

MESO STUDY SUMMARY: WATER ENGINEERING AND MANAGEMENT

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INTRODUCTION AND DEFINITIONS

In this part of the Meso Study, we will focus on one of the civil engineering sectors, namely the sector ‘Water Engineering and Management. More specifically, we will focus on two distinct classes as stated in the International Standard Industrial Classification (ISIC) of the United Nations. These are named, and defined as follows (Department of Economic and Social Affairs, United Nations, 2008):

- Class 3600 – Water collection, treatment and supply
- Class 3700 – Sewage

Although these two classes seem to be quite different from one another, they are actually entwined in practice. Therefore, they are also addressed simultaneously.

We studied these two classes using Porter’s Diamond (Porter, 1990). . The six ‘aspects’ of Porter’s Diamond will form the basic outline of the coming sections. These aspects firstly address four determinants, namely (1) demand conditions, (2) factor conditions, (3) related and supporting industries, and (4) firm strategy, structure and rivalry. Next to these determinants, there are also two external influences, namely (1) role of government and (2) accidental circumstances (chance).

Next to this will also compare the sector in Brazil with that in the Netherlands and will finish with some final conclusions and a short reflection on the use of Porter’s Diamond.

DETERMINANTS

Demand conditions

Brazil has a total of 8.233 cu km of renewable water resources. This seems an abundance when we take into account that Brazil only uses 59,3 cu km each year (CIA, 2000). However, accessing these resources is not a given to any person.

The figure below demonstrates the build-up of freshwater withdrawal in Brazil. The freshwater withdrawal per capita is 318 cu m/yr. This is clearly less than the 544 cu m/yr that is the case in the Netherlands.

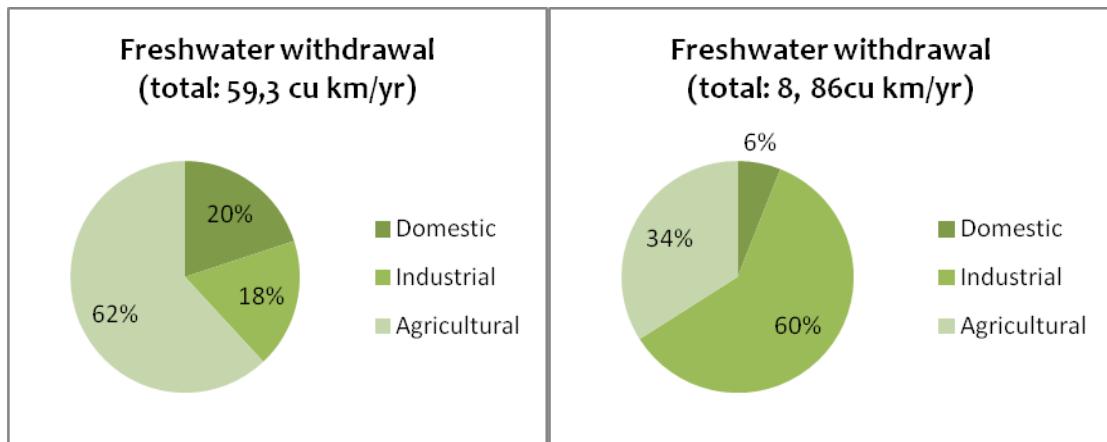


Figure 1: Freshwater withdrawal in Brazil (left) and the Netherlands (right) (CIA, 2000)

Table 1: Population numbers and water supply coverage, HC= household connection. (WHO/ UNICEF, 2008). * The coverage in Brazil of 2008 is determined by the amounts of 2006 that were the last records that were available.

Country	Year	Population			Water supply coverage (%)			
		Total (x1000)	Urban (%)	Rural (%)	Urban Total	Urban HC	Rural Total	Rural HC
Brazil	1990	149570	75	25	96	92	65	35
	1995	161692	78	22	97	93	70	42
	2000	174174	81	19	97	95	75	50
	2005	186075	84	16	98	96	81	57
	2008*	191972	86	14	99	96	84	62
Netherlands	1990	14953	69	31	100	100	100	100
	1995	15448	73	27	100	100	100	100
	2000	15915	77	23	100	100	100	100
	2005	16316	80	20	100	100	100	100
	2008	16528	82	18	100	100	100	100

To elaborate in more detail on the domestic freshwater withdrawal and use of sanitation, it is important to take into consideration that there is a difference in water supply and sanitation coverage in urban and rural areas. In table 1, an overview is given on the water supply coverage in urban and rural areas in the last two decades. What seems to be clear is that Brazil faces the challenge of providing water to all its inhabitants, especially those in rural areas. Table 2 gives an overview of the performance of Brazil and the Netherlands on sewage systems. These numbers indicate that Brazil faces an even bigger problem in providing everybody with improved sanitation

Table 2: Access to improved sanitation¹

Country	Year	Population			Access improved sanitation (%)		Sewage connection (%)	
		Total (x1000)	Urban (%)	Rural (%)	Urban	Rural	Urban	Rural
Brazil	1990	149570	75	25	82	-	53	-
	1995	161692	78	22	81	-	48	-
	2000	174174	81	19	81	32	54	3

¹ Improved sanitation includes (1) flush or pour-flush to a piped sewer, septic tank or pit latrine, (2) Ventilated improved pit (VIP) latrine, (3) Pit latrine with slab and (4) Composting Latrine (WHO/ UNICEF, 2008).

	2005	186075	84	16	86	-	-	-
	2008	191972	86	14	86	54	54	4
Netherlands	1990	14953	69	31	100	100	100	100
	1995	15448	73	27	100	100	100	100
	2000	15915	77	23	100	100	100	100
	2005	16316	80	20	100	100	100	100
	2008	16528	82	18	100	100	100	100

Porter argues that the home market can help companies create competitive advantage, when sophisticated home market buyers pressure firms to innovate faster and to create more advanced products than those of competitor. For Brazil, there is no competitive advantage and no pressure to innovate from buyers. The advantage for companies is that almost all companies are monopolist on their own market. But also a disadvantage for these companies is that because of social pressure they have to service poor people, that aren't commercially attractive.

In conclusion we can state that the demand condition of the Brazilian domestic market does not provide the primary driver of growth, innovation and quality improvement. The start with some private intensives and some innovative programs in the market are made. Maybe over time the Brazilian marked can be a healthy sophisticated marked just like the Netherlands.

Factor conditions

The water and sewage sector is one of the few utility sectors that has not been privatised during the 1990's. Nowadays the Brazilian government does not intend to do so, because of the low potential for competition in this sector. High fixed cost and fixed assets with a long lifetime make competition unlikely to happen. Another reason is that before 1985 Brazil knew a dictatorial government and has consequently always been public.

As a consequence, most water and sewage companies operate rather inefficient and not everyone is supplied with fresh water. The companies try to maximize their rate of return on investments (Tupper and Resende, 2003). Therefore the coverage of their services is not as well developed as in the Netherlands. The deficiency of regulation slows down development of water and sewage facilities. Another factor that acts upon the sector is the size of the country. Because of the huge size of it, the Brazilian government tries to keep states free to organise their own water sector.

Comparison with the Netherlands makes clear that the development of the drinking water systems and sewage systems in Brazil is more recent. In the Netherlands, the development of the water system began in 1854, when Amsterdam was the first city with fresh drinking water from water pipes. Further, during the period 1890 – 1940 all Dutch cities were provided with sewage systems (Lintsen, 2005). In Brazil, municipalities were responsible before 1969. Afterwards, organisations set up by the government took over and coverage of the services increased substantially, but as already said, not every household is served yet (Motta and Moreira, 2006). On the mentioned factors the Netherlands rather differs from Brazil. In the Netherlands the scale of the country and thus the involved companies is smaller. Like in Brazil, the land is regionally divided among the public owned water companies, though the scale is much smaller. The role of the states in Brazil is comparable to the provinces in the Netherlands (Vewin, 2010).

Related and supporting industries

There are a number of industries in Brazil that heavily depend upon the sector of water engineering and management. A description of the relation with the water sector follows below. Further, the industrial disposal of waste water and the equipment that is necessary to accommodate this, is of influence on the sewerage sector.

Electricity sector

Also indicated during the macro studies, Brazil depends heavily on hydroelectric energy. Around 80% of its electricity originates from hydroelectric installations (OECD, 2004). The construction of dams is vital for delivering even more (sustainable) energy in a world with increasing energy consumption and may be used as drink water reservoirs.

Agriculture

As mentioned before, 62% of the freshwater withdrawal in Brazil is for agricultural purposes. In 1998, this was only for irrigation 2,8 million ha (potentially 29,3 million ha), representing 5,7% of the cultivated area of Brazil. The irrigation methods differ throughout Brazil. There are traditional methods which are sufficient in places where water is available in abundance. However, more modern techniques are used in other areas where efficiency is desired and is mostly developed by private individuals and companies (FOA , 2000).

Water engineering/treatment equipment

Brazil is challenged in providing water supply and sanitation coverage. This requires massive investments in equipment like (high pressure) pumps, infrastructure, etc. It seems that in this sector many goods are provided by European countries like Germany, France, Sweden and the Netherlands (Ministerie van Economische Zaken, 2009). Also the treatment of water from the sewages may require large investments, for example in waste water treatment plants.

Transportation (by waterway)

Although strictly this is not included in class 3700 of the ISIC, transportation by water is also an important aspect of water management since rivers form an import way of transportation. Much effort is put into keeping waterways open for shipping. Obviously, this can conflict with policies for water management sometimes. Examples are the construction of dams or limiting the number of boats on a waterway due to environmental aspects.

Interesting to note is that these related sectors do have a different perspective toward the use of water resources so that conflicts can arise. Therefore, a policy on the management of water resources is important. In the same way, we can also look at related industries as it comes to water management in the Netherlands. Here, we see a very different perspective. In the Netherlands, we first see a real focus on safety against floods. Another important aspect is environmental regulation which is primarily directed at industries.

So in total, we can state that the related industries in the sector of water management is not so focused on the water as a product (it's considered a common good), but more important are the policies governing water resource management. Therefore, governments play an important role.

Firm strategy

Brazil, like many other developing countries, faces two great challenges in obtaining water supply and sanitation facilities. The first is that of receiving household services. Many people in Brazil do not have adequate sanitation facilities. The quality and reliability of existing services is low, and the costs of providing improved services are rising. The second challenge is that of environmentally sustainable development. There are problems of high costs and limited resources. Fewer financial resources are available for environmental protection, and Institutional capacity is weaker (ProQuest, 1994).

The strategies of the water and sanitation companies in Brazil, as well as in other development countries, are not efficient, due to a number of reasons (Kelman, 1998):

- Bad operation practices. In general, there is lack of proper planning and maintenance. Sometimes the physical losses reach 50% of the treated water.
- Bad commercial practice. The general picture is that metering is applied to a small percentage of consumers, subsidies are implicit rather than explicit, and there is no cutting-of-water policy for lack of payment. Furthermore, because the poorest segments of society are not commercially attractive, due

- to the high percentage of unpaid bills, sometimes they are simply not connected to the water distribution system, even in cases where the connection would be technically feasible.
- Lack of financial and administrative autonomy of the public companies. The boards of directors of public companies in Brazil are usually severely constrained in their autonomy to the business by complicated legal systems
 - Political interference. Directors of public companies are often selected based on their political connections to the ruling party, rather than on their technical or managerial abilities.
 - Lack of financial resources. It is estimated that it would be necessary to invest about 3 billion dollar annually, mostly on sewage collection and treatment.,

So in Brazil it is difficult to run a company because of many problems. In the Netherlands there are some problems. First we have to look at the difference in the structure of the water sector in the Netherlands compared to Brazil. In the Netherlands, water supply companies produce drinking water for the consumer, industry water and process water for the industry and irrigation water for agriculture and distribute this water to the various users. The sewerage systems and waste water treatment are in control of the municipals. The market structure for these companies is characterized by three aspects, the companies are monopolies, are public and are regulated by the government. This brings some problems to create a proper firm strategy:

- Bad efficiency, because of the lack of privatization the companies have a lack of efficiency. (Dijkgraaf, Jong, Mortel, Nentjes, Varkevisser, & Wiersma, 1997). It is argued that improving the performance is the most important aspect for Dutch water companies (Pieter & Dijk, 2006).
- Political interference, the water companies aren't allowed to invest in foreign countries, sometimes even by the law. (Schouten, 2009).

We can say that companies in Brazil are different and less efficient from companies in the Netherland. Many problems occur in Brazil because it is still a developing country. Bad rules and regulation are still a problem, also the financing of (sustainable) projects are a problem. We can see that the government plays a vital role to invest into sustainable project. Without the government a sustainable future for Brazil isn't possible. In the Netherlands it is quite the opposite of Brazil, although the sector is still public and not efficient enough, it is an innovative sector. The main challenge for a proper firm strategy is to cope with the problems of being a monopolist.

VARIABLES

Government

Brazil's overall policy and philosophy on water resources is defined throughout its National Policy on Water Resources (NPWR) originating from 1997. The NPWR proclaims that water is a common good of public domain. Water is a scarce a scarce natural resource endowed with economic value and in situations of critical scarcity priority must be given to human supply and animal consumption. Furthermore it states that water management must be decentralized and river basin based. The NPWR aims at a sustainable water supply, ensuring actual and future generations with water that meets both the quality and quantity required for the different uses. Lastly, it aims at prevention and defence from water related critical events (ANA, 2010).

Since the 1989 State Constitutions, in Brazil each level of government (the Union, the States, the Federal District and the Municipalities) has the right to individually create its own legislation on soil and natural resources management and environmental protection, as far as it does not conflict with federal rules. However, this may sometimes conflicts, because water basins often cross state boundaries. More effort was required to coordinate actions taken by the union and the states. Therefore the **National Water Agency** (ANA) was created in July 2000 as a subordinate of the Ministry of the Environment (Government of Brazil, 2010), with the mandate to enforce the National Policy on Water Resources (ANA, 2005).

Further, Brazil's legal framework on water resources, endows several River Basin committees, to support decision making. On their web site, the ANA states that besides enforcing the technical conditions of the Water Law, these committees must contribute to solve two critical national problems:

1. Prolonged drought, particularly for the North-East Region.
2. River pollution, specifically when a reduction/prevention needs to be realized in a basin that includes multiple states (ANA, 2010).

Because water management transcends national boundaries, international cooperation is necessary. One clear example of a multilateral relation is the Organization of American States (OAS) with their department of sustainable development that also focuses on integrated water resources management.

In the Netherlands, the water boards are special regionally orientated governmental organisations that take concern for most of the issues on water management. They are charged to determine and regulate water quantities in their area and to carry out maintenance. Municipalities are historically responsible for sewage systems (Kuks, 2006). The Dutch sewage and water expertise in water technologies can be regarded as outstanding (de Wit, 2009), due to governmental stimulation for a long time. Although Dutch companies are highly innovating, the demand for their services comes mostly from the Dutch due to a closed sector in almost all countries in the world and different circumstances on every market.

Chance

Porter emphasizes the role of chance in the model. Random events can either benefit or harm a firm's competitive position. These can be anything like major technological breakthroughs or inventions, acts of war and destruction, or dramatic shifts in exchange rates.

There are only a few indicators for Brazil that anything likely will influence the sector of water sanitation and sewerage. A challenge for Brazil, as in many countries worldwide, climate change. Long periods of drought like in 2001, and this year is also a very dry year, can influence the availability of fresh drinking water. The Brazilian National Water Agency therefore has as goal to ensuring actual and future generations with water supply that meets both the quality and quantity required for the different uses. It aims at promoting a rational and integrated use of the water resources, including water transportation, to ensure sustainable development.

Earlier we stated by the firm strategy that also there is a great political influence on water companies. This is also something that can influence the sector. Especially, with elections coming on October 3rd 2010.

In the Netherlands there are no indicators that anything is going to happen that will heavily change the water and sanitation departments. Like Brazil, also the Netherlands faces the problems of climate changes.

In conclusion we can say the main goal for Brazil and the Netherlands is to face the climate changes. It is a great uncertainty in water management. But it brings also large opportunities to create a sustainable future and provide water and sanitation for everyone.

DISCUSSION AND CONCLUSION

As stated in the introduction part of this report, the different determinants and variables of Porter's Diamond emphasize the different aspects that are important to us as study tour participants and civil engineering students. Because of this civil engineering background we focused on the most important and interesting aspects that are important in understanding this civil engineering sector and understanding what key-aspects are in Brazil's water resource policy.

Evaluating the different determinants and variable of Porter's Diamond in this specific sector we can determine several important aspects. First of all, we can see a huge demand for fresh, improved water and proper sanitation, especially when we compare this to the sector in the Netherlands. This stresses a very important goal for Brazil that plays a key role in policies (not only water management but also social development) and various projects that will be visited during the study tour. A second important thing to mention is that this demand is also closely linked to the related and supporting industries. This mostly due to the fact that it all considers the same sort of 'good', namely water resources. This immediately indicates the difference of this sector with a more free market sector: water is usually considered as a common good and is a consideration of

(inter)national proportions. In this sense the determinants of demand conditions and firm strategy are the same when we discuss water resource management (the focus of us civil engineering students).

It is therefore not strange to see the government playing a key-role in water management. In fact, we can state that it may be the most dominant factor of the six of Porter's Diamond although the starting point of most water policies concerns tradeoffs between different demands. This large influence of the government is quite common in water management sectors (also in The Netherlands for instance) and Brazil is most certainly no exception. The government Brazil is historically hugely involved in this sector and with this; the amount of private participation in this market is limited. Many problems arise within companies but also on the scale of municipalities, states and Brazil as a whole. Solving problems like providing people with improved water and sanitation and dealing with pollution, the government will likely keep playing an essential role. Because of the many different and country-specific problems, Brazil is not really competing in this sector on an international level (there is an internal/local focus).

From a sustainability perspective, it will be the government's task to take into account the concepts of sustainability in order to not only deal with the problems of today, but also those of tomorrow. The government simply has the most influence in this sector, especially in Brazil. This is done now through various programs that do take into consideration the aspect of sustainability. But we must not forget that besides dealing with future demands, Brazil already faces some big challenges.

We can therefore say, the water engineering and management sector of Brazil will stay an interesting civil engineering sector to study in the future!

Discussion about using Porters Diamond

For this research the model of Porter (1990) is used, though because the water sector is not competitiveness as Porter assumes. Therefore some critical notes could be given on an analysis with porter's diamond in this specific sector:

- The water engineering & Management sector is not really an open market sector and the ideas of Porter are focused on open markets.
- With the above, the government plays a key role in water management.
- Water Management even transcends national boundaries and multilateral cooperation is not uncommon. This is neglected in Porter's Diamond.

However, the four determinants and the role of chance and government do form a good outline for discussing the sector and explaining how these four (or actually six) factors influence one another and determine or explain the way Brazil is competitive in this specific sector

Comparison of Brazil and the Netherlands

Below, a table is provided that gives an indication of the differences between Brazil and the Netherlands as is discussed throughout the rest of the report.

Table 3: Comparison Brazil and the Netherlands

Factor	Brazil		The Netherlands	
Population (x1000)	191.972		16.528	
Population in urban areas	86%		82%	
Population in rural areas	14%		18%	
Water supply coverage urban / rural	99%	96%	100%	100%
Household connections urban/ rural	84%	62%	100%	100%

Access improved sanitation urban/rural	86%	54%	100%	100%
Sewage connection urban / rural	54%	4%	100%	100%
Structure of Government	Ministry of the Environment, ANA, Federal States may determine own policies. Organisations on large scale	Waterboards and Ministry of Traffic and Public Water Works involving several organizations and bodies Organisations on small scale		
Hydropower possibilities	Several large dams (currently provides >80% of electricity)	Almost none		
Private sector	Limited, government plays most important role.	Private investments are normal (PPP)		

LITERATURE

- ANA. (2010). ANA - National Water Agency - Brazil. Retrieved April 22, 2010, from <http://www.ana.gov.br/ingles/theagency.asp>
- ANA. (2010). ANA - Overall policy and Philosophy on Water Resources. Retrieved April 22, 2010, from <http://www.ana.gov.br/ingles/philosophy.asp>
- ANA. (2005). Pacific Water. Retrieved April 22, 2010, from <http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/Brazil%2520158.pdf>
- Briscoe, J. de Castro, P.F., Griffin, C., North, J. & Olsen, O. (1990). Toward equitable and sustainable rural water supplies: a contingent valuation study in Brazil. *The world bank economic review*, 4, 115 – 134.
- CIA. (2000). CIA Website. Retrieved April 21, 2010, from <https://www.cia.gov/library/publications/the-world-factbook/geos/br.html>
- Department of Economic and Social Affairs, United Nations. (2008). International Standard Industrial Classification of All Economic Activities, Revision 4. New York: United Nations.
- FOA . (2000). AQUASTAT - FAO's Information System on Water and Agriculture. Retrieved April 22, 2010, from <http://www.fao.org/nr/water/aquastat/countries/brazil/index.stm>
- Government of Brazil. (2010). Official web page of Brazil. Retrieved April 22, 2011, from <http://www.brasil.gov.br/sobre/brazil/structure/regulatory-bodies>
- Kelmann, J. (1998). Evolution of Brazil's water resources management system. Rio de Janeiro: Federal University of Rio de Janeiro.
- Kuks, S.M.M. (2006). The Privatisation debate on water services in the Netherlands: Public Performance of the Water Sector and the Implications of Market Forces. *Water Policy, Official Journal of the World Water Council*, 8, 147-169.
- Lintsen, H. (2005). *Made in Holland, een techniekgeschiedenis van Nederland [1800 - 2000]*. Zutphen, Uitgeversmaatschappij Walburg Pers.
- Ministerie van Economische Zaken. (2009). NL EVD International. Retrieved April 22, 2010, from <http://www.evd.nl/zoeken/showbouwsteen.asp?bstnum=218983>

- Motta R.S. da, Moreira, A.R.B. (2006). Efficiency and regulation in the sanitation sector in Brazil. *Utilities policy*, 14, 185 – 195.
- Neder, D., & Nazareth. (1998). *Condominium Sewerage Systems for the Federal District of Brazil*. Brasilia: Sewerage Systems at the Water and Sewerage Company of Brasilia.
- Porter, M.E. (1990). The competitive advantage of nations. *Harvard business review*, 68, 73 – 93.
- OAS- Department of Sustainable Development. (2010). OAS - Integrated Water Resources Management. Retrieved April 22, 2010, from <http://www.oas.org/dsd/waterresources.htm>
- OECD. (2004). OECD Economic Surveys. Retrieved April 22, 2010, from <http://www.oecd.org/dataoecd/12/11/34427493.pdf>
- ProQuest. (1994). *Water supply, sanitation, and environmental sustainability: The financing challenge*. Retrieved April 2010, from <http://md1.csa.com/>
- The World Bank (2003). *Brazil: Equitable, Competitive, Sustainable, contributions for debate*. Washington, The international bank for reconstruction and development/the World Bank.
- Tupper H.C., & Resende M. (2003). Efficiency and regulatory issues in the Brazilian water and sewage sector: an empirical study. *Utilities Policy*, 12, 29 – 40.
- Uffelen, x. v. (2009). Waterbedrijf redt het zonder marktprikkel. *De Volkskrant*.
- Vewin (2010). Leden Vereniging van Waterbedrijven in Nederland. Retrieved on April 28, 2010 from website: <http://www.vewin.nl/vewin/leden/Pages/default.aspx>
- WHO/ UNICEF. (2008). WHO / UNICEF Joint Monitoring Programme . Retrieved April 21, 2010, from <http://www.wssinfo.org/datamining/tables.html#>
- de Wit. (2009). *The Netherlands: Your One-Stop-Shop to sustainable water solutions*. Netherlands China Water Technology Platform .
- Wikipedia. (2010). Wikipedia. Retrieved April 22, 2010, from http://en.wikipedia.org/wiki/Water_privatization_in_Brazil