 Bouwens and Dankers, *Business Interest Associations: A Service to the Industry*.
16 ---, *Tussen concurrentie en concentratie*; Dalziel, "The Impact."
17 Cortat, "How Cartels stimulate."
18 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur*.
19 Herlihy, *Bicycle*; Lloyd Jones and Lewis, *Raleigh*; Millward, *Factors*; Rosen, *Framing Production*; Steele, *Betting on the Wheel: The Bicycle and Japan's Postwar Recovery, 1945-1958*.
20 Rhoads, "Cycles of Cathay."; Steele, "The making."
21 Burr, *Markets as Interactions*; Cox, *Modelling Bicycle History: Users and Non-users*.
22 Ebert, *Radelnde Nationen*.
23 Stoffers and Oosterhuis, "Ons populairste vervoermiddel."
24 Exceptions are: Veraart, *Geschiedenis van de fiets*; Vinne, *Eysink*.
25 Herlihy, *Bicycle,* 75-76.
26 Ibid., 75-81; Kobayashi et al., *Le Velocipede,* 35.
27 ANWB Archives (hereinafter ANWBA), Box 12.126, Map 1037, 1.03.2, *De Ontwikkeling van het Rijwiel*, 1932, by P.J. Frederiks, curator ANWB Archives; Hogenkamp, *Een halve eeuw wielersport,* 16.
28 The following sources mention a tricycle made in 1850 by instrument manufacturer Roelof Hommema (1791-1854) from St. Anna Parochie (Friesland): *40 Jaar - uit het archief der Kampioen,* 1; Berlage, *De Fiets,* 14-17; Hogenkamp, *Een halve eeuw wielersport,* 15.
29 http://www.wielrennensurhuisterveen.nl/FFA/welkom.htm. Jongsma and Pijper, *Wielrennen in Friesland*.
30 Martens, a Dutch plasterer, brought it from Paris. Hogenkamp's chronology is not reliable, as he writes that the Universal Exhibition in Paris was in 1865. Hogenkamp, *Een halve eeuw wielersport,* 16.
31 Millward, *Factors*.
32 There are several versions of the story how Burgers was inspired to produce bicycles; one is that retailer Timmer inspired the Deventer blacksmith when his bicycle broke down on his tour to Groningen (*Eigen Haard*, 1899, 190). It was never denied that Burgers' inspiration had foreign origins.
33 Hogenkamp, *Een halve eeuw wielersport,* 15-16.
34 Berlage, *De Fiets,* 21.
35 Soltow and Zanden, *Income and Wealth Inequality*. For details of the early Burgers bicycle: 'Leeuwarder Jeugd Herinneringen Hendrik Burger (1864-1957)', an unpublished manuscript about the childhood of doctor and Professor Hendrik Burger, http://www.gemeentearchief.nl/html/nl/176/Hendrik_Burger.
36 "Een en ander over de Burgers-fabriek." *De Kampioen* (1901): 727.
37 Advertisements in *De Kampioen*, 1885-1889; Soltow and Zanden, *Income and Wealth Inequality*.
38 For example, Webster referred to his ANWB board membership in advertisements in *De Kampioen*.
39 ANWBA, Box 12.81, Map 647, Minutes of meeting of the NVB, 20 November 1884; *Maandblad*, January 1885 and February 1885.
40 Ebert, *Radelnde Nationen*; Linders-Rooijendijk, *Gebaande wegen*.
41 ---, *Gebaande wegen*, 145-147, 150-151.
42 Ibid.
43 Millward, *Factors*, 241.
44 *De Kampioen,* February 1887, April 1887, 16 November 1894.
45 Hogenkamp, *Een halve eeuw wielersport,* 541.
46 *De Kampioen*, November 1886, 188.
47 *De Kampioen,* February 1887, April 1887, May 1887, September 1888.
48 http://www.fongers.net; Brusse, *De Groninger rijwielenfabriek*.
49 Herlihy, *Bicycle,* 161.
50 Ibid., 144, 161-163.
51 Zellekens, Willy A. "De Nederlandsche Rijwiel-industrie." *Eigen Haard*, no. 24 (1898): 266; "Een en ander over de Burgers-fabriek." *De Kampioen* (1901): 727.
52 ANWBA, Box BE, Correspondence book Edo Bergsma, Letter from H. Burgers, 16 January 1885.
53 Herlihy, *Bicycle,* 218.
54 *De Kampioen*, November 1886, May 1889, July 1, 1889, March 1, 1895.
55 "The Stanley exhibition of cycles, 1890." *The Engineer*, February 14, 1890, 138.
56 *De Tijd*, June 18, 1891.

57 *De Kampioen*, March 3, 1893, 201-202.
58 Kuner, Herbert. "Rijwielindustrie (1)." http://www.rijwiel.net/indust1n.htm.
59 *De Kampioen,* November 16, 1894.
60 *De Kampioen,* March 1, 1895.
61 Millward, *Factors*.
62 Ibid., 238.
63 Bijker, *Of Bicycles, Bakelites*.
64 Linders-Rooijendijk, *Gebaande wegen*, 81-84.
65 "Rijkswet op het wielrijden." *Leeuwarder Courant*, November 7, 1891.
66 There were 100,000 bicycle owners, see: Jong, *Geschiedenis eener Nederlandsche vereeniging,* 116.
67 Cornelissen de Beer, "Het rijwiel."; Fuchs and Simons, *Allemaal op de fiets,* 77-81.
68 *Algemeen Handelsblad*, September 18, 1885; "Posterijen en Telegraphie." *Nieuwe Amsterdamsche Courant*, March 12, 1886.
69 Linders-Rooijendijk, *Gebaande wegen*, 84-85.
70 "De Simplex." *Nieuws van de Dag*, October 16, 1903; Rietveld, Jos. "Fongers 1884-1922." *De Oude Fiets* (2004); Murk, Rutger. "Naar de wielen! Militair gebruik van rijwielen in Nederland." *Het Rijwiel*, no. 1 (2012): 4-19.
71 *De Kampioen*, March 1, 1901, 182-183.
72 Jong, *Geschiedenis eener Nederlandsche vereeniging*.
73 *De Kampioen*, May 3, 1895, 339.
74 Stadsarchief Amsterdam (Amsterdam City Archives, hereinafter SA), 1302 (RAI Archives), inventory number (inv. no.) 116, Minutes of RI members meeting, October 26, 1899; *De Kampioen,* March 2, 1900, 179.
75 SA, 1302, inv. no. 218, Letters from Wijnmalen & Haussman to RI (Scheltema Beduin), November 16, 1899, November 28, 1899.
76 Het Nieuws van den Dag, March 21, 1900.
77 In Dutch: Nederlandsche Vereeniging 'De Rijwiel- en Automobiel-Industrie'.
78 Centraal Bureau voor de Statistiek, "De Nederlandsche rijwielmarkt."
79 Ebert, *Radelnde Nationen*.
80 Murk, Rutger. "Naar de wielen! Militair gebruik van rijwielen in Nederland." *Het Rijwiel*, no. 1 (2012): 16-17.
81 Linders-Rooijendijk, *Gebaande wegen*.
82 Ibid.
83 Ibid., 161, 236.
84 ANWBA, Box 1097, Map 12-131, 1.03.31, File Rijwielhulpkist, Letter to the ANWB excutive committee, J.C. Redelé, April 11, 1914.
85 Linders-Rooijendijk, *Gebaande wegen*, 150-151.
86 In Dutch: Bond van Rijwielherstellers en –Handelaren in Nederland, later renamed to 'Bond van Rijwiel- en Motorhandelaren in Nederland'. See: Bond van Rijwiel- en Motorhandelaren in Nederland, *Een kwart eeuw organisatie*.
87 Metallicus: Orgaan van den Bond van Smedenpatroons in Hollands-Noorderkwartier 1, no. 50 (1904).
88 Bond van Rijwiel- en Motorhandelaren in Nederland, *Een kwart eeuw organisatie*., 47; Jong, *Geschiedenis eener Nederlandsche vereeniging,* 40-41, 45.
89 Bond van Rijwiel- en Motorhandelaren in Nederland, *Een kwart eeuw organisatie*., 13-15.
90 Linders-Rooijendijk, *Gebaande wegen*, 257.
91 Bureau of Foreign Commerce (USA) Department of Commerce and Labor, *Commercial Relations*.
92 Millward, *Factors*.
93 Department of Trade and Industry (UK), *Annual Statement (1892-1937)*; Statistisches Reichsamt, *Der auswärtige Handel (1897-1913)*.
94 Timmerman, *Rijwielfabriek Union*.
95 Rietveld, Jos. "Fongers, de Groninger Rijwielenfabriek." *De Oude Fiets*, no. 4 (1996): 4-11; Rietveld, Jos. "Het Fongers Fabrikaat 1897-1922." *De Oude Fiets*, no. 3 (2009): 4-9; http://www.rijwiel.net/gazellen.htm.
96 Lloyd Jones and Lewis, *Raleigh*.
97 Assuming that 20 Marks equal £ 1. Department of Trade and Industry (UK), *Annual Statement (1892-1937)*; Statistisches Reichsamt, *Der auswärtige Handel (1897-1913)*.

98 Kuner, Herbert. "De Rijwielhandel in de Jaren '20." *De Oude Fiets*, no. 4 (2005): 6-11.
99 Two major Dutch newspapers, *De Telegraaf* and *Algemeen Handelsblad,* show a peak in bicycle thefts in 1916 and 1917.
100 Kuner, Herbert. "De Hollandse Patent Metaal Industrie." *De Oude Fiets*, no. 4 (2002): 4-8.
101 Hopmi acquired 11 patents in total, mostly for bicycle locks and a carrier.
102 "Batavus-special" *De Oude Fiets* (2003).
103 Van der Horst, Jos and Herbert Kuner. "Durabo." *De Oude Fiets*, no. 3 (2005): 3-9.
104 For example, in 1915 a saddle manufacturing plant was established, see: http://www.encyclopediedrenthe.nl/Ohmann%20&%20Boddendijk.
105 De Rijwiel- en Automobielindustrie, September 1919, 13.
106 Nederlandsche Overzee Trust Maatschappij (NOT).
107 Jong, *Geschiedenis eener Nederlandsche vereeniging,* 46-48.
108 Linders-Rooijendijk, *Gebaande wegen*, 162.
109 Nederlandsche Vereeniging van Grossiers in Rijwielen en Onderdelen.
110 Centraal Bureau voor de Rijwielhandel. *De Rijwiel- en Automobiel-Industrie*, June 1920, 7 and August 1910, 5-6.
111 *Handelingen Eerste Kamer*, 21ste vergadering, March 2, 1921.
112 *Handelingen Eerste Kamer*, 25ste vergadering, March 9, 1921.
113 Linders-Rooijendijk, *Gebaande wegen*, 220-221.
114 Rietveld, Jos. "Het Fongers Fabrikaat 1897-1922." *De Oude Fiets*, no. 3 (2009): 4-9.
115 Lente, "The Crafts."
116 Eekels, Christiaans and Kaasschieter, *Ondernemen en vernieuwen,* 13-16.
117 Later a small fee had to be paid, except in special cases.
118 Brabants Historisch Informatie Centrum (Noord-Brabant Provincial Archive) (hereinafter BHIC) 169, inv. no. 55, Verslagen Nijverheidslaboratorium Delft.
119 Examples of specific literature: *Cycle and Motor Review*; *Bicycle and Motor Cycle Repairing*. See: BHIC, 169, inv. no. 25, List of available literature.
120 Nationaal Archief, Den Haag (Dutch National Archives, The Hague) (hereinafter NA), VNF, nummer toegang 2.19.042.07.
121 Probably in 1915, see: http://www.rijwiel.net/gruadamn.htm.
122 Rijksvoorlichtingsdienst ten behoeve van de Nijverheid, *Verslag 1920*.
123 This paragraph is based on: Gras, Thijs. "De Fiets als Ziekenvervoerder." *De Oude Fiets*, no. 1 (2008): 12-21.
124 NA, Nederlandse Rode Kruis: Hoofdbestuur, nummer toegang 2.19.224, inv. no. 381-383; *Nederlands Tijdschrift voor Geneeskunde* 82.I.7 (1938): 775-776.
125 In Dutch: Amsterdamse Gemeentelijke Geneeskundige Dienst.
126 Petty, "The Product Life Cycle," 119.
127 Pinkerton, *At Your Service*.
128 Rietveld, Jos. "Het Fongers Fabrikaat 1897-1922." *De Oude Fiets*, no. 3 (2009): 4-9.
129 Mulder, Oscar and Herbert Kuner. "Fa. Gebr. Bergreijer, Amsterdam." *Het Rijwiel*, no. 4 (2010): 6-15.
130 Centraal Bureau voor de Statistiek, "De Nederlandsche rijwielmarkt."; Jong, *Geschiedenis eener Nederlandsche vereeniging*.
131 ---, *Geschiedenis eener Nederlandsche vereeniging*.
132 Hoepen, ed., *Van veertig zegenrijke melkjaren*, 198-205.
133 Centraal Bureau voor de Statistiek, "De Nederlandsche rijwielmarkt."
134 Linders-Rooijendijk, *Gebaande wegen*, 221, 234-235.
135 Ibid., 316-317.
136 Tweede Kamer. Kamerstuk 447 ondernummer 2. 1933-1934; Eerste Kamer. Minutes of meeting, 54ste vergadering. June 26, 1935.
137 Tweede Kamer. Kamerstuk 153 ondernummer 3. 1932-1933; Tweede Kamer. Kamerstuk 355 ondernummer 1 (23 april 1935). 1934-1935; Eerste Kamer. Minutes of meeting, 57ste vergadering. July 18, 1935.
138 Statistisches Reichsamt, *Der auswärtige Handel (1922-1927).*
139 Hoogstraten, "De rijwielindustrie in 1929."; Millward, *Factors*.
140 Van Erven Dorens, W.K. "De Rijwielindustrie in Nederland." *Algemeen Handelsblad*, June 27, 1933.
141 Hoogstraten, "De rijwielindustrie in 1929."

142 Van Erven Dorens, W.K. "De Rijwielindustrie in Nederland." *Algemeen Handelsblad*, June 27, 1933.
143 Dalmulder, "De vraag naar rijwielen."
144 Van der Horst, Jos and Herbert Kuner. "Durabo." *De Oude Fiets*, no. 3 (2005): 3-9.
145 Kuner, "Fahrräder."
146 Rietveld, Jos. "Ontwikkeling van de Elektrische Rijwielverlichting (1889-1936)." *De Oude Fiets*, no. 1 (1999): 3-7.
147 De Kogel, Theo. "Rijwielindustrie en Rijwielhandel in Zwolle." *De Oude Fiets*, no. 3 (2001): 3-10; N.V. Gazelle Rijwielfabriek v/h Arentsen & Kölling te Dieren. "Achterspatbord voor Rijwielen en dergelijke Voertuigen en daarvoor voorzien Rijwiel." Dutch patent publication number 47900, February 2, 1940.
148 http:// www.encyclopediedrenthe.nl.
149 *De Rijwielhandel* was published by the BRHN since 1904. Between 1921 and 1923 and from 1926 the BRHN and the RAI published *Orgaan voor het Rijwiel- en Automobielbedrijf.*
150 Centraal Bureau voor de Statistiek, *Bedrijfstelling 1930*.
151 BHIC, 169, inv. no. 93, Maandverslagen Rijksnijverheidsdienst Den Haag.
152 BHIC, 169, inv. no. 55, Verslagen Nijverheidslaboratorium Delft; Kuner, Herbert. "Käuderer en Seitzinger: Twee Fietsenmakers met Passie (deel 1)." *Het Rijwiel*, no. 2 (2010): 22.
153 In Dutch: patroonsleergang. Rijksvoorlichtingsdiensten ten behoeve van Handel en Nijverheid, *Verslagen 1928*.
154 BHIC, 169, inv. no. 72, Lecture at the annual meeting of the BRHN, December 8, 1928.
155 Rijksvoorlichtingsdiensten ten behoeve van Handel en Nijverheid, *Verslagen 1929*.
156 Ebert, "Cycling towards the Nation."; Kuner, "Fahrräder."
157 http://www.beeldbankgroningen.nl, search 'Fongers'.
158 Kuner, "Fahrräder."; Millward, *Factors*, 330-340.
159 Kuner, Herbert. "De Rijwielhandel in de Jaren '20." *De Oude Fiets*, no. 4 (2005): 6-11.
160 Kuner, Herbert. "De Rijwielfabriek Mustang." *De Oude Fiets*, no. 1 (2002): 5-10.
161 Howells, "Intermediation."
162 Millward, *Factors*, 380-390.
163 Ibid., 267.

Chapter 5 – Roles of Intermediary Organisations in Three Sectors

1 Dalziel, *Why Do Innovation Intermediaries Exist?*, 5-8, 22.
2 The literature reviewed is not limited to activities for SMEs only, however, it does stress that SMEs are more in need of services of intermediary organisations. See also section 1.6.2.
3 Dalziel, *Why Do Innovation Intermediaries Exist?*, 5.
4 Bessant and Rush, "Building bridges," 101; Grindley, Mowery and Silverman, "SEMATECH," 748; Howells, "Intermediation," 722-723.
5 Dalziel, *Why Do Innovation Intermediaries Exist?*, 7; Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur,* 56-59.
6 There is of course a grey area between interacting with parties in order to provide advice or to develop knowledge, for example, if advice is based on newly developed knowledge.
7 Oldenziel and Albert de la Bruhèze, "Theorizing the Mediation Junction," 34-38; Veraart, *Vormgevers,* 308-311.
8 Oldenziel and Albert de la Bruhèze, "Theorizing the Mediation Junction."
9 Winch and Courtney, "The Organization," 757-758.

Chapter 6 – Evolving Roles and Dynamic Capabilities of an Innovation Agency

1 This article has been accepted for publication in Technology Analysis & Strategic Management and is co-authored with Mila Davids.
2 Howells, "Intermediation."; Klerkx and Leeuwis, "Establishment and Embedding."
3 Kirkels and Duysters, "Brokerage."; McEvily and Zaheer, "Bridging Ties."; Nauwelaers and Wintjes, "Innovating SMEs."
4 Dalziel, *Why Do Innovation Intermediaries Exist*; Howells, "Intermediation."
5 Boldrini, Schieb-Bienfait and Chéné, "Improving SMEs' Guidance."; Howells, "Intermediation."; Winch and Courtney, "The Organization."
6 Dalziel, *Why Do Innovation Intermediaries Exist*; Nauwelaers and Wintjes, "Innovating SMEs."
7 Kirkels and Duysters, "Brokerage."; Sapsed, Grantham and DeFillippi, "A Bridge over Troubled Waters."

8 Lintsen, *Made in Holland*.
9 Schot, Lintsen and Rip, eds., *Technology and the Making of the Netherlands*.
10 Lente, *Techniek en ideologie*.
11 Dalziel, *Why Do Innovation Intermediaries Exist*; Howells, "Intermediation."; Lente et al., "Roles of Systemic Intermediaries."; Roxas, Piroli and Sorrentino, "Efficiency and Evaluation Analysis."; Winch and Courtney, "The Organization."
12 Dalziel, *Why Do Innovation Intermediaries Exist*; Lente et al., "Roles of Systemic Intermediaries."; Winch and Courtney, "The Organization."
13 Dalziel, *Why Do Innovation Intermediaries Exist?*
14 Howells, "Intermediation."
15 Blondel, "Efficiency Criteria."; Coehoorn, *The Dutch Innovation Centres*; Hakanson, Caessens and MacAulay, "InnovationXchange: A Case Study in Innovation Intermediation."; Nauwelaers and Wintjes, "Innovating SMEs."
16 Boldrini, Schieb-Bienfait and Chéné, "Improving SMEs' Guidance."; Diaz-Puente, Cazorla and de los Rios, "Policy Support."; Hassink, "Technology Transfer Infrastructures."; Kolodny et al., "Design and Policy Choices."; Nauwelaers and Wintjes, "Innovating SMEs."; Roxas, Piroli and Sorrentino, "Efficiency and Evaluation Analysis."
17 Winch and Courtney, "The Organization."
18 Boldrini, Schieb-Bienfait and Chéné, "Improving SMEs' Guidance."; Hassink, "Technology Transfer Infrastructures."; Kolodny et al., "Design and Policy Choices."; Roxas, Piroli and Sorrentino, "Efficiency and Evaluation Analysis."
19 Winch and Courtney, "The Organization."
20 Van Lente (1990) notes that originally some RND proponents stimulated artisan SMEs to specialise in artistically crafted products, whereas RND consultants encouraged SMEs to transform into small industries.
21 Sinclair, ed., *Cobuild Advanced Learner's English Dictionary*.
22 Dalziel, *Why Do Innovation Intermediaries Exist*; Winch and Courtney, "The Organization."
23 Meulen, Nedeva and Braun, *Intermediaries Organisation and Processes: Theory and Research Issues*.
24 Dalziel, *Why Do Innovation Intermediaries Exist*; Howells, "Intermediation."; Lente et al., "Roles of Systemic Intermediaries."; Winch and Courtney, "The Organization."
25 Using characterisations of historical actors when speaking of the modernisation process was a reaction to the use of the term modernisation since the 1950s by various scholars when referring to the progressive transitions involving industrialisation and increasing government involvement in society and economy. The deterministic and normative aspects of that concept, however, were severely criticised, as countries' modernisation processes are not identical. To counter these objections, the specific context and 'the modernisation process characterised as such by the historical actors themselves' took centre stage. See: Lente, "Ideology and Technology."; Misa, Brey and Feenberg, eds., *Modernity and Technology*.
26 Schot, Lintsen and Rip, eds., *Technology and the Making of the Netherlands*.
27 Ibid.
28 Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur*.
29 Gerwen and Goey, *Ondernemers in Nederland*.
30 Sluyterman, *Dutch Enterprise*.
31 Teece, Pisano and Shuen, "Dynamic Capabilities and Strategic Management."
32 Helfat et al., *Dynamic Capabilities*.
33 Ludwig and Pemberton, "A Managerial Perspective."
34 Eekels, Christiaans and Kaasschieter, *Ondernemen en vernieuwen*; Lente, "The Crafts."
35 In 1930, the Centraal Bureau voor de Statistiek defined SMEs as firms with less than 51 employees. See: Centraal Bureau voor de Statistiek, *Bedrijfstelling 1930*.
36 RND Annual Report 1937
37 For 1929 and 1937 to 1939, no detailed data was found. Column totals do not equal the columns in table 6.3 due to differences in available data and categorisations in annual reports. See: RND Annual Reports 1913-1939
38 This consists of other sectors: ceramics, glass, lime, stone, chemical, leather, rubber, paper, board, printing, gas and electricity, other or unknown.
39 This consists of advice to the following types of organisations: governmental bodies, consultancies, associations, traders.

40 RND Annual Reports 1913-1939.
41 This consists of advice about: finance, law and regulations, start-up of new firms, sales and markets, business economics, intellectual property, certification, mediation and cases of trust.
42 Minutes of meeting VFHN, March and September 1900 (Municipal Archives, The Hague (hereinafter HG), 0245-01, inv. no. 6).
43 Nota oprichting bureau technische adviezen (HG, 0245-01, inv. no. 162).
44 Nota oprichting bureau technische adviezen (HG, 0245-01, inv. no. 162).
45 1902. *Tijdschrift der Nederlandsche Maatschappij ter bevordering van Nijverheid*, 84-87; Notulen hoofdbestuur VFHN, 11 November 1901 (HG, 0245-01, inv. no. 6); *De Ingenieur* 17, no. 3: 40.
46 Ingenool, *Vijf en twintig jaren middenstandsbeweging: Gedenkboek van den Nederlandschen Middenstandsbond,* 52; Lente, *Techniek en ideologie,* 142.
47 1909. *Tijdschrift der Maatschappij van Nijverheid*, 345-349.
48 http://www.parlement.com/9291000/biof/00925 (G.A.A. Middelberg); http://www.parlement.com/id/vg09lkyj4g00/d_dirk_bos (Dirk Bos).
49 Letter Meuwsen and Nouwens, 27 October 1908 (Dutch National Archives (hereinafter NA), 2.06.001 inv. no. 4545); 1908. *De Middenstandsbond*, 369-370; 1909. *De Telegraaf.* 22, 23, 26 November.
50 1909. *Tijdschrift der Maatschappij van Nijverheid*, 345-349.
51 Ibid., 499.
52 1909. Staatsbegrooting voor het dienstjaar 1910. 2.X.2. Bijlage A. Memorie van Toelichting, 16, and 2.X.9-10. Bijlage A, 24-25.
53 1909. Staatsbegrooting voor het dienstjaar 1910. 2.X.9-10. Bijlage A, 24-25.
54 Koninklijk Besluit no. 37, 20 July 1910 (NA, 2.02.14, inv. no. 5615).
55 1912. Staatsbegrooting voor het dienstjaar 1913. 2.X.10-11. Bijlage A, 26-28.
56 Eekels, Christiaans and Kaasschieter, *Ondernemen en vernieuwen*.
57 Correspondence about acquisition of land to build the RND laboratory (NA, 2.06.001, inv. no. 10911).
58 This is based on RND Annual Reports till 1920.
59 Minutes of meeting RND, 15 June 1915 (NA, 2.06.001, inv. no. F4528).
60 See VNF archive (NA, 2.19.042.07).
61 See RND Annual Reports for 1921 and later.
62 Letter BvU to RND, 30 September 1916, Letter RND laboratory to BvU, 11 April 1917 (Historical Information Centre Brabant (hereinafter BHIC), 169, inv. no. 106).
63 Letter BvU to RND, 12 November 1917 (BHIC, 169, inv. no. 106).
64 Minutes of meeting RND, 13 October 1913 (BHIC, 169, inv. no. 26).
65 Letters Committee Mechanical and Maritime Engineering Faculty to Delft Technical University Board, 10 June 1912, 23 October 1913 (NA 2.06.001, inv. no. 10911).
66 Letter Steketee to RND head, 21 February 1916 (folder 2396), Letter Begemann to RND head, 21 February 1916 (folio 2398) (BHIC, 169, inv. no. 73).
67 Minutes of meeting RND, 15 June 1915 (NA 2.06.001, inv. no. 4528). Letter Steketee, 21 February 1916 (BHIC, 169, inv. no. 73).
68 Minutes of meeting, 22 March 1916 (BHIC, 169, inv. no. 26).
69 Minutes of meeting, 9 January 1918 (NA 2.06.001, inv. no. F4528).
70 Minutes of meeting RND, 15 June 1915, 26 June 1915 (NA, 2.06.001, inv. no. F4528).
71 Minutes of meeting of RND consultants and eight consulting engineers, 27 October 1916, (BHIC, 169, inv. no. 108, folder Orde Nederlandse Raadgevende Ingenieurs, 1916-1927).
72 Minutes of meeting RND, 15 June 1915 (NA, 2.06.001, inv. no. F4528).
73 Minutes of meeting RND, 26 June 1915 (NA, 2.06.001, inv. no. F4528).
74 Letter from ONRI to Ministry of Interior Affairs, May 1919 (BHIC, 169, inv. no. 108, folder Orde Nederlandse Raadgevende Ingenieurs, 1916-1927).
75 These two paragraphs: see BHIC, 169, inv. no. 108.
76 1912. Staatsbegrooting voor het dienstjaar 1913. 2.X.1-2. Bijlage A.
77 RND Annual Reports up till 1920.
78 RND Annual Reports 1921 to 1939. See also reports of technical assistants (NA, 2.06.083, inv. no. 118).
79 Letter from RND laboratory director Grevers to head of RND, 12 February 1919 (NA, 2.06.001, inv. no. F4528).
80 RND Annual Reports up till 1920, 23.

81 See RND Annual Reports.
82 This section is based on RND Annual Reports 1921 to 1923, 9-15.
83 See RND Annual Reports over 1921 to 1924.
84 This paragraph is based on RND Annual Reports 1924 to 1939.
85 See RND Annual Report 1930.
86 Letter 28 February 1933, 28 March 1933 (Historical Centre Overijssel (hereinafter HCO), 350, inv. no. 56).
87 This paragraph is based on RND Annual Reports 1933 to 1935.
88 Minutes of meeting RND, 12 November 1913 (BHIC, 169, inv. no. 26).
89 Folder Werktuigencrediet (HCO, 350, inv. no. 39).
90 This paragraph is based on RND Annual Report 1939, 3, 5, 6-7.
91 Helfat et al., *Dynamic Capabilities*.

Chapter 7 – Conclusion

1 For this review I used the sources and results of the case studies.
2 Around 1911, PhD researcher Theodorus Van der Waerden visited two bicycle manufacturers. Simplex had 23.7 percent educated, 66.3 percent trained and 10 percent low-skilled employees. For Gruno this distribution was 10 percent, 40 percent and 50 percent. See: Waerden, *Geschooldheid en techniek,* 91-94.
3 A similar example of trade association influence can be found in the printing sector, see the historiography in Chapter 2: Nijhof, *De Nederlandse grafische industrie,* 51-64, 113.
4 The distance between early bicycle users and manufacturers was close, see also: Norcliffe, "G-COT."
5 See also the historiography in Chapter 2: Bouwens and Dankers, *Tussen concurrentie en concentratie,* 12; Waarden, "Regulering en belangenorganisatie," 239.
6 These factors are inspired by Bouwens and Dankers who propose that the following factors influence cartel stability: geographical spread of the firms, number of firms, distribution between large and small firms, existing traditions of consultation and coordination, product types, capital intensity, and personal relationships, see: Bouwens and Dankers, *Tussen concurrentie en concentratie,* 31-34.
7 Schoep, *100 jaren Nederlandsche Bakkersbond*.
8 During World War I, the number of members increased to 7,000 (see Chapter 2), which was probably about half of the total number of bakers.
9 See also chapter 2, footnote 69.
10 Ibid., 76.
11 Waerden, *Geschooldheid en techniek,* 163-172.
12 Lente, *Techniek en ideologie,* 131-136, 144.. See also ---, "The Crafts," 109.
13 Kolodny et al., "Design and Policy Choices," 216-220; Winch and Courtney, "The Organization," 758.
14 ---, "The Organization."
15 Jong, *De bron*.
16 Veraart, *Vormgevers,* 302-303.
17 Ibid., 221.
18 Veen, *Explaining E-business Adoption*.
19 Kolodny et al., "Design and Policy Choices," 216-217; Veraart, *Vormgevers,* 297; Winch and Courtney, "The Organization," 758.
20 ---, "The Organization," 758.
21 Klerkx and Leeuwis, "Balancing Multiple Interests," 368; Lente et al., "Roles of Systemic Intermediaries."
22 Veraart, *Vormgevers,* 296.
23 Meulen, Nedeva and Braun, *Intermediaries Organisation and Processes: Theory and Research Issues*; Oldenziel and Albert de la Bruhèze, "Theorizing the Mediation Junction."
24 Lanzaloco, "Business Interest Associations," 294-295.
25 Dalziel, "The Impact."
26 Blackford, *A History*; Sabel and Zeitlin, eds., *World of Possibilities*; Scranton, *Endless Novelty*.
27 Wengenroth, "Small-scale Business," 126-127.
28 Lente, *Techniek en ideologie,* 131-136, 144. Also, see: ---, "The Crafts," 109.
29 Gerwen and Goey, *Ondernemers in Nederland,* 274.
30 Scranton, *Endless Novelty,* 70-77, 269-275, 287-293, 354. According to Scranton, national associations in the US tended to have difficulty taking specific initiatives due to the different regional challenges (p. 290). In that respect, Dutch trade associations can be seen as regional associations.

31 Takeuchi, "Historical Features," 207-208.
32 Veraart, *Vormgevers,* 202.
33 As discussed at PhD research project group meetings with representatives of the Ministry of Economic Affairs and the Chamber of Commerce (Syntens), 30 May 2012 and 7 April 2014.
34 The second and third opportunity relate to building up dynamic capabilities that complemented the agency's activities in stimulating SMEs to innovate, either directly or through governmental bodies.
35 For those type of innovations, literature refers to systemic intermediaries, see: Lente et al., "Roles of Systemic Intermediaries." So far, the firms which this dissertation studied are followers of innovation. For a description of innovative firms, so-called 'growing diamonds', see: Adviesraad voor het Wetenschaps- en Technologiebeleid, *Briljante bedrijven*.
36 This also introduced the policy makers' dilemma. It is tempting to support innovation where firms need it least, because it is more likely to succeed in the short run, whereas more backward sectors or regions need it more, but success is likely to be more difficult and take longer.
37 Fagerberg and Godinho conclude that interventionist policies were the secret of success for countries that caught up with industrialised countries. However, they also conclude that current technologies demand much more of countries with respect to technological capabilities and R&D infrastructure. Governments need to start by investing in education, and once this is done, they can consider other options, see: Fagerberg and Godinho, "Innovation and Catching-up," 534-535, 537-538. This advice illustrates that in the early 1900s, the Netherlands lacked a solid policy for SMEs to catch up.
38 For roles in commercialisation, see: Howells, "Intermediation." Research on Dutch SMEs between 1985 and 2005 concludes that culture change (accompanying new competencies) is important for innovating SMEs, see: Wal and Es, "Innoveren bij het MKB."
39 Bouwens and Dankers, *Tussen concurrentie en concentratie,* 207-215.
40 In the bread bakers' case, the role of suppliers in funding the bread bakers knowledge institution was noted. For support for this recommendation, see: Davids, Lintsen and van Rooij, *Innovatie en kennisinfrastructuur,* 56-57.
41 Literature suggests it is an atypical case, as interventionist policies for institutional infrastructures and support are typical for countries that catch up, see Fagerberg and Godinho, "Innovation and Catching-up," 534-538.

Appendix 1

List of Archives for RND study

Dutch National Archives (NA), 2.02.14, *Kabinet der Koningin*, 1898-1945 (The Queen's Office, 1898-1945)

Dutch National Archives (NA), 2.06.001, *Ministerie van Economische Zaken: Directie van Handel en Nijverheid* (Ministry of Economic Affairs: Trade and Industry)

Dutch National Archives (NA), 2.06.083, *Rijksnijverheidsdienst, 1945-1963 en het Nijverheidslaboratorium, 1913-1962* (RND (Technical Information Agency), 1945-1963 and RND laboratory, 1913-1962)

Dutch National Archives (NA), 2.19.042.07, *Vereeniging Nederlands Fabrikaat* (VNF), 1915-1973 (Association 'Made in the Netherlands', 1915-1973)

Historical Centre Overijssel (HCO), 350, *Rijksnijverheidsconsulent voor het Noorden en Oosten van het land,* 1914 – 1959, Zwolle (RND consultant for North and East Netherlands, 1914-1959, Zwolle)

Historical Information Centre Brabant (BHIC), 169, *Rijksdienst voor Nijverheid in Tilburg*, 1913 – 1965 (RND (Technical Information Agency) in Tilburg, 1913-1965)

Municipal Archives, The Hague (HG), 0245-01, *Vereeniging Fabrieks- en Handwerksnijverheid Nederland* (Association to Promote Industry and Crafts)

RND Annual Reports

Rijksvoorlichtingsdienst ten behoeve van de Nijverheid. *Verslagen van de werkzaamheden*. Den Haag (RND Annual Reports)

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Page 100, 132 - Collection RHC Groninger Archieven, 1300_693_8
Page 101, 171 - Collection Historische Vereniging Avereest, 20624
Page 101 - Collection RHC Groninger Archieven, 818-5791
Page 126 - Centraal Bureau voor de Statistiek, 1937; Jong, 1968.
Page 127 - Centraal Bureau voor de Statistiek, 1937; Dalmulder, 1941.
Page 129 - http://register.octrooicentrum.nl/register
Page 137 - Collection RHC Groninger Archieven, 818-6213
Page 158 - RND Annual Reports 1913-1939
Page 150, 151, 162, 164, 166 - Collection BHIC, Historical Information Centre Brabant, Archive RND 169, inv. no. 52
Page 203 - Collection Historische Vereniging Avereest, 02349

Quotation Sources

Chapter 1

1. National Archives, 2.06.001, inv. no. F4526, letter from F.C. Kist to the Minister of Economic Affairs, 7 May 1910.
2. *Staatsbegroting* (State Budget) 1912, Appendix A2X10, 32.

Chapter 2

1. *Bakkers-Bondscourant*, 21 November 1910.
2. National Archives, 2.06.001, inv. no. H5043, Letter from George Enzlin to the Minister of Economic Affairs, 16 April 1917.

Chapter 3

1. *Leeuwarder Courant*, 1 November 1957.
2. RND Annual Reports, 1921-1923.

Chapter 4

1. ANWB, *De Kampioen*, 16 November 1894.
2. W.K. van Erven Dorens, *Algemeen Handelsblad*, 27 June 1933.

Chapter 5

1. Nederlandsche Bakkersbond, *Jubileumnummer van de Bakkers-Bondscourant* 1881-5 October 1931, 9.

Chapter 6

1. National Archives, 2.06.001, inv. no. 4528, RND Minutes of Meeting 22 March 1916.
2. RND Annual Report 1927.

Chapter 7

1. Chapter 7 of this dissertation.

List of Abbreviations

Abbreviation	Dutch	English
ANWB	Algemeene Nederlandsche Wielrijders-Bond	Dutch Cyclists Union, later renamed 'Royal Dutch Touring Club'
BRHN	Bond van Rijwielherstellers en –Handelaren in Nederland, later renamed 'Bond van Rijwiel- en Motorhandelaren in Nederland'	Dutch Association for Bicycle Repairmen and Retailers
BvU	Bureau voor Uitvinders	Agency for Inventors
CBR	Centraal Bureau voor de Rijwielhandel	Central Bicycle Trade Bureau
CBRW	Centrale Bond van Rijtuig- en Wagenmakerspatroons Verenigingen in Nederland	Central Association of Dutch Carriage and Wagon Makers Associations
EIM	Economisch Instituut voor den Middenstand	Economic Institute for the Trades
FOCWA	Federatie der Organisaties van Carrosserie- en Wagenbouwers en aanverwante bedrijven	Federation of Organisations of Body and Wagon Makers and related firms
MvN	Maatschappij van Nijverheid	Society of Industry
NEVGRO	Nederlandsche Vereeniging van Grossiers in Rijwielen en Onderdelen	Association of Wholesale Traders of Bicycles and Parts
ONRI	Vereeniging 'Orde van Nederlandsche Raadgevende Ingenieurs'	Dutch Association for Consulting Engineers
RAI	Nederlandsche Vereeniging 'De Rijwiel- en Automobiel-Industrie'	Dutch Association 'Bicycle and Automobile Industry'
RI	Vereeniging 'De Rijwiel-Industrie'	Association 'The Bicycle-Industry'
RND	Rijksnijverheidsdienst	Government's Technical Information Agency
SME	Midden- en kleinbedrijf (mkb)	Small and medium-sized enterprise
UK	Verenigd Koninkrijk	United Kingdom
US or USA	Verenigde Staten van Amerika	United States of America
VDN	Vereeniging van Directeuren van Nijverheidsscholen	Association for Directors of Vocational Schools
VFHN	Vereeniging tot bevordering van de Fabrieks- en Handwerksnijverheid	Association to Promote Industry and Crafts
VNF	Vereeniging Nederlandsch Fabrikaat	Association 'Made in Holland'

Bibliography

40 jaar - uit het archief der Kampioen. ANWB, 1923.

40 jaren Station voor Maalderij en Bakkerij, 1909-1949. Wageningen: Station voor Maalderij en Bakkerij, 1949.

Adviesraad voor het Wetenschaps- en Technologiebeleid. *Briljante bedrijven: Effectieve ecosystemen voor ambitieuze ondernemers*. Den Haag: Adviesraad voor het Wetenschaps- en Technologiebeleid, 2014.

Albert de la Bruhèze, Adri and Ruth Oldenziel, eds., *Manufacturing Technology, Manufacturing Consumers: The Making of Dutch Consumer Society*. Amsterdam: Aksant, 2009.

Arnold, David. *Everyday Technology: Machines and the Making of India's Modernity*. Chicago: University of Chicago Press, 2013.

Berlage, Titia M. *De fiets*. Rotterdam: Museum Boymans - van Beuningen, 1977.

Bessant, John and Howard Rush, "Building Bridges for Innovation: The Role of Consultants in Technology Transfer." *Research Policy* 24 (1995): 97-114.

Bijker, Wiebe E. *Of Bicycles, Bakelites and Bulbs. Toward a Theory of Sociotechnical Change*. Cambridge, MA: MIT Press, 1995.

Birnbaum, Karl. *Het broodbakken. Verklaard en toegelicht met aanwijzing van de grondslagen voor het bakkers-bedrijf. Voor Nederland bewerkt door dr. C.C.J. Teerlink*. Amsterdam: Nederlandsche Bakkers-courant, 1900.

Blackford, Mansel G. *A History of Small Business in America*. Chapel Hill: University of North Carolina Press, 2003.

Blondel, Danièle, "Efficiency Criteria for Intermediaries Involved in the Innovation Process." *International Journal of Technology Management* 10, no. 4/5/6 (1995): 478-488.

Blundel, Richard and Angela Tregear, "From Artisans to "Factories": The Interpenetration of Craft and Industry in English Cheese-making, 1650-1950." *Enterprise & Society* 7, no. 4 (2006): 705-739.

Boersma, Kees. *Inventing Structures for Industrial Research: A History of the Philips Nat.Lab 1914-1946*. Amsterdam: Aksant, 2002.

Boldrini, Jean-Claude, Nathalie Schieb-Bienfait, and Emmanuel Chéné, "Improving SMEs' Guidance within Public Innovation Supports." *European Planning Studies* 19, no. 5 (2011): 775-793.

Bond van Oud-Leerlingen van het Station voor Maalderij en Bakkerij (Wageningen). *Jaarboek van den Bond van Oud-Leerlingen van het Station voor Maalderij en Bakkerij (Wageningen)* 1932.

Bond van Rijwiel- en Motorhandelaren in Nederland. *Een kwart eeuw organisatie. Gedenkboek. Uitgegeven door den Bond van Rijwiel- en Motorhandelaren bij zijn vijf-en-twintigste jaarfeest*. Amsterdam: Bond van Rijwiel- en Motorhandelaren in Nederland, 1928.

Bouwens, Bram and Joost Dankers, "Business Interest Associations: A Service to the Industry," Paper presented at the European Business History Association, Barcelona, 2004.

Bouwens, Bram and Joost Dankers. *Tussen concurrentie en concentratie. Belangenorganisaties, kartels, fusies en overnames*. Vol. 3, *Bedrijfsleven in Nederland in de twintigste eeuw*. Amsterdam: Boom, 2012.

Braber, Hendrik, ed., *Van klep tot krat. Bijdragen over boerenwagens en andere voertuigen*. Amsterdam/ Antwerpen: vh Van Ditmar, 1950.

Brouwer, Piet, Gerard van Kesteren, and Antia Wiersma. *Berigt aan de heeren reizigers: 400 jaar openbaar vervoer in Nederland*. Den Haag: SDU, 2008.

Brummelen, Gijs van and Peter Leijten. *Tussen trog en machine, bakkersverhalen van toen*: Commissie Bakkerij Historie van het Genootschap voor de bakkerij, 1997.

Brusse, W.J. *De Groninger rijwielenfabriek A. Fongers*. Vol. 63, *Neerlands Welvaart*, 1920.

Bureau of Foreign Commerce (USA) Department of Commerce and Labor. *Commercial Relations of the United States with Foreign Countries during the Year*. Washington D.C.: Government Printing Office, 1896-1907.

Burr, Thomas, "Markets as Interactions of Producers and Consumers: The American and French Bicycle Markets, 1890-1910." PhD diss., University of California, Davis, 2001.

Carnevali, Francesca, "Social Capital and Trade Associations in America, c. 1860–1914: A Microhistory Approach." *The Economic History Review* 64, no. 3 (2011): 905-928.

Carnevali, Francesca and Lucy Newton, "Pianos for the People: From Producer to Consumer in Britain, 1851-1914." *Enterprise & Society* 14, no. 1 (2013): 37-70.

Centraal Bureau voor de Statistiek. *75 jaar statistiek van Nederland*. 's-Gravenhage: Staatsuitgeverij, 1975.

Centraal Bureau voor de Statistiek. *Bedrijfstelling 31 december 1930*. Den Haag: Centraal Bureau voor de Statistiek, 1935-1937.
Centraal Bureau voor de Statistiek, "De Nederlandsche rijwielmarkt." *De Nederlandsche Conjunctuur*, no. February (1937): 20-27.
Centraal Bureau voor de Statistiek. *Tweede algemene bedrijfstelling, 16 oktober 1950*. Zeist: W. de Haan, 1957.
Centraal Bureau voor de Statistiek. *Tweehonderd jaar statistiek in tijdreeksen 1800-1999*. Voorburg/Heerlen: Centraal Bureau voor de Statistiek, 2001.
Chandler Jr., Alfred Dupont. *Strategy and Structure: Chapters in the History of the Industrial Enterprise*. Cambridge, Mass: MIT Press, 1962.
Chesbrough, Henry. *Open Business Models: How to thrive in the New Innovation Landscape*. Boston, MA: Harvard Business School Press, 2006.
Coehoorn, Carine A. *The Dutch Innovation Centres: Implementation of Technology Policy or Facilitation of Small Enterprises*. Capelle a/d IJssel: Labyrinth Publication, 1995.
Commissie voor de Middenstandsenquete. *Verslag van het onderzoek naar den toestand van den handeldrijvenden en industrieelen middenstand in Nederland*, 1918.
Cornelissen de Beer, G.D., "Het rijwiel in Europese legers." *Armamentaria* 19 (1984): 61-86.
Cortat, Alain, "How Cartels stimulate Innovation and R&D: Swiss Cable Firms, Innovation and the Cartel Question." *Business History* 51, no. 5 (2009): 754-769.
Cox, Peter, "Modelling Bicycle History: Users and Non-users," Paper presented at the ICOHTEC, Manchester, July 22-28, 2013.
Dalmulder, J.J.J, "De vraag naar rijwielen." *Maandschrift Centraal Bureau voor de Statistiek* 36, no. 3/4 (1941): 360-362.
Dalziel, Margaret, "The Impact of Industry Associations." *Innovation: Management, Policy & Practice* 8 (2006): 296-306.
Dalziel, Margaret, "Why Do Innovation Intermediaries Exist?," Paper presented at the DRUID Summer Conference, London, 2010.
Davids, Mila, "Van stoom naar stroom: De veranderingen in aandrijfkracht in de industrie," Chap. 3, In *Techniek in Nederland in de twintigste eeuw. Deel 6 Industriële Productie*, edited by Schot, Johan, Harry Lintsen, Arie Rip and Adri Albert de la Bruhèze, 270-283. Zutphen: Walburg Pers, 2003.
Davids, Mila, Harry Lintsen, and Arjan van Rooij. *Innovatie en kennisinfrastructuur. Vele wegen naar vernieuwing*. Vol. 5, *Bedrijfsleven in Nederland in de twintigste eeuw*. Amsterdam: Boom, 2013.
"De Bakkerij. Goedkoop orgaan voor brood-, koek-, en banketbakkerij. Jubileumnummer 6 jan. 1928," Bolsward: A.J. Osinga, 1928.
Dekker, G., G.C. ten Klooster, P.R.A. Oeij, M.C. den Hoedt, and G. Reinders. *Innovatie door samenwerking in het midden- en kleinbedrijf*. Vol. R071004/031-11519, *TNO-rapport*. Hoofddorp: TNO Kwaliteit van Leven, 2007.
Departement van Landbouw Nijverheid en Handel. *Onderzoek naar de bedrijfstoestanden in de Nederlandsche broodbakkerijen*. 's-Gravenhage: Algemeene Landsdrukkerij, 1911.
Department of Trade and Industry (UK). *Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions*. London: HMSO, 1892-1937.
Detremmerie, Annick, "De mechanisering van de broodvervaardiging," Chap. 3, In *'t Is voor de bakker. De mechanisering van de brood- en banketbakkerij*, edited by Detremmerie, Annick and Guido Deseyn, 18-43. Gent: Museum voor Industriële Archeologie en Textiel, 1986.
Detremmerie, Annick and Guido Deseyn. *'t Is voor de bakker. De mechanisering van de brood- en banketbakkerij*. Gent: Museum voor Industriële Archeologie en Textiel, 1986.
Diaz-Puente, Jose M., Adolfo Cazorla, and Ignacio de los Rios, "Policy Support for the Diffusion of Innovation among SMEs: An Evaluation Study in the Spanish Region of Madrid." *European Planning Studies* 17, no. 3 (2009): 365-387.
Ebert, Anne-Katrin, "Cycling towards the Nation: The Use of the Bicycle in Germany and the Netherlands, 1880-1940." *European Review of History* 11, no. 3 (2004): 347-364.
Ebert, Anne-Katrin. *Radelnde Nationen. Die Geschichte des Fahrrads in Deutschland und den Niederlanden bis 1940*. Frankfurt/New York: Campus Verlag, 2010.
Eekels, Johannes, H.H.C.M. Christiaans, and R.H. Kaasschieter. *Ondernemen en vernieuwen: Hommage aan de kleine en middelgrote industrie naar aanleiding van 75 jaar Rijksnijverheidsdienst*. Delft: Delftse Universitaire Pers, 1985.

Efdée, Ria. *Bakker hoe bakte je 't toen. Een onderzoek naar baktechniek, bakkers en bakproducten op het Friese platteland (1919-1939)*. Leeuwarden: Vereniging voor Industriële Archeologie van Friesland, 1986.
Eillebrecht, Ad, Jet Grimbergen, and Peter Schipper. *De sigarennijverheid in Culemborg: Mensen en fabrieken*. Culemborg: Koolhof, 1986.
Elzinga, A. *Van wagenmakerij tot carroseriebouw*. Heerenveen: A. Elzinga, 1987.
Epperson, Bruce, "Failed Colossus: Strategic Error at the Pope Manufacturing Company, 1878-1900." *Technology and Culture* 41, no. 2 (2000): 300-320.
Everwijn, Jan Charles August, ed., *Beschrijving van handel en nijverheid in Nederland*. 's-Gravenhage: Belinfante, 1912.
Faber, Jasper F. *Kennisverwerving in de Nederlandse industrie, 1870-1970*. Amsterdam: Aksant, 2001.
Fagerberg, Jan, "Innovation: A Guide to the literature," Chap. 1, In *The Oxford Handbook of Innovation*, edited by Fagerberg, Jan, David C. Mowery and Richard R. Nelson, 1-26. Oxford: Oxford University Press, 2005.
Fagerberg, Jan and Manuel M. Godinho, "Innovation and Catching-up," Chap. 19, In *The Oxford Handbook of Innovation*, edited by Fagerberg, Jan, David C. Mowery and Richard R. Nelson, 514-542. Oxford: Oxford University Press, 2005.
Feldman, Gerald D. and Ulrich Nocken, "Trade Associations and Economic Power: Interest Group Development in the German Iron and Steel and Machine Building Industries, 1900-1933." *Business History Review* 49, no. 4 (1975): 413-445.
FOCWA. *1936-1976 FOCWA 40 jaar*: FOCWA, 1976.
Forster, Ben and Kris Inwood, "The Diversity of Industrial Experience: Cabinet and Furniture Manufacture in Late Nineteenth-century Ontario." *Enterprise & Society* 4, no. 2 (2003): 326-371.
Fuchs, Johannes M. and Wim J. Simons. *Allemaal op de fiets in Amsterdam*. Amsterdam: Stadsdrukkerij van Amsterdam, 1978.
Gaggio, Dario, "Pyramids of Trust: Social Embeddedness and Political Culture in Two Italian Gold Jewelry Districts." *Enterprise & Society* 7, no. 1 (2006): 19-58.
Ganzevles, Jurgen and Rinie van Est. *Collaborative Project on Mobilisation and Mutual Learning Actions in European Parliamentary Technology Assessment. Deliverable 2.2. TA Practices in Europe*: PACITA, 2011.
Geenhuizen, Marina van. *Technology Transfer and Barriers: The Role of Intermediary Organisations*, *EGI-Onderzoekspublikatie*. Rotterdam: Economic Geography Institute of Erasmus University, Rotterdam, 1993.
Gerwen, Jacques van and Ferry de Goey. *Ondernemers in Nederland. Variaties in ondernemen*. Vol. 1, *Bedrijfsleven in Nederland in de twintigste eeuw*. Amsterdam: Boom, 2008.
Gibcus, Petra and Jeroen de Jong. *Innovatiepiramide. Een segmentatie van het MKB*. Zoetermeer: EIM, 2008.
Goudriaan jr., Jan. *De doelmatigheid van de Amsterdamsche broodvoorziening*. Delft: Meinema, 1922.
Grindley, Peter, David C. Mowery, and Brian Silverman, "SEMATECH and Collaborative Research Design: Lessons in the Design of High-technology Consortia." *Journal of Policy Analysis and Management* 13, no. 4 (1994): 723-758.
Hakanson, Lars, Petra Caessens, and Sam MacAulay, "InnovationXchange: A Case Study in Innovation Intermediation." *Innovation: Management, Policy & Practice* 13, no. 2 (2011): 261-274.
Hall, Bronwyn H., "Innovation and Diffusion," Chap. 17, In *The Oxford Handbook of Innovation*, edited by Fagerberg, Jan, David C. Mowery and Richard R. Nelson, 459-484. Oxford: Oxford University Press, 2005.
Hargadon, Andrew and Robert I. Sutton, "Technology Brokering and Innovation in a Product Development Firm." *Administrative Science Quarterly* 42 (1997): 718-749.
Hassink, Robert, "Technology Transfer Infrastructures: Some Lessons from Experiences in Europe, the US and Japan." *European Planning Studies* 5, no. 3 (1997): 351-370.
Heijbroek, J.F. and C.R. Mönnich. *De Leidse wagenmaker. Een bedrijf in beeld*. Zutphen: Terra, 1981.
Helfat, Constance E., Sydney Finkelstein, Will Mitchell, Margaret A. Peteraf, Harbir Singh, David J. Teece, and Sidney G. Winter. *Dynamic Capabilities: Understanding Strategic Change in Organizations*. Malden, MA: Blackwell, 2007.
Herlihy, David V. *Bicycle: The History*. New Haven: Yale University Press, 2004.
Hoepen, L. van, ed., *Van veertig zegenrijke melkjaren: 1908-1948. Gedenkboek uitgegeven ter gelegenheid van het veertig-jarig bestaan van de Vereeniging voor Zuivelindustrie en Melkhygiëne*. Bussum: Kruyt, 1948.
Hogenkamp, George J.M.G. *Een halve eeuw wielersport*. Amsterdam, 1916.
Hooff, Giel van. *In het rijk van de Nederlandse Vulcanus. De Nederlandse machinenijverheid 1825-1914. Een historische bedrijfsverkenning*. Amsterdam: NEHA, 1990.
Hoogstraten, S. van, "De rijwielindustrie in 1929." *Economisch Statistische Berichten* 15 (1930): 680-681.

Hounshell, David A. *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States*. Baltimore: Johns Hopkins University Press, 1984.
Hounshell, David A. and John Kenley Smith Jr. *Science and Corporate Strategy: Du Pont R&D, 1902-1980*. Cambridge: Cambridge University Press, 1988.
Howells, Jeremy, "Intermediation and the Role of Intermediaries in Innovation." *Research Policy* 35, no. 5 (2006): 715-728.
Human, Sherrie E. and Keith G. Provan, "Legitimacy Building in the Evolution of Small Firm Multilateral Networks: A Comparative Study of Success and Demise." *Administrative Science Quarterly* 45, no. 2 (2000): 327-365.
Ingenool, A. *Vijf en twintig jaren middenstandsbeweging: Gedenkboek van den Nederlandschen Middenstandsbond*: Vereeniging " De Nederlandschen Middenstandsbond", 1927.
Jong, Jeroen de. *De bron van vernieuwing: Rol van netwerken bij innovaties in het MKB*. Zoetermeer: EIM, 2005.
Jong, Sicco de. *Geschiedenis eener Nederlandsche vereeniging: RAI 1893-1968*. Bussum: C.A.J. van Dishoeck, 1968.
Jonge, Jan Aart de. *De industrialisatie in Nederland tussen 1850 en 1914*. Nijmegen: SUN, 1976.
Jongsma, Martinus and Bernard Pijper. *Wielrennen in Friesland door de eeuwen heen: Fan tsjiltsjeriden oant hurdfytsen*. Franeker/Surhuisterveen: Pijper and Jongsma, 1998.
Jonker, Ineke. *Huisvrouwenvakwerk: 75 jaar Nederlandse Vereniging van Huisvrouwen*. Baarn: Bosch & Keuning, 1987.
Kamminga, L. and R.A. Van der Velde. *Hainje Heerenveen - 75 jaar mensenwerk: van kruiwagen tot standaardbus: 1907-1982*. Heerenveen: Carrosseriefabriek Hainje, 1982.
Kerste, Richard and Arnoud Muizer. *Effective Knowledge Transfer to SMEs. Lessons from Marketing and Knowledge Management*. Zoetermeer: EIM, 2002.
Kinney, Thomas A. *The Carriage Trade: Making Horse-drawn Vehicles in America*. Baltimore and London: Johns Hopkins University Press, 2004.
Kirkels, Yvonne and Geert Duysters, "Brokerage in SME Networks." *Research Policy* 39, no. 3 (2010): 375-385.
Klerkx, Laurens and Cees Leeuwis, "Balancing Multiple Interests: Embedding Innovation Intermediation in the Agricultural Knowledge Infrastructure." *Technovation* 28 (2008): 364-378.
Klerkx, Laurens and Cees Leeuwis, "Establishment and Embedding of Innovation Brokers at Different Innovation System Levels: Insights from the Dutch Agricultural Sector." *Technological Forecasting and Social Change* 76, no. 6 (2009): 849-860.
Kobayashi, Keizo, Nadine Besse, Gert-Jan Moed, and David V. Herlihy. *Le Velocipede*. Saint Etienne: Musee d'Art et d´Industrie, 2008.
Kolodny, Harvey, Bengt Stymne, Rami Shani, Juan Ramon Figuera, and Paul Lillrank, "Design and Policy Choices for Technology Extension Organizations." *Research Policy* 30, no. 2 (2001): 201-225.
Koorenhof, Michiel, "De kleine nijverheid in Nederland, 1900-1940. De middenstandsbeweging, de nijverheidsvoorlichting en de praktijk in het smedenbedrijf." MSc thesis, Erasmus Universiteit Rotterdam, 1989.
Kuner, Herbert, "Fahrräder und Fahrradindustrie in den Niederlanden (Teil 1)." *Knochenschüttler* 31 (2004): 2-5.
Lamoreaux, Naomi R., Daniel M.G. Raff, and Peter Temin, "Economic Theory and Business History," Chap. 3, In *The Oxford Handbook of Business History*, edited by Jones, Geoffrey and Jonathan Zeitlin, 37-66. Oxford: Oxford University Press, 2007.
Lanzaloco, Luca, "Business Interest Associations," Chap. 13, In *The Oxford Handbook of Business History*, edited by Jones, Geoffrey and Jonathan Zeitlin, 293-315. Oxford: Oxford University Press, 2007.
Lemercier, Claire, "Looking for "Industrial Confraternity" Small-Scale Industries and Institutions in Nineteenth-Century Paris." *Enterprise & Society* 10, no. 2 (2009): 304-334.
Lente, Dick van, "The Crafts in Industrial Society: Ideals and Policy in the Netherlands, 1890-1930." *Economic and Social History in the Netherlands* 2 (1990): 99-119.
Lente, Dick van, "Ideology and Technology: Reactions to Modern Technology in the Netherlands 1850-1920." *European History Quarterly* 22 (1992): 383-414.
Lente, Dick van. *Techniek en ideologie. Opvattingen over de maatschappelijke betekenis van technische vernieuwingen in Nederland, 1850-1920*. Groningen: Wolters Noordhoff/Forsten, 1988.
Lente, Harro van, Marko Hekkert, Ruud Smits, and Bas van Waveren, "Roles of Systemic Intermediaries in Transition Processes." *International Journal of Innovation Management* 7, no. 3 (2003): 247-279.
Lescure, Michel, "Small- and Medium-size Industrial Enterprises in France, 1900-1975," Chap. 6, In *Small Firms, Large Concerns. The Development of Small Business in Comparative Perspective*, edited by Odaka, Konosuke and Minoru Sawai, 140-167. Oxford: Oxford University Press, 1999.

Linders-Rooijendijk, Mathea F.A., "Gebaande wegen voor mobiliteit en vrijetijdsbesteding: De ANWB als vrijwillige associatie 1883-1937." PhD diss., Katholieke Universiteit Brabant, 1989.

Lintsen, Harry. *Made in Holland. Een techniekgeschiedenis van Nederland, 1800-2000*. Zutphen: Walburg Pers, 2005.

Lintsen, Harry and Martijn Bakker, "Meel," Chap. 3, In *Techniek in Nederland. De wording van een moderne samenleving 1800-1890. Deel I. Techniek en modernisering. Landbouw en voeding*, edited by Lintsen, Harry, Martijn Bakker, Ernst Homburg, Dick van Lente, Johan Schot and Geert Verbong. 71-102. Zutphen: Walburg Pers, 1992.

Lintsen, Harry, Martijn Bakker, Ernst Homburg, Dick van Lente, Johan Schot, and Geert Verbong. *Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving 1800-1890. Deel I. Techniek en modernisering. Landbouw en voeding*. Zutphen: Walburg Pers, 1992.

Lintsen, Harry, Martijn Bakker, Ernst Homburg, Dick van Lente, Johan Schot, and Geert Verbong, eds., *Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving 1800-1890*. Zutphen: Walburg Pers, 1992-1995.

Lloyd Jones, Roger and M.J. Lewis. *Raleigh and the British Bicycle Industry: An Economic and Business History, 1870-1960, Modern Economic and Social History Series*. Aldershot: Ashgate, 2000.

Ludwig, Gregory and Jon Pemberton, "A Managerial Perspective of Dynamic Capabilities in Emerging Markets: The Case of the Russian Steel Industry." *Journal for East European Management Studies* 16, no. 3 (2011): 215-236.

Mantel, S.J. and G. Rosegger, "The Role of Third-parties in the Diffusion of Innovations: A Survey," In *Innovation: Adaptation and Growth*, edited by Rothwell, R. and John Bessant, 123-134. Amsterdam: Elsevier, 1987.

Markman, Gideon D., Phillip H. Phan, David B. Balkin, and Peter T. Gianiodis, "Entrepreneurship and University-based Technology Transfer." *Journal of Business Venturing* 20, no. 2 (2005): 241-263.

McEvily, Bill and Akbar Zaheer, "Bridging Ties: A Source of Firm Heterogeneity in Competitive Capabilities." *Strategic Management Journal* 20, no. 12 (1999): 1133-1156.

Mende, Michael, "Verschwundene Stellmacher, gewandelte Schmiede. Die Handwerker des ländlichen Fahrzeugbaus zwischen expandierender Landwirtschaft und Motorisierung 1850-1960," Chap. 6, In *Prekäre Selbständigkeit. Zur Standortbestimmung von Handwerk, Hausindustrie und Kleingewerbe im Industrialisierungsprozess*, edited by Wengenroth, Ulrich, 93-130. Stuttgart: Franz Steiner Verlag, 1989.

Meulen, Barend van der, Maria Nedeva, and Dietmar Braun, "Intermediaries Organisation and Processes: Theory and Research Issues," Paper presented at the PRIME Workshop, Enschede, 2005.

Meurs, W.C. van. *Meel- en broodfabrieken "De Zeeuw" B. Hus, 's-Gravenhage, Nederlands Welvaart*. Amsterdam: Bureau Industria, 1919.

Millward, Andrew, "Factors Contributing to the Sustained Success of the UK Cycle Industry 1870-1939." PhD diss., University of Birmingham, 1999.

Minderaa, J.T., "Talma, Aritius Sybrandus (1864-1916)," In *Biografisch woordenboek van Nederland*, 1979.

Misa, Thomas J., Philip A.E. Brey, and Andrew Feenberg, eds., *Modernity and Technology*. Cambridge, Mass.: MIT, 2003.

Mom, Gijs and Ruud Filarski. *Van transport naar mobiliteit. De mobiliteitsexplosie, 1895-2005*. Zutphen: Walburg Pers, 2008.

Münstermann, Hans. *Bäckerei- und Technikgeschichte, ein Widerspruch? Die Entwicklung der Bäckereitechnik in den letzten 100 Jahren als historisches Phänomen - zum Problem der Technikgeschichte*. Frankfurt am Main: Peter Lang, 1988.

Murmann, Johann Peter. *Knowledge and Competitive Advantage: The Coevolution of Firms, Technology and National Institutions*. Cambridge: Cambridge University Press, 2003.

Nauwelaers, Claire and René Wintjes, "Innovating SMEs and Regions: The Need for Policy Intelligence and Interactive Policies." *Technology Analysis & Strategic Management* 14, no. 2 (2002): 201-215.

Nederlandsche Bakkersbond. *Jubileumnummer van de Bakkers-Bondscourant 1881 - 5 October 1931*. Amsterdam: Nederlandsche Bakkersbond, 1931.

Nijhof, Erik. *De Nederlandse grafische industrie in de 20ste eeuw: 100 jaar geleide innovatie*. Amstelveen: Grafische Cultuurstichting, 2001.

Noble, David F. *America by Design: Science, Technology, and the Rise of Corporate Capitalism*. New York: Knopf, 1977.

Norcliffe, Glen, "G-COT. The Geographical Construction of Technology." *Science, Technology, & Human Values* 34, no. 4 (2009): 449-475.
Norcliffe, Glen, "Popeism and Fordism: Examining the Roots of Mass Production." *Regional Studies* 31, no. 3 (1997): 267-280.
Odaka, Konosuke and Minoru Sawai. *Small Firms, Large Concerns. The Development of Small Business in Comparative Perspective*, *Fuji Conference Series III*. Oxford: Oxford University Press, 1999.
Oerlemans, Leon A.G., "De ingebedde onderneming: Innoveren in industriële netwerken." PhD diss., Technische Universiteit Eindhoven, 1996.
Oldenziel, Ruth and Adri Albert de la Bruhèze, "Theorizing the Mediation Junction for Technology and Consumption," Chap. 1, In *Manufacturing Technology, Manufacturing Consumers. The making of Dutch Consumer Society*, edited by Albert de la Bruhèze, Adri and Ruth Oldenziel, 9-39. Amsterdam: Aksant, 2009.
Oliver, George. *Cars and Coachbuilding: One Hundred Years of Road Vehicle Development*. London: Sotheby Parke Bernet, 1981.
Oostwoud, Johannes. *Van rijtuig tot ziekenhuisbed. Oostwoud in de jaren 1871 tot 1940*. Franeker: Telenga Drukkerij, 2001.
Otterloo, Anneke van, "Voeding. Nieuwe producten, schakels en regimes 1890-1920," In *Techniek in Nederland in de twintigste eeuw. Deel III*, edited by Schot, Johan, Harry Lintsen, Arie Rip and Adri de la Bruhèze, 248-261. Zutphen: Walburg Pers, 2000.
Panschar, William G. *Baking in America. Economic Development. Vol. I*. Evanston, Illinois: Northwestern University Press, 1956.
Park, Sub, "Cooperation between Business Associations and the Government in the Korean Cotton Industry, 1950–70." *Business History* 51, no. 6 (2009): 835-853.
Pavitt, Keith, "Sectoral Patterns of Technical Change: Towards a Taxonomy and a Theory." *Research Policy* 13 (1984): 343-74.
Petty, Ross D., "The Product Life Cycle and the Use of Bicycles to Deliver Goods and Services,", In *Conference on Historical Analysis & Research in Marketing*, 117-127, 2001.
Pinkerton, John. *At Your Service: A Look at Carrier Cycles*. England, 1983.
Renaud, Wouter F. *Wagens & Karren. Diversiteit van voertuigen op het platteland en de collectie van het Nederlands Openluchtmuseum*. Zutphen: Walburg Pers, 2008.
Rhoads, Edward J.M., "Cycles of Cathay: A History of the Bicycle in China." *Transfers* 2, no. 2 (2012): 95-120.
Rijksverzekeringsbank. *Ongevallenstatistiek 1904*. Amsterdam: Rijksverzekeringsbank.
Rijksverzekeringsbank. *Ongevallenstatistiek 1905*. Amsterdam: Rijksverzekeringsbank.
Rijksvoorlichtingsdienst ten behoeve van de Nijverheid. *Verslag van de werkzaamheden tot en met het jaar 1920*. Den Haag: Levisson, 1921.
Rijksvoorlichtingsdienst ten behoeve van Handel en Nijverheid. *Verslagen van de werkzaamheden over het jaar 1925*. 's-Gravenhage: Algemeene Landsdrukkerij, 1926.
Rijksvoorlichtingsdiensten ten behoeve van Handel en Nijverheid. *Verslagen van de werkzaamheden over het jaar 1928*. 's-Gravenhage: Algemeene Landsdrukkerij, 1929.
Rijksvoorlichtingsdiensten ten behoeve van Handel en Nijverheid. *Verslagen van de werkzaamheden over het jaar 1929*. 's-Gravenhage: Algemeene Landsdrukkerij, 1930.
Rizzoni, Alina, "Technological Innovation and Small Firms: A Taxonomy." *International Small Business Journal* 9, no. 3 (1991): 31-42.
Rogers, Everett M. *Diffusion of Innovation*. New York: The Free Press, 1962.
Rosen, Paul. *Framing Production: Technology, Culture, and Change in the British Bicycle Industry*, *Inside technology*. Cambridge, MA: MIT Press, 2002.
Rothwell, Roy, "The Changing Nature of the Innovation Process: Implications for SMEs," Chap. 19, In *Globalisation, Networking and Small Firm Innovation. Six Countries Programme on Innovation and Forfás, Ireland*, edited by O'Doherty, Dermot P., 266-281. London: Graham & Trotman, 1995.
Roxas, Salvatore, Guiseppe Piroli, and Mario Sorrentino, "Efficiency and Evaluation Analysis of a Network of Technology Transfer Brokers." *Technology Analysis & Strategic Management* 23, no. 1 (2011): 7-24.
Sabel, Charles F. and Jonathan Zeitlin, eds., *World of Possibilities: Flexibility and Mass Production in Western Industrialization*. Cambridge, UK: Cambridge University Press, 1997.
Sapsed, Jonathan, Andrew Grantham, and Robert DeFillippi, "A Bridge over Troubled Waters: Bridging Organizations and Entrepreneurial Opportunities in Emerging Sectors." *Research Policy* 36 (2007): 1314-1334.

Scheffer, H.J., "Ontwikkeling van de ambachts- en fabrieksnijverheid in Nederland." *Economisch Statistische Berichten* (1942): 542-546.
Schmidt, Dedan P.J., Jan-Peter van den Toren, and Marieke I. de Wal. *Ondernemende brancheorganisaties: Balanceren tussen belangen*. Assen: Van Gorcum, 2003.
Schoep, A. *Honderd jaren Nederlandsche Bakkersbond in een eeuw bakkerij-geschiedenis 1881-1981*. Den Haag: De Nederlandse Bakkersbond, 1981.
Schot, Johan, Harry Lintsen, and Arie Rip, eds., *Technology and the Making of the Netherlands: The Age of Contested Modernization 1890-1970* Zutphen: Walburg Pers, 2010.
Schot, Johan, Harry Lintsen, Arie Rip, and Adri Albert de la Bruhèze, eds., *Techniek in Nederland in de twintigste eeuw*. Zutphen: Walburg Pers, 2003.
Schulte to Bühne, Julia. *Das Bäckerhandwerk von 1896 bis 1996 am Beispiel der Stadt Münster*. Münster: Waxmann, 2000.
Scranton, Philip. *Endless Novelty: Specialty Production and American Industrialization, 1865-1925*. Princeton, NJ: Princeton University Press, 1997.
Seelen, Joost and Arnold Vogel. *De geschiedenis van het leerlooien in Noord-Brabant*. Tilburg: Gianotten, 1986.
Siegel, Donald S., David Waldman, and Albert Link, "Assessing the Impact of Organizational Practices on the Relative Productivity of University Technology Transfer Offices: An Exploratory Study." *Research Policy* 32, no. 1 (2003): 27-48.
Sinclair, John, ed., *Cobuild Advanced Learner's English Dictionary*. Glasgow: HarperCollins, 2003.
Sluyterman, Keetie E. *Dutch Enterprise in the 20th Century: Business Strategies in a Small Open Country*. London: Routledge, 2005.
Sluyterman, Keetie E., "Mechanisatie en werkloosheid in de sigarenindustrie vóór 1940." *De Ingenieur*, no. 7/8 (1986): 22-23.
Smits, Jan-Pieter, "Technology, Productivity and Welfare," Chap. 7, In *Technology and the Making of the Netherlands: The Age of Contested Modernization, 1890-1970*, edited by Schot, Johan, Harry Lintsen and Arie Rip, 433-484. Zutphen/Cambridge MA: Walburg Pers/MIT Press, 2010.
Soltow, James H., "Small City Industrialists in the Age of Organization: A Case Study of the Manufacturers' Association of Montgomery County, Pennsylvania, 1908-1958." *Business History Review* 33, no. Summer 1958 (1959): 178-189.
Soltow, Lee and Jan Luiten van Zanden. *Income and Wealth Inequality in the Netherlands 16th-20th Century*. Amsterdam: Het Spinhuis, 1998.
Spil, A.C. *Vakbekwaamheidskennis voor den bakker. Wat iedere bakker, aspirantbakker en verkoper, die de bakkerijen bezoekt, van het bakkersvak moet weten*. Purmerend: J. Muusses, 1940.
Statistisches Reichsamt. *Der auswärtige Handel Deutschlands*. Berlin, 1897-1913.
Statistisches Reichsamt. *Der auswärtige Handel Deutschlands*. Berlin, 1922-1927.
Steele, M. William, "Betting on the Wheel: The Bicycle and Japan's Postwar Recovery, 1945-1958," Paper presented at the ICOHTEC, Manchester, July 22-28, 2013.
Steele, M. William, "The Making of a Bicycle Nation: Japan." *Transfers* 2, no. 2 (2012): 70-94.
Stoffers, Manuel and Harry Oosterhuis, "Ons populairste vervoermiddel. De Nederlandse fietshistoriografie in internationaal perspectief." *Bijdragen en Mededelingen betreffende de Geschiedenis der Nederlanden* 124, no. 3 (2009): 390-418.
Takeuchi, Johzen, "Historical Features of Japanese Small and Medium Enterprises: A Comparative Economic Approach," Chap. 8, In *Small Firms, Large Concerns. The Development of Small Business in Comparative Perspective*, edited by Odaka, Konosuke and Minoru Sawai, 197-216. Oxford: Oxford University Press, 1999.
Teece, David J., Gary Pisano, and Amy Shuen, "Dynamic Capabilities and Strategic Management." *Strategic Management Journal* 18 (1997): 509-533.
Timmerman, Nico. *Rijwielfabriek Union: Een eeuw in beweging*. Eindhoven: N.B.E. Timmerman, 2004.
Tjong Tjin Tai, Sue-Yen, Mila Davids, and Harry Lintsen, "Hoe moderniseerden bakkers aan het begin van de twintigste eeuw? De betekenis van de Nederlandsche Bakkersbond en het Station voor Maalderij en Bakkerij." *Tijdschrift voor Sociale en Economische Geschiedenis* 10, no. 3 (2013): 55-79.
Utterback, James M. *Mastering the Dynamics of Innovation*. Boston, Massachussetts: Harvard Business School Press, 1994.
Veen, Marijke van der. *Explaining E-business Adoption: Innovation & Entrepreneurship in Dutch SMEs*. Enschede: Universiteit Twente, 2004.

Veraart, Frank, "Geschiedenis van de fiets in Nederland 1870-1940. Van sportmiddel naar massavervoermiddel." MSc thesis, Technische Universiteit Eindhoven, 1995.
Veraart, Frank. *Vormgevers van persoonlijk computergebruik. De ontwikkeling van computers voor kleingebruikers in Nederland, 1970-1990*. Eindhoven: Stichting Historie der Techniek, 2008.
Verhaegen, George H.M.J. *Rationeele broodvoorziening in Nederland*. Leiden: Eduard IJdo, 1942.
Verkuylen, C.A. *Brabantse klompenmakers en hun geschiedenis*. Amsterdam: Prinseneiland Uitgeverij, 1991.
Vinne, Vincent van der. *Eysink: van fiets tot motorfiets. Ondernemen tijdens de opkomst van het gemotoriseerd verkeer*. Amsterdam: Bataafsche Leeuw, 2001.
Vledder, Ingrid, Ernst Homburg, and Eddy Houwaart, "Particuliere laboratoria in Nederland. Deel 2: Achteruitgang, consolidatie, transformatie, 1914-1950." *NEHA-Jaarboek voor economische, bedrijfs- en techniekgeschiedenis* 63 (2000): 104-142.
Vlijmen, Maria G.A. van. *Rijden en omzien: 1894-1994 honderd jaar Vermeulen Hollandia*. Haarlem: Vermeulen Hollandia, 1994.
Voskuil, J.J. *Twaalf bakkers en twee bakkersdochters*. Wageningen/Arnhem: Genootschap voor de Bakkerij/Het Nederlands Openluchtmuseum, 1978.
Waarden, Frans van, "Regulering en belangenorganisatie van ondernemers," Chap. 11, In *De Nederlandse samenleving sinds 1815*, edited by Holthoon, F.L. van, 227-260. Assen/Maastricht: Van Gorcum, 1985.
Waerden, Theodorus van der. *Geschooldheid en techniek: Onderzoek naar den invloed van arbeidssplitsing en machinerie op de mate van vereischte oefening en bekwaamheid der arbeiders*. Amsterdam: Van Rossen, 1911.
Wal, Henk van der and Rob van Es, "Innoveren bij het MKB: Een race zonder finish." *M&O*, no. 1 (2010): 28-47.
Wallast, Martin. *100 jaar trucks: De geschiedenis van het wegtransport*. Raalte: Veldhuis, 1995.
Wengenroth, Ulrich, "Small-scale Business in Germany," Chap. 5, In *Small Firms, Large Concerns. The Development of Small Business in Comparative Perspective*, edited by Odaka, Konosuke and Minoru Sawai, 117-139. Oxford: Oxford University Press, 1999.
Winch, Graham M. and Roger Courtney, "The Organization of Innovation Brokers: An International Review." *Technology Analysis & Strategic Management* 19, no. 6 (2007): 747-763.
Yin, Robert K. *Case Study Research: Design and Methods*. Third ed. Vol. 5, *Applied Social Research Methods Series*. Thousand Oaks: Sage, 2003.
Zanden, Jan Luiten van. *De industrialisatie in Amsterdam, 1825-1914*. Bergen: Octavo, 1987.
Zanden, Jan Luiten van. *Een klein land in de 20e eeuw. Economische geschiedenis van Nederland 1914-1995*. Utrecht: Het Spectrum, 1997.

Summary

Connecting Small Firms for Innovation
Roles of Trade Associations and the Dutch *Rijksnijverheidsdienst*, 1900-1940

This dissertation studies the roles fulfilled by the trade associations and *Rijksnijverheidsdienst* (RND) in helping small and medium-sized enterprises (SMEs) in the Netherlands to innovate between 1900 and 1940. Using the insights of contemporary innovation studies on intermediary organisations, this historical study traces the role of these organisations in the transfer and development of knowledge. The research consisted of two main parts: a multiple-case study of three sectors and a separate study of RND. Data was collected through archival research and reviewing literature and publications.

The multiple-case study investigated innovation in three sectors: the mechanisation of Dutch bread bakeries (1900-1930), the transition of Dutch wagon makers to body making for motorised vehicles (1900-1940) and the development of the Dutch bicycle industry (1860-1940). In each of these cases the SMEs faced different circumstances, while the activities and the activity level of the trade associations and RND varied as well.

The multiple-case study was exploratory research into roles. It was supported by contemporary literature research that indicated the possible roles of intermediary organisations in both knowledge transfer and knowledge development, also taking into account the differences in flow directions and relationships. The study demonstrated that the early twentieth century cases were recognisable and relevant for contemporary innovation studies. Then, the results were used for further categorisation of the roles of intermediary organisations: providing knowledge, influencing, generating knowledge and standardisation.

The other part of this dissertation looks at *Rijksnijverheidsdienst* (RND), the first Dutch government agency which was established in 1910 to provide firms with technical information and advice. The analyses illustrate how RND's relationships and roles evolved in stimulating and enabling Dutch SMEs to innovate. This separate study added a temporal dimension to RND's roles. It showed that RND's dynamic expertise in mediation enabled it to ascertain SMEs' needs and thus adapt its roles and competencies. Additionally, RND's expertise in knowledge development complemented its activities in stimulating SMEs to innovate. Importantly, this study illustrates that an intermediary organisation like RND not only needed to gain the trust of SMEs and knowledge sources. It also needed to forge good relationships with private consultancies and other parties who may have seen innovation agencies as

competitors.

The historical analysis and review provided the following results: SMEs were often able to access new knowledge themselves. It was mainly for innovation-related lobbying and for training, standardisation and quality control that the trade associations and RND fulfilled an important role for SMEs, as illustrated by the bread bakers and wagon makers case studies.

The significance of the trade associations for SMEs' innovation evolved as follows. Firstly, they built a network of SMEs. This enabled knowledge circulation amongst SMEs and relationships with external parties, including knowledge institutes. Secondly, they encouraged innovation by making SMEs receptive to change. Lastly, they represented the sector's interests in various ways, including creating initiatives to stimulate innovation.

The significance of RND for SMEs' innovation can be summed up as follows: RND bridged the gaps from some SMEs to knowledge, skills and other organisations. It not only filled the gaps, but also showed considerable flexibility in doing so, depending on the sector, the technology and ongoing changes. Furthermore, it extended its knowledge transfer activities to those of knowledge development. Thanks to RND's guidance and advice on implementation, its consultants acted as knowledgeable influencers for developing regulations and articulating the SMEs' needs.

Finally, as the very different results of the case studies illustrate, the trade associations depended very much on the support and membership of the SMEs; at the same time, RND also relied very much on the strength of the sector's internal organisation, and on gaining the trust and support of the SMEs, private consultants, civic associations, the government and other organisations. Consequently, the trade associations and RND could only fulfil knowledge transfer and development roles based on their ability and the possibilities to build and maintain relationships with stakeholders. Therefore when studying the roles of intermediary organisations in innovation, we need to integrate relational aspects.

Samenvatting

Netwerken voor kennis
De rol van brancheorganisaties en de Rijksnijverheidsdienst bij innovatie in het midden- en kleinbedrijf, 1900-1940

Dit proefschrift bestudeert de rol die brancheorganisaties en de Rijksnijverheidsdienst (RND) tussen 1900 en 1940 speelden bij innovatie in het Nederlands midden- en kleinbedrijf (mkb). Het bestaat uit historisch onderzoek dat gebruik maakt van hedendaagse studies van intermediaire organisaties. Innovatie wordt omschreven als ontwikkeling en introductie van producten, diensten of processen, die nieuw zijn voor het betreffende bedrijf. Het onderzoek richt zich op kennis die nodig is voor innovatie. Grotere bedrijven zoeken in principe zelf naar nieuwe kennis en technologie om deze vervolgens toe te passen. Ondernemers in het mkb hebben echter minder tijd, geld en capaciteit beschikbaar dan grotere bedrijven. Door te bestuderen hoe en in welke mate deze ondernemers kennis verkrijgen via externe partijen nuanceert dit onderzoek het beeld van de vrije en onafhankelijke mkb-er.

Dit proefschrift onderzoekt de rol van twee soorten intermediaire organisaties: brancheorganisaties en de RND. De RND werd in 1910 opgericht en was de eerste Nederlandse overheidsorganisatie voor bedrijven. Deze dienst gaf adviezen aan ondernemers over mechanisering en andere technische en organisatorische verbeteringen in de bedrijfsvoering.

Het onderzoek bestaat uit drie casestudies van het mkb en een studie van de RND. Data is verzameld door middel van archief- en literatuuronderzoek. Omdat er maar weinig geschikte bedrijfsarchieven van mkb-bedrijven zijn, is er gebruik gemaakt van publicaties en documenten van vele andere organisaties, waaronder de ANWB, het Nederlands Openluchtmuseum, het Nederlands Bakkerijmuseum, Nationaal Fietsmuseum Velorama, de historische rijwielvereniging De Oude Fiets en de Contactgroep Auto- en Motorrijwielhistorie.

De casestudies onderzochten innovatie in drie sectoren: mechanisering van broodbakkerijen (1900-1930), de overgang van wagenmakers naar carrosseriebouw voor gemotoriseerde voertuigen (1900-1940), en de ontwikkeling van de rijwielindustrie (1860-1940). In iedere sector hadden ondernemers met andere uitdagingen te maken. Bakkers mechaniseerden hun bedrijf en veranderden daardoor hun werkwijze, wagenmakers verlieten hun ambacht voor werk in een nieuwe industrie, ondernemers in de rijwielindustrie bouwden een nieuwe sector op. Per sector verschilden ook de activiteiten van de brancheorganisaties en de RND. De studie van de RND analyseerde hoe de rol van de RND veranderde tussen 1900 en 1940.

Bakkers hadden in de onderzoeksperiode te maken met drie uitdagingen: concurrentie van broodfabrieken en nieuwe broodbakkerijen, de druk van nachtarbeid en de nieuwe wetgeving op het gebied van voedsel en hygiëne. Rond 1900 was het in de talrijke kleine broodbakkerijen gebruikelijk zonder machines te werken. Vooral het kneedwerk was zwaar. Vanaf het einde van de negentiende eeuw begonnen de eerste kleine bakkers kneed- en andere machines in te zetten, mede dankzij de opkomst van de elektromotor. Daarnaast verbeterden ze de broodkwaliteit door middel van controles van grondstoffen, standaardrecepten, specificaties en het gebruik van thermometers en andere meetinstrumenten. Behalve investeringskapitaal voor machines en ovens hadden ze daarvoor ook behoefte aan bijscholing. Veel bakkers kochten apparatuur na advies ingewonnen te hebben bij leveranciers en collega's. De Bakkersbond organiseerde onderwijsactiviteiten, stimuleerde standaardisering en kwaliteitscontroles en vertegenwoordigde de sector bij de overheid en andere partijen. Een belangrijk bondsinitiatief was de oprichting van het Proefstation voor Maalderij en Bakkerij in 1909. Dit Station controleerde grondstoffen, definieerde standaarden en specificaties, verzorgde onderwijs (avondcursussen, vakschool, lezingen) en verrichtte kwaliteitscontroles bij bakkers en leveranciers. De Eerste Wereldoorlog bracht vele bakkers ertoe bondslid te worden, omdat ze daardoor tegen redelijke prijzen meel konden krijgen bij de meelfabrieken die de bond had aangekocht. Daarnaast vervulden bond en Station een belangrijke rol in de distributie van meel en de controle van Regeeringstarwe. Na de oorlog resulteerden de Warenwet in 1919 en het Broodbesluit van 1925 in een stijging van het aantal bakkers dat hun brood liet controleren door het Station. Door het verbod op nachtarbeid in 1919 en de gestegen arbeidskosten na de oorlog besloten vele bakkers om een kneedmachine aan te schaffen. Het resultaat was dat in 1930 60 procent van de bakkerijen (voornamelijk kleine bedrijven) één of meer elektromotoren had, terwijl het gemiddelde van alle Nederlandse bedrijven 26 procent was.

In vergelijking met bakkers stonden wagenmakers rond 1900 minder onder druk. Echter, ook hun werkdagen waren lang, omdat zij hun houten producten vrijwel geheel handmatig produceerden. Onder kleine wagenmakers waren zelfs handmatig aangedreven machines ongebruikelijk. Door de industrialisering en de opkomst van de auto verminderde de vraag naar hun rijtuigen, wagens en (houten) landbouwwerktuigen. Tegelijkertijd bood de opkomende automobielindustrie vele kansen. Deze casestudie laat zien hoe vele kleine wagenmakersbedrijven overschakelden op carrosseriebouw, met name voor bedrijfswagens. Ze maakten carrosserieën op maat of produceerden kleine series. Tot circa 1920 verschilden de carrosserieën van rijtuigen weinig van autocarrosserieën, wat de overgang vereenvoudigde. Daarna veranderde zowel vorm als materiaal van autocarrosserieën als gevolg van ontwikkelingen in de automobielindustrie. Daardoor transformeerden wagenmakers van hout- naar metaalbewerkers. Tevens beïnvloedde nieuwe

wetgeving voor wegen en voertuigen de auto- en carrosserieontwerpen. Wagenmakers zetten veelal zelf de eerste stappen in carrosseriebouw, zodat zij al doende leerden. Eventueel volgden ze een tekencursus of huurden ze een metaalbewerker in. Echter, niet alle wagenmakers hadden voldoende scholing en leervermogen. De RND zette daarom vanaf 1920 een technisch assistent in die cursussen, lezingen en demonstraties gaf en wagenmakers opzocht in hun werkplaats om ze te helpen bij de bouw van hun eerste carrosserieën. Hij schreef artikelen, ontwikkelde standaardtekeningen en organiseerde collectieve stands voor wagenmakers tijdens de Jaarbeurs. Hij volgde de ontwikkelingen in de automobielindustrie, beoordeelde nieuwe werktuigen en productiewijzen en droeg zijn bevindingen vervolgens over door middel van lezingen en publicaties. De RND werkte hiertoe nauw samen met de wagenmakersbonden, die de overgang naar carrosseriebouw stimuleerden (in tegenstelling tot Amerikaanse en Duitse bonden). Net zoals de Bakkersbond hadden ook de wagenmakersbonden moeite met het aantrekken van leden. Hun ledenaantal groeide als gevolg van de Eerste Wereldoorlog en de economische crisis in de jaren dertig, maar deze bonden waren minder sterk dan de Bakkersbond.

De Nederlandse rijwielindustrie was een geheel nieuwe sector die vanaf 1860 ontstond door ontwikkeling van rijwielproductie en -gebruik. De eerste rijwielondernemers haalden hun product- en productiekennis uit Frankrijk en later uit Engeland. Daartoe bezochten ze beurzen en fabrieken in deze landen, kochten er rijwielen en rijwielonderdelen in of lieten ervaren technici uit Engeland overkomen. Door middel van assemblage en imitatie leerden ze al doende rijwielen te fabriceren. Ook latere generaties rijwielondernemers volgden dit patroon. Zij konden bovendien gebruik maken van productiechefs die het vak bij andere Nederlandse rijwielfabrikanten hadden geleerd. Verder beschikten beginnende ondernemers over kennis en ervaring die ze eerder hadden opgedaan in verkoop, marketing, metaalbewerking, wagenmakerij of rijwielgebruik. Door de activiteiten van de ANWB werd fietsen in Nederland vanaf 1900 een vervoerswijze voor werk en vrije tijd voor alle klassen. Naarmate fietsen populairder werd, groeide het aantal bedrijven in rijwielverkoop en -reparatie. Sommige van deze bedrijven produceerden of assembleerden ook rijwielen. De RND gaf enkele rijwielondernemers advies over materialen, productiewijzen en machines. Daarnaast keurden ze rijwielfabrieken voor het keurmerk van de Vereniging Nederlands Fabrikaat waarmee fabrikanten hun producten als Nederlandse waar konden aanprijzen. De relatie tussen de brancheorganisaties van grote rijwielfabrikanten en -handelaren (RAI) en rijwielherstellers en –handelaren (BRHN) verbeterde door de noodgedwongen samenwerking tijdens de Eerste Wereldoorlog. Bovendien kregen Nederlandse rijwielproducenten in de oorlog de gelegenheid om de weggevallen import uit Duitsland te vervangen. Na de oorlog vormden RAI, BRHN en de brancheorganisatie van de groothandelaren (NEVGRO) een kartel om zich te wapenen tegen import van

Duitse rijwielen die tegen zeer lage prijzen werden aangeboden. Het was een zeer succesvol kartel, omdat het de gehele rijwielsector in Nederland verenigde (terwijl pogingen in Engeland en Duitsland mislukten). De rijwielproductie verdrievoudigde in minder dan vijf jaar en de import daalde tot vrijwel nihil. Echter, een groot deel van de productie bestond uit rijwielassemblage met onderdelen die afkomstig waren uit . . . Duitsland. De rijwielfabrikanten produceerden voornamelijk goedkope standaardrijwielen gebaseerd op de voorkeuren van Nederlandse gebruikers: de typisch Nederlandse (oma)fietsen.

De voorgaande casestudies zijn gebruikt om een indeling te maken met vier soorten werkzaamheden die intermediaire organisaties verrichten. Bij deze werkzaamheden is sprake van een combinatie van gecodificeerde kennis (vastgelegd, opgeschreven) en stilzwijgende kennis (opgeslagen in mensen, *tacit knowledge*). De eerste twee soorten werkzaamheden van de indeling betreffen kennisoverdracht: 'kennis aanbieden' (van bronnen naar mkb) en 'beïnvloeding' (van mkb naar andere partijen). Het gaat hierbij om meerdere kennissoorten: informatie en kennis, bij- en nascholingsactiviteiten en vakonderwijs. De andere twee soorten werkzaamheden hebben betrekking op kennisontwikkeling: 'kennis genereren' (kennis transformeren vanuit verschillende bronnen, ten behoeve van mkb) en 'standaardiseren' (hiertoe kennis transformeren en deze overeenkomen met verschillende partijen, waaronder mkb). Standaarden bevorderen innovatie doordat ze de onzekerheid van implementatie van innovaties verminderen. Op deze wijze beschrijven de vier soorten werkzaamheden zowel het kennisaspect, de richting van de kennisstromen, als de verschillende relaties.

Uit de casestudies volgen drie conclusies. Ten eerste, brancheorganisaties leveren met hun ledennetwerk een cruciale bijdrage voor de stimulering en ondersteuning van bovengenoemde werkzaamheden. De organisaties ondersteunen met name activiteiten ten behoeve van 'kennis aanbieden' en 'beïnvloeding'. 'Kennis genereren' en 'standaardisering' kunnen ze stimuleren met behulp van hun kennisinstituut of een specialist. Ten tweede, brancheorganisaties stimuleren hun leden om te innoveren en hun bedrijfsvoering aan te passen aan de veranderende omstandigheden door het belang hiervan keer op keer te herhalen. Ten derde, brancheorganisaties vertegenwoordigen het belang van hun sector niet alleen op economisch gebied, maar ook op het gebied van innovatie, bijvoorbeeld door samen te werken met andere organisaties (zoals de RND), door te lobbyen voor wetgeving en standaarden die innovatie bevorderen en door initiatieven te nemen, zoals de oprichting van kennisinstituten en vakscholen en het organiseren van tentoonstellingen en vakwedstrijden.

De bovenstaande conclusies werden in het bijzonder geïllustreerd door de Bakkersbond en in mindere mate door de wagenmakersbonden. Brancheorganisaties bleken voor hun werkzaamheden sterk afhankelijk te zijn van hun ledenaantal en het draagvlak onder hun leden. Dit werd beïnvloed door urgentie als gevolg

van bedreigingen van buitenaf, zoals oorlog, wetgeving en nieuwe technologieën. Naarmate de nood ernstiger was, steeg het ledenaantal en nam het draagvlak toe.

De casestudies besteden weinig aandacht aan de tijdsafhankelijkheid van de rol van een intermediaire organisatie. Daarom is een studie verricht naar de veranderende rol van de RND tussen 1900 en 1940. Daarbij zijn ook de veranderingen in de relaties van de RND bestudeerd. Al vóór de oprichting veranderde de rol twee maal doordat verschillende partijen zich met het organisatieontwerp bezighielden. Na de oprichting namen de RND-consulenten verschillende initiatieven die hun werkzaamheden wijzigden en uitbreidden. Ze initieerden activiteiten in 'beïnvloeding' (o.a. door belangen van het mkb te behartigen tijdens materiaaldistributie als gevolg van de Eerste Wereldoorlog), 'kennis genereren' (o.a. door de demonstratiefunctie van het RND-laboratorium uit te breiden met een test- en ontwikkelfunctie) en 'standaardiseren'. De RND paste ook werkzaamheden aan na veranderingen in het overheidsbeleid. De consulenten droegen bijvoorbeeld werkzaamheden over aan overheidsinstituten die tijdens de economische crisis werden opgericht. De consulenten waren voor hun werkzaamheden afhankelijk van de organisatiekwaliteit van een sector. Ze moesten ook het vertrouwen winnen van ondernemers door op aansprekende wijze hun werkzaamheden te verrichten (demonstraties, praktische adviezen). Daarnaast hadden ze ook goede relaties nodig met andere organisaties die zich richten op de noden van het mkb (zoals de Maatschappij van Nijverheid), raadgevende ingenieurs in de private sector en de overheid. De RND wist goed wat er speelde in het mkb en paste aan de hand hiervan de werkzaamheden en competenties van de dienst aan. Daarnaast waren de RND-consulenten in staat om door kennisontwikkeling hun activiteiten te ondersteunen, aan te vullen en tijdelijk gaten in de nog jonge moderne Nederlandse kennisinfrastructuur te dichten.

Aan de hand van deze studie zijn een aantal conclusies te trekken over de RND als onderdeel van het toenmalige overheidsbeleid. De betekenis van de RND voor innovatie in het mkb tussen 1900 en 1940 was door het kleine aantal medewerkers dat de overheid beschikbaar wilde stellen gering. De RND begon in 1910 met één consulent, werd in 1913 uitgebreid tot drie consulenten, maar had in de onderzochte periode nooit meer dan twaalf medewerkers. Wat betreft de werkzaamheden die de RND wel kon verrichten, zijn er drie conclusies te trekken.

Ten eerste overbrugden de consulenten de kloof tussen mkb en nieuwe kennis, vaardigheden en andere organisaties. Daarbij stelden de consulenten zich flexibel op. In hun aanpak onderkenden ze de verschillende omstandigheden per sector en technologie. Ten tweede breidden de consulenten hun activiteiten uit met kennisontwikkeling toen ze merkten dat daar behoefte aan was en daar nog geen andere partijen voor beschikbaar waren. Tenslotte gebruikten de consulenten hun ervaringen met het mkb om de belangen en de behoeften van het mkb te

vertegenwoordigen op het gebied van regulering en beleid.

Dit onderzoek naar de rol van brancheorganisaties en de RND bij innovatie in het mkb in Nederland tussen 1900 en 1940 heeft tot de volgende vier resultaten geleid.

Ten eerste bevat het proefschrift drie bijdragen aan de wetenschap. De drie casestudies dragen bij aan de historiografie van het mkb en innovatie. Daarnaast zijn er twee bijdragen aan de hedendaagse literatuur over intermediaire organisaties. De eerste is de indeling met vier soorten werkzaamheden van intermediaire organisaties, die zowel de kenniscomponent, de richting van de kennisstroom en de verschillende relaties beschrijven. Het gaat hierbij om 'kennis aanbieden', 'beïnvloeding', 'kennis genereren' en 'standaardiseren'. Het onderzoek heeft geïllustreerd hoe en in welke mate brancheorganisaties en de RND deze werkzaamheden vervulden voor het mkb. De tweede bijdrage aan de hedendaagse literatuur is dat het onderzoek de tijdsafhankelijkheid van de rol van een intermediaire organisatie toont en hoe deze zich met behulp van haar kennis en vaardigheden aanpast aan veranderingen, zowel actief als reactief.

Ten tweede toont dit proefschrift aan voor welke innovatietypen ondernemers behoefte hebben aan intermediaire organisaties. Kennis over nieuwe apparatuur en werkwijzen kunnen ondernemers veelal zelf bemachtigen. Ondernemers met onvoldoende kennis en scholing hebben daarvoor ook hulp nodig van intermediaire organisaties, omdat deze nieuwe kennis geschikt maken voor de lokale context van het mkb ('kennis genereren'). Daarnaast hebben alle ondernemers een belang bij activiteiten van brancheorganisaties in 'beïnvloeding' en 'standaardisering'.

Ten derde geeft het onderzoek een beeld van de mogelijke rol van branche-organisaties en de RND. Brancheorganisaties bouwen een netwerk op dat kennisoverdracht tússen mkb-ers en van kennisbronnen náár mkb-ers mogelijk maakt. Dezelfde dubbelrol vervullen brancheorganisaties bij onderwijs, standaar-disering, kwaliteitscontrole en kennisontwikkeling. Enerzijds stimuleren ze hun leden hierbij, anderzijds vertegenwoordigen ze de belangen van hun leden bij de ontwikkeling hiervan, onder andere door middel van initiatieven, zoals de oprichting van een kennisinstituut of de organisatie van bijscholing. De RND had de competenties om alle vier soorten werkzaamheden uit de indeling uit te voeren, maar kon dat vanwege het geringe aantal medewerkers niet voor het gehele mkb doen. Bovendien was de RND voor de uitvoering mede afhankelijk van de interesse en acceptatie van de sector die weer afhing van de organisatiekwaliteit ervan.

Ten vierde mondt het onderzoek uit in een aantal aanbevelingen over de rol van de overheid in het stimuleren van 'toepassers' van innovatie. De casestudies tonen aan dat ondernemers voor innovatie een goed kennisniveau nodig hebben en dat de organisatie van de benodigde vak-, bij- en nascholing niet alleen aan ondernemingen overgelaten kan worden omdat ze te veel op de korte termijn zijn gericht. Tevens laat het onderzoek zien hoe wetgeving (met betrekking tot arbeidsomstandigheden

en productkwaliteit) en standaarden (op het gebied van producten en productie) innovatie stimuleren. Ook daar kan de overheid dus haar invloed aanwenden. Tenslotte toont dit proefschrift aan dat het mkb een bijpassende, op de ondernemerspraktijk gerichte kennisinfrastructuur nodig heeft om nieuwe kennis en technologie te implementeren. Dit onderzoek toont hoe zowel brancheorganisaties als RND daarin een rol konden spelen. Overheidsbeleid kan de grondslag leggen voor een geschikte kennisinfrastructuur ten behoeve van innovatie in het mkb.

Samenvattend geeft dit onderzoek meer inzicht in hoe het mkb innovaties toepaste tussen 1900 en 1940, wat daarbij de rol en de betekenis waren van brancheorganisaties en de RND en welke inzichten en aanbevelingen daaruit volgen voor hedendaags innovatiebeleid.

Curriculum Vitae

Sue-Yen Tjong Tjin Tai was born in Nijmegen, the Netherlands, in 1965. After passing her secondary school exams in Hardenberg in 1983, she went to the United States to study liberal arts at Dickinson College in Carlisle, Pennsylvania. Then she returned to the Netherlands to pursue mechanical engineering studies at the University of Twente in Enschede, along with courses in science, technology and society studies. In 1989 Sue-Yen graduated from the Applied Mechanics Department with her Master's thesis on condition monitoring of bearings: "Detection of Surface Defects in a Concentrated Contact". Since graduating, she has been employed by the Shell Group in various technical, commercial and project roles at their Head Offices in The Hague, the refinery and chemical plant in Pernis, and currently at Shell Project and Technology Centre in Rijswijk.

From 2000, Sue-Yen studied sociology at the University of Amsterdam. Part of her course work was a research project on Shell Hydrogen (*Van Shell naar Shell Hydrogen: Een poging om de wereld te verbeteren door benzine in waterstof te veranderen*). In 2003 she graduated cum laude in Sociology of Culture with her Master's thesis on Philips researchers and their visions of the intelligent home. From 2003 to 2010 she was first an editor, then a chief editor of 'Sociologie Magazine' (formerly 'Facta'), published by the Dutch Association of Sociologists (*Nederlandse Sociologische Vereniging*).

From 2005 she participated in an NWO research project on Dutch businesses in the twentieth century – *Bedrijfsleven in Nederland in de twintigste eeuw* (BINT) at Eindhoven University of Technology (TU/e). Consequently, she published an article on the invention of the hydrocyclone at Dutch State Mines, together with Mila Davids: "Absorptive Capacity, Knowledge Circulation and Coal Cleaning Innovation: The Netherlands in the 1930s". *Business History*, 51, no. 5 (2009): 668-690. In 2010 Sue-Yen began a PhD project at TU/e on innovation in small and medium-sized enterprises, the results of which are presented in this dissertation.

Publications

Tjong Tjin Tai, Sue-Yen, Frank Veraart, and Mila Davids, "How the Netherlands Became a Bicycle Nation: Users, Firms and Intermediaries, 1860-1940." *Business History* 57, no. 2 (2015): 257-289.

Tjong Tjin Tai, Sue-Yen, "Hoe werd de fiets een Nederlands product? Hollandse degelijkheid vormt de fiets voor dagelijks gebruik," In *Ons stalen ros. Nederland wordt een land van fietsers 1820 tot 1920*, edited by Hanenbergh, Kaspar and Michiel Röben, 192-197. Utrecht: Ons Stalen Ros, 2015.

Tjong Tjin Tai, Sue-Yen, Mila Davids, and Harry Lintsen, "Hoe moderniseerden bakkers aan het begin van de twintigste eeuw? De betekenis van de Nederlandsche Bakkersbond en het Station voor Maalderij en Bakkerij." *Tijdschrift voor Sociale en Economische Geschiedenis* 10, no. 3 (2013): 55-79.

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How can small firms survive the flood of new technologies? Do they need external support? More than a century ago, this was one of the urgent challenges facing small firms in the Netherlands and it has remained so to this day. Catching up with global developments in mechanisation meant that Dutch firms had to acquire knowledge and implement new technologies.

In this thesis, Sue-Yen Tjong Tjin Tai presents three cases of Dutch firms that innovated in the early twentieth century: bread bakers who mechanised, wagon makers who switched to making bodywork for motorised vehicles and entrepreneurs starting out in the bicycle industry. Many firm owners simply bought new machinery and learned to use it themselves or had some assistance from suppliers. Others had to rely on external parties such as the trade associations and *Rijksnijverheidsdienst.* The latter, which was established in 1910, was the first Dutch government agency to provide firms with technical information and advice.

The thesis examines what role these intermediary organisations played in helping small firms to survive the hard times. A separate study of the *Rijksnijverheidsdienst* illustrates that its roles and the way these evolved are inextricably linked to the context of a budding knowledge infrastructure, World War I, and the Netherlands' transition from a liberal economy in the late nineteenth century to a coordinated economy in the late 1930s.

By shedding light on how diverse sectors coped with transition, the author illustrates that to support their innovation efforts, small firms need joint activities particularly in education, standardisation and quality control. Such activities require knowledge, and that knowledge first has to be adapted to the small firms' context. Although entrepreneurs rely on government regulations and state supported education facilities, good sector networks are essential for successful innovation. Trade associations can help to create sector networks and government agencies can use these networks to stimulate innovation by transferring and developing knowledge.

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