Chapter 3 History of the Dutch drinking water sector

3.1 Purposes of the historical analysis

This chapter describes the past 150 years during which the drinking water sector became what it is today. This analysis serves three purposes. Firstly, it introduces the Dutch drinking water sector to the reader: how is it structured and why? Under what geographical and economic circumstances does it operate and how successful is it?

Secondly, it puts the sustainability debate in perspective. This chapter shows that sustainability is certainly not the first issue that society throws at these companies. It also makes clear why the concept doesn't make water companies jump for joy: fifty years before the rise of environmentalism, issues that now fall under the heading 'unsustainability' were already experienced as problematic by water companies. Many of these problems remained unresolved during decades of fruitless protest. Therefore, the water companies do not expect things to change overnight, just of the introduction of new terminology.

Thirdly, this historical analysis helps to simplify the task of the cross case analysis. The general context and the basic structure of the drinking water sector will be described. What explicit and implicit rules does it have to comply with, and which actors are structurally involved? These visible and invisible structures will lead to convergence of company strategies and operations. After the similarities are explored, the differences will stand out more clearly in the next chapters.

Guiding questions are:
- What are the historical *issues* they discuss, or problems they want to solve?
- What *structures* are eventually designed as a solution?
- In what ways does this historical process still *influence* the drinking water sector today (institutions, consensus about values, tacit assumptions)?

The analysis is mainly based on historical literature and jubilee editions published on behalf of companies in the drinking water sector. A few primary sources are used such as Dutch legislation and policy plans. Interview data are used for the period from 1990 until 2000.

For the historical analysis, the past was divided in periods. This division is arbitrary. There is always a tendency to cut historical periods off at round numbers, while history changes gradually. Another option is to cut off at notable events, for example, the royal permission to build the first water company in the Netherlands in 1851, or the day it became operational as an emergency measure in December 1853, or the day it officially started sales in May 1854. In this chapter historical events form a guideline, and periods are cut off at decades.

3.2 Preceding developments (1400-1850)

Before water companies existed, the Dutch population drank from rivers, brooks, and canals. People living in the lower parts of the Netherlands used surface water; in the higher parts they used groundwater wells. Until about 1400, population density was low and industrialization non-existent, so it was no problem to drink surface water (Wijmer, 1992, p.34).

In the Thirteenth Century, urbanization started to cause unacceptable water pollution. Excrements and carcasses were the most important pollutants, but there were also waste

streams from industries such as textile, leather, and paper processing. Municipalities prohibited dumping of waste and excrements in city waters, but this had little effect on the behaviour of citizens until the first enforcement measures were taken in the Eighteenth Century. The groundwater wells in the higher parts of the Netherlands were more reliable, although they were sometimes polluted by nearby cesspits (Wijmer, 1992, p.45).

Progressive pollution led to a decision of the Amsterdam brewers in 1480 to stop using canal water for beer production (Wijmer, 1992 p33). They began transporting water in ships from rural areas to the city, and sold drinking water as a by-product. This inspired others and the new profession of 'fresh water fetchers' was created, often combined with the distribution of fresh milk. In 1786, the 'Fresh Water Society' was founded, and already in 1796, this society had 44 large ships for transportation and 246 small ones for distribution in the city of Amsterdam (Leeflang, 1974, p.24).

In other cities such as Utrecht and Leiden similar solutions were found. Entrepreneurs transported surface water from rural areas into the city in ships or in wooden barrels on a horse-driven cart. Some city authorities built rain reservoirs, but this water was polluted by lead from roofs and gutters, and quickly exhausted in dry periods (Wijmer, 1992, p.42).

Between 1700 and 1800, Amsterdam was the largest and most industrialized city in the Netherlands (Wijmer, 1992, p.40). Therefore, it was not surprising that the water problems in this city were severe. Between 1530 and 1850, 43 plans for water supply were presented to the city government. They all ended in the city archives due to financial and technical hesitations.

In the Netherlands, the population grew from 2,5 million in 1800 to 5 million in 1900 (Wijmer, 1992, p.56). Extreme poverty was a side effect of industrialization and urbanization processes. In the nineteenth century, the Netherlands suffered from several cholera epidemics (see Figure 3.1). It was a new disease that approached Europe from Eastern Asia ('t Hart, 1990). Poor quarters were more vulnerable for epidemics than rich areas, though rich families were also afflicted.

At that time, the direct cause of cholera was unknown; it took until 1864, before Louis Pasteur discovered the existence of micro-organisms ('t Hart, 1990, p.34). The cholera epidemics caused an immense debate: what exactly was the problem, who was responsible for what, and who should pay? Was cholera a punishment from God ('t Hart, 1990, p.45)? Were epidemics caused by dirty drinking water, bad housing and lack of food, or by the immoral, alcoholic lifestyle of the poor (Wijmer, 1992, p.57)? What was the role of the government, was public health their task at all? And if yes, what should local governments improve first, sewerage or drinking water supply?

Two main theories were developed to explain cholera. Firstly, the *miasma* theory, which claimed that cholera-causing particles could develop in clay, sludge, and waste ('t Hart, 1990, p.21). These particles could form an invisible cloud that was recognizeable by its bad smell. The solution was to avoid breathing in the bad smells and to remove possible substrates for miasma growth from inhabited areas through canals. The competing *contagio* theory claimed that cholera-causing particles developed in the human body and were then transferred between human bodies ('t Hart, 1990, p.23). Adherents of this theory concentrated on measures such as quarantine of patients.

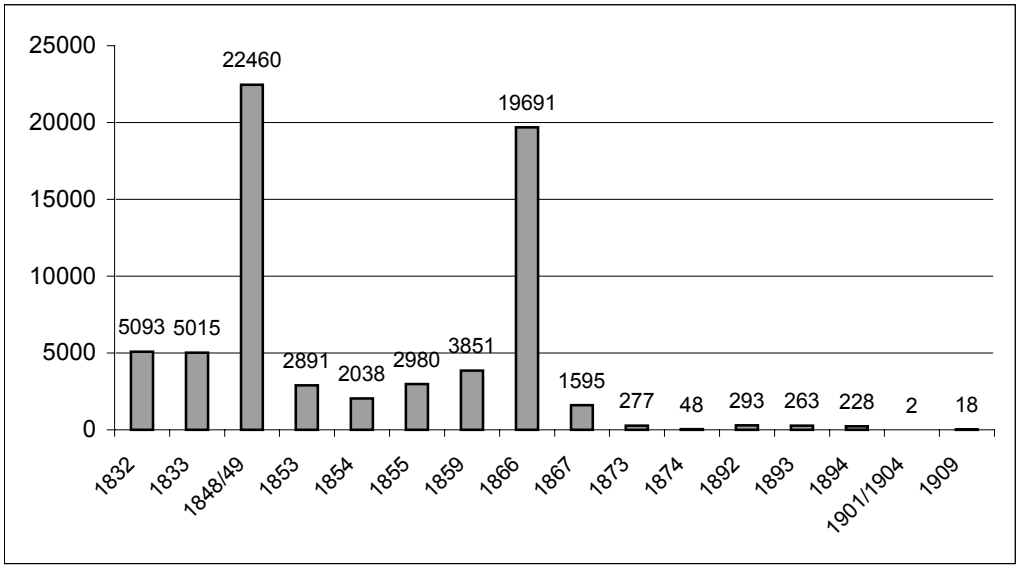

Figure 3.1: Cholera mortality in the Netherlands from 1832-1909 ('t Hart, 1990, p.303)

In 1849, physician John Snow noticed that workers in the beer industry in London, who received free beer from their patrons, did not suffer from cholera. Their neighbours, who drank from a public water pump in Broadstreet, were dying by dozens. Urged by Snow, the London government closed down the Broadstreet pump and the cholera epidemic vanished. Snow started to compare the effect of (already existing) drinking water companies in different parts of London. The Chelsea Waterworks Company that had worked with slow sand filters since 1829, turned out to function particularly well. Snow concluded that there must be a connection between polluted drinking water and cholera ('t Hart 1990 p 34, 46, 49). As a reaction to this discovery, the Metropolis Water Act became effective in 1852, prescribing that all water from the Thames had to be filtered before it was distributed. The British public water supply technology soon crossed over to other countries such as the US, Scandinavia, France, Belgium, and the Netherlands, accompanied with British engineers.

In the Netherlands, too, physicians played an important role in the debate. At the beginning of the nineteenth century, there were many different types of medical practitioners, and there was a lot of confusion about their competencies. In 1849, the 'medicinae doctores', medical practitioners with an academic degree, united themselves in the 'Society for the Advancement of Medicine'. This Society formed the core of a group of citizens called the 'Hygienists', who wanted to improve the situation of the lower class ('t Hart, 1990, p.93, Wijmer, 1992, p.35). The 'Hygienists' were *miasma* adherents and argued in favour of a public drinking water supply.

The main issue of this period was the relationship between drinking water and public health. Because there was no consensus yet, no structures developed apart from a lobby group called the 'Hygienists'. This debate is largely forgotten nowadays, so it is estimated to have little or no influence today.

3.3 Birth of the drinking water sector (1850-1890)

The year 1851 is often chosen as the starting point of the Dutch drinking water sector. In this year, King Willem III gave permission to establish the first Dutch water company in Amsterdam. The company was funded mainly with British investment capital, and received only a limited financial support from Amsterdam's own wealthy citizens (Wijmer, 1992, p.53). A 23 kilometre long transport pipeline was built from the dunes to the city. Because of early

frost in December 1853, impairing the water transport by ship, the citizens of Amsterdam were allowed to collect buckets of fresh dune water at the end of the transport pipeline, with a maximum of two buckets per customer per day. Soon after this, distribution pipelines were constructed, and in May 1854, exploitation officially started with the first 8 'subscribers' (Leeflang, 1974, p.30). Only rich people could afford their own supply of clean drinking water. Many poor city people drank dirty surface water until the end of the nineteenth century.

The Municipality Law of 1851 declared that public health was a task of the municipalities. Around 1855, health committees, which existed in Dutch cities with four or more 'medicinae doctores', installed a 'medical police' (Leeflang, 1974, p.32). This 'medical police' started to examine drinking water quality from public pumps, as the idea became more and more popular that this had something to do with cholera. However, there were many scientists who saw Snow's claims as just another unproven theory.

During a particularly severe cholera epidemic in 1866, the Dutch government installed a state committee to investigate the following two questions:

"a. What is the nature and quality of the drinking water consumed by the population of municipalities, that were more severely hit by this and previous cholera epidemics than others? Can one assume that there is a connection between the nature of the drinking water and the extent of the epidemic, also by comparison with the quality of drinking water in municipalities that were spared from cholera?

b. If there are municipalities as mentioned above, where supply of pure drinking water appears to be necessary, how should this be provided: should the care be left to private industries or should the government take the necessary measures?"

The committee wrote its 'Report to the King' in 1868, which concluded that drinking water only spreads cholera when it is polluted by human excrements (Leeflang, 1974, p.33). The committee was of the opinion that the quality of the drinking water in the Netherlands, in general, was bad, and advised a State intervention to improve the situation (Wijmer, 1992, p.68). The report contained ideas about legislation and governmental quality control.

The advice was not followed by the Dutch national government. Between 1840 and 1870, the government was strongly influenced by J.R.Thorbecke who believed in governing at a distance. Public health and caring for the poor were considered matters of private initiative (Wijmer, 1992, p.35). Therefore, it was still the municipality that was in charge of drinking water supply.

Manufacturers of iron pipelines became an important driving force behind the establishment of the drinking water sector. They actively promoted the public health advantages of water supply systems. Between 1875 and 1900, British and Belgian pipeline manufacturers and engineers contacted municipal governments, offering to construct a water supply system. They also wanted a concession to supply it to the citizens. For municipalities it was a difficult decision, because there were large investments at stake and the shaky technology was in the hands of only a few, mostly British engineers (Wijmer, 1992, p.60).

Each city made its own decision, depending on what they saw as the origin of epidemics and on their ideas about governmental responsibilities. Some municipalities thought the water supply business was too risky to get involved in, and licensed private companies to start a water supply system. They gave out limited concessions, and made a deal that part of the profit went to the government. Other cities such as Rotterdam and The Hague took total responsibility. Both cities started a governmental water supply in 1874.

For entrepreneurs it was not easy either. Was water really an attractive product, worth all their investments? Water was available everywhere for free and not many people were willing to pay for better quality. The industrialization, which started in the Netherlands around 1870, finally created enough momentum to get the water industry started. Especially steam engines needed a lot of water (Wijmer, 1992, p.69). Between 1875 and 1900, the number of companies raised from four to sixty (see Figure 3.2).

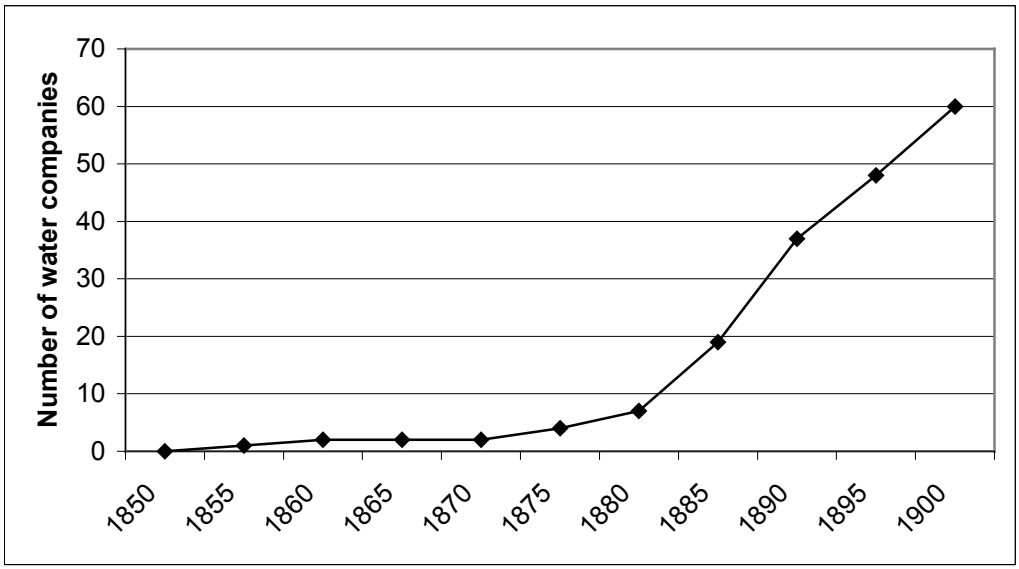

Figure 3.2: Number of water companies in the Netherlands between 1850 and 1900 (Wijmer, 1992, p.75)

Snows theory was finally confirmed in 1883 when Robert Koch isolated the causal agent of cholera, *Vibrio cholerae* ('t Hart, 1990). Koch quickly received support from the German government and he also had a good reputation internationally ('t Hart, 1990, p.42). His findings moved the debate about cholera and drinking water into a consensus state by the end of the nineteenth century. In 1900, a total of 60 companies supplied 100 larger municipalities (Leeflang, 1974, p.42). Of these companies, 39 were privately and 21 were publicly owned (Leeflang, 1974, p.44). Surface water was used by 13 companies, 11 used dune water, and 36 used groundwater. They produced a total of 59 million cubic metres in 1898, half of which came from surface water.

Table 3.1: Issues and structures between 1850-1890

Issues	**Structures**	**Influences in the year 2000**
How to solve public health problems?	water supply system in larger municipalities	public health is still a main argument for decisions
What are governmental responsibilities for the poor?	one third public utilities	belief in a centrally organized, large scale pipeline system
Should private companies be involved in the production and distribution of drinking water?	two thirds concessions to private companies	water is not sold under cost price, and not above cost price either

3.4 Switching to governmental ownership (1890-1910)

By the end of the nineteenth century, the debate about infectious diseases settled down into common beliefs among the decision-making elite[3]. Further proof was provided when a cholera epidemic hit the Netherlands between 1892 and 1894: even though only larger

[3] In the decade after the discovery of Koch, almost every disease was thought to be caused by micro-organisms. For example the discovery of the cause of beriberi between 1885 and 1886: "Eijkman could hardly believe his own conclusions that ordinary rice appeared to be the cause of beriberi in chickens. He began to question his basic observations (...) clinging to the idea that human beriberi was an infectious disease." (Verhoef, 2002)

municipalities had a water supply system, mortality rates remained low (see also Figure 3.1) (Leeflang, 1974, p.42). It was time for institutionalization of the new sector: the VWN association was founded in 1899 with 37 water supply directors as its members (Leeflang, 1974, p.54). Goals of the VWN were sharing knowledge and protection of water supply interests.

Sharing and developing knowledge was of vital importance to the sector because the new companies had all kinds of technical problems. Hydrological systems were only partly understood, there were no buffers for dry periods, and distribution technology was in its infancy. Between 1890 and 1920, the research focused on sufficient quantity supply (Wijmer, 1992, p.92). Monitoring water quality hardly took place, which occasionally led to small epidemics caused by the water supply system that was meant to prevent disease. Although the norm of a maximum of 100 bacteria per cm^3 drinking water was already formulated by Robert Koch in 1895, around 1900, there were no techniques available to achieve this (Wijmer, 1992, p.82). Governmental interest in the sector grew and control over hygienic problems increased, emphasized by the first water quality laboratories in 1892 and 1893 in two water companies (see also Table 3.3). The technical problems caused lengthy conflicts with municipalities about tariffs. The companies claimed they needed more money to build a better system; the municipalities were irritated and suspicious because the companies delivered such an unreliable product. Had the money been invested properly, or had profit been more important?

Nevertheless, several parts of the distribution system built in the nineteenth century are still operational today. An example is the water tower in Utrecht from 1895. In this tower four pipelines lead drinking water upwards to the water tank and downwards to the distribution system. One of these pipelines dates from 1895. Why durability became the norm in the early phase of the sector is not clear. Maybe the infrastructure was based on available technology, and only durable alternatives were available. They had no mathematical techniques for optimalisation of pipe thickness, no plastics, and no welding techniques.

Around 1900, the doubts about the private construction were increasing. Water had turned out to be a difficult product to sell. A kitchen tap was seen as a luxury, and why pay for water if you could get it for free in a nearby canal? Customers had to be won one by one (Wijmer, 1992, p.76), where it would have been much more efficient to build a supply for a whole street at once. Especially poor people continued to use traditional water resources and it was hard to convince them that the investment in clean drinking water was important for their health. It took the water company in Amsterdam ten years to become profitable (Wijmer, 1992, p.80). The market grew slower than expected (see Figure 3.3).

Between 1890 and 1910, consensus developed that public water supply was an important governmental task. The national Housing Law of 1901 forced municipalities to install regulations about availability of drinking water in new as well as old houses (Leeflang, 1974, p.63). Many municipalities translated this into a compulsory connection for houses near a main water pipeline. This enabled companies to build a distribution network for a whole street or neighbourhood at once. The Health Law of 1901 established a national Health Inspection that started to audit drinking water quality. Municipalities started taking over private water companies, for example, in Amsterdam in 1896, Groningen in 1918, and Leeuwarden in 1921, sometimes facilitated by their bankruptcy. A period of private ownership (1854-1920) was followed by a period of municipal ownership (1920-1975) (Blokland, 1999).

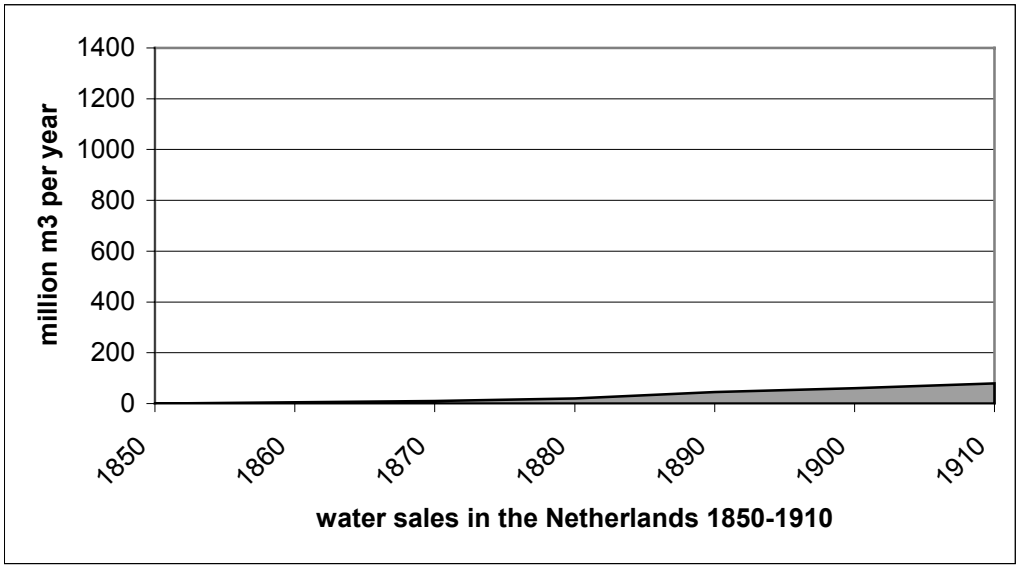

Figure 3.3: Drinking water sales in the Netherlands between 1850 and 1910 (Source: Leeflang, 1974, p.80)

The medical profession was still promoting the idea that drinking water supply deserved a national impulse, besides activities at the municipal level. An article titled "Construction of water supply" by Dr. W.P. Ruysch in the magazine for 'Social Hygiene' from 1908 was discussed in the Dutch Parliament in 1909, and in 1910, for the first time, the national budget showed an entry 'costs of preparations of supply in the need for drinking water' (Leeflang, 1974, p.65). In the same year a 'State commission on the drinking water question' was established. This committee soon received so many questions that it set up a Technical Bureau, which was officially named State Bureau for Drinking water supply in 1913.

Table 3.2: Issues and structures between 1890-1910

Issues	**Structures**	**Influences in the year 2000**
How to solve leakage and quality problems?	technology development for production, distribution and quality control	long term infrastructure is the prevailing standard
	foundation of VWN, State Health Inspection and Technical Bureau	VWN (now KVWN) and Health Inspection still exist, cooperative culture among water companies
What is the most efficient and effective economic structure?	companies came into governmental ownership	dominant role of governments in water supply
	legal arrangements to support distribution to more households	

3.5 Growth of the distribution network (1910-1950)

In the previous period, the water supply efforts focused on cities and were coordinated by municipal governments. In 1910, the first regional company was established in a part of Zeeland, supported with money from the national budget. The involvement of rural areas reflected the idea that drinking water supply was better for every Dutch citizen, not just for inhabitants in polluted urban areas. The following quote shows how these views changed from generation to generation:

"I still remember how my grandmother used water from the tap to clean the steps, and continued to drink from her own well" (laughing)[4].

For the older generations it was difficult to change the traditional view on drinking water. It had always been free, why should they pay for it now, and had grandfather not become 90 drinking ditchwater all his life? For today's generation water running from a tap is a fact of life. It is comparable to light coming from the sun, as is expressed in the following quote from Sesame Street (Children's Television Workshop, 1993):

Bert : *"Do you know what light is, Ernie?"*
Ernie : *"Light comes from a lamp, or from the sun, just like water from a tap."*

Water companies themselves describe this evolution as 'progressive water civilization'. Citizens are getting used to more hygienic lifestyles, as baths and water closets penetrate from elite to middle class and water demand steadily increases (Figure 3.4). For example, in the relatively progressive city of Amsterdam in 1897, 5% of the houses had a water closet and 3% a bath (Leeflang, 1974, p.50). In 1940 this had grown to 95% water closets, 15% baths, and 12% showers. In the rural area Zeeuws-Vlaanderen the percentages were still much lower, 22%, 3%, and 1,5% respectively. By 1940, the population did not resist public water supply anymore: villages without supply eagerly looked forward to receiving it (Leeflang, 1974, p.79).

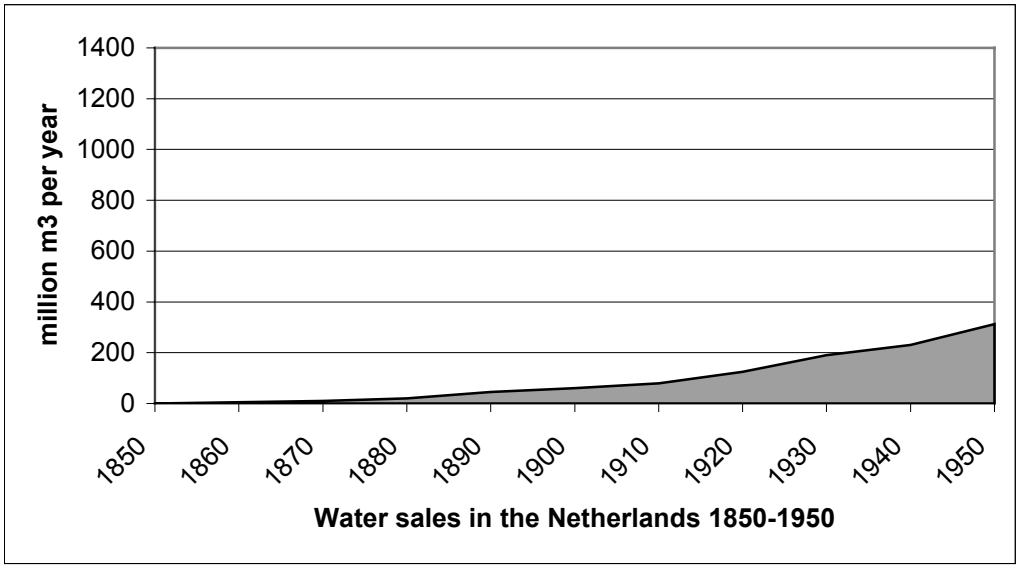

Figure 3.4: Water sales in The Netherlands from 1850-1950 (Leeflang, 1974; Water Statistiek, 1998)

Between 1910 and 1940, market growth was realized through foundation of new companies by municipalities. For municipalities with less than 10,000 inhabitants the necessary investments were a problem. This was solved by the upcoming role of provincial governments. In 1905, financial autonomy was reinstated for provincial governments, putting an end to the 'century of the municipality' in the Netherlands (Blokland, 1999). In 1919, the Province of Noord-Holland started a water company and at the same time introduced restrictive licensing for municipal companies: from then on, only groups of municipalities were allowed to set up a water company (Blokland, 1999). This example was soon followed by other provincial governments (Leeflang, 1974, p.68).

The national government supported this policy by providing subsidies only to cooperating municipalities or provincial initiatives. The State Bureau for Drinking Water Supply helped

[4] Told to me by a colleague from Erasmus University about his grandmother who lived in Zeeuws Vlaanderen.

state-subsidized companies by providing technical plans. Director and staff of this Bureau promoted public drinking water supply: “With bicycle and magic lantern they travelled around” (Leeflang, 1974, p.78). They had to overcome many objections and financial hesitations because of the economic crisis in the late twenties and thirties. The last regional company was established in 1937 in Drenthe. By then, groundwater had become the most important resource: 74% of the supply.

Table 3.3: Technology development in the water industry (Leeflang, 1974, p.46, 49-50, 82-85,90,92; Wijmer, 1992, p.50,82)

Discovery or first experiments		**First application in Dutch water industry**	
Production			
old trad.	sedimentation of surface water	1874	Rotterdam water works
1810	first application of surface water infiltration in Glasgow	1940	surface water infiltration applied in Leiden
1829	slow sand filters applied by James Simpsons in Chelsea Water Works	1874	Rotterdam water works
1868	Report to the King: cleaning surface water with FeCl	1950	Rotterdam water works
	German invention	1893	cokes towers for de-ironing of groundwater in Breda and dune water in Middelburg
		1907	gravel filters for de-ironing of dune water
		1924	slow sand filters for de-ironing of groundwater
1885	fast sand filters developed in United States for surface water purification	1931	fast sand filters in Rotterdam; adapted for de-ironing of groundwater
1900	ozonization studied by Schiedam water company	1960-1970	application in Rotterdam
1902	disinfection with chlorine developed by Maurice Duyck in Belgium	1922	chlorine applied as temporary measure in Maastricht
		1929	permanent chlorine dosage in Amsterdam
1922	first experiments with powdered carbon against taste and odour problems	1933	first successful application of powdered carbon
1972	first experiments with membrane technology	1998	first large scale application by PWN
Distribution			
		1853	steam engines for pumping
		1900	electric pumping
		1911	diesel engines for pumping (at first as emergency provision)
1678	Belgian iron industry produces first cast iron pipelines for water transport to a fountain in Versailles	1853	cast iron transport pipelines, smaller pipelines of lead
		1912	steel transport pipelines (corrosion problems)
1913	first asbestos cement transport pipelines in Casale, Italy	1931	asbestos cement applied by regional companies
1930	endemic lead poisoning in Leipzig because of lead water pipelines	1942	copper officially allowed for smaller pipelines
		1946	corrosion prevention in pipelines through a layer of asphalt bitumen
1937	PVC applied in Germany	1949	PVC applied in the Netherlands
Quality control			
1864	Pasteur discovers micro-organisms	1892	first bacteriological lab in Leeuwarden
		1893	first full water supply lab in Rotterdam
1904	first Coli tests developed by Van ‘t Hoff in Rotterdam	1933	Coli generally used as indicator for faecal pollution

The highest number of companies was reached in 1938, namely 231 (Blokland, 1999). In 1940, 75% of the Dutch citizens had drinking water supply (Leeflang, 1974, p.78). In densely populated areas such as Zuid-Holland it was supplied by a patchwork of many small companies. It became more and more difficult for these companies to meet the technical and hygienic standards that had been developed. Three of them merged with PWN: 1 in 1922

and 2 in 1927. The idea of an active concentration policy was launched by director of the State Bureau for Drinking water, Dr. Krul, in a VWN lecture in 1942 (Leeflang, 1974, p.116).

The period between 1910 and 1950 was also characterized by a struggle of water companies to improve technological control over the water supply system. Water quality needed to be reliable, the supply was supposed to be available 24 hours a day, 365 days a year. The most important problems were hygiene and corrosion of pipelines. Table 3.3 shows how water production and distribution techniques developed from science to practice.

Around 1920, Dutch water companies started to worry about an important resource, the river Rhine. Industrial growth in the German Ruhr area led to unacceptable taste and odour problems for drinking water (Leeflang, 174, p.110). Water companies experimented with a purification method based on powdered carbon. After unprecendentedly severe quality problems in the winter of 1929, a Committee Taste and Odour River Water was established. They started looking for the causes of the problems, suspected phenols, but did not succeed in proving this theory. In 1931, the Committee was alarmed by plans from French potassium mines to drain off salt waste into the Rhine. Although the size of the potassium industry, around 1930, did not directly lead to an unbearable salt load in the Rhine, the committee predicted that the maximum amount allowed by the French government, 200 g per m^3 river water, would be a problem in the future. In 1933, committee members travelled to France to raise objections but they achieved nothing. In the same year, the experiments with powdered carbon were successful, at least for the taste and odour problems, and the committee unfortunately lost its momentum.

Next to solving technological problems, water companies had to respond to a growing water demand. This was caused by population growth, a growing water use per person and migration from rural areas to cities in the western part of the Netherlands. Exhaustion of dune resources was expected. One of the first Dutch nature activists, Jac. P. Thijsse, wrote about the dunes in 1910, “In places where water companies have not yet done their destructive job, small lakes are shining” (Wijmer, 1992, p.115). In 1926, Amsterdam planned to extract drinking water from an area as distant as the Veluwe (Leeflang, 1974, p.105). Resistance from Veluwe inhabitants, local industry, and forestry, led to the establishment of a Veluwe Committee in 1927. Although Amsterdam abandoned its Veluwe plans in 1928, the Committee continued the hydrological research, and published an extensive report in 1933. One of the solutions in this report was the recommendation to make legal arrangements for desiccation damage.

In the same year 1926, another dune company, PWN, requested that the State Committee was set up to assess the resource problems (Leeflang, 1974, p.113). This Committee for Water Supply in the West of the Netherlands was established in 1931 and reported in 1940 about the water demand in the Netherlands as a whole. It advised to use more surface water resources, mainly the IJsselmeer[5] and the river Rhine. The report also contained a draft law to protect water resources. The same Jac. P. Thijsse was a member of this committee and since 1910 he had changed his view: although water extraction had led to lower groundwater levels in the dunes, the area was saved from building activities, because of its function for water production (Leeflang, 1974, p.115).

Hydrological research was needed to make groundwater resources more predictable. In 1936, the director of PWN organized a hydrological experiment to check Winklers’ idea of 1867, that forestation of the dunes with pine trees would lead to a higher water output by the dunes (Leeflang, 1974, p.105). The experiment had the following outcome:

[5] The IJsselmeer existed only since 1932 when the former Zuiderzee was cut off from the North Sea by a dam. At the time of the report in 1940, the water of the IJsselmeer was still brackish.

- Bare dune sand 75% of the rainfall available as drinking water;
- Natural (low) dune vegetation 40%;
- Hardwood forest 40%;
- Pine forest 22%.

These results were quite contrary to Winklers intuition.

Water companies often had difficult debates with governments about necessary investments. It sometimes took several decades before a problem signalled by engineers could be acted upon. Usually, the responsible administration would only react after a calamity that substantiated engineers' warnings. An example was the prediction of the director of the Amsterdam water company, J.M.K. Pennink, around 1903 that the cheap solution of deep groundwater extraction in the dunes would lead to salinization of resources. In 1901, he had suggested to infiltrate surface water from the Rhine into the dunes. As a result of a lenghty conflict Pennink was fired by the municipal government in 1916 (Wijmer, 1992, p.114). Although salinization occurred much later than Pennink expected, more and more dune wells produced brackish water in the 1920s and in 1929 Penninks plan was reconsidered by PWN. In 1940, the water company of Leiden was the first to implement infiltration techniques. In 1955 and 1957, the companies of The Hague and Amsterdam followed.

The VWN association played an important role in the diffusion of technical solutions across the sector through voluntary knowledge exchange (Wijmer, 1992, p.90). VWN also promoted institutionalization of technological achievements, for example, with a training course for pipeline fitters in 1929, the publication of norms for pipelines in 1933, and the establishment of an Inspection Committee for water supply articles in 1934 (Leeflang, 1974, p.102-103). Originally meant as an association for water company personnel, the VWN got more and more organizational tasks.

In 1940, the Netherlands were drawn into the Second World War. The damage of the three-day invasion by the Germans in May 1940 was limited, except for the heavily bombarded city of Rotterdam. The Dutch water industry was reorganized according to the German model: the State Bureau for Drinking water was renamed "State Institute for Drinking Water" (RID) and in 1941, a compulsory Trade Group was established for the water industry. The VWN association was dismantled in 1942. The VWN went underground and received help for their activities from the Trade Group and the RID, which led to tight bonds between the three organizations. The water companies continued most of their operational activities during the five war years. As Leeflang wrote, "Despite of the hunger, that exhausts the personnel, despite of the razzia's that threaten the young, the water companies continue. And the diagrams of the water use during 24 hours true-heartedly register the broadcast hours of Radio Oranje in its lowest points" (1974, p.123). Research, infrastructure investments, and policy making came to a standstill. The war of liberation by the allied forces in 1944-1945 caused a lot of damage, especially to water towers (Leeflang, 1974, p.124).

After the World War, not only the damaged infrastructure needed to be rebuilt. The water demand had kept on rising and the water companies need to catch up. A few initiatives to enlarge production capacity had already started before the war. The Hague had built a pilot installation near the Lek (a part of the river Rhine) in Bergambacht in 1936 (Leeflang, 1974, p.118), and in 1939 the city council of The Hague made a decision to transport water from the Lek to the dunes. After the war, a 45 km long, concrete pipeline was built, and in 1955 the first river water was pumped to the dunes (Leeflang, 1974, p.160). PWN started a pilot project to use water from the IJsselmeer in 1937. Rotterdam was also making plans before the war for extra capacity with an entirely chemical purification process (Leeflang, 1974, p.118). In 1953, such a water production unit was built.

In 1952, PWN and Amsterdam established a new company together, Water company Rhine-Kennemerland (WRK), to pre-purify water from the Amsterdam-Rhine canal and transport it to the dunes. The concrete pipeline covered 80 km, from Jutphaas to Castricum, and branched off to Velzen. It became operational in 1957. By then, the quality of the Rhine water was much worse, therefore, powdered carbon and chlorine were necessary as extra purification steps (Leeflang, 1974, p.162). Infiltration of Rhine water led to a short-lived return of dune vegetation that had perished as a result of the desiccation, but soon it disappeared again as a result of the pollution (Wijmer, 1992, p.116).

In 1945, the percentage of the population connected to the drinking water system was still 75%. This percentage had been reached with very little state support. In 1940, the remaining dispersed dwellings had already been judged as non-remunerative (Leeflang, 1974, p.147). In 1946, a "Committee Drinking Water Supply Stricken Areas" was set up to provide a subsidy for rebuilding war damage and at the same time building supply for non-remunerative areas. From 1949, the arrangement was also available for non-stricken areas, and in 1953 a ten-year plan was made to expand drinking water distribution to all non-remunerative households. In 1963, 96% of the population was connected to a water supply system (Leeflang, 1974, p.149).

The German interventions during the war years accelerated the maturation of water institutions. As the sector wanted to liberate itself from the German structures, the Trade Group is dissolved and the VWN re-established after the war (Leeflang, 1974, p.134). But a difference had grown between the more formal and professional activities of the Trade Group, and the underground activities of the personnel association VWN. Soon after the war, in 1946, a specialized water research institute KIWA was established. It included the Inspection Committee for water supply articles, which had started in 1934. Besides inspection activities, KIWA was supposed to do technological research into water production, hydrology, and distribution. Vewin was established in 1952 as a trade association to further the interests of the sector and to deal with the government, allowing VWN to concentrate on educational activities (Leeflang, 1974, p.138)

Table 3.4: Issues and structures between 1910-1950

Issues	**Structures**	**Influences in the year 2000**
How to convince rural populations of the benefits?	growing number of regional companies	
	an increase in water infrastructure outside as well as inside houses	a lot of the distribution infrastructure is still operational today, which keeps the water price at an acceptable level
How to deal with new pollutants?	three institutions to support technology development: RID, KIWA and Delft University	KIWA and Delft department still exist, RID became part of RIVM
How to balance the demands for low tariffs and a good quality supply?	technologies to cope with pollution and corrosion	many technologies are still used
	trade association to further water company interests	local, provincial, and national governments trust the sector
How to reach non-remunerative areas?	national laws to subsidize distribution in sparsely inhabited areas	
How to prevent exhaustion of resources?	unresolved	

A final development worth mentioning was the involvement of the Technical University of Delft. After the war, this university decided to take up drinking water technology into its research and education program (Leeflang, 1974, p.212). In 1947, the director of the State Bureau for Drinking Water Dr. Krul was invited to become extraordinary professor. He organized the first 'holiday course' for VWN members in 1948. In 1958, he became a full-time professor, and the department "civil health engineering" was formed with drinking water

production and waste water treatment as its subjects. His successor, in 1963, also was a former drinking water director, this time from the Amsterdam Company. This shows the tight relations between this university and the drinking water sector, from the start.

3.6 Legislation and growth of demand (1950-1970)

The period between 1950 and 1970 can be considered as the period of technological maturation of the water industry. Firstly, the distribution project was completed. In 1963, 96% of the population was connected to the system. For the remaining 3,4% of 'super non-remunerative' households, a new subsidy arrangement was made in 1962 and 99% of the population was connected in 1968 (Leeflang, 1974, p.149). Next to that, production and distribution technologies were perfected in a united effort of KIWA, RID, and research within individual water companies. Purification steps with activated carbon, chlorodioxide and ozone were developed, and corrosion in the pipeline network was finally under control (Leeflang, 1974, p.188).

In 1949, PVC pipelines were introduced, which meant a spectacular advancement in corrosion control. At first, PVC was only used to replace smaller pipelines made of copper. KIWA declared them appropriate for all water types in 1951. In the same year, the start of the Korean War caused a rise in the copper price, speeding up the decision of water companies to switch to the new material. WMO was the first company to use PVC for main water pipelines in 1954 (see also section 5.4.5). In 1970, 40% of the smaller pipelines consisted of PVC. From then on, copper is only used for pipelines inside houses.

This was also the period of increased state control on the drinking water sector. The first law concerning the water industry was the Groundwater Law for Water Companies of 1955 (Leeflang, 1974, p.200). It transferred the groundwater licensing task from the municipal to the national level: licenses to water companies were now issued by the Ministry of Health and Environment. The law also contained regulations for financial compensation of desiccation damage. This law was expanded to all other actors dealing with groundwater in a general Groundwater Law in 1981. From 1981 onwards, provincial governments were responsible for groundwater licenses.

Secondly, the State started to work on a Drinking Water Law after the war. The first ideas about legislation of the sector already existed in the Report to the King of 1868, inspired by a British example. If this would have received follow-up, the Dutch sector might have become privatized (Leeflang, 1974, p.203). However, the new law was based on a report from 1940, published by the State Committee for Water Supply in the West of the Netherlands (see Section 3.4). In 1940, nearly all Dutch water companies were government owned.

In 1947, the Dutch State send a law proposal to the water industry Trade Group, but the industry immediately objected to the "absolute power of the central government" over water companies. They argued that the water companies were already functioning well, so they did not need these tight regulations. After the establishment of the Vewin in 1952 negotiations became more structured. The final law, issued in 1957, contains broadly formulated performance requirements. The Drinking Water Law also regulates monitoring of drinking water quality, and authorizes the Health Inspection to check on water company performance at all times. The Vewin was allowed to formulate more specific water quality demands, and did so in its Recommendations of 1960.

The Drinking Water Law also expressed the intention of reducing the number of companies through mergers. The main instrument for this, according to the law, was *persuasion*, and only if this was not effective other legal instruments were to be used. This brought about a

tendency to merge companies, supported by provincial governments (Leeflang, 1974, p.151). Progressive environmental pollution was another driver because it hindered production of drinking water in inhabited areas. Urban companies merged with regional companies to make resources from rural areas available for urban customers. In 1967 there were still 146 companies, many of which were very small (Leeflang, 1974, p.210).

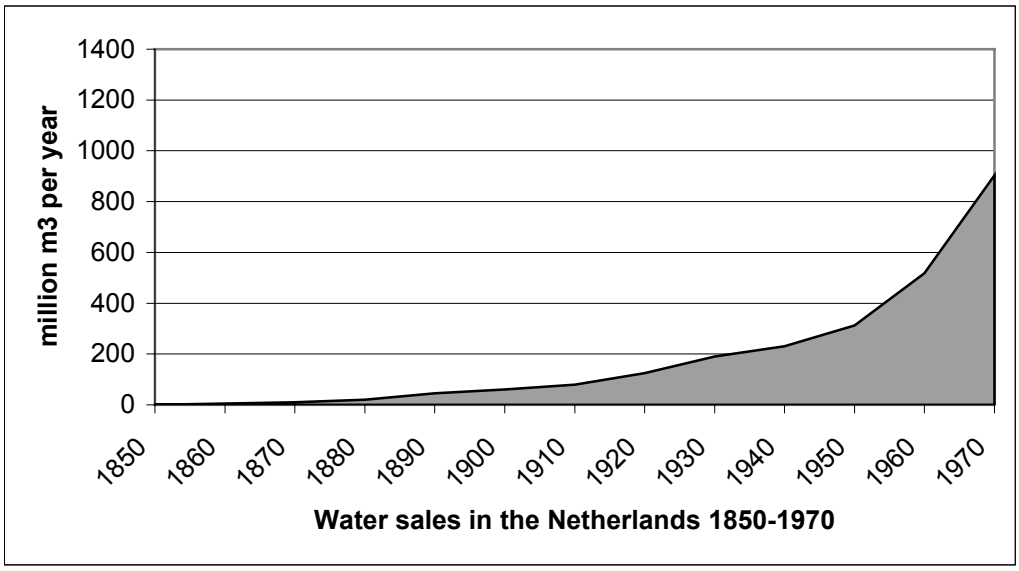

Figure 3.5: Rapidly growing water demand between 1950 and 1970.

Between 1950 and 1965, water demand grew explosively, due to population growth, penetration of sanitary appliances, such as toilets and showers, penetration of water heating appliances, and industrial growth (Leeflang, 1974, p.168). Figure 3.5 shows the effect of these developments on water demand. For the water companies this caused constant pressure to expand their production capacity. The law from 1957 obliged them to respond to any demand; therefore, they strived for some overcapacity at all times. WRK had to be enlarged by the water company of Amsterdam. PWN built a new production unit in Andijk near the IJsselmeer. Vewin started the first water saving campaigns (Wijmer, 1992, p.118).

The water company of Rotterdam had difficulties keeping up with industrial growth, and was even more troubled by the unreliability of the river Rhine. During the low water season, more concentrated pollution came down the river, and because the Rotterdam harbour had been deepened to receive larger ships, salt threatened to come in from the sea. A strong western wind in 1963 caused such a salt invasion up the river Rhine, past the water production units, and for three days the households of Rotterdam got brackish water out of their taps. This calamity was named ‘the Salt Disaster of 1963’ (Leeflang, 1974 p178). After this crisis, the municipal government of Rotterdam allowed the water company to invest in large water reservoirs in the nature reserve the Biesbosch. These reservoirs form a buffer when the water level is low or when an unacceptable pollution comes down the river. Besides that, a natural purification process takes place, while the water remains in the reservoir (Leeflang, 1974 p188). The Dutch State supported the construction of these reservoirs, under the condition that they were shared with other water companies in Zeeland, West-Brabant and Zuid-Holland.

Table 3.5: Issues and structures between 1950-1970

Issues	Structures	Influences in the year 2000
is there a need for state control?	legislation: Drinking Water Law and the Groundwater Law	Drinking Water Law of 1957 is still effective
	Vewin adds voluntary regulations about product quality	
how to cope with fast growth of water demand?	reservoirs in the Biesbosch	three Biesbosch reservoirs still play a crucial role
is the scale of the companies too small?	unresolved	

3.7 Environmental pollution (1970-1990)

The period between 1970 and 1990 is characterized by a growing environmental awareness. The publication of Rachel Carson's book "Silent Spring" in 1962, is often taken as a starting point for this development (Wijmer, 1992 p104). Inspired by this book, the use of insecticide DDT was restricted in 1970. Another starting point was the Club of Rome report of 1972, calculating that human population growth would lead to the exhaustion of many natural resources within a few decades (Meadows et al, 1972). Carried by a wave of democratization, protest and renewal, hundreds of environmental groups were established in the Netherlands during the seventies (Wijmer, 1992 p121, Cramer, 1989 p42).

The pollution itself was not new. The first recorded environmental incident happened as early as 1875: BASF in Ludwigshafen drained arsenic into the Rhine, which led to a conflict between the Dutch and the German government (Wijmer, 1992 p89). In 1897, the first State Committee was formed to prepare legislation about surface water pollution, leading to a first outline of a law between 1909 and 1912 (Leeflang, 1974 p203). We already saw how drinking water companies had to deal with taste and odour problems since 1920, and in 1946 the first negotiations had started between Dutch and German governments about the pollution of the Rhine (Leeflang, 1974 p192).

The establishment of the chemical industry in Germany after the war made the situation worse. Between 1950 and 1975, the river Rhine was considered a 'dead river'. Drinking water made out of surface water was barely drinkable, despite the purification efforts of the water companies. Water companies became annoyed that they had to use more and more technology to clean up pollution of other industries. In 1951, a group of water companies established the Rhine Committee Water Companies (RIWA) to combine forces in their fight for clean resources (Leeflang, 1974 p195). In 1953, German water companies followed this example by starting the 'Arbeitsgemeinschaft Rhein-Wasserwerke', and these agencies jointly started to investigate Rhine pollution. As a result, the oil dumping by ships into the Rhine was forbidden in 1954. Oil receiving facilities were built along the river bank, but most ships ducked the regulations, and by 1970, only 20% of the oil waste was collected.

After more than 15 years of fruitless efforts by RIWA, a big crisis occurred in 1969. On the 23rd of June the Dutch Ministry of Water Management was informed that an extreme fish mortality had occurred in Germany. On the same day all Dutch water companies closed off their extractions from the Rhine. Luckily, the water companies could use the Biesbosch reservoirs, so water production continued. On the 24th of June, the Dutch State Institute for Public Health (into which the RID had merged) found out which pollutant it was: the insecticide Endosulfan. After this crisis, surface water pollution was taken more seriously. The environmental group Stichting Reinwater took the Rhine salt problem to court in 1974. They formed a coalition with RIWA and the Dutch horticultural sector and finally had success in 1977, when a compromise was reached about maximum salt levels from French potassium mines (van Ast, 2000). In 1991, the second part of the Rhine Salt treaty was signed, allowing a maximum of 200 mg salt per liter at the Dutch-German border. This did

not really solve the salt problem but spread it over many years (Wijmer, 1992 p121). It is expected that the problem will end, when the salt mines are exhausted in 2010 or 2020 (van Ast, 2000 p295).

After 1970, the Dutch government produced environmental legislation for water, air and soil, including enforcement of these regulations. The Law on Surface Water Pollution was completed in 1970, and formed the starting point for waste water treatment in the Netherlands. Industrial waste water treatment was introduced between 1980 and 1990, which led to further improvement of surface water quality (Wijmer, 1992 pp122,130). Improved chemical detection methods enhanced these developments. With the growing knowledge about pollution, requirements for drinking water expanded, which in turn asked for new technology, which then enabled even stricter requirements for drinking water.

The years between 1965 and 1975 were not only characterized by environmental pessimism, but also by growing prosperity (Wijmer, 1992 p102). Water demand was growing fastly. Figure 3.5 in the former section shows the growth curve the water companies and the Dutch government were looking at in 1970. At the time, it was expected that demand would eventually grow to 315-390 liter per person, per day (Wijmer, 1992 p119). Vewin started another round of water saving promotion. This seemed to have some effect on the curve of water use, as is shown in figure 3.6.

Water production requires a lot of space in the form of reservoirs, infiltration areas, and groundwater protection areas. In a densely populated country as the Netherlands, spatial claims are hard to realize, especially when everything else is growing as well: housing, industries, roads, recreation facilities and so on. To manage such pressures, extensive procedures for spatial planning are customary. This makes it necessary for water companies to look ahead at least ten years, if they want to expand production capacity. Between 1960 and 1970, the combination of these factors led to a large number of expansion plans, which seemed impossible to realize.

In 1964, the Minister of Health decided the time had come for a more central approach to production capacity planning. He asked the RID to make some basic plans (Wijmer, 1992 p119). Apparently, the RID lacked the expertise to make such plans, due to the autonomy of the companies. In 1972, a governmental policy statement (Structuurschema Drink- en Industriewatervoorziening) asked the association of water companies, Vewin, to produce a ten year plan. The intention was to coordinate all demands, and to look for cooperation possibilities between water companies. In 1978, Vewin produced its first ten-year plan. It was a compilation of plans made by individual companies, but at least large spatial claims could be coordinated. This central planning effort led to much closer relations between the state and the water companies.

Another development in this period was the concentration of the sector. After the peak of 231 companies in 1938, the need to merge into larger entities was suggested at a VWN meeting in 1942. Since the Drinking Water Law of 1957 it was formal policy. The number had gone down to 146 in 1967, which was seen as insufficient. Triggered by the capacity problems, the national government made an amendment to the Drinking Water Law in 1971, prescribing that a water company should at least serve 100,000 households. Provincial governments were asked to develop reorganization plans (Leeflang, 174 p210). Although the norm of 100,000 households was not directly enforced, it gave provincial governments a strong argument for mergers, often with the provincial water company as a core. In 1973, the number of companies was already down to 118, and in 1992 only 40 companies remained (see Figure 3.7).

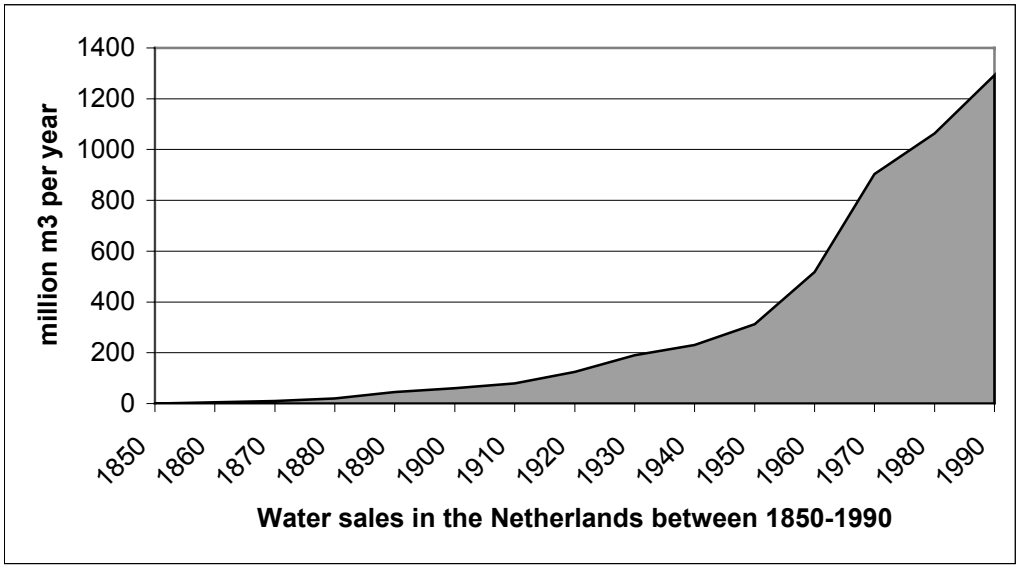

Figure 3.6: Water sales in the Netherlands until 1990

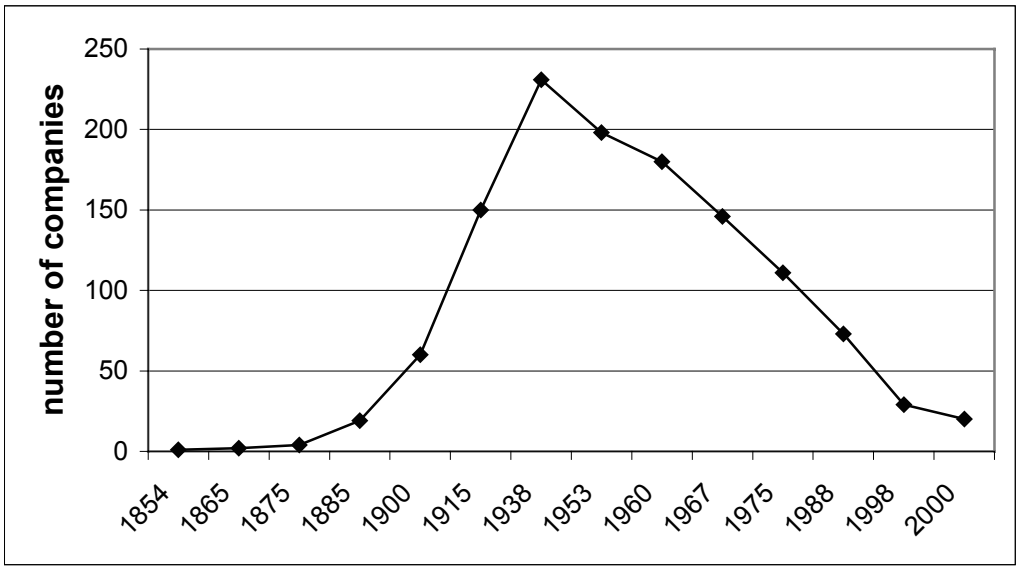

Figure 3.7: Curve showing the establishment of new water companies until 1938 and the mergers until 2000 (based on Wijmer, 1992; Blokland, 1999)

Around 1975, desiccation became a hot issue. Triggered by the large scale expansion plans, environmental groups started opposing against surface water infiltration (Wijmer, 1992 p113). The Foundation for Dune Conservation (Stichting Duinbehoud) was established in 1977 with the explicit goal to drive the water companies out of the dunes. The water companies felt wronged by this opposition. They doubted if they were to blame for the desiccation problems, because pine forests planting and polder drainage also had resulted in lower groundwater levels in the dunes. Even if water extraction was negative for nature, wasn't public health much more important? Besides, if the water companies had not defended the dunes against building houses, industrial expansion and agriculture, there wouldn't have been any dunes left at all. A 'real war' between water companies and environmental groups followed.

During the eighties, the Foundation for Dune Conservation changed its strategy. They realized that water companies had a societal task to fulfil, and started acquiring knowledge

about alternative technologies for drinking water production. Around 1985, they were on speaking terms with the water companies, and in 1990, one of their proposals was adopted by the water companies: deep infiltration was applied, which requires less space compared to surface infiltration (Wijmer, 1992 p117).

A comparable story can be told about the fourth reservoir in the Biesbosch nature reserve, against which the Association Preservation Biesbosch had successfully protested since the seventies; it was never built.

In 1975/1976, the first Parliament files about a new Groundwater Law appeared, giving possible exhaustion of groundwater resources as the most important reason to develop this law. This may have been inspired by the Club of Rome report. Provincial governments had started to regulate groundwater protection several decades earlier, for example, Limburg had its first regulation in 1955, Gelderland in 1962 and Utrecht in 1964 (Van Geleuken, 1998). The Groundwater Law was issued in 1981, and became effective in 1984. It decentralized the groundwater licensing responsibility from a national to a provincial level. The law also required water companies and other industries to measure and report extracted groundwater quantities.

From 1986 onwards, groundwater quality became threatened, mainly by fertilizers and pesticides (Wijmer, 1992 p123). This especially affected regions with intensive agricultural activity and superficial groundwater layers such as Overijssel, Gelderland and Limburg.

Between 1980 and 1990, most of the companies were reorganized into public limited companies. This had to make internal decisionmaking processes more efficient. Municipalities and provincial governments became shareholders. With this development, the period of municipal companies ended (1920-1975), and the period of public limited companies (PLC's) had started (Blokland, 1999).

Table 3.6: Issues and structures between 1970-1990

Issues	**Structures**	**Influences in the year 2000**
how to deal with resource pollution?	environmental groups, RIWA	still exists
	environmental legislation to protect water resources from pollution	legislation is still effective
	technology for water treatment and water purification	advanced technology to deal with pollution
how to realize growth of production capacity?	addition to Drinking Water Law: planning procedures in a national framework	
	guideline about minimum of 100,000 customers leads to mergers	tendency to merge and improve company efficiency
how to deal with desiccation?	provincial influence on water companies is increased with the Groundwater Law	an important role for provincial governments regarding water companies

3.8 Looking for sustainable solutions (1990-1995)

Around the year 1990, an important change took place in the general societal attitude towards environmental problems. Suddenly everyone agreed that something needed to be done: the general public, the media, politicians and large industries. A cartoon by the Dutch cartoonist Peter van Straaten describes the atmosphere in this period: a woman embraces a somewhat surprised man while she says: "I'm so glad I finally meet someone who is against the environment too!". International events marking this shift were the Brundtland report, published in 1987, and the UN Summit on sustainability in Rio de Janeiro in 1992. In 1989, the Dutch government published an ambitious first 'National Environmental Policy Plan: to

choose or to lose'. In this period, the term 'sustainability' was introduced in all Dutch governmental communications: in the National Environmental Policy Plan, in the Third Act on Water Management of 1989, in provincial plans and so on.

This dissertation is not meant to explain the societal change regarding the environment around 1990; see for example Hajer (1995) about the role of international institutions, Hannigan (1995) about the role of scientists and the media, and Eder (1996) about the role of green politicians. We are interested here in how the change affected the drinking water sector in the Netherlands.

The National Environmental Policy Plan induced Vewin to publish a Vewin Environmental Plan in 1991 (Wijmer, 1992 p131). This plan looked at environmental problems from two angles: "...on one hand water companies as 'victims' of environmental pollution, on the other hand water companies as 'polluters'." (Vewin, 1991). It dealt with waste management, energy and chemical use, and desiccation. Another important topic was water saving. Vewin provided individual water companies with leaflets and other information material to promote water saving behaviour by households.

The National Environmental Policy Plan mentioned desiccation as one of seven environmental themes. Operationalization of anti-desiccation policy was delegated to the provinces. They had to report how large the 'desiccated area' in their province was, and what percentage of the problems was solved or was being solved. This responsibility induced many provinces to formulate stricter groundwater policies. Around 1990, groundwater extractions were seen as one of the main causes of desiccation, so water companies were confronted with a standstill or even reduction of extraction licenses.

Water companies stopped arguing about who was to blame for the desiccation, and started to think about technical solutions. This led to many plans for drinking water production out of surface water. They also made plans for the production of a different quality of water, called 'household water'. Household water is made of surface water, which has been purified lightly, but the final, most difficult steps of pathogen removal have been skipped to save costs; it and can be used for purposes such as toilet flushing and clothes washing. This type of use was estimated as 40-50% of household water use, so it was supposed to lower the pressure on groundwater resources. A similar development took place for large-scale users: they were offered cheaper 'industry water'.

The ecotax-law of 1994 introduced a tax on groundwater extractions. This was preceded by heavy protest of the water companies, who had been arguing for years with their governmental shareholders about every cent the tariff was allowed to rise, and now all of a sudden it was raised with 34 cents. It annoyed them that this tax money would go into general state funds, instead of into groundwater protection or other water-related goals (Wijmer, 1992 p132). The idea behind the tax was that it would make groundwater more expensive, so that surface water became more attractive. Apparently, the national government saw surface water as a more sustainable resource. Although the tax made some water companies consider the use of surface water, it also encouraged medium customers in areas with good groundwater to disconnect from the network (called 'water flight'). Farmers made their own well for watering livestock. This was facilitated by the 'hole' in the groundwater law, that says extractions below 10 m^3 per hour do not need a license. This mechanism caused reduced the water demand for many water companies, without lowering the pressure on groundwater resources.

By 2000, the municipal company had become an exception, with only Amsterdam and Tilburg still resisting provincial plans. The sector expects to merge further, until only 3-6 companies will be left.

Table 3.7: Issues and structures between 1990-1995

Issues	Structures	Influences in the year 2000
how to deal with desiccation?	ecotax law for groundwater	ecotax still exists
	efforts to switch to surface water production	a few companies made the switch to surface water
		availability of tailor-made water qualities for industry
	promotion of water saving, water saving appliances	stabilized demand
how to deal with sustainability?	Vewin environmental plan	waste reuse organization
how to enlarge the scale of the companies?	mergers	small number of large water companies

3.9 Debate about liberalization (1995-2000)

Between 1995 and 2000, the liberalization debate was the hottest topic in the drinking water sector. Different events were mentioned by respondents as a starting point for this debate: the privatization of water companies in the UK in 1989; the new 'purple' government in the Netherlands in 1994; and the EU Report on Competition Policy of 1995, expressing the intention to liberalize the utility sectors energy, waste, public transport and telecom. Around 1995, the idea developed that this liberalization trend was applicable to drinking water as well, although the EU never made this explicit. Several energy companies, who were on a way of no return towards a free market, wanted to include water to improve their market position. Large water users, such as the food industry and the chemical industry, also saw the advantages of a free market. So did the Ministry of Economic Affairs, that regarded drinking water technology a promising export product. These actors formed a coalition in favour of liberalization.

Around 1996, the Ministry of Environment decided to revise the Drinking Water Law of 1957. It included the liberalization option in a first outline of the Law. Unexpectedly, this led to upheaval in the drinking water sector. The majority of companies was against liberalization, which was based on a number of arguments:

- "The distribution network is too expensive, so newcomers on the market can never compete with existing companies. This makes drinking water a natural monopoly. A free market is impossible, and a public monopoly is better than a private monopoly."

- "Production and distribution of water cannot be separated, because if there is a hygienic problem, one organization should be responsible to detect the cause as soon as possible throughout the whole system. We should waste no time on finding out which organization is to blame."

- "Private companies are expected to pay less attention to nature management and other sustainable, but unprofitable aspects of water production."

- "The sector functions well: Dutch drinking water quality is very good, and most consumers think the water is cheap. Quality will suffer if the companies are forced to restructure."

A minority of water companies was in favour of liberalization, so this caused severe tensions within the sector, previously characterized by a cooperative culture. Provincial and municipal shareholders were divided on the issue as well. The minority coalition in favour of liberalization had strong arguments such as:

- "Liberalization is more progressive; liberalization is the future, because eventually the EU will prescribe it."

- “Liberalization will make the sector more efficient.”

- “Liberalization will improve customer friendliness.”

- “Liberalization will strengthen the position of the Dutch water sector on the international market, which is now dominated by only a few French companies.”

To counter the arguments about efficiency and customer-friendliness, the drinking water sector developed a voluntary benchmark, covering four themes: product quality, customer satisfaction, environmental performance and costs. In the environmental performance measurement, energy use was a dominant issue. Companies using green energy got a good score, an outcome that influenced many other companies to think about green energy too. Some of the pro-liberalization companies decided not to participate in the benchmark: a free market was the only real benchmark for them. The first version was published in 1999, presenting figures of 1997, and the second in 2001 with figures of 2000. A three-yearly ‘full’ benchmark is planned for the future, plus a yearly benchmark on costs.

While the Ministries of Environment and Economic Affairs investigated possibilities for a market mechanism, opposition arose in Parliament. In April 1998, a motion against liberalization of the drinking water sector by Feenstra received broad support. After the elections in May 1998, a new Minister of Environment, Pronk, ended the debate by opting for a public monopoly structure. In the revised Drinking Water Law large customers, using more than 100,000 m^3 per annum, will get the opportunity to choose their own supplier. Although Pronk was backed up by the Dutch Parliament, this did not silence the pro-liberalization lobby. They expect the liberalization trend will prevail in the end.

Even though the majority of the companies formally favoured the public monopoly structure, and even though this public structure was the formal choice of the Dutch national government around the year 2000, behind the scenes many companies started to prepare for a liberalized future anyway. They lowered their costs, heightened their solvability, developed products for the private market, acquired commercial water laboratories, took a look inside ‘real’ commercial companies, worked on their internal culture, and hired new managers with a commercial background. Companies worked on customer friendliness; in some companies contact with larger customers was improved, others did a survey to check consumer wishes. The liberalization debate has put things in motion, and these efforts may themselves become a driving force towards liberalization.

To the drinking water companies, the liberalization debate was about survival. Would they remain autonomous or would they become a small part of gigantic international multi-utility companies such as Vivendi? This automatically pushed environmental issues lower on the list of priorities. Sustainability did not disappear though, because it was one of the arguments against liberalization. The debate opened the sector up to society. Many companies used ‘stakeholder models’ to assess their overall performance. Consensus was also growing on the ‘grey’ environmental issues such as use of sustainable energy and reuse of waste. The ‘green’ environmental problems, concerning nature and desiccation, were more difficult to solve.

Around 2000, it became clear that the message to save drinking water had been picked up by households and industry. Total water demand in the Netherlands stabilized, even though the population and the economy were still growing (see figure 3.8). No one seems to have expected this success. As a consequence, most of the large scale surface water plans were canceled, because no extra capacity was needed. The plans could also have facilitated a switch from groundwater to surface water, but the liberalization debate induced more cautious investment behaviour. Most companies stopped active water saving promotion:

'Why would we promote reduction of our own sales?' Provincial and national governments lost their interest in water saving, so there was no pressure from shareholders anymore.

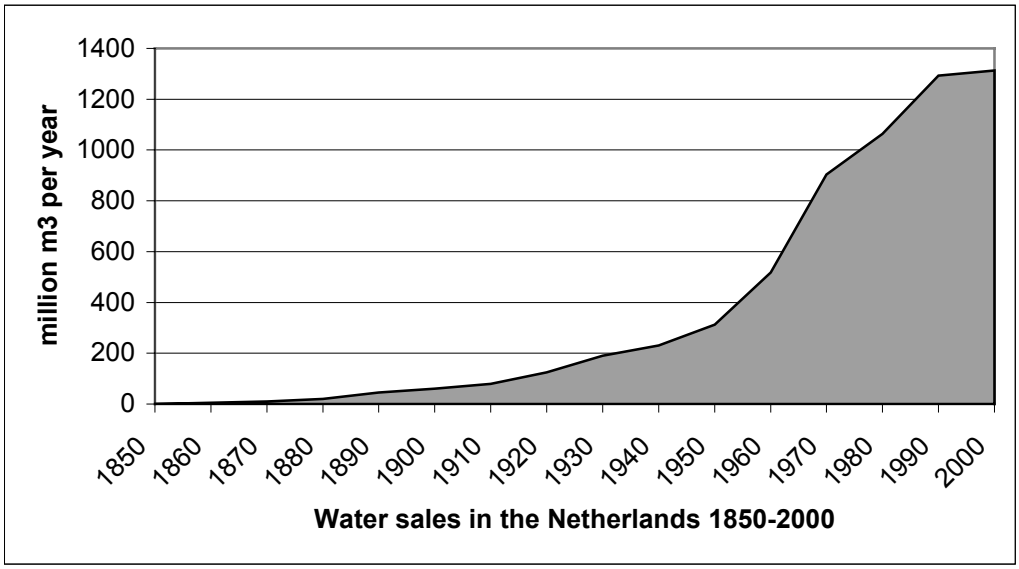

Figure 3.8: Water sales stabilized between 1990 and 2000

One more development put sustainability lower on the list of priorities. Ongoing research into desiccation showed that water companies are only responsible for about 20% of the desiccation. Drainage of rural areas by water boards accounts for 60%, and drainage in inhabited areas for the remaining 20% (RIVM, 1995). In general, measures at surface water level are expected to lead to more nature recovery than reduction of deep groundwater extractions. These are averages, and at local level the effect can be different. This new information reduced the pressure on water companies to lower groundwater extraction.

In the late nineties, a debate has started that water companies should cooperate more closely with water boards. In the Netherlands, operations in the water chain are divided over three types of organizations: drinking water companies produce and distribute water; municipalities collect and transport the waste water in a sewerage system, and water boards treat the waste water before it is drained off to the surface water. These organizations each receive their own income through tariffs, taxes and levies. In the present system, drinking water is mostly paid per cubic metre, while sanitation and waste water treatment are paid in fixed amounts per household.

There are many incentives for the process towards cooperation in the water chain. Firstly, there is the so-called 'financial water track': linking the price for sanitation and waste water treatment to the amount of drinking water should induce households to save drinking water. This idea was promoted by environmental organizations between 1992 and 1995. The 'water track' concept was picked up by governments and water companies, but there were legislative barriers for implementation. Besides, about 10% of the households still didn't have a water meter in 1995. Governments demanded water companies to introduce metering for all their customers, a program that is expected to be finished by 2003 or 2004.

Secondly, the changed view on water management in the Netherlands drove the municipalities, water boards and water companies together. Between 1995 and 1998, several periods of heavy rainfall in the Rhine and Meuse catchment areas, as well as the Netherlands itself, caused unexpected flooding problems. Apparently, fast drainage and dikes were not enough to guarantee the safety of the Dutch population. The new idea is that we should work more 'with nature' than to fight it. Water flows should be more accommodated, rainwater should be retained and surface water slowed down.

Thirdly, the liberalization debate and the stabilization of the drinking water demand made water companies alert to new markets, such as waste water treatment. A somewhat paradoxical aspect is that the water chain was seen as an alternative 'harbour' for water companies who feared mergers with the energy sector. Six water companies gave the debate a push forward by commissioning Kiwa and Rioned (a research institution for the sewerage sector) to investigate the synergies between water supply and sewerage in 1997. In 1998, water boards are drawn in to cover the whole water chain. The resulting Kiwa/Rioned report concluded that cooperation in the water chain could save 5 to 15 billion Dutch guilders between 1998 and 2005. This conclusion had a large impact on peoples perceptions of the water chain, even though it was based on rough estimates.

Since this report, a lot has been going on in the "water chain": meetings, workshops, reports, letters of intent and so on. In practice, the cooperation hasn't taken form yet, apart from a few win-win projects. The explainations the respondents give are:

- Institutional barriers and personal motives keep the structure the way it is;
- Water boards are merging to a larger scale; they are too busy with introspection to be interested in drinking water companies;
- Central or national steering of the process is absent.

It is not clear yet, where this water chain development will lead. The idea itself is logical, but in practice it is complicated. Maybe an optimal construction crystallizes somewhere and is subsequently copied across the country.

Table 3.8: Issues and structures between 1995-2000

Issues	**Structures**	**Influences in the year 2000**
should the sector be liberalized?	voluntary benchmark	benchmark, efficiency goals
	further mergers	smaller number of companies
	legal possibility for a free market for users above 100,000 m^3 per year	some competition
how to deal with sustainability?	'grey': sustainable energy, 'green': unresolved	
how to cooperate with water boards?	unresolved	

3.10 Summary: shared views

While structuring the above analysis, the format 'issues - structures - influences' was used. We have to realize, that a large part of the story does not fit into these boxes. The concluding tables at the end of each section are incomplete, and solutions are not always found in the period in which it was a hot issue. Implementation takes place during a longer period, for example, building the distribution network took more than fifty years, and so did the mergers. Sometimes a solution is the beginning of a new problem and returns in the form of an issue, for example, after everyone is convinced that a water supply system is a good idea, the demand grows so fast that resources are threatened. Although we recognize this complexity, we'll continue our summarizing effort in this final section. Below, the factors influencing the behaviour of drinking water companies are grouped in five categories. For each of the factors, their relevance for sustainability will be assessed.

1. Culture / beliefs:

- Public health is a main argument for decisions.
- A centrally organized, large scale pipeline system is seen as the best solution.
- Building long term infrastructure is the standard.
- A cooperative culture has developed among the water companies.
- Local, provincial and national governments trust the water sector.
- There is a tendency to merge and improve company efficiency.

This group of factors leads to a well organized and innovative sector and to a serious approach of the concept of sustainability. Translation of the concept will often start from the central belief in a large scale pipeline system.

2. Economic structure and governance:

- Water is not sold under cost price and not above cost price either.
- Governments have a dominant role in steering the water sector.
- Provincial governments have an important role as shareholder and as groundwater licensing office.
- Water demand has stabilized because of saving behaviour of customers and an increase in private wells.
- There is a benchmark, and efficiency goals have become important.
- On the industrial market some competition is possible.

The economic structure of the water sector enabled investment in infrastructure as long as the demand was growing. It has led to less leakage of product in the distribution network and to up-to-date technology, both having a positive effect on sustainability. The stabilization of the demand and the market mechanisms may lead to less investment in infrastructure. However, the competition may also lead to (sustainable) innovations.

3. Organizational structure:

- The KVWN association for water company personnel facilitates knowledge exchange and debate.
- The State Health Inspection controls product quality.
- KIWA Research develops technology and knowlegde about resources.
- The Vewin association promotes sector interests towards the government and the general public.
- At the Technical University Delft, the department Sanitary Technology educates water company personnel and develops production and distribution technology.
- Environmental groups form coalitions with water companies to lobby for cleaner surface water, but also attack water companies because of desiccation.
- The RIWA association promotes prevention of Rhine and Meuse water pollution.
- A waste reuse organization specializes in selling drinking water sludges.
- There is a small number of large water companies, rather on a provincial then on a municipal level.

This set of assisting organizations shows the high level of institutionalization of the sector, and its emphasis on research and development. Two of the organizations aim specifically at solving sustainability issues: RIWA and the waste reuse organization.

4. Existing infrastructure and technology:

- A lot of the old infrastructure is still operational, helping to keep the water price at an acceptable level.
- Many technologies are still used.
- The three Biesbosch reservoirs still play a crucial role as buffers in the supply system.
- Advanced technology has been developed to deal with pollution.
- A few companies indeed switched to surface water.
- Tailor-made water qualities have become available for industry

Existing infrastructure can inhibit implementation of new, more sustainable options. The interest in technology development itself can be positive. Combined with the interest in sustainability it has led to some changes already.

5. Legal structure:

- The Drinking Water Law of 1957 is still effective.
- A lot of environmental legislation has become effective to protect surface water and groundwater resources.
- The ecotax law raises the price of products based on groundwater, which makes surface water production more attractive, but also causes medium water users to start their own well.

The legislation concerning this sector almost automatically has an environmental character. There is a direct relationship with sustainability.

We expect the water companies to show similar views and behaviour in most of these aspects. Issues that turned out to be unresolved in Chapter 3, such as desiccation, nature management and cooperation with water boards, are likely to lead to diverging views. In the next chapters, four companies will be explored in depth, in order to find the differences in views on sustainability.