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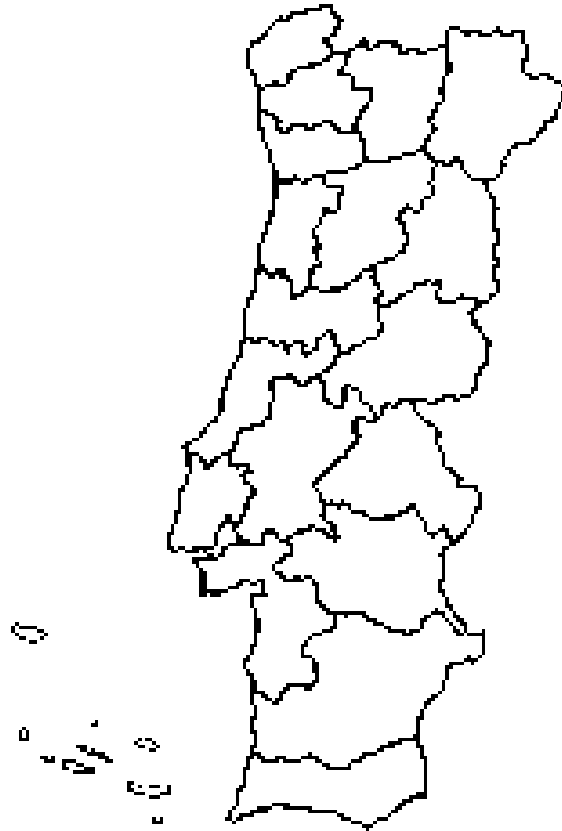
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Innovation capacity in the Portuguese system of water use

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Preamble

"Without water there is no life", this statement is made by various persons all over the world, and shows the importance of the daily use of water. This master thesis is written to give a view in the organization of the current system of water use in Portugal and more important the factors that have a decreasing or increasing effect on the innovation capacity in that system. This research and the report that is written concerning this subject makes it possible for me to finish my master's in Public Administration, main subject Decision Making and Management for Complex Spatial Developments, at the Erasmus University Rotterdam. In order to finish my master thesis, with the focus on the main subject, an internship is one of the requirements. The internship that I did was partly in the Netherlands and for the most part in Portugal. In Portugal I have enquired data and various subjective views concerning this subject, which provided an aggregation of the views towards this master thesis.

Rotterdam, April 2009
Angela Gomes

Summary

This research concerns the innovation capacity in the Portuguese system of water use and is done for a master thesis. The goal of this study is to create a comprehension in the innovation capacity of the system of water use in Portugal. This means that it is of importance to research and understand the possible factors that have an increasing or decreasing effect on the innovation capacity, with the roles of the governmental organizations as one of the important objectives.

This research is a qualitative research and is part of a comparative research. By this comparative research four countries are described and analyzed. The innovation capacity in the system of water uses in the four countries is measured by the use of one conceptual model and the indicators. DHV Portugal and DHV Netherlands both benefit from this research, due to the comparisons that are made between the countries. These comparisons provide a clear view on the elements that determine the innovation capacity in the system of water use. The Erasmus University and DHV, as mentioned earlier, both are part of the EGPA 2008 conference. The data that is used for that conference concerning this subject is partly obtained by this research and report.

This research is also relevant for the Ministry of Housing, Spatial Planning and Environment and the Ministry of Traffic and Water Works. These two Dutch Ministries are working on a vision for the system of water use in the Netherlands. This vision has to be obtained for the long-term, by which an increasing effect on the innovation capacity in the system of water use is possible. This research provides limited recommendations for the clusters in the Dutch system of water use. The main question of this research is: *What generates the increasing and decreasing factors of the innovation capacity in the Portuguese system of water use?*

The main question is divided in the following sub questions, which will together answer the research question. Hereby are several sub questions that need to be answered:
1   *How are the clusters in the system of water use organized in Portugal?*
2   *How is the Portuguese innovation system organized?*
3   *How are innovations generated in the Portuguese system of water use?*
4   *What are the drivers and barriers in the process of innovation?*
5   *How can the government influence the drivers and barriers?*

The description and analysis of the system of water use is based on the use of the conceptual model: the national innovation system model, which is based on the theoretical framework. The conceptual model provides the answers to the main question and sub questions. The (main) theories that are used to create the conceptual model are: the innovation climate by Ekvall, this theory shows that innovation is only possible when people are provided with circumstances that creates a profitable climate for innovation; the national innovation system by Lundvall, this theory gives an understanding to the working of the national innovation system; and Triple Helix by Gibbons, this theory shows the importance of knowledge within the innovation system.

The conceptual model is divided in three sections: the country specific elements, the four cluster and the six relations between the clusters. The first section focuses on the national elements. As is visualised in the conceptual model, the focus is on the national level. To comprehend this level the country specific elements need to be analysed. Therefore, a list of six elements is included within this research that provides indicators to describe and analyse the Portuguese context that have an influence on the innovation capacity. These elements concern the geographic country specifics, cultural aspects, historical aspects, political aspects, economical situation, human development and education level. These elements all have a direct or indirect influence on the innovation capacity in the Portuguese system of water use. The second section concerns the clusters. The conceptual model represents four clusters that have their own roles and tasks within the system. A description will be given of these clusters

and the organizations that take part within that cluster, by which the analysis can take place. The four clusters concern that of knowledge organizations, implementing organizations, the water policy organizations and the innovation policy organizations. The third and fundamental section within this model is that of the relations. In figure 3.1 six relations are visualised between the clusters. There is a seventh relation added that represents the international relation that Portugal has with the European Union. Between the four clusters the relations are visualized, these relations are important to analyze, hereby the innovation capacity in the system of water use is determined. The use of the indicators makes the analysis of the system of water use possible. The conceptual model that is used for the analysis is based on the theoretical framework and provides indicators to measure the innovation capacity in the Portuguese system of water use.

By taking the first steps in answering the main question and the sub questions it is important to have one understanding of the definition of innovation capacity. The definition that is used for this research is the innovation climate. This theory provides an understanding of the innovation climate. This is the following definition: "The innovation climate is the melting of the three areas of resources: idea time; motivation (trust and openness); and exploration (risk taking)." (www.m1creativity.com, Goran Ekvall) These areas are invented by Professor Goran Ekvall, whom also created a list of ten dimensions that indicates the degree of innovation in organizations / institutions. The ten dimensions will be used as a checklist for the innovation climate. As mentioned earlier, Portugal is in the beginning stage of their development of the innovation capacity. Portugal has taken big steps in establishing stable clusters in the system of water use. Portugal is now looking at ways to improve and innovate the established clusters in the system of water use. Therefore, determining the innovation capacity in the clusters of the system of water use is done by the checklist of the innovation climate. There is no past situation present, where this analysis can refer to in order to determine the innovation capacity. In order to answer the main question the current system of water use is the only moment that can be measured to determine the increasing and decreasing factors of the innovation capacity. This will be done by the use of the ten dimensions which determines if the organizations within the clusters provide circumstances that have an increasing or decreasing effect on the innovation climate and therefore on the innovation capacity. This understanding of the innovation climate is used to take the next steps in developing the conceptual model and its indicators in order to measure the system.

The description and analysis of the Portuguese system of water use have produced some interesting and important results. The innovation capacity in the Portuguese system of water use is influenced by the European Union. The legislation that needs to be guided by Portugal creates innovation possibilities. To comply with the EU regulations, concerning the water quality, changes have to be made within the process of the system of water use. The input, throughput and output of the Portuguese system of water use are dividable in: 'systemas em alta' and 'systemas em baixa'. This means that the upstream for the water side of the services consist of the collection and treatment of water. The downstream of the water service is then the storage and supply of water. Each cluster is explored on various governmental levels, where they operate. The analyses of the system of water use focuses on three types of water: drinking water, storm water and sewerage. The government and especially the municipalities are responsible for the system of water use. The water policy organization, in which the European commission and the Ministry for Environment, Spatial Planning and Regional Development are important / influential actors, were mainly recognized on the higher organizational levels. These outcomes concluded that water policies are created on the top levels, without the influence of the regional and local level. The implementing organizations have the main task of implementing the policy within the system of water use. The main implementing organizations within the Portuguese system of water use are EPAL and ADP. EPAL is in charge of the supply and distribution of drinking water and ADP is in charge of

90% of the waste and solid waste water sector and delivers their services to 75% of the population. The knowledge organizations have the goal to obtain knowledge and eventually create innovations. The creation of innovation is possible when co operations are made and knowledge is spread. In the Portuguese system of water use co operations are recognized on national and international levels, for example the Cost Action Networks EU that is a part of European networks of research organizations. The Portuguese system of water use shows that there is an innovation policy present, namely the Technological Plan. The Technological plan is a policy mix of various existing policies with as goal to face challenges by 2010, the prime minister is in charge and responsible for this policy.

The relations between the clusters have a great impact on the innovation capacity in the system of water use. These relations vary from a relation based on complying with the regulations to willingly being a part of a network. The indicators that determine the innovation capacity in the relations is based on the following approaches: knowledge transfer, knowledge development, decision-making, development of innovations and policy adjustment. For each relation a different approach is used. The relations / interaction between the clusters in the system of water use are still very low. In order to develop innovation, knowledge transfer has to be made. The organizations / institutions within the clusters of the system of water use are taking part in various networks, on national and international scale. The national networks are for the most part project based, meaning that national networks are created when a technical issue occurs, which can only be solved by the co operation of various actors. The biggest issue here is that the results coming from these networks are not interacted with all the actors in the Portuguese system of water use. This means that a lot of new information gets lost. The international networks, like IWA (International Water Association), are not only practical related but also provide a great part of scientific researches. These scientific results are spread with all the members of IWA and also can be bought by non IWA members. This example shows that the international network has got more transparency concerning their results then the national networks. The institutions within these networks need to contain certain skills in order to give contributions to the network.

The recommendations that are provided are focused on the Portuguese and Dutch government. The most important recommendation made for Portugal is creating awareness. Throughout the research it was noticeable that the respondents did not know that there is an innovation policy present that is applicable for the system of water use. By making sure that awareness and clarity is given within the system of water use a lot of organizations will know where they stand and where they can be headed to improve the innovation capacity with the help of other organizations / institutions. By having an organization that is responsible for creating awareness and clarity, an increasing effect on the innovation capacity in the system of water use is stimulated, because now the organizations will know with whom they can share their knowledge and where they can gather the knowledge. The recommendations for the Netherlands throughout the Portuguese case are hard to make. In comparison with the Portuguese system of water use the Dutch system of water use is outstanding and an example that is followed by Portugal, in the institutional ass the technical matters. Therefore one recommendation is made, concerning the innovation agenda. This recommendation focuses on what should be kept in mind during the making of the innovation agenda. By making sure that the operational level of the system of water use are included by making the agenda the acceptance on the operational will be increased. This lack of cooperation in the Portuguese system of water use has caused a lot of problems and a decreasing effect on the innovation capacity. The most important recommendation for DHV Netherlands that is made for further research concerns the countries for the comparative research. Comparing the Netherlands and Canada to the countries Portugal and South-Africa is, considering their different status in education and system of water use, very difficult. The research subject is very interesting and

will be of more value when countries are compared within the same status range in education and system of water use. Therefore, I would like to advice DHV Netherlands to do further research on this matter but comparing countries in the same range.

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Introduction

"With the recognition of the right to water as a human right, the Netherlands will be able to point out to the governments of developing countries that they must do everything in their power to fulfill their people's right to water." (www.irc.nl, 20th march 2009) This statement, which is made by the Dutch representatives of the Ministry of Foreign Affairs, shows that every human being on the planet earth should have clean water to their disposal and that the government has a fundamental position in providing clean water for their citizens. On the World Water Day 2007 the ministry of Foreign Affairs made a clear statement that the government should be held responsible for providing a fundamental human need such as water. These responsibilities are divided into various tasks for water management. In order to prevent national and international catastrophes by the use of water, governments in various countries show that the private sector is also of great importance to improve the water quality. Professionalism and specialization is usually found in the private sector. The divided tasks may be an improvement on strategic level, like providing insights for a new water policy, or on operational level, like managing water treatment plants.

Looking at Portugal, the government is very aware of their responsibility to provide the human right of water to their citizens. Over the years the organization of the Portuguese system of water use is going through a lot of changes. These changes have everything to do with complying with the EU regulations of the water quality. The managing of the organization of the Portuguese system of water use was first divided over the municipalities, after dealing with a national catastrophe due to a lack on providing qualified water. Decades later the Portuguese government has come to the conclusion that the sub water systems have to be pulled to a higher level. Transforming the sub water systems into one national water system has been the goal from then on. This transformation is still going on and has been acknowledged by the Portuguese government, because the municipalities do not have the ability to provide the qualified water by the Portuguese and European standards. But the government also realizes that the private sector needs to be included in the management of water. The private sector is becoming an important cluster within the system of water use. Their specialization and professionalism is needed to upgrade the water quality in Portugal. This upgrade is needed in order to comply with the Portuguese standards and European legislation. With this upgrading comes the needs to improve the systems of water use and most important the providing of a climate to innovate in the clusters of the system of water use. To upgrade the system, it means to improve the system so that it complies with the EU regulations.

The innovation capacity plays a crucial part in this report, in various countries and in the system of water use. In order to satisfy the current needs of human beings the standards of water quality have been changed over the decades. The changing of the standards and the urge to keep up with the rising standards configures to innovation being a crucial part in this matter. The government has taken its responsibility of water use in account over the years that have produced the needs to control and understand the system of water use on an effective way. This means that the innovation urge comes through the changes of the market and the changes of the regulations. This is one of the reasons why innovations are wanted and needed. Another interesting factor that influences the Portuguese system of water use in its innovation capacity is that of the interference of the European Union. Portugal is a member of the European Union since 1986; this means that Portugal not only has to take the national law and legislation into account, but the European law as well. In fact the European law has more weight than the national law in most cases. This means that the national water policy has to fit the European standards or else a fine can be imposed. The innovation climate depends not only on the national government but also on the European Union standards, concerning the law and legislation. The ways in which the organizations / institutions in the system of water use take efforts to realize innovation in the organizations of the system of water use is interesting. Especially in the case when these efforts have a long time effect on this system.

The networks, organizations and institutions in the system of water use are the determining factors for the innovation capacity. Within the networks, organizations and institutions relations are maintained and interactions between various organizations take place. The relations and interactions create the possibilities and climate to share knowledge. Various sources on innovation state that the sharing of knowledge is fundamental for the constitution of innovation. Without providing a suitable climate to share knowledge the innovation capacity will not increase.

As mentioned in the preamble, this research is part of an international comparative study. DHV Netherlands is the organization that assigned my two colleagues and me to do the country specific researches. The various researches and reports are compared and joined into one paper. DHV is an international organization that focuses on the consultancy and engineering of complex spatial developments. A comparative research is interesting for DHV, because four countries are analyzed by one conceptual. This analysis explains the innovation capacity in the system of water use with the country specific elements attached to the analysis. This study made clear that the innovation capacity in one country can be different than in the other. This depends on the country's specific characteristics. For example, one country may have more money to spend on innovative projects but the other has less support for such projects. The innovation capacity also depends on the private funding as in the case of Portugal. This report is one of the reports written for the international comparison, the countries are: Canada, Netherlands, Portugal and South-Africa.

The goal of this study is to create a comprehension in the innovation capacity of Portugal. This means that it is of importance to research and understand the possible factors that have an increasing or decreasing effect on the innovation capacity, with the roles of the governmental organizations as one of the important objectives. Explaining the increasing or decreasing effect on the innovation capacity is not done by analyzing the process of innovation. The Portuguese system of water use is in the beginning stage of making innovation possible and creating innovation capacity. Therefore the innovation capacity will be analyzed and measured by determining the ways in which the organizations / institutions provide a suitable innovation climate. The following objective of this report focuses on the innovation climate. In short, this means acquire insights in the way organizations / institutions are organized within the Portuguese system of water use. By this objective the elements of the innovation climate will be researched, by making clear how clusters cooperate, also what the interaction network constitutes.

One of the requirements for this master thesis is that the relevance with the master program and especially the main subject has to be noticeable. As mentioned earlier, the master program is that of Public Administration and the main subject is Decision Making and Management for Complex Spatial Developments. The system of water use is a governmental responsibility, which is complex and difficult to understand. Portugal has not only have the national law to obey but has to keep the international European law as first and foremost guideline in their daily and future practices. Not only is the innovation capacity in the system of water use a spatial development, but it is also a complex issue. Especially in Portugal, where the deristiction of water is still not solved and clear-cut both national as international. This means that the responsibilities of managing the water can be put on various actors. By understanding and explaining the innovation capacity in the system of water use in Portugal, various scientific theories are used. These scientific theories are coherent to the views that are created within the master program Decision Making and Management for Complex Spatial Developments. The coherence is of important, considering the fact that this subject embodies elements presented in the master program.

The practical relevance of this research is for the Ministry of Housing, Spatial Planning and Environment; the Ministry of Traffic and Waterworks; DHV Portugal; DHV Netherlands; and

the Erasmus University. The Ministry of Housing, Spatial Planning and Environment and the Ministry of Traffic and Water Works can benefit from this research. These two Dutch Ministries are working on a vision for the system of water use in the Netherlands. This vision has to be obtained for the long-term concerning the increasing of the innovation capacity. With this research recommendations are made to the Dutch system of water use through the objectives from the Portuguese current situation in the system of water use. Considering Portuguese current situation in their system of water use limited recommendations are made. Various Portuguese organizations in the system of water use made it very clear that they see the Dutch system of water use as an example in the steps that Portugal needs to take to improve their current situation. DHV Portugal and DHV Netherlands both benefit from this research, by the comparisons that are made between the countries, which give a clear view on how they stand within the innovation capacity. The Erasmus University and DHV, as mentioned earlier, are both part of the EGPA 2008 conference. The data that is used for that conference concerning this subject is partly obtained from this research and report.

1.2   Research questions

The objective above will be concretized in the following main question and sub questions. The focus will be on the innovation climate that determines the innovation capacity in the clusters of the system of water use. The main question will be:

What generates the increasing and decreasing factors of the innovation capacity in the Portuguese system of water use?

The main question is divided in the following sub questions, which will answer the research question. There are several sub questions that will be answered:

1   *How are the clusters in the system of water use organized in Portugal?*
2   *How is the Portuguese innovation system organized?*
3   *How are innovations generated in the Portuguese system of water use?*
4   *What are the drivers and barriers in the process of innovation?*
5   *How can the government influence the drivers and barriers?*

The methods which are used to get answers to the questions and to collect the empirical material are first and far most interviews and document analysis. These will be further specified in paragraph 3.5.

1.3 Chapter description

This chapter has been an introduction for this research. The innovation capacity in the system of water use in Portugal will be analyzed by guiding through the following chapters, which give answers to the sub questions mentioned above.

The theories that are used to distinct the scientific relevance of this research is presented in chapter two. The theoretical framework provides scopes to view this report by the use of the following (main) theories: the innovation climate by Ekvall, this theory shows that innovation is only possible when people are in certain the circumstances which makes a profitable climate for innovation; the national innovation system by Lundvall, this theory gives an understanding to the working of the innovation system; and Triple Helix by Gibbons, this theory shows the importance of knowledge within the innovation system. In chapter three the theories are used to create measurable concepts for this research. These concepts form a model, which makes concepts visual and understandable. The conceptual model is added with indicators, based on the theoretical framework, which makes the analysis of the Portuguese system of water use possible. Also, the research design is presented in this chapter. Throughout the research design the process of this research is explained. Chapter four presents the country's specific element. This chapter provides a description of the elements that have an influence on the innovation capacity in the system of water use. The Portuguese

system of water use is highlighted in chapter <u>five</u>. The organizations / institutions of the clusters that are part of the system of water use in Portugal will be described. The roles and tasks of these organizations / institutions of the clusters are also presented. Chapter <u>six</u> constitutes that of the analysis of the Portuguese system of water use. The innovation capacity within the system is analysed by the indicators form the conceptual mode. By this analysis the increasing or decreasing effects on the innovation capacity in the system of water use is determined. Last but not least, chapter <u>seven</u> will answer the main question of this report. The conclusions and recommendations are also to be found in this chapter.

Chapter 2 Theoretical framework

This chapter concerns that of the theoretical framework, which provides a scientific fundament for this research. The theories that are used will provide scientific approaches in order to come to one conceptual model. The theories that are selected for this research have everything to do with the focus of the main question. The main question of this research focuses on the increasing and decreasing factors of the innovation capacity in the system of water use. The innovation capacity is central in this report, determining the increasing and decreasing effects of the innovation capacity it is of importance to have an understanding of this term. Taking the main question into account it is of importance to make use of theories that not only provide an understanding of the innovation capacity; but also provide views on how to analyse and determine the innovation capacity in the clusters of the Portuguese system of water use.

Portugal is in the beginning stage of generating an innovation capacity within the system of water use. Taking this factor into account determining the effects on the innovation capacity is only possible by analyzing the current situation in the clusters of the system of water. To analyze the current situation three theories have been selected that provide the scope to develop the conceptual model as the basis for this research. The indicators of the three theories highlight separate approaches for the conceptual model. These approaches are presented separate but are also in cohesion with each other. One theory has a strong focus on the conditions for a suitable innovation climate within organizations and the other theory focuses on the interaction and relations between the organizations in order to review the learning process. Not only are these indicators of importance for innovation, in fact innovation has everything to do with sharing and creating knowledge. There is another theory presented in this chapter that provides a scope on the importance of knowledge within the clusters. It is noticeable that the theories have different and various approaches, but the cohesion is to be seen in the sequence of the theories. This means that the theory on innovation climate views the innovation on the organizational level. The organizations within the clusters of the system of water use needs to provide a suitable innovation climate in order to make innovation possible on a higher level. The theory that outlines the importance of interaction and relations amongst the organizations and clusters looks at the national level. This theory does not only look at the various organizations separately but outlines the importance of interacting with each other. This takes us to the next theory that provides a view on why interacting and maintain relations are of importance. The sharing of knowledge is one of the fundaments for the development of the innovation capacity. Sharing and creating the knowledge can only take place when relations and interaction is present. The people within the organizations need to be in a suitable innovation climate in order to learn and share what is learned. This shows that the three theories provide separate views and approaches but are combined by viewing the current situation in the clusters of the Portuguese system of water use.

Paragraph 2.1 will introduce the theory of innovation climate by Goran Ekvall. This theory provides an understanding of the innovation climate. This is the definition of innovation climate: "The innovation climate is the melting of the three areas of resources: idea time; motivation (trust and openness); and exploration (risk taking)." (www.m1creativity.com, Goran Ekvall) These areas are invented by Professor Goran Ekvall, whom also created a list of ten dimensions which indicates the degree of innovation in institutions. The ten dimensions will be used as a checklist for the innovation climate. As mentioned earlier, Portugal is in the beginning stage of their development of the innovation capacity. Portugal has taken big steps in establishing stable clusters in the system of water use. Portugal is now looking at ways to improve and innovate the established clusters in the system of water use. Therefore, determining the innovation capacity in the clusters of the system of water use is done by the checklist of the innovation climate. There is no past situation present, where this analysis can

refer to in order to determine the innovation capacity. In order to answer the main question the current system of water use is the only moment that can be measured to determine the increasing and decreasing factors of the innovation capacity. This will be done by the use of the ten dimensions which determines if the organizations within the clusters provide circumstances that have an increasing or decreasing effect on the innovation climate and therefore on the innovation capacity.

Paragraph 2.2 explores the theory of the National Innovation System by Lundvall (1992). This theory makes it possible to analyze the national innovation capacity of a country. This theory states that an organization does not only consist out of machinery but the learning process of people is of greater importance in order to reach innovation. This means that the maintenance and development of the interactions and relations between the institutions / people adds to the innovative capacity. The interactions are needed to get the process of learning started. Without the interactions, information and knowledge would not be spread. Within the relations and interactions between the organizations and clusters the focus is on the elements of the learning process. The learning process is then an indicator for the determining of the increasing or decreasing effect on the innovation capacity.

Paragraph 2.3 presents the triple helix theory that is described by Gibbons et al. (1994) in their book 'Mode 2'. Gibbons et al. give an insight on how knowledge is shared and created. Innovation constitutes for the gross part of creating knowledge. This theory provides views on how knowledge is shared and in what constructions knowledge is created. For the conceptual model this theory provides views about the cluster types that are present within the innovation system.

2.1 Innovation climate by Ekvall

Ekvall (1980) approached the innovation concept by focussing on the interconnection of three areas, which cannot be seen separate from each other. The three areas of resources: idea time; motivation (trust and openness); and exploration (risk taking) represent the following ten dimensions that determine the innovation climate of the organizations / institutions. The ten dimensions play a role in the organizations / institutions of the clusters in the system of water use. This role concerns that of determining if there is an innovation climate present. This means that the ten dimensions function as a checklist that is used for the research. This checklist makes it possible to provide indicators to determine the increasing or decreasing effects on the innovation capacity in the clusters of the Portuguese system of water use. The ten dimensions involve people whom give shape to the organizations / institutions and give direction to the innovation climate. The people also determine the content of the organization / institution and form the relations between the organizations / institutions in the clusters of the system of water use. To see if there is an innovation climate present, the following ten dimensions by Ekvall (1980) should be explored:

1) **Challenge** (How challenged, emotionally involved and committed are employees to their work). This dimension focuses on the degree in which people are involved in the organization, from the goal settings to the implementing of new ideas. The more people are involved, the more people are willing and motivated to take effort in doing a good job and investing energy in the organizational goals.

2) **Freedom** (How free is the staff to decide how to do their job) The independency that people have in their work will determine the degree in which initiative is taken. If the work environment is surrounded with strict rules and set up roles then people will not have the urge to take initiative in the organizational work process.

3) **Idea time** (Do employees have time to think things through before having to act) The time that is available to create and discuss new ideas is crucial for the developing of and implementing of new (well over thought) ideas.

4) **Dynamism** (The eventfulness of life in the organization) The opportunities that people get in the organizations / institutions to shift from assignments internal and external. If the work environment allows the eventfulness within the organization knowledge is spread.

5) **Idea support** (Are there resources to give new ideas a try) Creativity leads to innovation; creativity is possible if new ideas are developed and implemented. The developing and implementing of ideas in an organization are only possible if they get support.
6) **Trust and openness** (Do people feel safe speaking their minds and offering different points of view) If there is trust present people can be open and willing to share ideas, off which discussions can be destillated.
7) **Playfulness and humour** (How relaxed is the workplace, is it okay to have fun) A relaxing environment is an aid to the creativity possibility; people's spontaneity can have an added value to the innovative process.
8) **Conflicts** (To what degree do people engage in interpersonal conflict of warfare) In case of the personal tensions are higher then the organizational visions, the goals of the organization and the innovation climate will decrease. As dimension number six shows, trust and openness are important factors in the innovation climate, in case of personal tensions rising trust is not present anymore, which has its effect on the openness in the organization.
9) **Debates** (To what degree do people engage in lively debates about the issues) The debates, concerning ideas contributes to the value and usefulness of the ideas, because of the different views that are discussed.
10) **Risk taking** (Is it okay to fail) This dimension focuses on the fact if uncertainty is accepted in the organizations, the implementing of new ideas without knowing what the outcome is. Innovation also means being willing to take risk and overcoming the uncertainty.

These ten dimensions are providing a checklist that determines the innovation climate within the organizations / institutions of the clusters in the system of water use. These dimensions also provide the indicators that determine the increasing or decreasing effects on the innovation capacity focused on the people in the organizations / institutions in terms of creative and innovative opportunities. As mentioned in the introduction of this chapter Portugal is at the starting point of the developing of the innovation capacity. This means that measuring the innovation capacity in terms of increasing or decreasing is possible by looking at the chances that are created to develop innovation. Therefore the theory of the innovation climate is appropriate and applicable, because it provides a checklist to measure the current situation without reviewing the past considering the fact that Portugal has not got a past situation in the matter of the innovation capacity in the clusters of the system of water use. This theory then determines the innovation capacity. The reason of not selecting a clear-cut theory on innovation capacity is because the clusters in the Portuguese system of water use have not experienced an existing innovation capacity but are building / developing one. This theory on innovation climate provides the views on how innovation develops in the conceptual model.

2.2 National Innovation System by Lundvall (1992)
In this research the focus is on the relations and interactions between the organizations and clusters. In order to determine the increasing and decreasing effects of the innovation capacity in the clusters of the system of water use, the relations and interaction are analysed. Throughout this analysis the effects can be reviewed and overseen. By maintaining relations and interaction, knowledge is shared and created, which is one of the fundaments of innovation. In this paragraph theories will be presented that focuses on the relations and interaction between the organizations / clusters. By these theories views are presented that provide indicators of what elements the relations and interaction consist of.
The theory of Lundvall (1992) will give more length to the theory of Ekvall in his book National systems of innovation. This approach creates the possibility to analyze the innovation capacity of a country by reviewing the relations and interaction between the organizations / clusters. A national innovation system can be described as follows: "The elements and relationships, which interact in the production, diffusion and use of new and

economically useful, knowledge and that a national system encompasses elements and relationships, either located within or rooted inside the borders of a nation state" (Lundvall (1992: 2) This shows that Lundvall (1992) sees knowledge and learning as the most important factors concerning innovation. In order to make innovation growth and development possible it is important to not only focus on the technological innovation but ass well on the knowledge transition and the learning process amongst the institutions in the system. Lundvall (1992) emphasizes that the national innovation system is a social system, in which learning is the most important activity. In order to make the activity learning happen it is necessary to interact with other institutions or other people. By interactions knowledge is shared and the interacting organizations / institutions will be informed about the processes they are dealing with and what is needed from one and other. So being a part of a social network or group is of great importance for such an interaction. The message of Lundvall's theory (1992) is that the capability of an organization is not only based on the machinery but also on the transformation from input to output. The machinery looks at the hard figures, also known as the results and the way these results are reached, which is not the most important issue. Looking at the learning process, from input to output, means that the steps taken to the results are of greater importance. The process of learning takes a central position within this theory and is an approach that is used for the conceptual model. Therefore the interactive patterns and relations have to be present with for example the customers, public organizations, research institutions and so one (Lundvall, 1992: 3 11) The arrows in figure 2.1 represent the relationships within the national innovation system, some of them may be one-sided and others reciprocal. As figure 2.1 presents the innovation system is in fact an innovation system of relations. The maintenance and improvement of those relations are of importance, in order to stimulate the learning process in which knowledge is shared and created. In the next chapter the most important elements of this figure will be outlined by the measurable concepts.
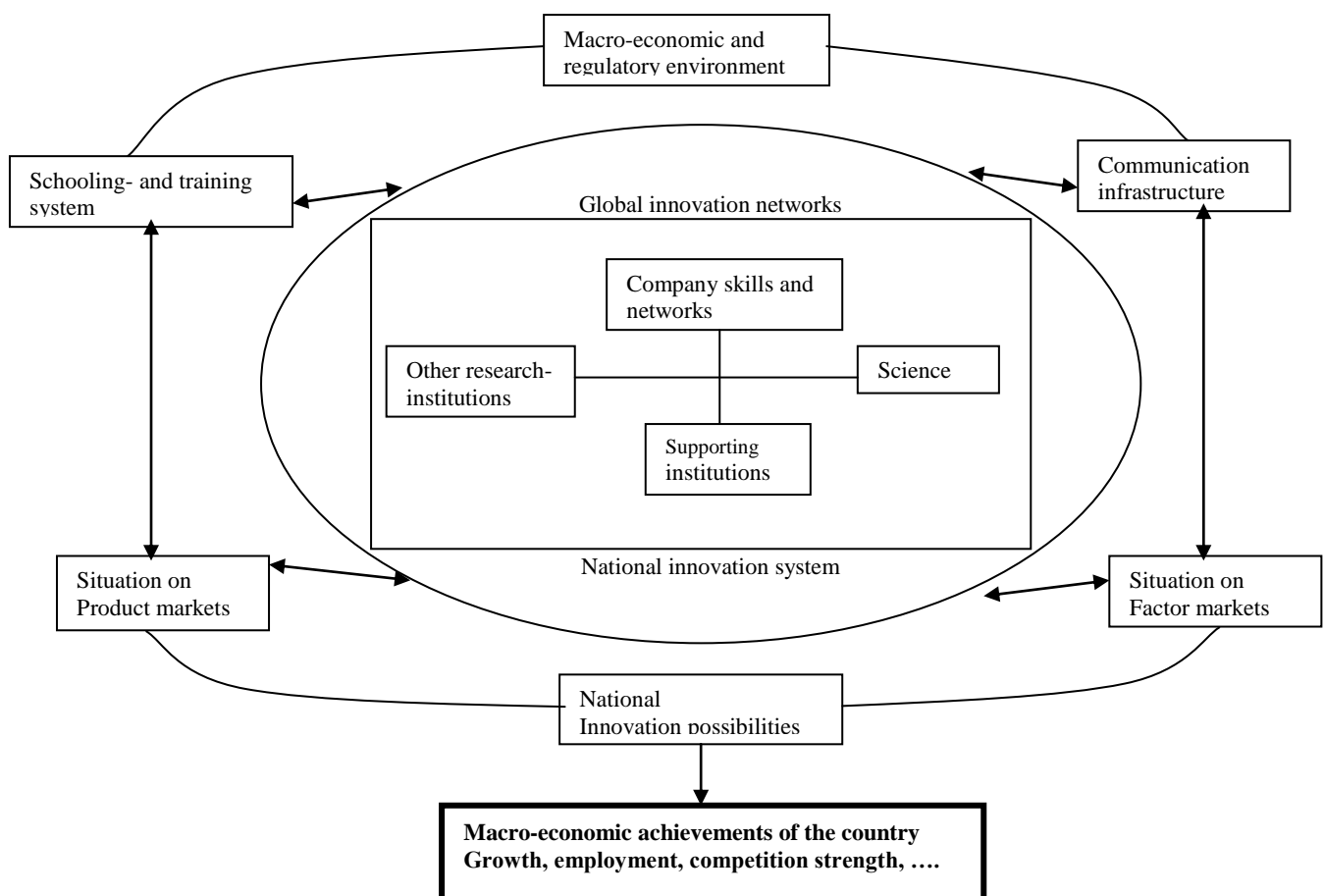
Figure 2.1 NIS Lundvall (1991) OECD report

This innovation system occurs on a national level, but this model is also applicable on a regional or local level. Therefore a general classification of innovation is necessary, which can be used at national, regional and local levels; in order to create measurable concepts for this research. The following classification and types of innovation makes that possible.

Innovation can be seen in different ways and on different levels. There are a lot of books and articles written about innovation and their characteristics. For the system of water use in Portugal the next definitions and characteristics of innovation are applicable. Kleinschmidt and Cooper (1991) use the definition of innovation by the classification; every classification has another view on the defining of innovation. The classification of innovation, which is of use for this research, is as follows: high innovative, average innovative and low innovative. This classification of innovation shows the degree in which a change in the organizations work processes can be counted as an innovation. In the system of water use it is important to get a clear view on this classification, because the understanding of innovation in the system of water use can vary noticeable. For example, the introduction of a new pipeline in the drink water industry can be seen as an innovation but the waste water industry uses this pipeline for years now, so for them it is not an innovation but a change in the drink water process. The meaning of the high innovative class focuses on the products which are new for the entire world and new for the product lines of enterprises. The average innovative class sees innovation as the products that are new for the enterprises but not new for the entire world. Last but not least, the low innovative class is seen as product modifications and small improvements of existing products. These classes of innovation are used to determine the ways in which the clusters in the Portuguese system of water use want to innovate and analyzing what steps will be taken to come to the innovation. Also is this theory of importance to see if the respondents of the interviews (also the people in the organizations / institutions of the clusters). To have one understanding concerning the innovation they are working on with other organizations / clusters. This understanding can show if the relation is build upon one understanding of innovation.

After viewing the different classes of innovation, it is also important to mention the factors on which these classifications are based. Therefore, the innovation types of Edquist (2004) will be described in the following paragraph.
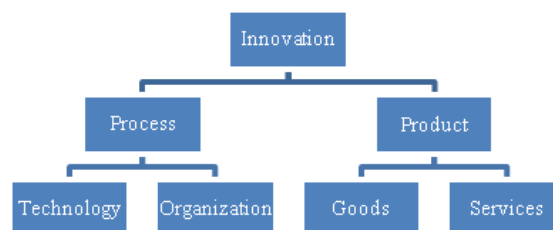
Figure 2.2 Innovation types Edquist (2004)

As visualised in figure 2.2, there are three types of innovation recognizable; product, process and system. Each type is split into various elements, by which the meaning of it will be outlined in the following. The product innovation is split into two elements. These two elements are goods and services, meaning that the product innovation focuses on these two elements. For the system of water use this can be translated to the water as the good and the supplying, collecting, treatment and transporting of water as the services. For instance an innovative machine for the treatment plant is innovation on the product side, because the materials are innovated.

The process side of innovation concerns the following two elements: technology and organization. Edquist (2004) states that process side of innovation focuses on new ways to make product innovation possible, which are technological or organizational. For instance an innovative change in the institutional / organizational setting of the system of water user

means that the relations within the process changes and certain institutions have to deal with other or new institutions.

The system side of innovation captures both the product side of innovation and the process side of innovation. "All important economic, social, political, organisational, institutional and other factors that influence the development, diffusion, and use of innovations." (Edquist, 2004: 183) This means that innovation emphasis on the learning of innovative changes. The learning takes place in the system, which consists of various institutions. The relations and interaction between the organizations / institutions should be coherent with each other in order to create synergy and eventually innovation.

The practice shows that these three types of innovation are in cohesion with each other. This means that the product, process and system have to be adjusted to each other, in order to have a successful innovation process. For example, a new product or service is not able to be well implemented in an organization if the process side of the organizations changes a long. This means that the interweaving between the various types of innovation in the innovation process is of great importance. The managing and controlling of these interactions / relations has to be well overseen, in order to create similarities between the different yet so interconnected types of innovation.

2.3 Triple Helix by Gibbons

The theory of the Triple Helixes by Gibbons et al. (1994) has a strong focus on relations as a fundament factor for innovation, as by the theory of the National Innovation System of Lundvall (1992) Within the National Innovation System, as described in figure 2.1, there are several boxes which can be seen as clusters. These clusters interact with each other in order to create / develop a climate in which innovation can take place and organizations / clusters can work together. M. Porter (1995) developed a cluster theory, in order to complement the NIS theory of Lundvall (1992). The main reason for the existence of clusters is: "*Clusters provide a vehicle to bring companies, government, and local institutions together in a constructive dialogue about upgrading, offering a new mechanism for business-government collaboration.*" (M. Porter 2000:30) The way these organizations / clusters come together and collaborate in the system of water use will be described in this paragraph by using the theory of Gibbons et al. (1994), concerning the Triple Helix thought (which is based on theories created by various authors). The Triple Helix provides views on how institutions are brought together in a setting in which innovation is developed. This setting can be seen as a cluster, like Porter (1995) mentions. Gibbons et al. (1994) identifies three types of Triple Helix, which provides the boundaries for the various types of innovation. Portugal is now at the stage of establishing an innovation capacity, meaning that various elements of the three types are recognizable and implemented.

The theory of Gibbons is of importance for the conceptual model, because this theory states that innovation is a process of crossing boundaries. They approach the process of innovation from an interrelated point of view, meaning that various fields and sectors come together to transfer knowledge. The transfer of knowledge is an important matter in the innovation process; this is the reason why boundaries are not strict and flowing. By flowing is meant that (for example) the private and public sector share the available knowledge in order to add value to the innovation process. Also for the conceptual model various elements of the three types of Triple Helix have been selected to comprehend the indicators for the analyzing of the relations and interaction.

The Triple Helix theory identifies three types of clusters in which the governmental roles change. The three types of clusters consist of the government, universities and private organizations. In the first cluster type the government is willing to include the universities and private organizations in their network. There are strict boundaries within this cluster and the top-down approach concerning innovation is in order. In the second cluster type the government recognizes the independencies of the network and organizations / institutions. This means that the overwhelming role of the government is decreasing and the roles of the

universities and private organizations is carrying more weight. A bottom-up approach is wanted and needed within this cluster to stimulate the knowledge flow. The third cluster type is recognized as a tri-lateral network. This network is used to interconnect and create interdependence between the government, universities and private organizations. In the clusters of the Portuguese system of water use these elements are to be seen. The theory of the Triple Helix also provides elements to analyze how innovation generates within a cluster. Appendix A consists of further detail of the Triple Helix Theory.

2.4 Summary
This chapter contains of the theories that provide views and approaches to understand the innovation capacity in the clusters of the Portuguese system of water use. These views and approaches are used to create the conceptual model in chapter three. The important theories that are used to analyze the innovation capacity in the clusters of the Portuguese system of water use are: the innovation climate by Ekvall, the national innovation system by Lundvall (1992) and the Triple Helix by Gibbons et al. (1994). The theory of Ekvall provides a checklist that shows in what conditions organizations / institutions should be working, in order to have a suitable innovation climate. This checklist will be used for the analysis of the clusters in the Portuguese system of water use in order to determine the innovation capacity of these clusters. The theory of Lundvall is also of great importance for the creating of the conceptual model. This theory provides a wide scope on possible clusters and the relations between them, which can be a part of a national innovation system. For the conceptual model the most important elements, clusters and relations are selected, which are recognizable for the Portuguese system of water use. The theory of Gibbons is used for the conceptual model and the analysis of the clusters in the Portuguese system of water use. Within this theory the knowledge flows are of great importance, because the fundament of innovation is the sharing and creating of knowledge. This is only possible when clusters are interacting and maintaining relations. This theory provides views on the constructions of such clusters. The elements mentioned in the theories, as described in this chapter, will be of use in defining the innovation capacity and describing the National Innovation system of the Portuguese system of water use.

Chapter 3 Conceptual model

In this chapter the conceptual model is presented. This model is based on the theoretical framework, which are to be found in chapter two. This conceptual model enables the measuring of the innovation capacity in the clusters of the Portuguese system of water use. The measurements and determining of the innovation capacity will be possible by the indicators that are drawn from the conceptual model and based upon the theories in chapter two.

The conceptual model, presented in figure 3.1, consists of three sections that will be dissected throughout this report. The first section focuses on the national elements. As to be seen in figure 3.1 the conceptual model focuses on the national level. To comprehend this level the country specific elements need to be analysed. Therefore, a list of six elements is included within this research that provides indicators to describe and analyse the Portuguese context that have an influence on the innovation capacity. The second section concerns the clusters. The conceptual model presents four clusters that have their own roles in the national innovation system. A description will be given of these clusters and the organizations that take part within that cluster, by which the analysis can take place. The third and fundamental section within this model is that of the relations. In figure 3.1 six relations are visualised between the clusters. There is a seventh relation added that represents the international relation that Portugal has with the European Union.

Figure 3.1 Model of innovation in the system of water use
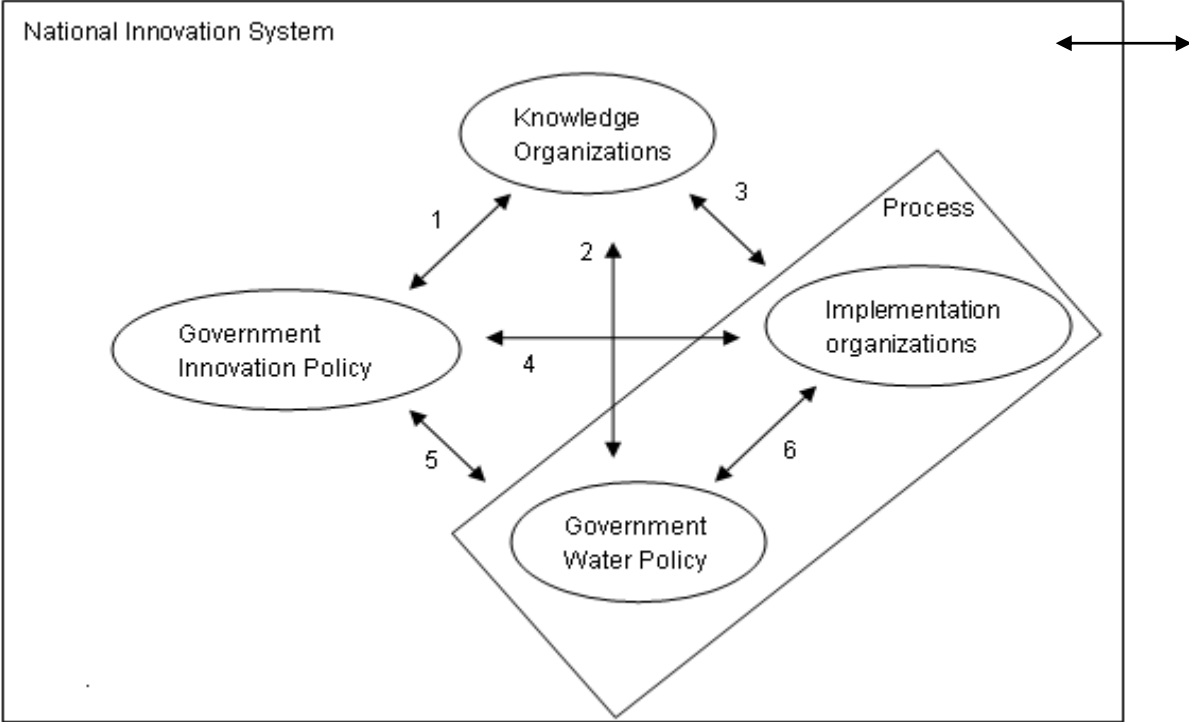
Source: Comparative study of the international innovation in the system of water use

The views of the theories presented in chapter two are implemented in this model. The first section of this model is the country specific elements. This section presents the clusters and relations. As mentioned in chapter two, the system side of innovation concerns: "All important economic, social, political, organisational, institutional and other factors that influence the development, diffusion, and use of innovations." (Edquist, 2004:183) This

understanding shows that not only the clusters and the relations between them define the innovation capacity of a system but the context in which the system is surrounded is also of great importance. Therefore it is needed to analyse the country specific elements, before analyzing the system. The country specific elements are, according to the theory of Edquist (2004), factors that influence the innovation capacity of a system.

The clusters visualised in this model are based upon the theories of Lundvall (1992) and Ekvall (1980). The theory of the National Innovation system plays an intriguing part in the modifying of this model. This theory made clear what elements constitutes in the innovation capacity on a national level. By this theory the clusters are identified by the elements for the learning process. The clusters visualised in figure 2.1 represent the elements that contributes to the learning process of the people within the clusters. For example the cluster of the macro-economic and regulatory environment has a significant impact on the learning process of the people. If there are strict regulations and the macro-economics of the system is not at its best, this means that the people will not have enough space to cross boundaries and there is not enough money available to do innovation projects. These factors all have an influence on the national innovation system; also without the opportunities to innovate the learning process will not develop. The elements of this theory are included in the model ass well in the indicators that determine the innovation capacity of the system. The clusters consist of organizations / institutions. These organizations / institutions all have their own tasks. In order to determine the innovation capacity of these organizations / institutions, it is of importance to measure that by analyzing the actions of people. The people play an important part within this research, they are in fact the ones whom share and create the knowledge. The theory of Ekvall (1980) is used to analyse the clusters and interview the people of the clusters. The checklist provided by Ekvall (1980) is transformed into the indicators that determine the increasing or decreasing factors of the innovation capacity. By the use of this theory the innovation climate is defined, out which the innovation capacity of the clusters in the Portuguese system of water use will be determined.

The theory of Triple Helix by Gibbons (1994) is used to develop the indicators for the relations between the clusters in this model. Within this theory innovation can be explained through the interactions between government, universities and private organizations. The arrows in this model make the interaction and relations between the clusters clear. As defined in this research by Edquist (2004) the innovation process is the way in which the product is realized. In the system of water use the product is not produced by private organizations because the product is a public good (except in the case of industrial water). This means that the production is done by a state-owned company. The Triple Helix theory is adapted within this model, because of the role the government has. Within the conceptual model the governmental role is of importance. The change of the governmental organizations has a significant impact on the entire system. Therefore the changing governmental roles, within this theory need further clarifications and especially its effects on the innovation capacity within the system. This role changes throughout the Helixes but the clusters remain in their construction, namely consisting of the government, universities and private organizations.

In the following paragraphs further description of this model is given. The indicators for the increasing or decreasing effects of the innovation capacity in the clusters of the Portuguese system of water use are presented. First the national context factors are presented, these factors enables the describing of the Portuguese institutional context. Second the indicators for the clusters are presented. The four clusters represent the four types of organizations that are part of the national innovation system. These clusters will be analyzed separately by task

and organisational form. Third the indicators for the relations / interaction between the clusters are presented. The relations / interaction are of great importance to determine the effects on the innovation capacity, in fact without interaction amongst the cluster the innovation capacity will be diminished. In order to research these interactions in the Portuguese system of water use, this section shall be explored by defining the arrows and the indicators that determine the effects.

3.1 Factors of influence on the National Innovations System

The clusters in the model are part of the national innovation in the system of water use; there are several context factors that influence the national innovation system. According to the national innovation system theory of Lundvall (1992) external factors influence the innovation system. Edquist (2004) also underlines in his theory that context factors can have a direct or indirect influence on the innovation capacity of a system. Some factors are not changeable and some can change only on the long term. In this research it is not reachable to include all the possible context factors that may influence the innovation capacity. Therefore the following six context factors will be used, based upon the theory of Edquist (2004) and Nelson (1993). Nelson (1993: 135) mentions the following: "Innovation systems differ significantly between countries, depending on their economic structure, knowledge base, and institutional specificities" These context factors influence the innovation climate directly within the organizations / institutions of the clusters. The context factors also have an indirect influence on the path that is been chosen by the clusters in the Portuguese system of water use. By these context factors, the influence will be determined by the analyzing of the country specific elements within the clusters.

1. **Geographic country specifics** A huge categorical system can be made to describe these specifics, but for this research a plain description will function. This description will include; the climate, the geographic structure and the size of the country.

2. **Cultural aspects** Because culture is a very broad definition we will only use it when necessary to explain relations between organizations. A basic description of the culture in how people cooperate with each other can give an insight in a country. A "claim-culture" or a "polder-culture" will have great influence on results of organizations.

3. **Historical aspects** Path dependency is in this factor of great importance. A chosen way cannot easy be changed and therefore is history a part of the prediction of tomorrow. A small description of the large historical facts of the country like the abolishing of the apartheid in South Africa will be sufficient.

4. **Political aspects** The political system is partly created by the juridical system and partly by political parties. The juridical system can be described as Anglo-Saxon (common law) or a more European Continental law where more is written down. Organizations are created in the boundaries of the law and therefore this factor is of great influence. The political system decides how the organizations function. The political system as defined here needs to scope the level of the government, the way of voting (one vote-one man, or representative), the way of governing one party or collective cabinets and the size off the administration

5. **Economic situation** and **human development** The economic situation of a country says something about the possibilities of the companies to innovate on its own. Hereby is the human part important like the percentage of the different work categories, this indicates the level of economic development in a country (agricultural, technological or services). But also the financial economic situation, the competition, the possibilities to have a

monopoly. An important part is the labour market this has everything to do with human development. Within a population development can be found. Human development uses indications as population size and growth, average population age, percentage of immigrants and emigrants, urbanization, individual economic situation. Large international companies can have huge influences on the economy (international enterprises). These can also be included in this paragraph

6   **Education level** The education level of a population has great influence on the capability to become innovative. Indicators of the education levels can be found in the organizations and in the individuals. For individuals are statistic numbers an indication of the education level (literacy rate, years of education, percentage of total population per sector)The more organizational factors of education and the function of the knowledge institutions will be described later in the paragraph of the knowledge organizations.

The six factors vary from each other and influence the clusters in the Portuguese system of water use differently. The context factors have for the gross part a direct influence on the innovation climate, the working and the organization of the clusters. Except the context factors geographic and historical context factors have an indirect influence. These two factors give clarification in the reason why certain paths have been chosen.

3.2 The clusters

In the following subparagraphs the clusters, presented in figure 3.1 will be described. By the description of each cluster the organizations / institutions that take part in that cluster are mentioned; the organizational / institutional structure and tasks will be explored. The indicators for the measurement of the increasing and decreasing effects on the innovation capacity within the clusters of the system of water use will be described as well. The clusters are distinguished as follows:"Knowledge organizations", "Implementation organizations", "Government water policy organizations" and the last cluster is "Government innovation policy organizations". The clusters have various roles and tasks within the conceptual model. The indicators given per cluster are partly based on the theory of Ekvall. The theory about the innovation climate focuses on the circumstances within the organizations / institutions. Within this research the organizations / institutions are part of the clusters. By the use of the ten dimensions for the determining of the innovation climate, the innovation capacity of the cluster enables the analysis. In the following subparagraphs the ten dimensions are also transformed into the measurable indicators, which are used for the analysis.

3.2.1 Knowledge organizations

The knowledge organizations, as a cluster within the national innovation system, consist of organization that creates knowledge and information within the system of water use. As mentioned in paragraph 2.4 the creation of new ideas and information is of great importance in order to make innovation possible. Such processes are found in the knowledge organizations. There are various types of knowledge organizations recognizable within the system of water use, which are divided in three categories; universities, private organizations and governmental institutes. These categories are created by the theory of Gibbons (1994), the Triple Helix theory states that innovation develops within a system of a network that consist of the universities, private organizations and government. Even though the theory of Lundvall (1992) does not explicit mentions the importance of knowledge transfer, this theory states that the learning process is of great importance. Within the learning process knowledge is the fundament. Figure 2.1 National Innovation System, shows that there are four clusters that focuses on the learning process. These clusters consist of knowledge and the relation between them for the sharing of knowledge. These four clusters visualised in figure 2.1, contribute to developing knowledge and skills in order to increase the innovation capacity within the system. These clusters and the Triple Helix are used to determine the organizations that will be analyzed in the Portuguese system of water use. The cluster of science stands for the

operationalized category of universities. The cluster of company skills and networks is operationalized in the category private companies. The cluster of supporting institutions focuses on the government institutes, these institutions are introduced within the governmental system in order to provide knowledge-based support in times of governmental decisions. These three types of organizations have different roles within the system of water use. In order to determine the roles and tasks of knowledge organizations within the innovation capacity several elements will follow, that may have an increasing or decreasing influence. The roles of these three types of knowledge organizations are described in the following.

Universities
According to the Triple Helix theory by Gibbons et al. (994), the universities are part of all the three types of Triple Helix and are an important actor in the innovation system. Universities are founded to educate their students and to deliver the best education. The universities and their students have to share and create new knowledge. Therefore scientific research enables the developing of knowledge. A university will also sell its knowledge to private or public organizations and uses its patents to receive money, because their employees need to be paid. The research done by a university can be basic or practical. The basic research is done to educate and to know more. The practical research is done to design, advice and control.

Private companies
Ekvall (1980) describes the factors out which a profitable innovation climate should exist. The companies should consist of certain factors that stimulate the innovation climate; keeping those factors in mind the following operationalizations are created. Private companies will produce new knowledge to create profit. There are several / various roles that private companies have to earn profit. Known knowledge and new techniques will be sold to organizations in a process. But they can also educate, design, advise and control.

Governmental institutes
The task to do scientific research is also done by governmental organizations. This contains policy fields in which the private companies or universities will not supply. These fields obtain the research as a pure public task.

As Gibbons (1994) states in his theory the knowledge transfer is an important matter within the innovation process. Therefore, various organizations and institutions interact within a cluster so that knowledge can be shared and created, by which innovation is developed. This also means that innovation only can occur if the tasks of the organizations / institutions are in good coordination with each other. With the current level of communication, knowledge is transferable to all the places in the world. Although the three categories of knowledge organizations have the same task to find and create knowledge there are different purposes for the use of knowledge. One knowledge organization may use knowledge as a tool to do elementary research and another knowledge organization may use knowledge as a trigger to get new assignments. So the creation of knowledge is always used to educate, to design, to advise and to control.

To measure the innovation capacity within this cluster, there are a few indicators that will determine if there is a sense of increasing or decreasing innovation capacity in the system of water use. There are five elements on which the indicators are applied, namely the institutional structure of the knowledge organizations; the degree of competition between the three types of knowledge organizations; the type of research that is done by the knowledge organizations; the financial flow, how are the knowledge organizations funded; and the human capital, the expertise of the employees of the knowledge organizations.

The indicators for determining the innovation capacity of the knowledge organizations are strongly focused on the working and the organization of the organizations / institutions within this cluster. Appendix A represents a detailed table in which the characteristics of the three types of Triple Helix are described. The characteristics constructed by Gibbons et al. (1994) have led to the gross part of these indicators.

The indicators for the innovation capacity have an effect on the knowledge flow. The sharing and creating of knowledge is either stimulated or not stimulated by the organizations / institutions that are a part of this cluster. The first element is the institutional structure. Gibbons (1994) mentions the importance of the knowledge flow. This knowledge flow takes place in a network that consists of both public and private organizations. The boundaries between the public and private organizations determine if the knowledge flow can take place. If strict boundaries are present, which are not able to be crossed, cooperation and the sharing of knowledge is lacking. This view explains as well the third element competition of table 3.1. By the need to compete, the need exists to come with new and better ideas then the other organizations / institutions in the cluster. The element of the financial flow, analyzing this indicator determines if the knowledge organizations are willing to take risks. If the knowledge organizations are not willing to invest money into innovation projects, risk is not taken and innovation is not stimulated, as Ekvall (1980) states in his theory. By the lack of this stimulant there is no need to share and create knowledge. Dynamism is one of the elements, which is mentioned by Ekvall (1980) in his theory. By dynamism is meant the opportunities that people get in the organizations / institutions to shift from assignments internal and external. This element is also a determining factor for the innovation climate. Therefore, the indicator of human capital is added to this table.

Table 3.1

	Indicator for decreasing innovation capacity	*Indicator for increasing innovation capacity*
Institutional structure	Dependency present of the KO's on the policy or implementation organizations. Separation between the public and private KO's.	KO's are independent. Public and private KO's are mixed.
Competition	No competition between KO's. No cooperation between the three types KO's.	Competition between the KO's. Cooperation between the three types through platforms.
Type of research	Main focus on technological knowledge and problem solving. Research based on specific topics.	Focus on the use of various knowledge A broad range on research topics.
Financial flow	KO's are not willing and not able to take risks of losing money.	KO's are willing and able to take risks.
Human capital	Low educated employees. Low degree of labour mobility.	High educated employees. High degree of labour mobility.

3.2.2 Implementation organizations

The cluster of the implementation organizations remains on the production side of the system of water use. The implementation organizations are in charge of the producing and collecting of the water. The tasks of the implementation organizations are the following: the production and distribution of drink water, the collecting of storm and sewerage water and the treatment of sewerage water, are important tasks for the various organizations. These tasks are done by different kinds of implementation organizations in the system of water use. The organizations are divided into three categories private, public and semi-public organizations. They all have their own goal settings; it differs from profit (private and semi-public) until non-profit (public). Their goal settings will be realizing a maximum of profit or efficiency and effectiveness. These organizations will be shortly described. These organizations are present in different layers within a country on national, provincial, regional and other lower level. The differences between these layers are to be found in the citizen's range. The organizations on

the national level deals with the citizens of the nation; the organizations on the provincial level deals with the amount of citizens that live within that province; and the organizations on the regional level have their scope on the citizens within their region.

- Private organizations, these organizations are organized to realize a maximum profit and most of the time they are owned by an individual person or by stakeholders.
- Public organizations, these organizations are organized by the government and try to realize a product, service or process. Most of the times they do not want to realize a maximum profit but a public good.
- Semi-public organizations, these organizations are a combination of partly public and partly private organized organizations.

These organizations produce a product, service or process. Within the system of water use it is common that the product concerns that of water. In model 3.1 it is noticeable that the product is part of the cluster "Implementation organizations". In the following paragraph the product water will be outlined. The theory of the innovation climate by Ekvall (1980) is also of great importance within this cluster. The innovation climate introduces elements that determine if the settings within the implementing organizations are in cohesion with each other to have an increasing innovation capacity. These elements are very much focussed on the human capital of the implementing organizations, because they are in fact the ones who possesses and transfer the knowledge. In table 3.2 the elements of the innovation climate are translated into measurable indicators.

Product
The definition of the product as a part of the system of water use is written in the Bestuursakkoord Waterketen 2007. The definition that is used is the following: "The system of water use can be defined as the services for the household and companies that is involved with the use and discharging of water. The system of water use includes the wasting and supplying of drinking water, the collecting of effluent wasting of it trough the sewerage (including the redundant storm water) and the transporting and treatment of the urban effluent." (Bestuursakkoord Waterketen, 2007) This description distinguishes three kinds of water: drink water, storm water and sewerage water. This has an influence on the organizations, because they have to produce one product at the time or do they produce a combination of more products at the same time. This choice and goal setting influences the process and the possibility of innovation within the system of water use. The advantages may be that more effectiveness, efficiency or synergy will be realised if there is a combination of producing different kinds of water within one organization, in which knowledge is shared over a wider area.

We measure this definition with a couple of variables. According to Edquist (2004) there are different types of innovations, namely the product, process and system. As shown in figure 2.3, the product innovation consists of the goods and the services; the process consists of the technology and organization; and the system consists of both innovation types. There are different kinds of organizations involved with the implementation of the product or service. These organizations are public, private or semi-public as mentioned in the text above. The organizations are focussed on one particular aspect/task within the system of water use implementing the product or service. In order to make this approach measurable, the next indicators will be used for measuring the innovation capacity on the system of water use as a product and the tasks within the system.

The indicators presented in table 3.2 focuses on various elements that determine the innovation capacity of this cluster. For these indicators the checklist of Ekvall (1980) also has been used to be able to analyse the current situation within the organizations / institutions of this cluster. The following dimensions of Ekvall were used to develop these measurable indicators: challenge, freedom and risk taking. The dimension of challenge focuses on the involvement of the people within the organization / institution. The more the people are

involved within the organization / institution from the policy making, the more people are willing and motivated in the implementation phase of the new policy. The elements of structure and discretionary space in table 3.2 conceptualize this dimension into a measurable indicator. The dimension freedom is conceptualized in the elements of structure and human capital. By this dimension is meant the independency of the people within the organizations / institutions of this cluster. If the work environment is surrounded with strict boundaries concerning the roles and tasks of the people, the urge will not exist to take initiative in improving work processes and innovation is not stimulated. The dimension risk taking is transformed into the indicator of financial flow. Ekvall (1980) states that innovation also means being willing to take risks and overcoming the uncertainties of innovation projects. With innovation comes risk and financial resources are needed to take the risks. If the financial resources are not present taking the risks is very difficult. Not only is the theory of Ekvall used to create the indicators in table 3.2. The element product and interaction is based upon the theory of Edquist (2004), he emphasizes that innovation is all about the learning process that takes place within the system side of innovation. By focussing on one product type the learning process will not take place in various organizations / institutions, but only in the organizations that deal with that product type. Hereby knowledge is not shared in the cluster, because it is a specific product with a specific innovation. This is not increasing for the innovation capacity. Also the interaction amongst the organizations / institutions of the clusters should be coherent with each other in order to create synergy in the cluster and eventually develop innovation.

Table 3.2

	Indicator for decreasing innovation capacity	*Indicator for increasing innovation capacity*
Structure	The IO's are centralized and there for clear-cut boundaries.	The IO's are decentralized.
Culture	The IO's are conservative with incremental improvement as guideline.	The IO's are open minded for new ideas with the willingness for radical changes.
Product	IO's focus on one water product type.	IO's focus on various water product types.
Discretionary space	Limited space and less ability to innovate.	Large space, with a wide spectrum concerning their policy.
Financial flow	IO's do not possess own financial resources for innovation projects.	IO's do possess own financial resources for innovation projects.
Interaction	No interaction between the IO's.	Interaction between the IO's.
Human capital	Employees are bound to their task with no space for sharing new ideas.	Employees have freedom and are stimulated to implement their own ideas concerning innovation.

3.2.3 Policy organizations

In the conceptual model the policy organizations are distinguished as organizations that implement and create policies. In this paragraph the policy organizations are seen as organizations that create policies within the system of water use and are part of the government. These are public organization and operate on five different levels: international, national, provincial, regional, and local. The top level (international) has the permission to create legislation and to create policy. The other levels can also create legislation for the creation of new policies but have to be implemented on the same level or a lower rank. The innovation policy organizations are, like the water policy organizations, governmental organizations. The focus of these policy organizations are not the same. The water policy organizations have a strong focus on making a policy concerning the organizations and the working of the system of water use. The innovation policy organization focuses on stimulating innovation by creating the condition for the development of knowledge for the system. These policy organizations use regulations and subsidies to realize goals / tasks, but not only are those aspects important. Water is a public good, this means that the private organizations have to produce water in cooperation with the government; this is mostly done

by the sustaining of the control function by the government. This function gives a certain guarantee that with the production, the guidelines and regulations are granted, out which the safety of water use is applicable. To achieve the production of water with help of private organizations the government has to fulfil different roles. The government has a great sense of responsibility by providing this public good. The responsibility of the government is towards the consumers, also regarded as the citizens. In all the roles of the government, the citizens play a significant part in the policy. At the end of the day it is the public for who the water is produced and whose votes are of importance. So it is also important to see how the government sees oneself and how the other actors describe the government. This makes it possible to determine what position they take in the clusters, as within the theory of Gibbons (1994) the roles of the government changes in the three types of Triple Helix. By the changing of the roles the interdependency of the clusters is determined. The more the clusters are interdependent and less dependent of the government, the more a suitable situation is present for innovation. By determining which roles the policy organizations of the government have within the cluster and the innovation system, also determines in what extent the policy organizations of the government creates space for a suitable innovation climate. These roles will be described in the following paragraphs.

3.2.3.1 Government water policy organizations
The concept water policy has a broad understanding. To specify this concept the various roles of the government will be explained. The descriptions of these roles elucidate the choices in the water policy. This paragraph contains elements which allude to the governmental roles for the water policy. The government in the water policy has a strong focus on the water quality aspects of water. These aspects are of importance, because water is a public good that can have a direct impact on the public health. Therefore the following roles are entirely directed to the maintenance or improvement of the water quality. These roles are based on a research which is done by DHV Netherlands, Dialogic and the Dutch Ministry of Traffic and Water State, named 'Needle sting or spearhead' (2004). The roles that fit the water policy organizations are described in the following:

The government as *legislature* has the task to make decisions, concerning the national objectives, strategies, functions and services and translate them to legislation. (http://web.uct.ac.za, 27/03.2008) This role of the government usually obstructs the increasing process of innovation. The government gives restrictions to the water quality, which should give the assurance of safe water. By these restrictions there is no or limited space for new innovative projects.

The government in the role of *administrator* shows leadership. In this role the government gives directions to the system of water use, concerning the policy and practices of the system of water use. The political face of the government plays an important part in this role. The maintenance of the political face is crucial, in which risk taking is not a part. Hereby the innovation capacity is slim.

The role of *financer* shows the way in which the government determines budgets for projects concerning water and innovation. This role also reflects in what way projects are financed, focusing on the partition of public and private financing. In this role the government has a lot of power to increase the innovation capacity in the system of water use. By investing in innovative projects, not only does it mean that the implementing organizations and knowledge organizations have funding but it also gives out a sign of trust and willingness to take risks. This trust and sign can lead to more public or private organizations to provide funds.

The role of *owner / proposer* focuses on the public tasks that the government has. These public tasks are currently more market conform, due to the fact that the public sector for a part is mixed with the private sector. The introduction of public goods has given more weight to this role. The mixing of public and private organizations has an impact on the institutional setting in the system of water use. The system of water use obtains more organizations and various types, these varieties leads to various points of views concerning the system of water

use. By which the knowledge increases and if this knowledge is shared, there will be a positive effect on the innovation capacity.

The government in the role of *public tender / enquirer* shows the way in which the government gives assignments to private organizations. The government contract the tasks out which are better fulfilled by other organizations then the government. The professionalizing of this relationship and making the private organizations apart in the policy making process, the innovation capacity is stimulated. The government has the possibility to make the private organization a co-partner in the project, in order to increase the available knowledge and the innovation capacity.

The government in the role of *system controller* focuses on keeping supervision of the product organization. In this role the government should be able to locate the sense of urgency of innovation in the system of water use, if it is there. In this role the government can increase the innovation capacity by putting the sense of urgency on the political agenda, and making this subject negotiable.

All these governmental roles in the system of water use show that governmental control, financial funding and cooperation are of importance for the innovation capacity. The indicators presented in table 3.3 are based upon these roles.

Table 3.3

	Indicator for decreasing innovation capacity	*Indicator for increasing innovation capacity*
Policy aims	Policy aims focuses for the most part on prescribed standards, technical applications and methods.	Policy aims consists of general goal setting on output and outcomes.
Policy instruments	The use of repressive instruments, i.e. strict norms, rule-setting and tariffs.	The use of both repressive and stimulating instruments and communication.
Hierarchy	Top-down steering and decision making.	Steering and decision making by mutual adjustment with KO's and IO's.
Finance	Funding for low risk projects, with clear results.	Funding for high risk projects, with uncertainty about the results.

3.2.3.2 Government innovation policy organizations

The government also has a part in which she is responsible for the stimulation of the national innovation policy. The innovation policy organizations of the government stimulate innovation in order to meet up with the development prescriptions. The descriptions of the following roles clarify the government by the concept of the innovation policy. The role of legislature, which is described within the context of government water policy, is applicable in the same way within the context of government innovation policy. This paragraph gives further insight in the roles of the government within the innovation policy.

The role of *facilitator* for a learning environment expects that the government creates space in policy and practice to make innovation happen. The government in this role makes innovation happen by maintaining the interaction with the environment. The elements are the following:
The government in the role of *knowledge broker / director* focuses on the degree in which the government gives direction to the available knowledge. It is not only about directing the knowledge but also adding to the available knowledge. Give direction to knowledge in a network is possible by making use of knowledge management. This means the registration of available knowledge in a computer system and linking the available knowledge to the persons / actors who consists of the knowledge. By doing this a project can easily be linked to the person / actor who has the knowledge to make the project succeed. The government can do this by stimulating the knowledge sharing, through subsidising research programmes and making sure that different parties are part of such a programme; through making co operations for innovation within the system that is in the benefit of all the concerning clusters. In this

case the innovation is 'pushed through' the system by the government by creating pleasant circumstances to work in.

The role of *system controller* shows a government which focuses on management and preservation of the quality in the system of water use. The government needs to make sure that the system deals accurate with the process of water, especially drinking water. Drinking water has its effects on the public health. Guarding and over viewing the public health is one of the main objectives of the government, so this is an important role of the government. The government stimulates innovation in this role, through setting norms and new standards for the quality of water. The clusters then need to oversee their work methods and perhaps change it, by which they are reaching the new norms. In this case the innovation gets 'pulled out' of the system by setting up the norms.

The innovation capacity is decreasing when innovation goals are too specific and the financing of innovation projects are related to certain outcomes. With specific goals there is not much room left for knowledge organizations and implementing organizations to implement their own ideas, as would be in the case of a top-down steering. Also risk is minimized by financing projects only when realizing certain outcomes. In this case the knowledge organizations and implementation organizations do not have the space in their learning process to focus on new found elements that can generate other innovation. As Ekvall (1980) states freedom is one of the needed dimensions when developing innovation. The limited space that comes with such specific policy and financing boundaries are decreasing for the innovation climate and therefore the innovation capacity.

The innovation capacity is increasing when innovation goals are general and innovation projects are financed with unclear outcomes. The indicators for the increasing of the innovation capacity shows that the work environment offers more space and freedom to develop new ideas and take chances / risks. These indicators are also based on the ten dimensions of Ekvall (1980).

Table 3.4

	Indicator for decreasing innovation capacity	*Indicator for increasing innovation capacity*
Policy aims	Specific innovation goals and financing of KO's.	General innovation goals and support of system innovation by creating network facilities.
Policy instruments	Organizing meetings concerning applied innovation and copying that.	Organizing platforms, workshops and congresses concerning innovation.
Hierarchy	Top-down steering and decision making.	Steering and decision making by mutual adjustment with KO's and IO's.
Finance	Financing KO's for specific projects with clear outcomes.	Financing KO's for projects with unclear outcomes.

3.3 Relations between the clusters

The model of national innovation system does not only show the four clusters and the organizations, concerning innovation, the relations between the clusters are of great importance. These relations are focussed internal, within the cluster and external, between the clusters. To maintain and optimize the relation within a system, interaction is needed. Various authors claim that, within every type of system interaction is the base to make the system work; this is also the case within the system of water use. Reviewing the term innovation, concerning relation between the clusters, the following is stated: "A system of innovation is constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge." (Lundvall, 1992:2) The relationships are not considered to be one of the elements, but an outstanding factor to make the system of innovation work. This definition of innovation system emphasizes the importance of the relationships; better yet it is making interaction the core of the innovation system. This is very

understandable, considering the fact that innovation has everything to do with knowledge and the sharing / transfer of it, which can only appear when the relationships within the innovation system is maintained through interaction and communication.

Organizations within a system are related to each other. In order to guarantee the realization of the maximum possible results, organizations are in communication with each other. The arrows in the model stand for the connection between the organizations. Internal interaction is present but it is not part of the arrow. Interaction does not only occur internal and between organizations within the group but is also present on an external base, this is what the arrows stand for. As made clear earlier, the arrows stand for communication and interaction between the different organizations and networks. By communication is meant sharing information (knowledge and views) and by the connections between the organizations / networks is meant cooperation. This relation is then based on a struggle of power (also the question who is dominating who) and it is also based on mutual adjustment and dependencies. Not only is the connection power related but it also makes the mobility of labour possible.

The importance of the relationship is also distillated within this thesis. In the next paragraphs the relationships that are shown in the model of national innovation system are conceptualized in measurable indicators. These indicators have an increasing or decreasing effect on the innovation capacity. There are a total of six relations, which are described in the following.

The relation between the Knowledge Organizations and the Implementing Organizations
This relation is based on the knowledge transfer. The creation of innovation and the buying of innovation are the outstanding activities within this relation. These activities are also the driver for the maintaining of the relation. The Knowledge Organizations are the ones who create the innovation by doing the research; they have the resources and capacity to do so. The Implementing Organizations are the ones who have the image of buying the innovation. The Implementing Organizations either can choose for a relation in which they request for specified information, which is decreasing for the innovation capacity; or they create partnerships with the Knowledge Organization in which both parties are hierarchical on the same level and do research that benefits the entire system, which is increasing for the innovation capacity.
The indicator for decreasing effect on the innovation capacity, concerning this relation, focuses on the principal / agent relation. This relation has to do with the creating and buying of innovation. Looking at the relation, based on the agent, it concerns that of one party having the knowledge and not sharing it. The principal (knowledge organizations) creates the innovation by implementing it, without letting the other party absorb and obtain the knowledge. The relation based on the principal, concerns that of the buying of innovations by the IO from the KO. The IO does not take the effort to experience the steps in creating innovation and gathering knowledge. This experience is very valuable for the future projects, it is a learning experience that is not followed but bought.
The indicator for increasing effect on the innovation capacity, concerning this relation, focuses on the equality in the relation. The partnership makes both clusters insert their specific knowledge, to create new knowledge for the innovation. This partnership can also lead to platforms and congresses, where their knowledge is further spread and where other specific knowledge is gained. Not only does this partnership lead to an equality in working methods but also in the activities that is done. The KO's have the opportunity to do unsolicited research, which can be brought into practice by the IO's. Such partnerships and risk taking can create innovation. The following table describes this relation in short.

Table 3.5 Relation IO-KO

Relation	Element	Indicator for decreasing innovation capacity	Indicator for increasing innovation capacity
IO – KO	Knowledge transfer	Strict principal/agent relation between IO (as an principal) and KI as agent(s)	KI's do unsolicited research and IO's are willing to use this knowledge
		Demand steering from IO focused on problem solving	Collaborative communication about possible improvements/innovations

Relation between the Knowledge Organizations and Water Policy Organizations
The Knowledge Organizations and the Water Policy Organizations have a mutual gain by cooperating. The Water Policy Organizations are in need of knowledge from the Knowledge Organizations, when new policies or new techniques are created. Either it is an incremental change or fundamental change, knowledge is needed to make the change happen. The Knowledge Organizations need the Water Policy Organizations to use their knowledge and test if their knowledge reaches the policy, by which it is able to reach the implementing organization that, bring the knowledge into practice. This mutual dependence creates a situation in which it is giving and taking, so neither is left empty handed.

The indicators that have a decreasing effect on the innovation capacity, concerning this relation point out the technological knowledge that is central in this relation. The gaining of such knowledge is for a specific problem or issue with the consequence that the problem solving is of short term and the use of that knowledge has a slim focus.

The indicators that have an increasing effect on the innovation capacity, concerning this relation point out knowledge transfer for a broad focus. This broad focus makes the relation between the KO and WPO focussed on fundamental research, in which the knowledge of both clusters is of great importance. The learning process of gaining and sharing knowledge is experienced by both parties. In this relation the KO's have the chance to do unsolicited research, out which knowledge is applied within the WPO's. All the factors have an increasing effect on the innovation capacity. The following table describes this relation in short.

Table 3.6 Relation WPN-KO

Relation	Element	Indicator for decreasing innovation capacity	Indicator for increasing innovation capacity
WPN-KO	Knowledge transfer	Strong focus on technological knowledge and problem solving	Combination of technological and ´administrative´ knowledge with broad focus
		Strict principal-agent relation focused on problem solving	KO's do unsolicited research and WPN is willing to use this knowledge

Relation between the Knowledge Organizations and the Innovation Policy Organization
This relation is quite different from the relation between the Water Policy Organizations and the Knowledge Organizations. Even though the Water Policy Organizations and the Innovation Policy Organizations are both governmental institutions, their focus varies. The relation between the Knowledge Organizations and the Innovation Policy Organizations is based on the knowledge development. The roles of the Innovation Policy Organizations, as described in paragraph 3.2.3.2 exist of activities to increase the innovation capacity of the national innovation system. This means that the IPO stimulates innovation by creating the condition to develop knowledge for the system. The developing of the knowledge is done in the relation with the KO, however the relation form determines if this relation as a decreasing or increasing effect on the innovation capacity.

The indicators that have a decreasing effect on the innovation capacity, concerning this relation have everything to do with the freedom that the KO's get from the IPO's. If this

relation consists of the IPO's giving strict norms and guidelines for doing a research for their policy with or by the KO's, the KO's will not have the space to include other views in the research. This is principal-agent relation will not be accountable for the creation of innovation.

The indicators for the increasing on the innovation capacity the development of knowledge starts in the first steps of policy making. This means that the KO's are included from the start of the research. The research design is created in partnership and both parties have equal saying in the steps that have to be taken, the KO's are autonomous, which give them the freedom to have a broad scope in the knowledge development. The innovative capacity increases by the communication concerning the research questions and the investments that are made by both parties within the knowledge development. The following table describes this relation in short.

Table 3.7 Relation KO-IPN

Relation	Element	Indicator for decreasing innovation capacity	Indicator for increasing innovation capacity
KO-IPN	Knowledge development	Strict demand steering from IPN to KO	Communication between KO and IPN about appropriate knowledge questions
		Principal – agent relation under strict conditions	Broad conditions for knowledge development with autonomy for KO

Relation between the Implementing Organizations and the Water Policy Organizations
In this relation the hierarchical structure is of great importance in determining the innovation capacity. The governmental structure determines the process of the decision-making, meaning the decisions considering the elements that are stated in the policy and have to be transformed in practice, also implementation. In paragraph 3.2.3.1 the roles of the Water Policy Organizations are explored, which have a decreasing or increasing effect on the innovation capacity. Al these roles show that the control factor is a crucial element in determining the effects on the innovation capacity in the system of water use. The control that the Water Policy Organizations have and want to maintain on the Implementing Organizations say much about the relation form that is maintained.

The indicators for decreasing the innovation capacity focus on the control and boundaries between the WPO's and the IO's. A strict policy by the WPO's, concerning the structure of the work processes, is not providing an innovating climate for the IO's. In such a setting the IO's have the main task of implementing policy guidelines, crossing that boundary would mean that the IO's are included in the policy making. Keeping the boundaries separated is the case when the control of the WPO's is high, which is not favourable for the innovation capacity. The IO's have know-how about issues and problems on the operational level, because they are the ones working with the policy outcomes and see problems on the first hand. Excluding the IO's in the policy making process has the consequence that vital knowledge is not obtained and used within the policy.

The indicators for increasing the innovation capacity show that the WPO and the IO should have a relation based on mutual adjustment. Crossing the boundaries and making use of each other's knowledge makes it that the policy is implemented by agreement in this relation. The focus is then not so much on how to implement a policy on the operational level, because the policy is already accepted by both clusters by the including of the IO in the policy making process, but more on how the policy can be improved to create innovation. The following table describes this relation in short.

Table 3.8 Relation WPN-IO

Relation	Element	Indicator for decreasing innovation capacity	Indicator for increasing innovation capacity
WPN-IO	Decision-making	Strict boundaries between policy making and implementation	Degree of decision-making by mutual adjustment

		Focus on conservation and problem-solving	Focus on improvement and innovation

Relation between the Implementing Organizations and the Innovation Policy Organizations

This relation has everything to do with creating stimulant and a fruitful environment for innovation. In this relation policy is created to embody or improve innovation in the national innovation system. The Innovation Policy Organizations have the ability to pull the innovation from the Implementing Organizations, by setting up new standards for the system of water use; or they push the innovation through the system of water use by creating a setting in which the Implementing Organizations get the chance to create innovation.

The indicators that have a decreasing effect on the innovation capacity concerning this relation have to do with the policy and the involvement. In case of IPO's that do not maintain an innovation policy for a specific sector, the IO's do not have a specific focus from the government. This means that the IO's do not have a direct interaction line with the IPO's, because their policy is meant for various sectors. Another important factor is when the IO's are not involved in the creation of innovation there can be stated that there are boundaries in this relation. This is not improvable for the innovation capacity.

The indicators that have an increasing effect on the innovation capacity concerning this relation are also the involvement and the financial flows. Without making money available to create innovation it will be very difficult to do the research and develop projects. The financial support from the IPO's is needed by the IO's to do the research and development for the creation of innovation. The involvement of the IO's within the policy making is of importance for the increasing of the innovation capacity. As mentioned earlier, involving the IO's from the start of the policy making process, more knowledge is shared and gained and the acceptance of the policy is higher. The following table describes this relation in short.

Table 3.9 Relation IO-IPN

Relation	Element	Indicator for decreasing innovation capacity	Indicator for increasing innovation capacity
IO-IPN	Development of innovations	No sector specific Innovation policy	Financial flow from IPN to IO's for R&D purposes
		No user involvement in knowledge development	User involvement in knowledge development.

Relation between the Water Policy Organizations and the Innovation Policy Organizations

In this relation the policies for the system of water use are important and the adjusting of the policies to each other's insights determines the innovation capacity. The innovation within the system of water use depends for a great part on this relation, because the policy determines the implementation process and the outcomes. There is dependency between the WPO and the IPO. The IPO's need the information of the WPO's to understand how the system works and where improvements or developments are needed, which can lead to the creation of innovation. The WPO needs information from the IPO to have an insight on where the national innovation system stands and where the system of water use needs to be in term of innovation.

The indicators of decreasing innovation capacity concerns that of cooperation. If the policy organizations are working separate from each other, information is not shared, whereby the policy making cannot happen with a profound base of information. This means that cooperation is needed, by which both policy organizations are working on the same level.

The indicators of increasing innovation capacity also steer on cooperation. The knowledge sharing is of great importance, if knowledge is shared policies can be adjusted to each other's points of views. A network that works with the method of mutual adjustment has an increasing effect on the innovation capacity. The following table describes this relation in short.

Table 3.10 Relation WPN-IPN

Relations	Element	Indicator for decreasing innovation capacity	Indicator for increasing innovation capacity
III WPN – IPN	Policy adjustment	Both networks are working in silos	Mutual adjustment and policy integration occurs
		If cooperation: demand steering from WPN to IPN	If cooperation: mutual search towards useful knowledge questions and innovation policy

3.4 Interaction between the clusters

Next to the indicators for the relation that is given in the above paragraphs, the next elements are also of importance to keep in mind for the interaction patterns between the clusters. The interaction between the different clusters by arrows is presented in the model and stands for the relations. The relations are described and conceptualized in the above paragraphs but the relations are maintained through interaction, communication and financial flows. In the following the arrows are numbered from 1 to 6 and in that order they will be described. The description and indicators are based upon the ten dimensions of Ekvall (1980). Even thought the relations are between the clusters, the research is done within the organizations / institutions that take part of the clusters. The way in which the relations are maintained is researched by analyzing the organizations / institutions within the clusters. The checklist of Ekvall (1980) is operationalized into the following measurable components.

Arrow 1 IPO ⇔ KO Focus on innovation steering/control
- Subsidies and the way organizations finance their innovations
- The amount and the form (boundaries) of the assignments (already existing or new ones);
- Innovation in an umbrella organization (platform) or is innovation organized specific. Is there a relation between these two types of organizations structure ring?
- Is the steering and control embedded to increase the innovation or is it used to regulate the processes?

Arrow 2 KO ⇔ WPO Focus on amount of specific policy questions and independent researches
- Is there any harmonization between the governmental policies and the researches of the knowledge organizations?
- Are there meetings betweens different types of organizations? Who are present with these meetings and how often are they. Where do meetings take places and who is the organizer? What is (in most of the cases) the subject of those meetings?
- What is the form of these meetings? Are their procedures and do standardization of processes occur;
- Are the knowledge organizations bounded through water legislation formed by the government;
- What is the role from the government and private organizations concerning implementing new innovations in the system of water use? How do new innovations get assimilated in the (new) water policy?

Arrow 3 KO ⇔ IO Focus on mobility of labour in organizations / institutions of the system of water use and employees training
- Development of new technological improvements. Are there any experiments (laboratory), if so how many times do they occur;
- How often do they implement knowledge/innovations and what do organizations do with suggested knowledge within organizations;
- Do the organizations give assignments to each other and in what form;
- Are the implementing organizations self responsible for their actions or is it another governmental organization.

Arrow 4 IPO ⇔ IO Focus on Influence of water implementation on innovation policy and vice versa / back around
- Are there topic lists like "Endurance and the environment" within the policy of the implementation organizations and is there any kind of harmonization?
- Which stimulations / support do organizations get from the government or business life to innovate?

Arrow 5 IPO ⇔ WPO Focus on degree of compartmentalization
- Is there an innovation agenda and is there integration between the two elements (government innovation policy and government water policy)?
- Is there any overlap and cooperation between these different governmental organizations?
- Do these organizations have shared political responsibility?
- Are there shared (cash) flows (for example shared information and is there a water policy to fund more money for innovation within the system of water use)?
- Governmental organizations do they have a set of innovation topics (agenda)?

Arrow 6 WPO ⇔ IO Focus on the integral system of water use
- How does the government control the implementing organizations? Is this based on efficiency or is this based on goal setting?
- What is the mobility of labour, how many times do employees switch within these organizations?
- Is there policy harmonization?
- What is the trust between the different organizations within the system of water use? What kind of images do organizations have of each other?

The arrows in the model go both ways so the analysis in this research is done in the same matter. The arrows are considered to be a few pointers that are kept in mind throughout the analyzing of the innovation capacity in the system of water us in Portugal. These indicators that will be kept in mind throughout this research determine the extent in which the innovation climate is stimulated within the interactions between the clusters.

3.5 Research design
This master thesis is based upon a qualified research that concerns the national innovation model. The purpose of this research is describing and analyzing the innovation capacity in the clusters of the Portuguese system of water use. By describing is meant "observing and then describing what was observed" (Babbie, 2008:99). The national innovation model, see figure 3.1, is based upon scientific theories and should give the answers to the main and sub questions. The collecting of the data for this research is based upon the conceptual model to examine the innovation capacity in the clusters of the Portuguese system of water use. In this paragraph the steps that are taken within the research will be explored. There are three aspects that are described in this chapter: research type, research method and research instruments. These three aspects will be included in the description of the reliability and validity. This research is a qualitative research, meaning that the measurements of the perceptions / views of the respondents play the crucial role in the gathering of the data. The measuring of these perceptions is done by structured interviews, in which representatives of the various clusters and organizations are approached and interviewed. This research is not only based on interviews, another crucial research instrument is document analysis. Hereby existing data is collected before, during and after the interviews. A comparative study of four countries has made a great impact on the research design of this thesis. During the comparative research it has been of great importance to create a research design that is applicable to all four countries. Hereby a comparison of the four countries could be made. This research design still shows coherency to the comparative study but is composed by the needs of this research. In the following paragraphs the research design will be explored.

3.5.1 Research type and research method

The innovation capacity in the Portuguese system of water use is the title of this master thesis. The meaning of this research is to describe and analyze the innovation capacity of the organizations / institutions in the clusters of the system of water use in Portugal. The available information concerning the innovation capacity of Portugal and in specific within the system of water use is limited. This does not mean that there is no innovation present within the system. This means that there are not many researches done, concerning this subject.

The research type that is used concerns the qualitative field research. By this research is meant an observation research in which theories are generated and data is collected. "...attempt to make sense out of an ongoing process that cannot be predicted in advance-making initial observations, developing tentative conclusions..." (Babbie, 2008:314) This shows that by the use of this research type hypothesis concerning this subjective does not exist. The scientific theories within this research are used to develop an understanding on how to approach the subject and the respondents. Hereby an understanding of innovation capacity for the situation in Portugal is developed, through the collecting of data. This means that data is collected so that the way in which the clusters in the national innovation system effect the decreasing or increasing innovation capacity in their daily practice can be described and analyse. The organizations / institutions that take part of the clusters are the social phenomenon that is researched. Making use of the qualitative field research the social phenomenon is observed by first hand, namely the researcher. "By going directly to the social phenomenon under study and observing it as completely as possible, researchers can develop a deeper and fuller understanding of it." (Babbie, 2008: 314)

In short, this means that this research type provides tools to analyze the social settings in which the clusters part take and understanding it by the use of various existing theories.

Research method

The research method that is chosen is that of the case study. The case study concerns that of a detailed description of the situation in the Portuguese system of water use concerning its innovation capacity. Babbie (2008) states: the research method case study seeks for an understanding in a particular case. An important characteristic of the case study is that of the time limitation. This research had to be completed in a period of six months, therefore the current situation needed to be researched within that time frame. There were no resources and time available to do a comparative research within the case of Portugal. This research is done in two countries, for three months in the Netherlands and for the other three months in Portugal. I travelled to Portugal so that the respondents could be interviewed and the available documents were analysed accurate by seeing national innovation system and the system of water use on first hand.

Research instruments

The research instruments are: document analysis and interview. The document analysis is used to collect qualitative data for this research. This instrument is used in the pre-research phase, in which an idea was created about the subject. The theoretical framework and the conceptual model are also created by the use of this instrument. By reviewing various documents, existing theories and data of the current situation in the Portuguese system of water use, a fundament was created which determined the process of this research. The documents concern scientific theories with the focus on innovation, governmental policies, law descriptions, annual reports of organizations / institutions and so one. The interview instrument is used to collect qualitative data of a selected population through a structured questionnaire. See appendix B for the developed questionnaire. This instrument has the advantage that statements, distillate throughout questioning, are generalized. This means that various statements can be put into context (Baarda & de Goede, 2001). In the following description of the research process, step six contains a detailed description of the interviews and the selected respondents.

The underline goal of this study is to create a comprehension in the innovation capacity of Portugal. This means that it is of importance to research and understand the possible factors that have an increasing or decreasing effect on the innovation capacity. To reach this goal it is important to get an idea / insight of the current situation. This indicates that the current strengths and weaknesses of the organizations in the innovation system are meant to be put into vision. The document analysis and interviews are instruments to acquire these insights. Throughout these instruments the perceptions of the actors are highlighted but also very important to know what the actors think about the other actors. These insights say a lot about the relations and interaction between the clusters.

Research process
The research that is done has been through various steps. For this research a process is followed, in which explains what steps have been taken and the meaning of those steps. This research process is the methodological responsibility of this report. The research process is based upon the theory of Babbie (2008:118)
1. Interest. The interest for this research came from DHV Netherlands. This consultancy- and engineering agency had an interest in doing a comparative research. DHV is an international organization that operates in the field of spatial development. This agency had an interest in doing this unsolicited research to broaden their international working field and create an interest at the Dutch ministries for the innovation agenda. Throughout this interest the research object was determined, namely the innovation capacity in the clusters of the Portuguese system of water use.
2. Idea. This research is part of a comparative research consisting of four countries. My two colleagues and I have reviewed and discussed the shape of the research. The idea existed to create a conceptual model that is applicable for all the countries out which a comparison would be the result. For this research, the Portuguese system of water use, the idea to conceptualize the interest was transformed by reviewing the assignment thoroughly and then editing the main and sub questions. Hereby the interest was minimized into a main focus and a smaller scope of view. By identifying the smaller scope of view the problem is identified. The problem was the lack on researches done concerning this subject, hereby a pre-research is performed in order to understand what the subject comprises.
3. Theory. In this phase the theories were selected that could give the answers to the main question and the sub questions. Keeping the goal and questions of this research in mined various theories were selected to create a model for the determining of the innovation capacity in the clusters of the system of water use. The theories also provide an understanding of the items introduced in this research. For example the way the innovation capacity is viewed within this research is grasped within the theoretical framework.
4. Conceptualization and operationalization. Within this phase the theories are transformed into measurable concepts and variables that can be analyzed. The operationalization concerns the detailing of the concepts and variables by the added indicators. The conceptual model is created by the theoretical framework and the data gathered from the pre-research. The conceptual model embodies the indicators that are needed to describe and explain the innovation capacity in the clusters of the Portuguese system of water use. The conceptual model is split up in three sections. First section consists of the context variables, in which the country specific elements are described. Second section consists of a description of the organizations (clusters) this will include an institutional description (structure, culture and tasks) and a description of its functions. This will be measured by known data (scientific data, laws and policy papers) and by new data interviews (for this purpose the use of an item list and a survey list to get some quantitative numbers). The interviews will also include the third part of the model, the connections. The third section concerns the relations / interaction and will be seen through analyzing the process in the national innovation system and the relations between the clusters. The indicators are added to the description of all three clusters and are based on the theoretical framework.

The focus of this research is also determined within this phase. The focus is the innovation capacity in the clusters of the Portuguese system of water use. To maintain the focus of this research the definition of innovation capacity is described and applied to the conceptualized model (figure 3.1), the clusters and organizations within the model are typified and the relations and interaction between the cluster and organizations are indicated. The context variables are also important to analyze, because they have an effect on the innovation capacity. The context variables are the following six: geographical, cultural, historical, political, economical and educational variables. The focus should be preserved by following the model and only describing the six context variables.

5. Choice of research. The research type that is chosen concerns the qualitative field research. This research type provides the opportunity to observe the social phenomenon, also the organizations / institutions of the clusters, by document analysis and interviews.

6. Population and sampling. In this phase the social phenomenon is selected. The organizations / institutions that will be observed were selected. More specific selection also took place in this phase, namely the selection of the people that would be interviewed. The respondents of the interviews will be selected on the base of the elite-interview. The elite-interview stands for the selection of respondents that are prominent persons within the case. (Baarda en de Goede, 2001:136) The selection of the elite respondents is done, because they are usually the ones whom have the knowledge based upon their position. Furthermore they are the ones whom have the position to create the relations and interaction with the other clusters, within the national innovation system. For this research the innovation capacity in the system of water use, it is also important to find out how the four clusters of the national innovation system see the national innovation system. To get their views on the national innovation system the interview method is then applicable, in essential the gathering of data through interviews. Interview with key-players in the organizations / institutions of the clusters is necessary, to get insight in the national innovation system. It is of importance to interview at least one key-player of one knowledge organization (apart from DHV), one water policy organization, one innovation policy organization (who gives a good insight in the national innovation system) and one implementing organization. A total of 21 key-players were selected and interviewed, by this instrument and in deliberation with my supervisor in Portugal. The information gathered through interviews will clarify the views that are carried by the partners of the various organizations.

7. Observation. The data was collected for the analysis and gathering of various views of the organizations / institutions. This step required looking into various documentation and data concerning the national innovation system and the system of water use in Portugal. The main documents that were analysed for this research are the following: 'Relatorio annual do sector de aguas e residuos em Portugal (IRAR, 2006), Série guias téchnicos (LNEC, 2004) and PEASAAR I and II'. These documents are policies in which the current situation of the system of water use in Portugal is described and future plans for the system of water use are presented. These documents are small presentations of all the files and data that is analysed for this research. For these documents it is important to note that they were written by various organizations / institutions which are dividable into various clusters. This is an important factor within this step, gathering knowledge throughout various perspectives, by which data can be compared and contradictions will be noticeable. For this research it was also crucial to collect and analyse various data from different sources so that the various subjective points of view could be collected into one document. Next to the document analysis, the interviews also took place within this phase. The questionnaire for the interviews was already composed for the comparative research.

8. Data processing and analysis. Within this phase the collected data from the documents and interviews were described and analyzed. This means that the various views were gathered and brought into perspective with the indicators. The measurements of the indicators made it possible to form this research and write this report. The conclusion of this research is

also a part of this phase. This is to be found in this report and the results are found in the last chapter.
9. Application. The results of this research concern that of this report, the modifying and editing of this research into a logic story, ends in the presenting of this report.

3.5.2 Reliability and validity
Reliability stands for the consistency of measurements, also the degree in which an instrument measure the same way each time it is used under the same conditions with the same subjects. For this research it is of importance to secure reliability by internal consistency. The internal consistency of the instrument interview will be done by making use of one questionnaire, which is used by all of the students that are gathering the data. Not only can the use of a questionnaire guarantee the reliability of the instrument but also the style of the questionnaire. The style of the questionnaire is determined by grouping the questions into concepts. In each concept there are at least three questions present, which measure the same concept. At the point that the results of the questionnaire is analyzed it is important to see if the questions per concept are parallel. This analysis also request that the outcomes per concept will be compared by class participation. This means that the results of on questionnaire will be compared to another questionnaire, to see if the participants of the different organizations share the same or different images of the current situation. This comparison can add to or decline the degree of the international comparison. (http://www.socialresearchmethods.net, 03/04/2008)

Validity stands for the degree in which we are measuring what we meant to measure. Validity is also seen as the value that is given to the conclusions of the research. The validity in this research will be focused on the external validity. The external validity determines the degree in which the results of the individual researches are generalizable to the other researches. This means that the research questions, as mentioned in chapter one, have to create the space in the research in order to make comparison possible. (http://www.socialresearchmethods.net, 03/04/2008) This also means that the uses of the following instrument are of importance:
- A definition list of words which we will use in our research. This list will give the assurance that there is a matter of the same understanding of the concepts that are used.
- The operationalization of the theoretical framework into a conceptual model makes the research measurable. By the use of the same concepts we have created the opportunity to give the same shape to the different country specific research. Hereby the creation of a higher degree of comparability of the different country specific researches.

Triangulation is one of the important ways to prevent the problems concerning the reliability and validity with case studies. Triangulation stands for a combination of work methods and instrument, for example the use of observation, the analyzing of documents and interviews.

3.6 Summary
This chapter showed the conceptualization of the theory into the model and the research design. This model consists of four clusters: the knowledge organizations, the implementing organizations, the water policy organization and the innovation policy organizations. The relations in this model are of great importance. By this model the understanding of the innovation capacity is broadened by the use of indicators for the country specific elements and the clusters. The relations / interaction between the clusters determine if knowledge is transferred. Innovation concerns that of the sharing and creating of knowledge. These relations are also outlined by the indicators that have a decreasing or increasing effect on the innovation capacity. The indicators for the country specific elements provide the possibility to describe and analyze The Portuguese context and determine its influence on the innovation capacity in the system of water use.
This research is done by taking various steps in the process. In order to grasp these steps the paragraphs of the research design focuses on the research type, research method, research

instruments and the research process. By explaining these components of the research the reliability and validity of this research is presented. The research design is important to explain the ways in which the theoretical framework and analytical framework is formed. The research type is that of qualitative field research and the research method is that of the case study. The research instruments are document analysis and interviews. The instruments and methods make the analysis of the clusters and organizations within the national innovation system and the system of water use possible. The research process consists of nine phases, in which the methodological responsibility is outlined.

Chapter 4 Portugal the country specific elements

This chapter presents information about the country specific elements of Portugal. A brief description of the country specific characteristics will be given. The six context factors have for the main part a direct influence on the innovation climate, the working and the organization of the clusters. Except the context factors geographic and historical have an indirect influence on the innovation climate. These two factors give clarification in the reason why certain paths have been chosen. In all of these parts the six factors of influences as mentioned in paragraph 3.1 are applicable. These factors of influences will be described in the following paragraphs.

4.1 Geographic factors of Portugal

The republic Portugal has a population of 10.956.117 inhabitants, who are allocated unequally over the small, mountainous and rainy regions of the country. "The demographic development is characterized by three trends: increasing longevity, decreasing birth rates and an increasing percentage of population from foreign extraction." (http://en.wikipedia.org, 18th April 2008) Over 10% of the population lives in cities and almost 50% are spread out over places with less than 2000 inhabitants. Lisbon is the capital of Portugal and is seen as one of the two metropolitan areas of the country. The other metropolitan area is Porto and its surroundings. "Portugal is located in the far south-western Europe on the western side of the Iberian Peninsula, is bounded on the north and east by Spain and on the south and west by the Atlantic Ocean." (http://www.fao.org, 17th April 2008) Portugal was divided into six provinces: Algarve, Alantejo, Estremedura, Beira, Trás-o-Montes and Minho, but for administrative reasons the country got divided into 18 provinces of which the six names mentioned above are still a part of.

Portugal has three diverse types of climates in the country. The northwest is characterized by moderate winters, short summers and abundant rain falls. The north-east deals with long, cold winters and hot summers. The south has a typical Mediterranean climate, which consists of a dry weather type with soft, short summers and hot, long summers. (www.evd.nl, 23rd April 2008) The figure shown in Appendix C shows the varieties of climates in Portugal:

4.2 Cultural aspects of Portugal

A significant element of the Portuguese culture is first and for most the FADO. The FADO is described as the Portuguese life song. In the nineteenth century the FADO was used as a political satire but now it is seen as an art of singing, which expresses all feelings of the human beings. The ruling religion in Portugal is Roman-Catholic; to be exact 84,5% of the population adheres to this religion. The population has the freedom to express any sort of religion.

The consensus culture is dominant at the moment. This statement is made by various respondents. Portugal has the culture of making consensus and is working for the most part with objectives that are very well negotiated and very common for the involved parties. The biggest issue that the Portuguese system of water use is dealing with, does not concern the objectives (what they want), because there is consensus reached up to this point. However, the way to get there is an issue which still needs work. The system of water use is therefore triggered by a rationalisation process. The rationalisation process concerns that of the following "a process where beliefs, social institutions and individual actors all become more logical and orderly. Sensual, spiritual, traditional and irrational aspects of social life decline." (http://www.soci.canterbury.ac.nz/resources/glossary/rational.shtml, 23rd of November 2008). A lot of actors in the system of water use see that the consensus culture is not working as well as needed. Portugal is already lacking behind in comparison to other EU countries and looking at the water quality standards, there is a lot of catching up to do. In order to make drastical changes and considering the time that is spent and the time that has to be made up, the consensus culture within the system of water use needs to be transformed: the past has

shown that this cultural characteristic takes a lot of time, which Portugal does not have. Therefore little steps are taken to transition, from the consensus culture to a new way of logical working.

4.3 Portugal and its history
Portugal is at the moment a European Union country; Portugal best eras were in the 15th and 16th century. In these times Portugal conquested several countries and reached countries that were not able to be reached before (like China and India) In the centuries after that Portugal lost power and status, due to the fact that other European countries were also emerging in the slave trades and build concurring empires. The destruction of the capital and the loss of the largest colony (Brazil) made Portugal even weaker. By the instalment of a new government in 1974, the African colonies were granted their independency. This government dealt with democratic reforms, which valued the independence of the colonies. (http://en.wikipedia.org/wiki/History_of_Portugal, 21st April 2008)

In the 19th century Portugal had a private owned system of water use, which was formed by small water constructions in the villages. After the democratic revolution (which contributed to a greater awareness towards water policy issues and political environmental regulation; Portugal's entry in the European Communities) of 1974, the King decided that the system of water use should be owned publicly. This decision was for a great part based on the fact that epidemics were reaching the population and people were getting sick. The epidemics were not only reaching the 'normal' citizens but also the families of the members of the court. The court insisted that the King would make an effort to improve the water system. The revolution also had its effects on the opinions of the citizens. The citizens were convinced that everything that was owned private had to be bad. Their opinions were formed by the experiences they had before and during the revolution. The municipalities were the only ones in charge of the water services.

At the moment a mixture in the system of water use is recognizable. For the most part the system of water use is public owned and for a small part the system of water use is privately owned. This change is caused by the joining of Portugal to the European Union. The joining with the European Union means that the regulation on this level has to be applied on the regulation of the nation. Portugal had to change its water policy to comply with the European Union regulation. The latest news, concerning the water policy of Portugal, shows that Portugal has not been showing the required results and procedures for the water quality, which were stated by the European Union. In order to keep up with the rest of the European Union countries Portugal was granted to make changes in its system of water use. The service quality of drinking water and wastewater is still not on the level, demanded by the European Union. As the documents show the drink water quality in Portugal is not consistently good, especially in smaller systems. The wastewater discharge does not always function properly: after a heavy rainfall, the sewers get overflowed and water treatment is difficult. Therefore national plans were created and implemented that are now tuned to the European Union standards. In the following sector these plans will be explained.

4.4 Political aspects of Portugal
Portugal is a parliamentary democracy with a Republican state form. The governmental organization looks as follows: The constitution of Portugal, which dates of 1976, determines that the legislature is stated by the parliamentary. The 230 members of the parliamentary are elected every four years through the system of proportional representation. The parliamentary has the right to make changes to the constitution every five years.

The executive power is, according to the constitution, in hands of the government. The president chooses the prime minister, who will be in charge of the composition of the government. The members of the government are officially appointed by the president. The president is chosen by presidential elections, which has a five year term. The president only

can be re-elected one more time. The president is supported by the Council of State. Portugal has the characteristics of a semi-presidential system, which consists of a parliamentary and a president, both democratically legitimated. This system makes the government accountable from two sides. The government has to explain itself politically to the parliamentary and institutionally to the president.

The government system is typified as a centralized system. The country is divided into eighteen districts and 151 municipalities. Reviewing various documents of the financial flows, all the municipalities have the right to their own regional water system, but they are financially dependent on the central government. On paper this means 151 water systems, in practice this possibility does not appear. There are municipalities who decided to work together, so connecting the various water systems to a greater whole, for efficiency and effectiveness reasons. These reasons also made the government look more at the public – private cooperation, in order to get various projects of the ground, which are meant for the public sector, as various respondents of the interviews mentioned. The capacity building is also an important factor for the municipalities to work together. The limited capacity of the municipalities, concerning the process of the system of water use, made the municipalities come to an insight that improvements are needed. The improvements have to be configured by the use of knowledge from various points of views. Therefore the public – private cooperation is also becoming an important issue.

4.5 Portugal economics and human
The economic situation of Portugal seems to be recovering, from a period of continuing growth (1995-2000), to a period of stagnation (2001) and even a period of recession (2003). After the recession the Portuguese government decided to take action in order to make the economical situation in Portugal healthier. The government did that by cutting into the budgets (this means more expenses for the citizens and higher taxes). The population was not happy with this decision. They were the one who would feel these economical measures the most.

The government had to stick to their decision, because they had to make efforts to change their economic situation, also in relation to the Stability and Grow pact which implicates all the EMU-countries. Even though there is an improvement notable in the economic situation, the inland investments are decreasing. However 2004 was a good year for the infrastructural projects. The investment activities in 2004 were focused on the infrastructural projects in the context of the European Football championships. Further, the inland investment show a modest recovery in comparison to 2002 (when an economic crisis was declared due to the low investment) but is still in a decreasing line. The economic situation of Portugal in comparison to the other EU countries, gives Portugal the right to EU aid. This is an aid of 22,5 milliard Euro that has to be spend on the thematically programmes (national):
• Schooling and vocational education (6,1 milliard Euro)
• The stimulation of competitiveness (3,1 milliard Euro)
• Quality improvement of spatial infrastructure (4,7 milliard Euro)
• The remaining 8,6 milliard Euro is meant for regional programmes

The respondents of the interviews have a clear point of view on the economics and human aspects in Portugal. The development in the market in comparison with other European Union countries is very low, especially in the agricultural sector. The cause of this symptom is due to the fact that Portugal deals with land of bad quality, irregular rain fall, technological arrears and a lack of distribution- / marketing expertise. Not only do the factors mentioned above influence the bad position of Portugal in comparison with the other European Union countries, the competition they have to face with the other EU members is not reachable for Portugal. By the accession of Portugal in the EU the foreign competition grew, which was difficult to pre-empt by the Portuguese agriculturists. The accession also meant that Portugal had the right to

the financial aid from the EU, which was estimated on one milliard Euro. This financial aid is necessary for the agriculturists, but will not be enough in the long run. Investments were not made in the structural reforms, whereas modernizing lacked behind. The lack of this investment means that Portugal will remain / keep behind concerning the modernizing in comparison with the other European Union countries.

The population of Portugal is aging, which will have its effect on the social insurance and health systems. The population structure is visible in table 4.1, in which the age structure is seen.

Table 4.1 Population

Principal cities and population	
Lisbon	559,400
Porto	264,200
Amadora	175,600
Braga	114,500
Setubal	114,000
Coimbra	103,200
Funchal	103,000
Age structure	
0-14 year	16,5%
15-64 year	66,3%
65 year and older 17,2%	

Source: CIA The World Fact book, Portugal, 2007

The gross part of the population lives in the North region of Portugal. About 62 % of the population was suited in the North, Porto and Lisbon. There has been an increasing movement the last years of the population from the countryside tot the cities. Also Algarve is dealing with an increasing population, due to the fact of the tourism flow. In the ninety 60's and ninety 70's a lot of Portuguese inhabitants immigrated to another country, because of the (miserable) economic situation in Portugal. This symptom turned around when, in the second halve of the nineties: the emigration to the foreign countries decreased and the inland economy improved. The improvement of the economy meant that a lot of people immigrated to Portugal. The new population groups mostly come from Portuguese colonies, like: Angola, Cap Vert, Brazil and so on. Various respondents of the interviews stated that the immigration to Portugal had its effects on the water systems of the municipalities. The increasing of the population means that the system of water use also needs to configure their system to supply water for a bigger population.

4.6 Educational status of Portugal
Recent research has shown that only 20,4% of the Portuguese population, in the ages of 25 to 64, has a secondary school degree. Education is obligatory till the 15th year. After that children of 15 year and older can decide to continue or end their education. The figures mentioned above, show that a gross part of the population will not be able to reach higher education. The low educational level in Portugal is seen as the biggest cause for the low labour productivity level. The government sees that they have to take action for this problem; they have already submitted measures to improve the educational level. A couple of examples of these measures are the following:
- Since 2005 English language is obligated at school from the age of six year.
- The extra attention given to the development of skills concerning information technology.
- The resetting of the various profession educations in the third year of secondary school.

The educational situation of the engineers in the Portuguese system of water use has to be overlooked. The respondents of the interviews made it very clear that the engineers in the Portuguese system of water user are higher educated then the average educational level of Portugal. The system of water use of Portugal consists for the most part of engineers, who design the water systems, work on the water treatment plants, or do researches in the system of water use. Nevertheless, the educational level of the engineers in the system of water use does not mean that the engineers do not lack on certain skills. This means that the size of the system of water use is not in need of more engineers. The engineers are for the gross part higher educated and such work pays well in comparisons to other jobs in Portugal. The skills that are needed by the engineers are different from the skills they learn at the universities at the moment. The system of water use faces challenges, which for a long time were focussed on the construction of new water systems. These challenges are now on another level namely the sustainability and improvement of the water system's operations. Therefore the needs of the engineers and the entire system of water use have to be reflected in schooling / the educational system. For example starting from next year a training course concerning technical management of urban water systems will be arranged in order to facilitate this lacking area. This training course is to improve the skills of the engineers who are responsible for the management of the water systems in Portugal; they can distillate their learning to other engineers.

4.7 Summary
This paragraph has given insights in the status of the Portuguese context variables. The respondents of the interviews made it very clear that the country needs to make giant steps to recover its lacking points within the European Union. The municipalities are at a stage where the cooperation is starting, so that the system of water use can cover a larger part of the population. Portugal is a part of the European Union, which does not only make them change the current system in the country but also gives them a financial push to improve / develop the system. The respondents state that the influence of the European Union on the Portuguese system of water use causes the quality of water needs to improve, out which the innovation projects have to solve the current problems.

Chapter 5 System of water use

"Ha grande ansiedade nos privados" This is a statement made by Nuno Correia, the minister of Environment, Spatial planning and Regional development. This statement claims that there is a great anxiety amongst the public and private organizations. This anxiety focuses on the cooperation between the public and private organizations within the system of water use. This cooperation does not only mean a principal-agent relation but more as a partnership. Different sources made clear that sustainable development can be achieved in the system of water by the cooperation of the public sector and the private sector. This statement gives private organizations the idea that they have an opportunity to invest and make profit in the system of water use. The path that has been taken by Portugal, concerning the system of water use, explains the situation they are in at the moment. In the following paragraphs, insights will be given into the current situation in the Portuguese system of water use. To analyze the national innovation system the most important parties / institutions of the clusters in the Portuguese system of water use will be described in the following paragraphs. This chapter has the main focus on describing the current situation in the clusters of the system of water use.

5.1 National system of water use
Portugal has a process in the system of water use which controls the roles and tasks of the clusters in the system of water use. This system is referred to as the vertem / systemas em alta − vertem / systemas em baixa, which means upstream − downstream of the system of water use. The vertem / systemas em alta concerns of organizations / institutions who are dealing with water distribution and sewers. The vertem / systemas em baixa consist of organizations / institutions that are concerned with water supply and wastewater treatment. The process of the system of water use is established in the vertem / systemas alta as well as in the vertem / systemas baixa. The process is fulfilled by the working of implementing organizations; see the following paragraph for further information. In figure 5.1 the system of water use is visualised by the processes that are made in the system. The government and especially the municipalities have the responsibility of taking care of the upstream and downstream in the system of water use. Before capitalizing and describing the figure, further explanation will be given concerning the background of the system of water use.

1868 was an important year for the Portuguese system of water use. In this year the CAL, also the Lisbon water company was established. This company had the main objective of supplying safe and qualified drink water to the gross part of the inhabitants of the region Lisbon. This company is now transformed into the company EPAL (see paragraph 5.2).

As mentioned earlier the system of water use tries to include private organizations in the public sector. The year of 1993 was the breakthrough for this new objective. New standards and requirements were developed, so that the private organizations knew what standards they had to comply to. The inclusion of private organizations did not only have its effect on the new legislations for the enabling of concession agreements. It also has its effects on the process of the system. By the new work method new objectives were established. This means that the water service coverage needed to be increased by this new work method. Portugal has shown that their service coverage is not complying with the EU regulations. There are still approximate 790000 inhabitants who are not served with the drinking water supply and the sewerage service. Figure 5.1 and 5.2 visualize these numbers in perspective of the entire population. The water quality needed to be increased and the increase of efficiency in the utility operations was also an objective that needed to overlook. All these objectives needed to be improved in order to comply with the new legislation for the system of water use, which was based on the European Union guidelines. This new way of cooperating was one of the important items on the agenda in the government from 1993 − 1999. Within this period an important partnership was introduces, namely the Multi-municipal system. This system is a type of concession, but will be further described in paragraph 5.2.

The European Union and Portugal were not satisfied with the results that were established, concerning the service coverage of the drinking water, storm water and sewerage. As the documents show Portugal is one of the countries that have the lowest service coverage of the population. See appendix D for the graphics of the service coverage in comparison with the other EU-countries. This meant for Portugal that drastic changes needed to be made so that to the EU guidelines would be reached. From the year 2000 onwards strategic plans were made, that would capitalize the enhancements for the results that have to be achieved. This means that for the service coverage of water supply 95% of the population had to be reached; and for the waste water treatment 90% of the population needed to be covered.

In 2006 the strategic plans were introduced. These strategic plans for water and waste water was that of PEASAAR, this strategic plan is for the period 2007-2013; the strategic plan for the urban solid waste was that of PERSU, this strategic plan is for the period 2007-2016.

Figure 5.1 Public water supply service
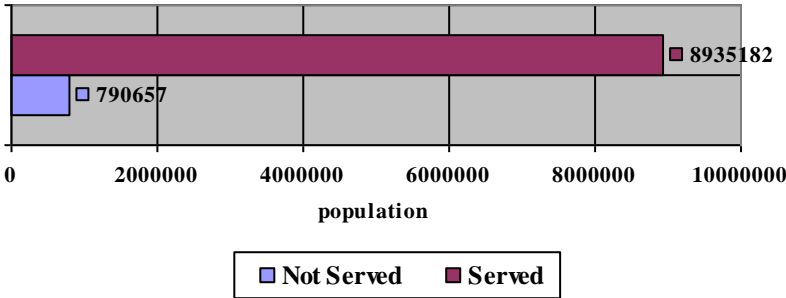
Source: ERSA Congress paper, 2005: Avillez, 2005

Figure 5.2 Service level of performance of public sewage treatment plats
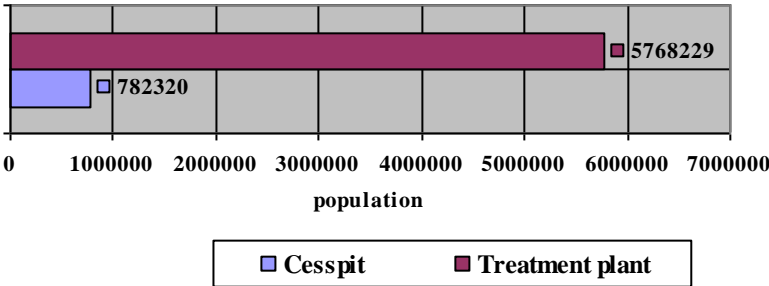
Source: ERSA Congress paper, 2005: Avillez, 2005

Before analyzing and explaining the organizations / institutions of the clusters in the system of water use, the process of the system needs to be explored. This exploration provides an understanding of the process in the system of water use. The system of water use in Portugal is divided into three sections. These three sections represent the entire system of water use. The first section concerns that of supply of public water, also called the upper system; the second section concerns that of the sanitation of the urban waste, also called the lower system; and the third section is that of the management of the urban solid waste, both upper and lower system. Every section has to comply with the service coverage.

The first section has the following steps are taken:

The first step is that of **capitation**, hereby is meant the Extraction of the water from the superficial capitation or the underground. Then the second step of **pumping**, within this step the water pumping, which main purposes is in the pressure circulation and overcomes graphic barriers. The third step is **treatment** of the pumped water. The correction of the physical, chemical and microbiological water characteristics is needed in order to be adequate for

human consumption. The fourth step is that of **adduction**, also the transport of treated water from the production zone for the consumption zones. The **storage** is the fifth step in the process in the first section. The storage of treated water will take place in order to assure the continuity in the water supplying. The sixth and last step in this section is **distribution**. The water distribution takes place, with the prescribed water quantity and adequate pressure, to the users.

The second section consists of the following steps:

The first step is that of **drainage**, this concerns the wastewater collection. The second step is **pumping**, the wastewater pumping is done to overcome or graphic barriers. The third step is the **treatment** of urban waste water. This is done for the correction of the physical, chemical and microbiological water characteristics, taking the characteristics in consideration of the middle receiver. The fourth and fifth step takes place in the solid phase. In the solid phase the fourth step concerns that of the **sludge treatment**. This treatment and final destination concerns the producing of sludge in the wastewater treatment. The fifth step in this phase is the **final destination**, by this is meant the guiding of the sludge to the final and adjusted destination (agriculture, landfill, etc.). The section also has a fourth and fifth step in the liquid phase. The fourth step in this phase concerns that of the **reutilization**, also known as the utilization of the treated wastewater for compatible uses. The fifth and final step in this section and phase is that of the **final destination**. This means the discharging of the treated wastewater at the middle receiver.

The third section in the system of water use concerns that of the following steps:

The first step in this section is the **collection** and transport of the urban wastes of the house holdings; this may be the undifferentiated or selective collection. The second step is the **selection**; this is the operation of the selection of passive waste by valuation. The third step is **valuation**, these operations which permits making profitable wastes treatment process trough the production of recycled materials, including the organic compost, electricity or warmth. The fourth and final step in this section is that of the **elimination**, also the guiding of the waste fraction resulting in the treatment operations and designated valuation trough the confinement.

Figure 5.3 the water system RASARP 2007
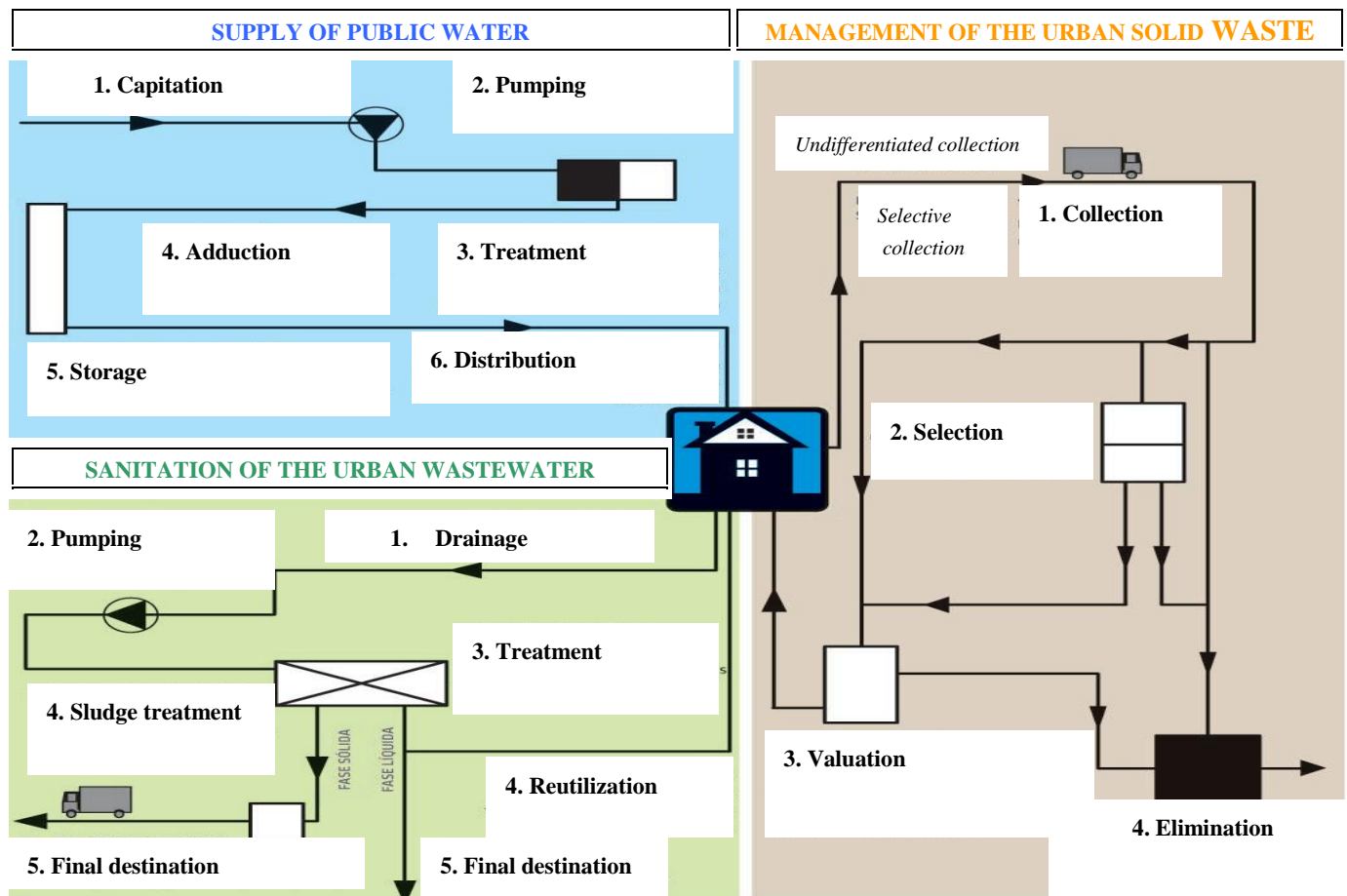
In short this means that the water side of the system of water use consists of the following steps: collection, treatment, adduction, storage and supply. The waste water side consists of the following steps: collection, treatment and recycling. The input, throughput and output of the Portuguese system of water use are also divided in the national water system, namely systemas em alta and systemas em baixa. This means that the upstream for the water side of the water services consist of collection, and treatment. The downstream of the water service is then the storage and supply of water. See figure 5.4 for the visual content of this conclusion. The entire system is created and supported by various organizations international and national level. The next paragraph and subparagraphs provide figures of the Portuguese system of water use and the most important organizations / institutions of the cluster are displayed in the diagram.

Figure 5.4 Water Services
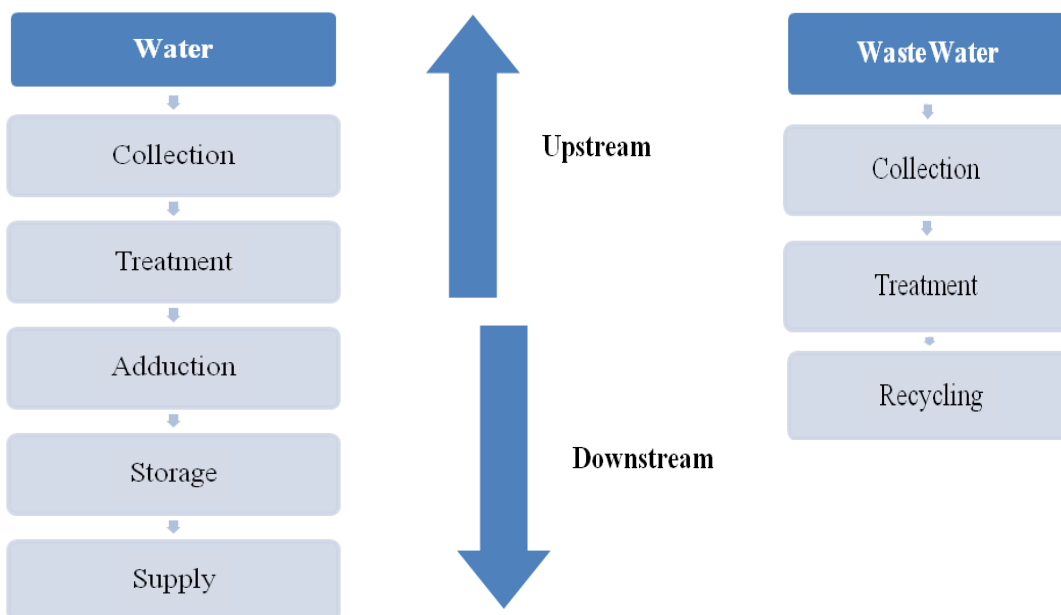
Source: KPMG: Presentation on Portuguese water industry

5.2 The clusters in the Portuguese system of water use

The Portuguese system of water has a lot of activities going on various governmental levels, which is not only national orientated but has also crosses over the country's boundaries, meaning international involvement in the system. The important parties that are presented in the Portuguese system of water are reflected by the use of the clusters from figure 3.1. In the next paragraphs the organizations / institutions within the clusters will be described. This will be done by a short description of the roles and the tasks of the organizations / institutions. So what they stands for and what their value is in the Portuguese system of water use. In the following subparagraphs the system of water use will be visualised by the use of figure 5.4. This figure visualizes the organizations and prime connections within the system of water use, but also shows the four different governmental levels where the organizations are institutionalised. These organizations will be explored by the use of the clusters of the national innovation system, which are presented in figure 3.1, with the governmental levels kept in mind.

5.2.1 The Portuguese system of water use, the actors

Figure 5.5 Actors Portuguese system of water use
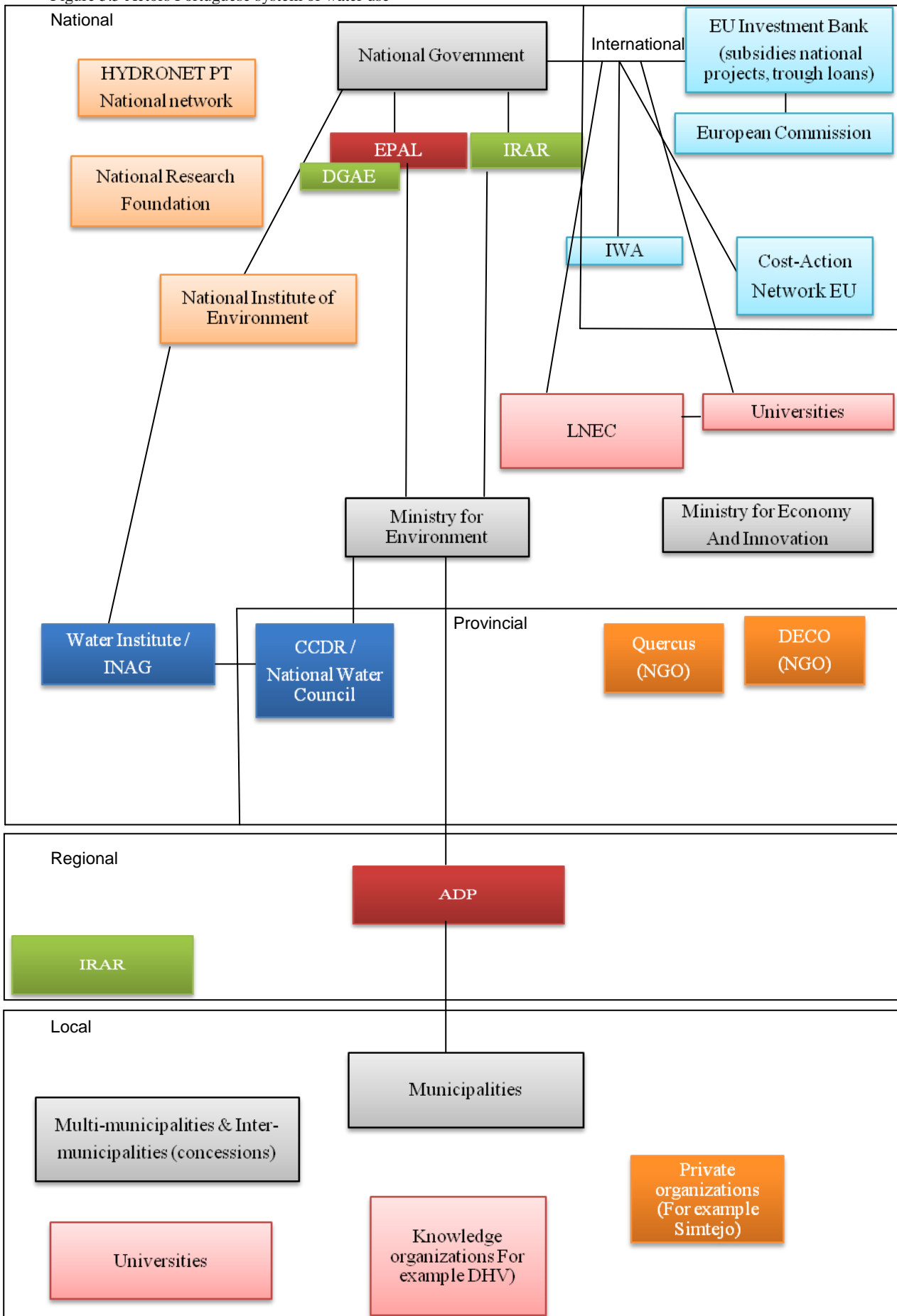
The four clusters are represented within this figure. Also the international section is visible within this figure. The colours of the organizations / institutions show what cluster is represented in the figure. The colours within the figure mean the following:

Knowledge Organizations	International Organizations / Institutions	Implementation Organizations	Private Organization
National Network Knowledge Organizations	Regulators	Water Institutes	Governmental institutions
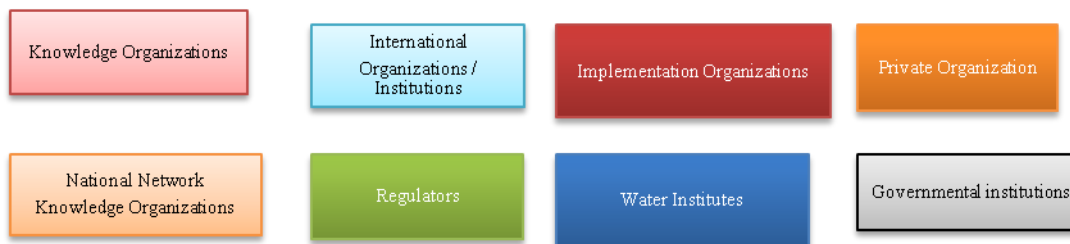
5.2.2 Water policy organizations

The Portuguese water policy is an important area in the public policy of Portugal. This policy area has national and international influences, which creates challenges for implementing all these influences. The first form of water policy was created at the end of the 19th century. In 1892 the enactment of the Hydraulic Services Regulation was agreed. In 1995 the European court decided that Portugal has been lacking on the water area, based on the following figures: 79.6% of the Portuguese population had access to a water supply system, the European Union average registered 95,1%. This shows that Portugal was still lacking behind. These facts show that the Portuguese water policies are based on the European Union directives. The international relation is recognizable due to the water framework directive, which has a significant impact on the content of the water policies of the various organizations / institutions in the Portuguese system of water use. In the following the organizations / institutions on international level will be explored.

WPO on international

European Commission

The WPO in Portugal are first and foremost guided by European regulations, also an international influence. The European commission is the executive body and representative of the European Union. The European commission decides on the EU regulations. The European commission has the Water Framework Directive as the instrument which provides the legislation and guidelines for the treatment of water to the various European organizations / institutions in the system of water use. This directive provides an environmental organization for the treatment of water pollution. This directive concerns the improvement of cleaner rivers and lakes, out which the abstraction for drink water happens. The European commission also makes use of an Urban Waste Water Directive, which provides the legislation and guidelines for the treatment of urban waste water. The European commission spends a lot of time on the issue of water, because water is a precondition for human beings, animals, plant life and for the economy as resource. "The stakes are high and the issues transcend national boundaries and concerted action at the level of the EU is necessary to ensure an effective protection." (http://ec.europa.eu, 10/06/2008)

WPO on national level

Instituto Regulador de Águas e Resíduos

IRAR is an important party in the system of water use on national level. This institute is responsible for the consolidation of a clear and effective regulation model for the water, urban wastewater and solid waste management in the public sector. IRAR is not in fact the government but is stated by the government to be in control of the regulation in the system of water use, due to the European Union regulations. IRAR is an independent organization financially and institutionally. By their independence they are free to share knowledge. They get their money directly through taxes paid by consumers and producers. The operators (the organizations in the system of water use) are the ones who pay taxes for waste water treatment

and this tax money goes directly to the company. IRAR is stated since 1997 and is under supervision of the prime-minister. IRAR has the goal to create a good and safe environment for all the actors they are involved with. IRAR has two structures concerning their regulation: one structure focuses on the regulation for the behaviour of the operators and the other structure focuses on the regulation for the waste water companies. IRAR has a very important department, namely the waste water department, who is in charge and responsible for the quality of the waste water treatment. IRAR is not only the regulator but also examines the tariffs which are set up for water. They control whether the prices are in line with the economical situation of Portugal. IRAR examines this by the use of indicators, which is an instrument to test and control the water quality.

Direcção-Geral das Actividades Económicas
DGAE is the organization who is in charge of the regulation in the system of water use, especially for the organization EPAL. DGAE focuses on the regulation for the water supply and water distribution and is making sure that the guidelines of the water policy are strictly observer by EPAL. DGAE does this in the same way as IRAR, so the uses of indicators are applied.

Ministry of Environment, Spatial Planning and Regional Development
The ministry of Environment is the department of the government that is in charge of the defining, implementation and coordination of the governmental policy on their concerning systems. Even though the ministry has its tasks on the national level, its supervising role focuses for a part on the provincial level. This means that for the system of water use this ministry determines the policy, concerning the drinking water, storm water and sewerage, which have to be followed. This ministry has to provide a policy which has a long term view, for the development of the system and making sure that there is cohesion present amongst the actors of the system. In order to make sure that the policy is implemented and maintained in that way, the ministry of Environment cooperates with other national and provincial organizations. These organizations, INAG and CCDR function like governmental departments, they manage and steer the system of water use. The water policy focuses on the development of action plans, these plans are for the maintenance and improvement of water, by reviewing the system. The ministry is very careful with the water process, because a mistake may cause a national catastrophe. Therefore, the monitoring of the system of water use is also a focus. By monitoring is meant the way in which the measurement of the water quality takes place. The main goal of the water policy is to protect the water quality in the system of water use by configuring standards the organizations need to apply. The stated institutions INAG and CCDR are important, because they are the organizations within the system of water use that enforce the requirements that needed to be applied.

INAG
As displayed in the figure above, INAG is the national water institute, who's under the responsibility of the Ministry of Environment. INAG is the national water institute, who is in charge of the development and implementation of water policies, also known as the national body of the water resources. This institute was born in the year 1993 and has legal competences which are bounding trough the water regulation of 2005. INAG is a national authority on water with functioning regulators and coordinators concerning the hydraulic resources. INAG has the following tasks:

- ➢ Develop information systems concerning the availabilities and necessities of water resources on national level.
- ➢ Stimulate an integrated planning method on water resources and an integrated planning method on costs in joint ventures with other entities / institutions.
- ➢ Consider the objectives and strategies for the management of the national water resources.

- ➢ To study and consider the technical, economical and legal measurements that is necessary for the optimalization of the management of national water resources.
- ➢ Stimulate the conservation of national water resources by quality and quantity in its physical and ecological aspects.
- ➢ Give assurance, in cooperation with other institutes, to the accompaniment of water resources related questions on the communitarian and international level.
- ➢ To apply to the water necessities concerning a sustainable development to protect and value the national water resources; also to prevent and to minimize the natural and induced catastrophes.

INAG, as mentioned earlier has the main task of issuing various water resource planning instruments. PEASAAR is such a plan, which is a strategic plan on water that constitutes the following instruments for the Portuguese water policy (http://www.mirandalawfirm.com, 10/06/2008):

- ➢ The national water master plan, which is set up by INAG, is one of the planning instruments for the Portuguese water policy. This plan is an integrated document which gives a national wide definition to the water resource management (based on actual data through diagnoses of the situation) and a definition of the objectives for water in accordance with the water regulation (more specific the Decree law nº45/94. This plan consists of two volumes, volume I focuses on the characterization of the water resources in Portugal, the national ass well ass the international relations are described; volume II focuses on the diagnoses of the Portuguese water resources in accordance to the applicable legislation. (www.inag.pt, 10/06/2008) The National Water Plan is drawn up functioning as the water policy of Portugal. The National Water Plan is based on the Portuguese situation concerning the water resource, the water policy abstracted from this plan is at the moment PEASAAR The national government is in contact with international institutions and own or co operate with national institutions. In the following paragraphs these organizations / institutions will be explored.
- ➢ River Basin management plans, these plans focus on the ways in which small water basins can be aggregated in accordance with ministerial guidelines. This shows that the territorial scope on water basins is highlighted in these plans, meaning that these plans enclose the integrated river basins in a water region and the coastal areas. These plans include a general description of the water regions, a characterization of the natural influences, which are related to the human activities (which can lead to unfortunate incidents) and a program of measures that will be taken to reach the goals and guidelines which are established in the water legislation. (http://www.confagri.pt, 10/06/2008) The international co operations come from the bilateral agreement with Spain, which consist of the river basin management plans.
- ➢ Specific water management plans, these plans are a complement on the river basin management plans but they are more focused on a territorial scope (a specific geographic area) This scope enhances the enclosing of a problem and the specific aspect of an economical activity which has a significant interaction with water. (http://www.aprh.pt, 10/06/2008)

In short INAG is the central regulator for the Portuguese system of water use, with the competences of general co ordination, planning and the licensing of the management concerning the water resources in terms of the capturing of water and the discharging of waste water. INAG also has the responsibility to manage water on national level and gives guarantee to the practice according to water law. (RASARP, 2007)

WPO on provincial level
Commissão de Coordenação e Desenvolvimento Regional
CCDR is the provincial institution that is in charge of the river basin district administration. The river basin district administration concerns eight river basins. A river basin district is the management of water in its natural unit. CCDR has a direct connection with the ministry of Environment and Regional Development and delivers the service of administrator of the state concerning water. CCDR has the following tasks:

- ➢ Contribute to the political definition concerning the regional and social development of the country.
- ➢ CCDR executes, evaluates and fiscalizes the national regulations on the regional level in order to be able to protect the environment, conservation the nature and mark the territories of the cities.
- ➢ Guarantee the elaboration, accompaniment and evaluation of the instrument s for territorial management.
- ➢ To co-ordinate the de-concentrated services from the regional scope
- ➢ Assure the fulfilment of management responsibilities in Portugal is in line with the regulations of the European Union.
- ➢ To strengthen the interregional and transnational co operations.
- ➢ Give technical support to the local authorities in co operation with the general Direction of the local authorities.

CCDR is the organization that has to integrate the disconcentrated administration of the State; this integration concerns that of the regional and local development. This means that the linking of the central administration and the local administration is in the hands of CCDR but it is not only on a national level. The links between the regional level and the European level also have to be guided by CCDR; this is done by managing regional operational programs and the European territorial cooperation.

5.2.3 Implementation organizations
In this paragraph the implementation organizations of the Portuguese system of water use will be explored.

IO on national level
Empresa Portuguesa da Águas Livres
EPAL is a subsidiary of ADP (who has 100% of the company's shares) and is in charge of the water supply and water distribution (so partly vertem alta and partly vertem baixa) EPAL is the water company, who is the closest to the inhabitants of Portugal, the water bills that citizens receive are designed by EPAL. The goal of EPAL is to supply qualified water to as much as possible inhabitants of Portugal. At the moment this concerns 2.6 million people. The mission of EPAL is rendering of services of water and the sustainable management of the urban cycle of the water. Throughout its sequence of activities and businesses EPAL does this by using and applying water indicators that they have to comply with. The instrument used to comply with the indicators is the Tele-management. This tool is the most important one concerning management of EPAL's water supply system. This technological system keeps a track on the process of the production and distribution of water for the infrastructural and human ends. EPAL is the institution in Portugal who has direct contact with the inhabitants and is the organization which is well known by the population (do to the water bill). Therefore EPAL has a vested interest in minimizing as much as complaints as possible. (www.epal.pt, 10/06/2008).

IO on regional level
Águas de Portugal
ADP is a state owned company, who's in charge of 90% of the system of water use. Águas de Portugal is responsible for the waste water projects which are funded by the European Union. "In the last decade of the 20th century, Portugal revealed itself to have serious insufficiencies in the water supply systems for public consumption, low waste water sanitation servicing levels and an absence of suitable systems for waste management." (www.adp.pt, 10/06/2008) ADP is a publicly owned organization, which was 15 years old when approximately four billion Euros on investments had been made. These investments needed to be made in order to reach compliance with the European Union regulations. So for the last years that was the priority of ADP and still is, because a lot of work is not completed yet. ADP is a holding with 61 subsidiaries stated national and international. ADP has, with his sub holdings a leading role

in the Portuguese system of water use. Their goal is to protect and have an added value to the natural and human environment. ADP's activities are the following: water collection, treatment, storage and supply. These activities are performed in line with the European legislation, so a living standard of quality of the activities for the population is assured. This is done by pursuing the goals set up in the national strategic plans (PEASAAR II), which has the specific guidelines for ADP, namely connecting 95% of the population to the public water supply system and connecting 90% of the population to the public urban waste water sanitation system. ADP does not only look at the strategic plan PEASAAR II, but also base their work on the strategic plan for urban solid waste, which is PERSU II. This strategic plan sets out goals and challenges for the nation, concerning the treatment in the urban solid waste sector. PEASAAR II and PERSU II are both strategic plans for the (long time) period of 2007-2013 and both plans are set out with objectives and targets in the environmental areas which are in compliance with the EU regulations.

ADP delivers their services, in partnerships with the municipalities, to more then seven million people in Portugal. Considering that Portugal has got an inhabitant number of 10.956.117, it can be said that ADP covers a gross part of the population concerning the water supply and waste water sanitation. These services are, as mentioned earlier, done in partnerships with the municipalities. These partnerships are formally bounded through concessions, which are long terms contracts (see paragraph 6.3.4 for further detail) so they will be able to perform their activities. These activities are the following:
   ➢ The water activities, which concerns the collection, treatment, delivery, storage and distribution of water. This means that the operation and maintenance services are of importance and therefore are under contract through partnerships, not only with the municipalities but also with other private parties. The operation and maintenance are in line with the IRAR water regulation, by the use of the water indicators.
   ➢ The waste activities concern the treatment and recovery of urban solid waste. "The ADP group plays a key role in supporting the creation and definition of environmental policies and in the implementation of solutions for a sustainable management of waste." (www.adp.pt, 10/06/2008) The management of waste concerns the creation of awareness of the consequences of actions in the urban solid waste sector.
   ➢ ADP is expanding its activities by looking at new areas of renewable energy. ADP focuses on the development of new projects concerning the production of electricity from wind, the sun and so one. This activity adds to the improvement of economical and environmental sustainability and also is in compliance with the European directives concerning the production of electric energy from renewable energy.
   ➢ ADP is also active in providing professional training in the areas of water supply, waste water sanitation, waste treatment and waste recovery. These trainings are developed for the operators and engineers in the system of water use.
   ➢ Another activity of the ADP group is Tele-management, which is an information system designed for technical management, operation, maintenance of water supply, wastewater treatment, solid urban waste collection treatment and recovery systems.
ADP provides these activities on regional level. They are the spill between national and local level. As it is notable from figure 5.5, the national level concerns the ministry of environment (and the national government). The local level concerns that of the municipalities. ADP and his activities have the role / mission to bring the national level perspective and the local level perspective to the regional level, where coordination can take place. This means that the shareholder's goals, namely the government, are translated into the regional policies. The translations of the goals are made possible by the creation of new organizations / institutions that are not focussed on the local perspective (like the municipalities). The focus is on the regional perspective, in order to loose the separate local water system and create a regional bounded water system. To be specific, ADP's work consist of negotiating with the local and national governments, in order to capture expertise and invest in capacity building so that the existing water systems can be expanded and upgraded from a local level to a higher level.

This work construction solves a big problem by the smaller municipalities, namely the lack of available knowledge. The combination of part systems are stimulated by creating a need for knowledge. By this is meant that the mutual gain is the main stimulants to comply with this work method.

IO on local level
Municipal, Inter-municipalities and Multi-municipal systems
The Portuguese system of water use is structured by three types of municipal systems.
The municipal system is characterized by dealing with the water system within the municipality without interference or co operations of other municipalities.
The second type of municipality system is the inter-municipality system, which focuses on the co operation of at least two municipalities concerning the water system. Such co operation is made without interference of the national government. The co operation is established in order to make the first steps to broaden the scale of the water systems. The broadening of the scale is then focussed on the quantity of people that receive the water services: by working together with other municipalities. The concept is then two can do more as one. The government also invest these concessions, which causes this type of co operation to be more interesting for the organizations.
The third type of municipality system is the multi-municipal system. In Portugal there are 32 of them. This system is characterized by concessions. The multimunicipal systems are those systems that have a large investment by the state and serve more then one municipality. The concessions that are made are contracted for a period of 30 years, in some cases it may be for 15 or 20 years. The municipalities give concessions to private companies, which are the ones who sell the water to the municipalities and the municipalities sell the water to the consumers. This means by the concessions that are made the private companies are contracted to retract, treat and distribute the water to the municipalities. In these concessions there is an involvement of the state by ADP, whom is the biggest shareholder. IRAR is in this case the regulator and controls whether the prices of the concessions are justified to the economic status of the country.

Private organizations
These organizations are contracted by the municipalities to do the specified work. This work concludes the management of the treatment plants, supplying of drink water, the maintenance of the sewerage and so one. The municipalities do not have human capital and knowledge available for this specified work. Therefore private organizations are hired to do this work.

In figure 5.5 the organization APA is mentioned as one of the private organizations. APA stands for Advance Prising Agreements. This organization provides guideline concerning the heights of the taxes. These guidelines are based on the considerations of the tax payers, the tax authorities and the legislation.

Quercus-DECO
After a national catastrophe, due to the lack of water quality at a hospital, these two private organizations demanded to evaluate the current level of legislation enforcement criteria on the quality of drinking water. Quercus and DECO are two NGO's, which are non-governmental organizations. Their mission is to fight for the rights of the consumers concerning the environmental sector, in which water is one of the issues.

5.2.4 Knowledge organizations
In this paragraph the knowledge organizations within the system of water use is explored.

KO on international and national level
National civil engineering laboratory
LNEC is an important research institute of Portugal, as various respondent of the interviews claim. LNEC is a public organization, which means that they are depending on the ministry of public works. LNEC does a lot of various types of research within civil engineering. Even thought it is a national organization, a gross part of the researches that is done by LNEC is done by international co operations, mostly with other European Institution and IWA. LNEC distinguishes three main types of activities. The first main type of activity is *strategic research*, meaning that research is done for the national research foundation and for private clients (a group of customers whom are willing to give support to research a certain given topic). The strategic research is done on national scale and international scale. Another type of activity is *specialized consultancy*, meaning that LNEC works as consultants concerning studies that have not been done before. The routine consultancy, in which a design has to be made, is not their work field, meaning that they are not in competition with the normal market. The various ministries are big clients for this activity. For example LNEC gets assignments to do certain types of audits or comparative analyses which are complex. The third type of main activity that LNEC carries out is the *general support* to the industry that includes all the works such as material tests, training courses, organizing conferences and being a part from committees. Most of the researchers of LNEC are active in various committees which focus on water related issues. This is the three-third of LNEC, which can be seen separate from each other but are in fact very complement to each other.

National Institute of Environment
This institute is the national institute that focuses on the study, the conception, the coordination, the planning and the technical and normative support in the management area of the environment. This institute also stimulates the sustainable development of the aim to keep citizens informed gradually increase the participation of the citizens. The function of this institute is to coordinate, fit and harmonize the work processes in the environmental sector from the view of the ministry of environment. The Institute of Environment does this by using normative instruments required by the ministry of Environment and establishes this on the regional or local level. The following tasks of the Institute of Environment are important for the system of water use:
  ➢ To coordinate national plans and national programmes concerning the sustainable development, in particular in the environmental source.
  ➢ To proceed the strategies, that has the aim to integrate the environment in various sectors concerning the climatic alterations.
  ➢ To define a national strategy concerning the environmental education.
  ➢ To give support to non-governmental organizations.
  ➢ To stimulate public access to information concerning the environment and the stimulation of public participation concerning the formulation and debating of environmental issues.
  ➢ To proceed activities to prevent and control various forms of industrial pollution. This is done by evaluating the impact of certain situations and analyzing the risks for the environment, which has caused impact on the environment.
  ➢ To develop the laboratorial activities referring to the environment, by developing the examination and standardization of the sector's accreditation.
In short, the national Institute of Environment is an organism with various competences within his environmental domain. This institute has an important activity as a national authority, which is the evaluation of environmental impacts, from the water supply, urban water sanitation and the management of urban solid waste. (RASARP, 2007)

Hydronet PT
There is a network called HYDRONET PT that is a network of organizations involving researches related to water. The core group of HYDRONET PT are the following

organizations: LNEC, Instituto Superior Technico, University of Evorra, University of Coimbra, University of Porto and the University of El Minno. So this is the core group of the institutions that creates HYDRONET PT. The idea is to create synergy in some way, to make change.

National research foundation
The government has set up a research foundation, which depends on the ministry for Science and Higher Education that covers universities, education and research. It is a governmental settled foundation, which you can apply for funds. This foundation supplies co-funds, meaning that the expenses only be covered to a maximum of 50%. The funds are for all type of researches, not specified for innovation research. Therefore, this is an organization that stimulates the knowledge transfer and not so much the stimulation of the development in innovation.

KO on local level
Universities
The knowledge organizations within the Portuguese national innovation system are within the various universities. The universities in Portugal are important players within the knowledge organizations. The universities on national level are: new university of Lisbon, University of Algarve, University of Porto. The universities on international level are: Erasmus University and the Technical University of Delft. These universities are reached to broaden the local scope. Specific local problems are often resolved by the help of such universities.

5.2.5 Innovation policy organizations
As it is visible in figure 5.5, Portugal maintains a lot of international relations, concerning the national innovation system. There are a few co operations which will be outlined in this paragraph. These co operations play a role in the national innovation system of Portugal. This paragraph will also outline the IPO's on the other governmental levels.

IPO on international level
International Water association
IWA connects worldwide professionals, which focus on research, science, technology and practice. IWA consists of 10,000 individual and 400 corporate members, spread across 130 countries. The members of this worldwide network get the chance to collaborate with other professionals. The members include researchers, private consultancies, utilities, regulators, administrations, so it is mixed. Knowledge and skills are shared with the participating members through annual congresses (which is the biggest event in the water field), journals, books, IWA magazine and so on. The leading – edge conferences that are organized by the IWA office in London, are all focussed on water related issues and specifically the research & development in drinking water treatment, waste water treatment and the management of the treatment. A lot of institutes and prominent figures in the Portuguese system of water use are a member of IWA, in order to develop their knowledge and skills and contribute to a worldwide net of knowledge sharing. The International Water Association obtains close relations to the Portuguese institution LNEC. As mentioned in paragraph 6.2.4 LNEC is a knowledge organization, which is one of the actors in the national innovation system. They are considered to be an industrial research centre that also has the role as innovation intermediate. (Annual Innovation Policy Portugal, 2006: 7). LNEC has been working on performance indicators over a period of 20 years concerning water and waste water services, throughout the IWA co operation. Two projects were created from out this case within the IWA co operation, concerning a performance indicator system, which is at the moment internationally recognized. Throughout various co operations with organizations spread worldwide, the manuals (functioning as the performance indicators) that were created throughout these two projects got recognized and appreciated by 24.500 organizations worldwide. This means that the knowledge that was created within a small group of

researchers got spread out over the entire world and, implemented in a great amount of organizations. This work, which is at the moment referred to as the IWA PI system, has become the international standard for the performance indicators concerning water and wastewater. This is just one example of the many projects which are developed and worked out within the IWA coordination. However LNEC is an important Portuguese institution within the IWA cooperation. There are other Portuguese organizations which are active within IWA. Various universities take part in IWA, like the New University of Lisbon, the University of Port, the University of Coimbra and so one. There are also independent researchers who link themselves to IWA, so their contribution to the worldwide knowledge sharing is taken into account and used.

Cost Action Networks EU
These networks are European networks of research organizations. "COST – European Cooperation in the field of Scientific and Technical Research – is one of the longest-running European instruments supporting cooperation among scientists and researchers across Europe. COST is also the first and widest European intergovernmental network for coordination of nationally funded research activities." (http://www.cost.esf.org/, 10/06/2008) The structure of the various cost actions are subject related, so every cost action consist of another organizational structure. The cost actions were made up to give an added value to the European science and technology and to enable research possibilities across countries. LNEC is one of the Portuguese organizations which take part in this network.

Ministry of Economy and Innovation
This ministry has ownership over the programme PRIME management. This programme stands for the Incentives Programme for the Modernisation of Economic Activities publicity rules. This programme makes money available for innovative projects. The competition for these funding are high, the projects that are usually funded by this programme are the following:
- Billboards and ads (TV, press, radio, Internet, etc.);
- Leaflets, brochures, studies and publications, as well as any other information and dissemination materials;
- CD-ROM, DVD and any other audio or video records;
- Websites, newsletters and electronic messages;
- Publicity gifts and merchandising items;
- Interviews and public speeches (TV, press, radio, Internet, events, etc.);
- Documentation and support materials for events such as conferences, trade fairs, seminars, among others.

These types of projects have the chance to be funded with the focus on innovative projects, but the funding is partly. With this opportunity the organizations / institutions in the system of water use can take an effort in applying for such funds. If money is available innovation projects can be done. (http://www.prime.min-economia.pt, 27th March 2009)

Ministry of Science, Technology and Higher Education
This ministry is also a ministry that stimulates the increasing of the innovation in the nation. This is done by making funding available for the organizations within a system. The main foundation organization in Portugal is that of the Foundation for Science and Technology, better known as FCT. This funding organization is the prime agency of this ministry. "This agency is responsible for the promotion, follow-up and evaluation of institutes, science and technology projects and programs and also, in the advanced training and qualification of human resources in the areas under this Ministry." (http://ec.europa.eu, 27th March 2009)
Another funding agency is that of the Innovation Agency, better known as AdI (Agencia   de Inovacao). "This agency has the main goal of promoting innovation and technological development, through the strengthening of relations between the research world and the

Portuguese enterprises." (http://ec.europa.eu, 27th March 2009). This ministry is not the only owner of the agency. The ownership is shared with the ministry of economy and innovation.

5.2.5.1.1Innovation policy

In the Portuguese system of water use the term innovation is not used often and seen as a separate process which has to be integrated in the system. Innovation is not supported by a great part of the Portuguese professionals in the system of water use. Innovation means risk and risk means a chance of losing public money. (Interview A) The goal of PEASAAR (2000 – 2006), as mentioned earlier, was to get 95% of the population connected to the drinking water and 90% connected to the sewerage. In fact 93% of the population got connected to the drinking water and only 80% of the population got connected to the sewerage. The PEASAAR did not reach his goals, so a part of the public money got lost; taking such a risk again is not desirable. The new investment plans state otherwise. PEASAAR II (2007 – 2013) provides 4 milliard Euros for the constructing and improvement of the regular distribution piping (downstream) and 1.6 milliard Euros is reserved for the head piping (upstream). There is 200 million Euros reserved for the resolving of specific problems, for example for the purification of waste water coming from farms. Looking at these figures and the statements made by the minister of Environment, Spatial planning and Regional development the relation between the government (water policy) and implementation organizations is gaining weight at the moment. According to new investment plans and the demands that are made by the European Union, the relation between the government (innovation policy) and the implementation organizations should get more important.

As the statement in the first paragraph implies, the private parties (read implementation organizations) are ready to acquire a place in the system of water use, but the public sector has to provide the space for this change. The ministry of Environment, Spatial planning and Regional development is open to this change and fit their policy to this new idea.

The government is now at the state that they are looking at possibilities to strengthen the governance systems and promoting capacity building, by sharing and gathering knowledge from various points of views. The involvement of the private partners in the system of water use can provide a wider scope in the innovation possibilities, so risk taking is unavoidable. The ministry of Environment seems to pick up the stimulations from the European Union (concerning the institutional changes and the influence of the private sector into the public sector), due to the fact that this ministry is also making changes in their institutional structure and emphasises on the involvement of the private sector in the public sector. The Portuguese government sees that taking these steps are necessary, especially now when Portugal is clearly falling behind the European Union average, concerning the economy as well as the innovation status.

The Prime Minister of Portugal is first and far most responsible for the innovation governance system. This means that the actors whom are active in the national innovation system have to answer to the Prime Minister, concerning the indicators from the national innovation policies. To be more precise there is one policy, which is recognized and active in the Portuguese governance system. This is the Technological plan. This policy also has an impact on the Portuguese system of water use; therefore these plans will be explored in the following sections.

The Technological Plan consists of the main objectives concerning innovation. The Technological Plan is divided into three pillars, which uphold the entire innovation performance of this plan. These pillars are: knowledge, technology and innovation.
  ➢ The knowledge pillar focuses on improvements that have to be made in the Portuguese population. As described in paragraph 4.6 the educational level is below the European Union average. In order to add value to the innovation status of the country, measures have got to be taken to improve the skills of the Portuguese citizens and to strengthen the knowledge society.

- The technological pillar concerns the improvement and up warding of the technological status of the country, which is as the economical status lacking in accordance to the European Union average. The technical pillar does not only concern the technical aspects but also refers to the scientific lacking of the country. The technical plan provides measures to deal with these lacking areas.
- The innovation pillar concerns measurements for the strengthening of the innovation in the Portuguese private sector. The focus is to adapt to the globalization concept by the changing of the organization structures of the businesses.
  These three pillars are further divided into clear cut measurements for the country, to be more precise 21 specific quantitative targets which have to be achieved by 2010, see Appendix E for these targets. These targets concern that of the education degree of the country's population to the R&D expenditures of the country. These targets are set to face the following three challenges of Portugal, concerning innovation:
- The first challenge concerns that of the improvement of the capabilities of Portugal's human resources by focussing on the development of the education and training status of the citizens in the country. In the first place, it may be that this challenge is a matter for the educational policy and not so much for the innovation policy. In fact the educational and training challenges are for a major part focussed on the employed citizens, in order to strengthen the business ventures. The measures for this challenge can be divided in the following four categories: "promotion of training by companies, development of technological schools, encouraging the employment of skilled human resources in the business sector and promoting the integration of companies into the digital economy." (Annual Innovation Policy Portugal, 2006) The first steps for these measurements have already been taken in the system of water use, which are supported by the European Commission. These first steps that have been taken, are not so much focussed on the change in the educational matters but more on the training aspects for business. This means that knowledge institutions develop training programmes in cooperation with businesses, in order to make a link between the needs of the company and the needs of the national economics. An example is the training course, which HYDRONET PT has developed and will start providing from next year. This training course concerns the technical management of urban water systems, with as goal is to improve the skills of the engineers, who are responsible for managing the water systems in Portugal (so the decision makers on the technical level) This link makes it possible to add value to the skills of the engineers and operators, to the needs of the country's situation.
- The second challenge that the country and also the system of water use faces is that of he poor interlink ages between the players / institutions in the national innovation system. The national innovation system is an existing construction in Portugal but the interactions amongst the players in this field have to be optimized in order to make the national innovation system work. The Technical Plan has created measurements to face this challenge of connecting the players in the field, due the fact that Portugal is lacking at this point, is also an important reason for the innovation status of Portugal. The reason for the low factor on interaction in the system is due to the fact that the public organizations and private organizations are divided and both parties are not willing or able to cross those lines. As mentioned in paragraph 3.3 the Portuguese history shows that the separation of the public sector and private sector was linked to situations that were appearing in the population's health issues. Therefore breaking this separation and crossing the lines from the public sector and private sector is a long time process of mind changing and is a difficult task to overcome. Despite the difficulties facing this process, the Technical Plan provides measurements to take steps in overcoming these separations a stimulating the co operations. These measurements are the following four: "fostering research consortia between S&T organizations / universities and companies for the developments of new products, processes and

systems; technology transfer offices; industrial property support offices; and specific instruments to promote cooperation between companies." (Annual Innovation Policy Portugal, 2006). These measurements do not only need a mind change concerning the separation of the public sector and the private sector but also a mind change in the working methods within and across the sectors. Instead of a top-down approach in designing and implementing the innovative projects, a bottom-up approach should be promoted and applied in order to assure that all interesting parties are involved and ideas get spread in the system.

➢ The third and final challenge that Portugal is facing with the Technological Plan is the capability building of the companies and stimulating the emerging of new players in the field. This challenge concerns knowledge intensive companies in the country, by which the existing companies have to invest in their capacity of their knowledge and new (more) companies have to emerge in Portugal to contribute to the upgrading of the quantity and quality of the Portuguese knowledge status. The changes that have to be made in the companies have to be made from high-tech employer to high-knowledge employers. The measures that the Technological Plan provides for this change are a various set of seven types of initiatives.

These initiatives concern the following: encouraging company R&D investments; promoting the use of industrial property rights; "strengthening the capabilities of human resources capabilities by employing young management and S&T graduates (including masters & doctors); improving SMEs managerial and organizational capabilities; and encouraging the creation of new innovation-oriented firms." (Annual Innovation Policy Portugal, 2006) These initiatives are clear-cut and well received in the system of water use. The national water plan (PEASAAR II) also spends time on the issue of human resources and the   emerging of new high-knowledge organizations. As mentioned in the introduction   of this chapter the ministry of Environment has the intention to cross the line of   public   sector   and private sector in order to make knowledge sharing possible. This   development   does not only focus on the line that will be crossed but also focuses on the   attraction of new companies which can add value to the knowledge intensity of   the country.

These challenges are addressed and taken as the basis for the measurements which are presented in the Technological Plan (see Appendix F, for the extended version of the measurements). The Technological Plan is a policy mix of various existing policies, in the following a view of these policies will be mentioned and explained.

▪ National Innovation Plan of 2005 is an action plan, which falls under the responsibility of the Ministry for Science and Higher Education. This action plan had the most influence in the policy design phase of the Technological Plan. This plan also consists of the main objectives for the national innovation policy, like the Technological Plan. The big difference between these two policies is that the Technological Plan combines the elements of existing policies, in which the innovation perspectives of different parties are combined and fitted into one national plan. The elements from the National Innovation Plan are also integrated in the Technological Plan. The National Innovation Plan did not get as much as support from the government as the Technological Plan did. The reason for that is in the National Innovation Plan got presented at a time when new elections were coming up. After the elections the new governmental parties were not supporting the National Innovation Plan as the former governmental parties did. So the National Innovation Plan was moved to the background and the Technological Plan got introduced as the solution to improve the innovation status of Portugal.

▪ Lisbon Strategy of 2000, this policy falls under the responsibility of Prime Minister and focuses on the growth of employment and economy of Portugal with as goal to get this country in the top of the European Union. This is planned to be accomplished by the

improvement of skills and capabilities of people, companies, organisations and territories in Portugal and developing connections that crosses the country's boundaries.

- Operational Programme for the Economy of 2000, the Ministry for the Economy and Innovation is the responsible body for this policy, which focuses on the
- Operational Programme Science, Technology and Innovation of 2000, which is the responsibility of the Ministry for Science and Technology.
- Integrated Programme on Innovation of 2001 is the responsibility of no ministry but of their office. This programme ended in 2003 and within this programme innovation was considered to be an issue, which had many relations that crosses the existing boundaries. So competitiveness was an important issue in this programme.
- Programme of Incentives for Modernising the Economy of 2003, the Ministry for the Economy and Innovation is responsible for this operational programme. This programme focuses on the modernisation of the Portuguese economy.
- DINAMO of 2004 is an action plan under the responsibility of the Ministry for the Economy and Innovation. This action plan concerns the modernisation of traditional industries.
- Public Central Administration Restructuring Programme 2006, this government decision falls under the responsibility of the Ministry of Science, Technology and Higher Education. This government decision aims at rationalising and strengthening the public administration.

As you can see in the description of the policy programmes above, they are all involved with the element of innovation and development. See Appendix E for the detailed description of the policy programme and its objectives. A respondent of the interviews made this statement: "A policy mix contains various policy types, concerning innovation." The technological plan has taken elements from all the policies above and implemented / used them to create an innovation policy on national level, which can be used / integrated in various systems. By combining the elements of the various policies, the Technological Plan is able to provide a better perspective / view on the changes and actions within the innovation status of the country. Even though the Technological Plan is a step in the good direction, innovation does not only concern the technical aspects, it is much more like the involvement of structural changes within organizations / institutions. (Annual Innovation Policy, 2006: 5-10) In the following paragraph the financial aspects of the innovation within the clusters of the Portuguese system of water use will be explored.

5.3 Money flows
All the projects and researches concerning the national innovation, within the clusters of the Portuguese system of water use, cost money. Portugal is, as mentioned in chapter 4, one of the poorest European Union countries, which relies a lot on foreign funds and investments. In figure 5.5 the European Union Investment Bank is placed as an institution that is related to the Portuguese national innovation system. The total amount of investments that were made in the period of 1993-2006 in the Portuguese system of water use is estimated on 6.877 million Euros, which are both hesitant from international and national resources. In this paragraph this institution and the other organizations that play a part in the economical side and specifically their role in the Portuguese system, will be outlined.

EU Investment Bank is the European bank which provides loans against a low interest rate. "The European Investment Bank was created by the Treaty of Rome in 1958 as the long-term lending bank of the European Union. The task of the Bank is to contribute towards the integration, balanced development and economic and social cohesion of the EU Member States." (http://www.eib.org/about/index.htm, 10/06/2008) The organizations / institutions in the clusters of the Portuguese system of water use also make use of these loans. The institutes that apply for the loans have to be publicly owned, meaning that the risk of not being able to pay the loan back is minimized so there is no bankruptcy. For example, Águas de Portugal makes

use of these opportunities. In fact more then 70% of their financials is from banking and most of them from European investment banks. In order to get into account for these loans, the support of the national government is necessary, because they are the ones who are kept accountable for the payments of the loans. The European Union Investment Bank provided loans up to an amount of 1.668 millions of Euros, for water and waste water projects in the period of 1977-2006. These projects are managed by EPAL and Águas de Portugal. See the following figure for the investments that were made by the EU investment Bank in the period 1977-2006 (the amount are in millions of euros):

Figure 5.6 Investments made by the EU investment Bank
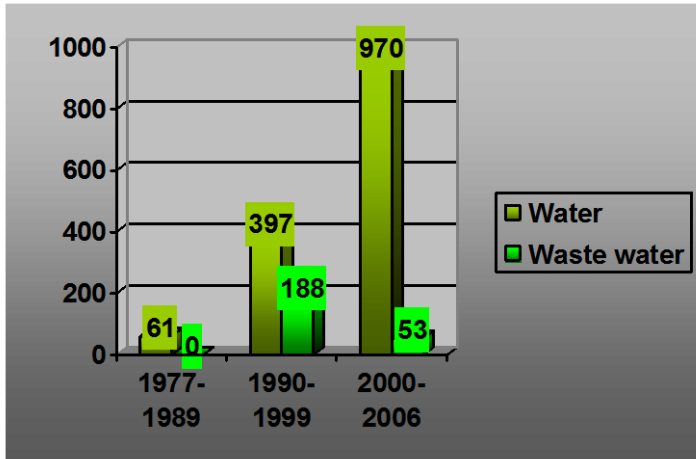
Source: RASARP, 2006: 87

National Research Foundation is, as mentioned earlier, the organization that provides funds for researches concerning science and technology. The mission of this organization is the following: "continuously promoting the advancement of scientific and technological knowledge in Portugal, exploring opportunities that become available in any scientific or technological domain to attain the highest international standards in the creation of knowledge, and to stimulate their diffusion and contribution to improve education, health, environment, and the quality of life and well being of the general public." (http://alfa.fct.mctes.pt, 23/06/2008)

INAG is, as mentioned earlier, a Portuguese water institute that works with contract programmes. The contract programmes are made with the CCDR, which is the central administration body of the system of water use. These programmes concern investment and expenditures of the development of the central administration, focussing on the infrastructure for water systems. The infrastructure is a very broad understanding, therefore the scope on the infrastructural financing changes every year. These changes are made because the contract programme has the mission to finance programmes which are in contrast with the need of the inhabitants. This means that this governmental programme has to be in line with the public entity. INAG is the responsible institution that focuses on the water elements within this programme. The total investments that were made possible due this programme are estimated around the value of 222 million Euros. The participation of INAG within this contract programme delivered 79 million of euros of the total investments. The following figure shows the regional (financial) investments that were made, through contract programmes of INAG:

Figure 5.7 Regional investments through contract programmes
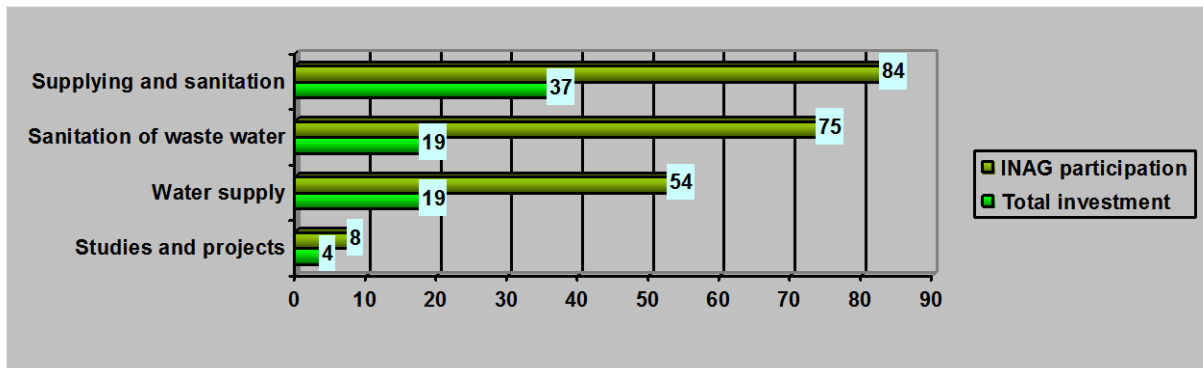
This figure shows that INAG is not only investing on the construction and maintenance of the water system, but is also investing money in studies concerning projects in the Portuguese water system.

Governmental Investments

The government also invest money in the system of water use. The following table will give an overall view of the investments in the Portuguese system of water use concerning the period 2000-2005 (the values are in millions of Euros):

Table 5.1 Investments made in the Portuguese system of water use

Period 2000-2005	Total	Approved	Executive	National
	Investments	Participation	Community	Counterpart……..
Cohesion fund	2.350	1.561	1.367	789
FEDER (European Fund for the Regional Development	1.128	771	584	357
Total	**3.479**	**2.333**	**1.951**	**1.146**

The cohesion fund is a financial source which resulted from the European cohesions and is fit for the making of constructed infrastructures and the infrastructures that have to be constructed. This fund is created by law in 1994 in order to make the economic and social position of Portugal more concrete and stronger.
The FEDER stands for the European Fund for Regional Development, which makes it possible to support the community. This fund focuses on projects which are developed for the construction of infrastructures in the domain of the basic sanitation. This fund is managed on the level of CCDR related issues.

IRAR is as mentioned earlier the organization that analyses the water prices. Besides the water law there is the decree law. This law is used as an economic instrument in the system of water use in order to provide a sustainable water use. This law was not working effective: water was not used sustainable and the financial issues in the system of water use were not resolved (meaning that the citizens are paying not enough money for the water that is used, as various respondents stated in the interviews) Changing this situation was only possible if the decree law got changed as well. From the first of July, a decree law was introduced; the main aim of this new law is not only to solve the economic problems that were identified in the implementation of this instrument but also to set a frame of water prices that needed to be collected in order to keep up with the EU water frame work directives. The new decree law will be active, at the moment the economic instrument is implemented in order to start

changing the situation. These changes are: establishment of water resources, taxes that are implemented for the protection of the resources and also creating tariffs that are oriented for services (water supplying sanitation). These instruments will be relevant to contribute to the efficient use of water but it is also going to support the activities of planning and resourcing within the system of water use. The instruments are going to be supported by these taxes. The main objective is to establish a system in which the user is starting to pay for the system of water use, considering the environmental cost and also the resources cost. There is a coefficient for the water scarcity, we have an affiliation amongst the river basin district and all this collected money, amongst this economic instrument are going to be distributed at national level, at regional level and also to a fund. This means that 50% of the implementation of the water resources tax is going to be allocated in water resource fund that is going to be spread, considering the priorities, into technical and political issues by the ministry of environment. 40% is going to be registered by the regional authority, 10% is going to be allocated in the national water institute, as respondents of the interviews stated. IRAR plays an important role in this, because they have to approve the tariffs that are stated in the law and used in the economic instrument. IRAR advises the minister concerning these tariffs. Even though the minister has the final word, usually he goes along with the advice given by IRAR because they are in fact the institution that performs the analysis.

5.4 Summary
In this chapter the system of water use is explored by the use of the national innovation system. First the system of water use is explored, which consists of the following steps: collection, treatment, adduction, storage and supply. The waste water side consists of: collection, treatment and recycling. The input, throughput and output of the Portuguese system of water use are dividable in systemas em alta and systemas em baixa. This means that the upstream for the water side of the services consist of collection and treatment. The downstream of the water service is then the storage and supply of water. Each cluster is explored on their governmental level. After describing the work processes of the system of water use, the organizations within the national innovation were explored by each cluster and on their governmental level. After reviewing all these organizations / institutions, the money flows within the system was also an important fact to overlook. The European investments are important for the system. Without these investments innovation projects would be difficult to accomplish. By describing these sections of the conceptual model in chapter four and in this chapter, the following chapter is the next step in the research process. Chapter six concerns the analysis of the innovation system. The described situation of the Portuguese system of water use, by the sections of the conceptual model, is to be analysed in chapter six. This analysis is done by the indicators of the conceptual model, mentioned in chapter three, based upon the conceptual model.

Chapter 6 Innovation system

The innovation capacity is the ability to innovate within a system. The organizations / institutions of the clusters should be focused on the melting of the three areas of resources: idea time; motivation (trust and openness); and exploration (risk taking), by which a suitable innovation climate is stimulated. In order to describe the innovation capacity of the Portuguese system of water use, the innovation capacity of the Portuguese system of water system will be outlined first. In chapter five this system is described in this chapter the clusters in the Portuguese system of water use are analyzed. This analysis will be done through the measurement of the system by the use of indicators of the conceptual model. By analyzing the clusters of the system of water use, the innovation capacity of the system is measured. By analyzing the relations / interaction between the clusters of the Portuguese system of water use, statements are made concerning the possibilities of the existence of an innovation system within the Portuguese system. Also the decreasing and increasing effects on the innovation capacity is analysed within this chapter by focussing on the three sections of the conceptual model and measuring the innovation capacity by the indicators.

The Portuguese system of water use is characterised by two layers, named sistema em alta (also referred to as the upper system) and sistema em baixa (also referred to as the lower system). The upper system concerns the organizations / institutions who are dealing with drinking water distribution and sewers. The lower system consists of the organizations / institutions that concern with water supply and wastewater treatment. This approach is managed throughout the entire system of water use in Portugal. This system deals with the input, throughput an output of water (more specific the collecting of purified water, the treatment of waste / drinking water and the distribution of waste / drinking water). The characteristics of this system are expressed through the organizations / institutions, which are involved within the Portuguese system of water use. These organizations / institutions are analysed by the use of indicators based on various theories presented in chapter two and figure 3.1, in order to determine the increasing and decreasing effects of the innovation capacity in the system.

The innovation system of the Portuguese system of water use is recognized / analyzed by various co operations between the organizations / institution of the clusters in the nation and outside the nation. The innovation capacity is determined by the working of the market mechanism, meaning that there is a request for a certain (new) product or service by the government and the market responds on this request by making sure that these (new) products or services are provided. The implementing organizations are within this mechanism of the Portuguese system of water use. The providers of technological opportunities and the government take care of public good water and protect the social needs. In short, the innovation capacity depends on the working and relations / interaction of the organizations / institutions of the clusters. To make innovation possible it depends on organizations / institutions that make the policies, organizations / institutions that implement the policies and organizations that obtain knowledge. So it is in fact a network of those organizations working together and creating new products or services, which enables the production and implementation of innovation. In the following paragraphs relations between the organizations / institutions of the clusters within the system of water use is analysed. These relations will determine the increasing and decreasing effects on the innovation capacity in the system of water use.

6.1 The clusters of the National Innovation System
In this paragraph the clusters of the system of water use are analyzed. Before analyzing this section of the conceptual model, the influences of the country specific elements need to be

reviewed and analysed. These elements are described in chapter four but statements concerning the influences on the innovation capacity will be made in this paragraph.

The geographic factors of Portugal make it difficult to take the steps into one national system of water use. The various climate types have various effects on the system of water use. Therefore, the part systems in the system of water use are still seen in Portugal. To overcome this problem the municipalities, which are in charge of the part systems, need to come together and develop a system of water use that can provide services in the various climate types. This contributes to the creation of innovation projects for the problem solving. This challenge has a positive influence on the increasing effect on the innovation capacity of the system. According to Ekvall (1980) a challenge is one of the ten dimensions that are needed to create a suitable innovation climate, by which a step towards the increasing of the innovation capacity is taken. This challenge makes various municipalities come together with other organizations to share knowledge and ideas in order to develop a national system of water use.

The cultural aspects of Portugal are characterised by a consensus culture. This culture type in Portugal focuses on the consensus reached to the objective point of what is wanted and needed. But reaching consensus about how to get to the objective is an ongoing a slow process. Portugal is already lacking behind on their water indicators (the service coverage and the water quality) by the EU standards. Therefore, the consensus culture has a negative influence on the innovation capacity. The consensus culture takes up a lot of time and effort, while Portugal is now at the stage in which drastic changes need to be made in order to comply with the EU regulations. Time is of the essence, considering the fact that Portugal can be fined by the EU if they do not reach the set up standards / goals by 2010.

The historical aspects of Portugal for this thesis focus mainly on the separation of public and private sector. This separation went on for decades and is still the case, for the fear of repeating a national catastrophe. Portugal is now taking steps in changing this separation, because the government is seeing that the knowledge within the private sector is needed to change its system of water use. This realization has a positive influence on the innovation capacity. As Gibbons (1994) makes clear in the theory of the Triple Helix, the public and private sector come together to share and create knowledge in order to have a setting in which value is added in the innovation process. By including the private sector in the system of water use another viewpoint is added, out which new ideas are developed.

The political aspects of Portugal have a decreasing effect on the innovation capacity. The centralized system that is wielded by the Portuguese government is a negative influence on the innovation capacity in the system. The steering and control from one centralized point does not make the operational level and the policy makers cooperate and share their knowledge.

The economical and human factors in Portugal have a negative influence on the innovation capacity in the system. Portugal is one of the poorest EU-countries. There are not much financial means available, therefore taking risks, in losing the limited finances that are available, is not wanted. Innovation projects usually have high risks, because the outcomes are uncertain, luckily for Portugal financial aid is offered by the EU. These financial aids create possibilities to take steps in doing innovation projects, which have a positive influence on the increasing effect on the innovation capacity. Also the uncertainty of the movement of the population makes it very difficult to calculate what service coverage is needed for the system of water use. The uncertainties and the limited financial resources have a negative influence on the innovation capacity of the system.

Even though the educational status of Portugal is not high, the system of water use claims that they do not lack qualified and high-educated engineers, which have a positive influence on the innovation capacity in the system. As mentioned in paragraph 4.6, the skills that are needed in the Portuguese system of water use differ from the skills that engineers obtain. Therefore, new trainings are developed to develop the needed skills by which knowledge is shared.

In the following sub paragraphs the clusters in the Portuguese system of water use will be analyzed.

6.1.1 The Water policy organizations

The Portuguese system of water use has a government which is responsible for the development of a water policy. This concerns the ministry of Environment, to be more exact the policy arena of Brussels is at order concerning the making of the policy. Bovens et al. (2001) described this arena on European level as being complex. Looking at the process of the Portuguese water policy, from the policy making to the policy evaluation, it can be said that a lot of organizations / institutions (national and international) are involved. Portugal is a member of the European Union, meaning that the national water policy has to comply with the EU regulations. For example the water framework directive (which is the legislation concerning the river basins) shows that the Portuguese water policy is based on the European guidelines. The decisions that are made by the European Commission concerning the water legislation, for EU countries, take place in Brussels. These directives get translated on national level by the water management plans. The Portuguese water policy (PEASAAR) shows that the development of the policy is in hands of the Ministry for Environment. At the moment there is a second water policy volume: the national water policy, also referred to as the national water master plan, is set up by INAG. This plan is an integrated document (based on actual data through diagnoses of the situation) that gives a national wide definition to water resource managements. It also defines objectives for water in accordance with the water regulation. INAG has the competence to co ordinate, plan, and license the management for the water resources. INAG is responsible for water management on national level by keeping the water law in mind.

The execution / implementation of the water policy is done by various organizations / institutions working on the national, regional and local level. The main institutions are EPAL, DGEA, IRAR (national), ADP (regional), the municipalities and private water organizations. These organizations / institutions will be explored in the following section.

The evaluation of the water policy is done by regulators: IRAR and DGAE. They evaluate by using indicators. Afterwards this will be reported to the Ministry of Environment, who make the decision of either customizing the current policy or keeping the policy as it is. (For example the PEASAAR case). It is not only the ministry, who is in charge of keeping the water policy under control. Also the European commission looks at the progress of the water policy and they see whether this still complies with the development of the other EU countries. After evaluating the PEASAAR, it can be said that the first volume was not as successful as aimed to be. The goal of PEASAAR (2000 – 2006), as mentioned earlier, was to get 95% of the population connected to drinking water and 90% connected to sewerage. In fact 93% of the population got connected to drinking water and only 80% of the population got connected to sewerage. The PEASAAR did not reach its goals, so a part of the public money got lost; taking such a risk again is not desirable. The new investment plans state otherwise. PEASAAR II (2007 – 2013) provides 4 milliard Euros for the construction and improvement of the regular distribution pipes (downstream) and 1.6 milliard Euros is reserved for the head pipes (upstream). There is 200 million euros reserved for the resolution of specific problems, for example the purification of waste water coming from farms. Looking at these figures, the statements made by the minister of Environment, Spatial planning and Regional development, the relation between the government (water policy) and implementation organizations is exceeding at the moment. According to the new investment plans and demands that are made by the European Union, the relation between the government (innovation policy) and the implementation organizations should get more important.

The indicators that determine the innovation capacity of the WPO's are the following:

Table 6.1 the innovation capacity of the WPO's

	Indicator for decreasing capacity	*Indicator for increasing capacity*
Policy aims		Portugal sets its goals on a national level based on EU-regulations. Portugal also set general goals for levels of access to drinking water and sewerage
Policy instruments	There are two regulators, IRAR and DGEA, that evaluate the conducting of the water policy by the use of strict water quality and quantity indicators	
Hierarchy	Portugal WPO's are founded at the top governmental levels; influence from the operational levels is not recognized.	
Finance	The WPO's are not willing to fund high risk project, risking the loss of losing public money the political aspects are factors that have to be considered.	

This analysis shows there are no WPO's analyzed on the regional and local level; this shows that the policymaking happens on the top level. As mentioned in paragraph 3.2.3.1 the role of legislature maintains its tasks by focussing on decision making and translating legislation into policy. As seen in this analysis the water policy organizations give restriction to the water quality and limited space is give for innovation projects. This governmental role that is taken by the WPO's has a decreasing effect on the innovation capacity. Even though this governmental role is exceeding at this moment, the WPO's are making changes in their current situation. These changes have the tendency towards the governmental role of owner / proposer. Within this role the WPO's focuses on its public tasks and is executing their tasks by letting the private sector interfere in the public sector. By this mixture the system of water use obtains more organizations and various types, these varieties leads to various points of views concerning the system of water use. By which the knowledge increases and if this knowledge is shared, this has an increasing effect on the innovation capacity.

6.1.2 The Implementation Organizations

The implementation organizations have the main task of implementing the policy within the system of water use. The main implementation organizations within the Portuguese system of water use are EPAL and ADP.

- EPAL stands for the Empresa Portuguesa da Águas Livres (the Portuguese company for free water), which is in charge of the supply and distribution of drinking water, better known as the upper water system..
- ADP stands for Aguas de Portugal (water of Portugal). ADP is a state owned company that is in charge of 90% of the waste and solid waste water sector and delivers their services to 75% of the population. To be specific, ADP's work consists of negotiating with the local and national governments. That way they can capture expertise and invest in capacity building. This will enable them to expand and upgrade the existing system of water use to a higher level.

The government plays an important part within the system of water use and that is especially notably by the connection with the implementation organizations. Both implementation organizations need to comply with regulations and policy guidelines, which are stated and published by the Ministry for Environment. These regulations and guidelines are specified by indicators, which are measurable rules for the protection and assurance of the quality of water. The government has stated two regulators to define and supervise these indicators.

EPAL has to deal with the DGEA, which stands for Direcção Geral das Actividades Económicas. These indicators determine the tariffs policy for EPAL in contrast with the current economic situation and the quality of their drinking water, better known as the upper system.

ADP deals with IRAR that is responsible for the consolidation of a clear and effective regulation model for the public, concerning the system of water use, urban wastewater and solid waste management; better known as the lower system.

Both regulators are stated by the government to be in control of the regulation in the system of water use, focused on the European Union regulations. DGAE and IRAR are independent organizations, financially and institutionally. Reviewing this analysis there can be stated that the role of the government towards the IO's can be typified as the role of an *administrator*. The administrator shows the degree of leadership. In this role the government gives directions, concerning the policy and practices of the system of water use. The gross part of the regulation comes from the European Union, meaning that creating national regulation is not necessary. So the government has the task to translate the European water legislation into national water policy. Therefore the role of administrator is of great use, even though it is a top-down approach, meaning that a lot of input comes from the EU legislation and the government's vision. The inclusion of other organizations / institutions within the system of water use is not present at the moment. The implementation organizations are then in the role of agent, in which they are responsible for the implementation of the policy made by the water policy organizations. Looking at the implementation organizations, it can be said that the way in which they implement the policy is up to them, as long as the indicators are reached.

The indicators that determine the innovation capacity of the IO's are the following:

Table 6.2 the innovation capacity of the IO's

	Indicator for decreasing capacity	*Indicator for increasing capacity*
Structure		The IO's are working on various governmental levels but they are bound to the indicators included in the water policy.
Culture	A strong consensus culture and a strong top-down culture apply. Decisions can be made quickly, however implementation occurs very slowly as consensus is to be reached about working methods	When water sanitation accidents occur, radical changes can be made. However available knowledge will be used in such a case.
Product	IO's focus on one water product type, the indicators and set up work methods based upon the concessions do not allow the IO's to focus on other water types.	
Discretionary space	Considering the direct and clear cut guidelines / indicators given by the national government, the freedom of implementation organizations is restricted.	The municipalities can set higher goals than the provided standards
Financial flow	Municipalities collect funding for the system of water use through taxes, subsidies and loans. National government does not invest in renewals and does not subsidize municipalities. This results in low budgets for renewals or extension of the infrastructure.	
Competition	There are no signs of competition between the water providers, as water tariffs are to be	

	approved by the regulators.	
Human capital	Because of the indicators that are set up on the higher levels, employees are bound to their task with no space for sharing new ideas.	

The implementation organizations are working on various governmental levels, but they are bound to specific indicators for their working process. These indicators make it difficult to make any changes in the work processes, because that could mean that the work process needs to be desecrated by which the indicators are not reached. The various implementation organizations have a strong focus on one water type. These elements make it noticeable that the organization of IO's has for the gross part a decreasing effect on the innovation capacity.

6.1.3 The Knowledge Organizations

The knowledge organizations have the goal to obtain knowledge and to eventually create the innovations. As mentioned earlier the creation of innovation is possible when co operations are made and knowledge is shared. In the Portuguese system of water use the following co operations are recognized on national and international level:

- Hydronet PT is a national network that consists of organizations involving research related to water. The idea is to create synergy and to make changes. At the moment this is done by the creation of a training to improve the skills of the engineers who are operating in the system of water use.
- The international Water Association connects professionals worldwide which focuses on research, science, technology and practice. Knowledge and skills are shared with the participating members through annual congresses (which is the biggest event in the water field), journals, books, IWA magazine and so one.
- Cost Action Networks EU is a European network of research organizations. "COST – European Cooperation in the field of Scientific and Technical Research – is one of the longest-running European instruments supporting cooperation among scientists and researchers across Europe. COST is also the first and widest European intergovernmental network for coordination of nationally funded research activities." (http://www.cost.esf.org/, 10/06/2008)

These co operations show that knowledge is spread and shared over the system of water use with other knowledge organizations. Hydronet PT shows that the coordination to organize researches is present and the outcomes will be presented to the concerning organizations / institutions. These co operations are done by the involved institutions, meaning that the government does not steer / control these researches. Nevertheless, as mentioned earlier, the governmental organizations hire knowledge organizations to do research concerning the water policy in which they have the power to control the research design. On international level it is notable that the mobility of researchers is high. LNEC has researchers who take part in various networks and project (like IWA). All these co operations do not show signs of competitiveness, because the scales, on which the co operations acquire, differ and the delivery of qualified work is of greater importance. The indicators that determine the innovation capacity of the KO's are the following:

Table 6.3 the innovation capacity of the KO's

	Indicator for decreasing capacity	*Indicator for increasing capacity*
Institutional structure	The KO's, like LNEC depend on the policy organizations and the IO's. This financial dependence has an impact on the direction taken by the KO's. By this dependency the directions of the researches are mostly determined by the IO's and the policy organizations.	The organizations / institutions within this cluster are both public as private organizations. This mixture makes it happen that various views from various perspectives are included within the researches. .
Competition		There is competition between knowledge institutions concerning the available funds for research, which comes from the National Research Foundation. This foundation focuses on Research & Development in the Portuguese system of water use; the best projects get the funds.
Type of research		There is a linkage between fundamental research and applied science. The universities and knowledge institutes work together with implementation organizations in order to answer to the needs of the system of water use.
Financial flow		The KO's are willing to take risks to do innovation projects but they are only able to do so with the funding of IO's and IPO's.
Human capital		The KO's show High educated employees. The high degree of labour mobility is due to the fact that national and international co operations lead to the instalment of new projects with new partners.

These indicators show that the innovation capacity is increasing within this cluster. By various and new co operations, relations are based with different types of organizations / institutions. The knowledge sharing and creating with these organizations / clusters have an increasing effect on the innovation capacity.

6.1.4 The Innovation policy organizations

The Portuguese system of water use shows that there is an innovation policy present, namely the Technological Plan. As mentioned earlier the Technological plan is a policy mix of various existing policies as goal to face challenges by 2010. In the following these will be mentioned and explained.

- The first challenge concerns the improvement of the capabilities of Portugal's human resources by focussing on the development of the education and training status of the citizens in the country. In the first place, it may be thought that this challenge is a matter for the educational policy and not so much for the innovation policy. In fact the educational and training challenges are for a major part focussed on the employed citizens, in order to strengthen the business ventures. The measures for this challenge can be divided in the following four categories: "promotion of training by companies, development of technological schools, encouraging the employment of skilled human resources in the business sector and promoting the integration of companies into the digital economy." (Annual Innovation Policy Portugal, 2006) The first steps for these

measurements have already been taken in the system of water use, which are supported by the European Commission. These first steps that have been taken, are not so much focussed on the change in the educational matters but more on the training aspects for the businesses. This means that knowledge institutions develop training programmes in cooperation with the private organizations, in order to make a link between the skills of the engineers and the needs of the private organizations. An example is the training course developed by HYDRONET PT, which will start next year. This training course concerns the technical management of urban water systems, to improve the skills of the engineers, which are responsible for managing the water systems in Portugal (so the decision makers on the technical level). This link makes it possible to add value to the skills of the engineers and to comply with the needs of the private organizations.

- The second challenge that the country and also the system of water use face, namely the poor links between the organizations / institutions in the national innovation system. The national innovation system is an existing construction in Portugal but the interactions amongst the players in this field have to be optimized in order to make the national innovation system work. The Technical Plan has created measurements to face this challenge. Portugal is lacking on this point and is therefore of great importance for the status of Portugal. The reason for the low interaction in the system is due to the fact that the public organizations and private organizations are divided and both parties are not willing or able to cross those lines. As mentioned in paragraph 4.3 the Portuguese history shows that the separation of the public sector and private sector was linked to situations that were appearing in the population's health issues. Therefore breaking this separation and crossing the lines from the public sector and private sector is a long time process of mind changing and is a difficult task to overcome. Even the difficulties facing this process, the Technical Plan provides measurements to take steps in overcoming these separations a stimulating the co operations. These measurements are the following four: "fostering research consortia between S&T organizations / universities and companies for the developments of new products, processes and systems; technology transfer offices; industrial property support offices; and specific instruments to promote cooperation between companies." (Annual Innovation Policy Portugal, 2006). These measurements do not only need a mind change concerning the separation of the public sector and the private sector but also a mind change in the working methods within and across the sectors. Instead of a top-down approach in designing and implementing the innovative projects, a bottom-up approach should be promoted and applied in order to assure that all interesting parties are involved and ideas get spread in the system.

- The third and final challenge that Portugal is facing with the Technological Plan is the capability building of companies and stimulating the emergence of new players in the field. This challenge concerns the knowledge intensive companies, by which the existing companies have to invest in their capacity of their knowledge. New (more) companies have to emerge to contribute to the upgrading of the quantity and quality of the Portuguese knowledge status. The changes that have to be made in the companies have to be made from high-tech employers to high-knowledge employers. The measures that the Technological Plan provides for this change are various sets of seven types of initiatives.

The Technological Plan is a generic policy that is applicable in different systems, meaning that the goal of this policy does not concerns the selections of certain types of innovation projects to be subsidised, but this is what happens in practice. The National Research Foundation, which is, just like the Technological plan, under the responsibility of the Prime Minster, provides funds for certain researches. There is a limit to the amount of funds that can be given, meaning that there are more requests for funds then what is available. As a result,

the best ideas, for innovation projects are chosen. In this case competitiveness between the possible winners is notable and understandable.

The indicators that determine the innovation capacity of the IPO's are the following:

Table 6.4 the innovation capacity of the IPO's

	Indicator for decreasing capacity	Indicator for increasing capacity
Policy aims		An innovation policy is present, and is described by the Technological Plan. This plan is a generic policy that is applicable to different systems. The National Research Foundation provides funds for certain researches.
Policy instruments		IPO's are organizing platforms, congresses and so one (concerning the new innovation)
Hierarchy	The Technological plan is developed on a national level without involvement of lower levels of government in a top-down manner. Various policy sectors are implemented in this plan.	
Finance	Financing KO's for specific projects with clear outcomes. There are two main funding agencies, concerning innovation. To apply for the funding clear-cut proposals, need to be handed in. The expected outcomes have to be formulated. Also, the funding, only covers a part of the entire project costs.	

This means that the Technological Plan is a policy mix which provides not only benefits for the national innovation status. The policy mix also provides coordination for the various separated policies that are innovation orientated.

6.2 The relations within the National Innovation System

The relations that are identified in the National Innovation System are various types of relations. These relations vary from a relation based on regulation to a network. In this paragraph all the relations within the system of water use will be explored and reviewed by the indicators that determine the increasing and decreasing effects of the innovation capacity in the relations.

6.2.1 Relation Knowledge Organizations ⇔ Implementattion Organizations

The making of water policy is an intensive process, especially when the previous goals of the water policy were not reached. So a lot of research needs to be done, in order to provide measurements to prevent and determine the policy failures. This means that expertise is coming from various places on international and national level. This expertise is coming from universities and professionals working in the water industry. LNEC is a knowledge organization that gets hired by the Ministry of Environment to do research on certain measurements. LNEC is a publicly owned company and performs most of their research based on the assignments that the government gives them. The gross part of the assignments focuses on building new systems and not accorded to the maintenance of the existing systems. The researches done by LNEC are for a part co-funded by the National Research Foundation. The knowledge organizations are seen as a very important actor for the innovation capacity in the Portuguese system of water use.

This relation means the following for the innovation capacity:

Table 6.5 the innovation capacity of the relation IO – KO

Relation	Element	Indicator for decreasing capacity	Indicator for increasing capacity
IO – KO	Knowledge transfer	KO, like LNEC and universities, receive requests from implementation organizations to do research and to create a scientific basis for solving problems they have to deal with.	
			The multi municipal system provides a platform for various municipalities to work together and to increase the communication between each other to improve their water system and the capacity for innovation. Experiments for the creation of new technologies are supported within these platforms.

6.2.2 Relation Knowledge Organizations ⇔ Water policy organizations

The Portuguese system of water use shows that the implementing organizations contract a lot of their work out, meaning that the treatment of the water in accordance to the national water master plan is under the responsibility of the implementing organizations but the actual work is mostly done by a private organization. Looking at the working method of ADP, in which municipalities work together and create concession, the concessions are mostly made for periods of 30 years. These concessions in which at least two municipalities give a private organization an assignment, for example the construction of a new water treatment plant, are made by the state. This means that the private organization is assured of a job during the concession, resulting in giving up 51% of their shares to the involved municipalities. In this case the private companies, which have concessions, are the organizations which provide the municipalities their services. These services are based on knowledge equipments that they have and are needed by the municipalities. Even though the knowledge is hired by the municipalities, the outcomes of certain projects are not spread with the other municipalities. This is has a decreasing effect on the innovation capacity.

This relation means the following for the innovation capacity:

Table 6.6 the innovation capacity of the relation WPO – KO

Relation	Element	Indicator for decreasing capacity	Indicator for increasing capacity
WPO-KO	Knowledge transfer	The relation between the WPO and the KO is characterized as doing research to solve a problem by the use and input of technological knowledge.	
		The relation between the WPO and KO is based on a principal-agent relation focuses on problem solving	

6.2.3 Relation Knowledge Organizations ⇔ Innovation policy organization

The innovation policy shows that the system of use is stimulated to innovate. This is done by the instrument of the National Research foundation. National Research Foundation is the organization which provides funds for researches concerning science and technology. This foundation is set up by the government in which a small part of the public money is used to do research on public works. Nevertheless public works is a big area and water related issues are not the most important research subjects at the moment. So applying for the funds have to show the importance of the research. The government co-funds such researches but the gross part of the funding comes from private organizations. These co-funding mean that a lot of money still needs to be arranged by the knowledge organizations themselves. The Portuguese

system of water use shows a certain market mechanism of question and demand, meaning that the industry needs certain knowledge and knowledge organizations will provide those needs. This relation means the following for the innovation capacity:

Table 6.7 the innovation capacity of the relation KO - IPO

Relation	Element	Indicator for decreasing capacity	Indicator for increasing capacity
KO-IPO	Knowledge development		The KO and IPO communicate by doing researches to solve problems and think about future developments in the system of water use. The KO then come together and form a network which focuses on innovative projects, like HYDRONET PT.
			The knowledge institutes are autonomous but dependant of funding by the IPO, largely on a project basis.

6.2.4 Relation Implementation Organizations ⇔ Water policy organizations

As mentioned earlier the water policy is created by the Ministry for Environment. There are a lot of influences coming from the European Union. The European Union tries to stimulate the Portuguese water policy by the use of subsidies. The European commission has this stimulating instrument and the instrument of informing the Portuguese government about the various opportunities of innovation within the system of water use. The ministry of Environment seems to pick up the stimulations from the European Union (concerning the institutional changes and the influence of the private sector into the public sector), due to the fact that this ministry is also making changes in their institutional structure and emphasises on the involvement of the private sector with the public sector. On national level however there is a top-down approach in all stages of the policy process, as seen in the description above. Instead of having a top-down approach in designing and implementing the innovative projects, a bottom-up approach should be promoted and applied in order to assure that all interesting parties are involved and ideas get spread over the sector.

This relation means the following for the innovation capacity:

Table 6.8 the innovation capacity of the relation WPO-IO

Relation	Element	Indicator for decreasing capacity	Indicator for increasing capacity
WPO-IO	Decision-making	There are still strict boundaries between the public and private sector. There is a strong sense of top-down approach concerning the water policy without including the implementation organizations in the phase of policy making.	
		The focus of the water policy organizations and the implementation organizations is for a great part on the conservation and problem-solving of the water constructions that were made over the years.	

6.2.5 Relation Implementation Organizations ⇔ Innovation policy organizations

The various implementation organizations are not aware of the presence of an innovation policy in the Portuguese system of water use. This means that the stimulation of the government to innovate by the use of the innovation policy is not recognized by the implementation organizations within the Portuguese system of water use. EPAL is standing close to the government and acknowledges the stimulations of the government to innovate.

Looking at the money flow of the innovation projects, the gross part of the money is coming from the European Union by means of loans or funds. There is a national research foundation, which also focuses on Research & Development in the Portuguese system of water use, but the knowledge organizations are the ones who use these funds.

This relation means the following for the innovation capacity:

Table 6.9 the innovation capacity of the relation IO -IPO

Relation	Element	Indicator for decreasing capacity	Indicator for increasing capacity
IO-IPO	Development of innovations	There is no specific innovation policy, but a mixed policy which is applicable for various sectors.	The National Research Foundation manages the financial flow from the IPN to KO's and to IO's for R&D purposes.
		IPO's such as the NRF do not make use of information provided by operators such as EPAL.	

6.2.6 Relation Water policy organizations ⇔Innovation policy organizations

There is an innovation policy present, namely the Technological plan. The Technological Plan is a policy mix of various existing policies, as goal to implement various views of the Technological sector of Portugal. The Prime Minister of Portugal is first and far most responsible for the innovation governance system. This means that the actors who are active in the national innovation system have to answer to the Prime Minister, concerning the indicators from the national innovation policies. The Technological plan focuses on three pillars, which all have its impact on the Portuguese system of water use. These pillars are: knowledge, technology and innovation. These two policies are fitting and influencing the policy implementation from both sides. The two ministries are aware of their own and each other´s work, meaning that strict separation of the ministry with the danger of doing the same work twice is not present in the Portuguese system of water use. The Technological plan is mainly under the responsibility of the Prime Minister. This plan is a generic plan which is applicable in numerous systems.

This relation means the following for the innovation capacity:

Table 6.10 the innovation capacity of the relation WPO - IPO

Relations	Element	Indicator for decreasing capacity	Indicator for increasing capacity
III WPO – IPO	Policy adjustment	The ministries work on their own, however the challenges that are dealt with in the innovation policy also occurs in the water policy.	
		There is no cooperation between the WPO and IPO.	

The relations / interaction between the clusters in the system of water use are still very low. In order to develop innovation, knowledge transfer has to be made. The organizations / institutions within the clusters of the system of water use are taking part in various networks, on national and international scale. The national networks are for the most part project based, meaning that national networks are created when a technical issue occurs, which can only be solved by the co operation of various parties. The biggest issue here is that the results coming from these networks are not interacted with all the actors in the Portuguese system of water use. This means that a lot of new information gets lost. The international networks, like IWA, are not only practical related but also provide a great part of scientific researches. These scientific results are spread with all the members of IWA and also can be bought by non IWA members. This example shows that the international network has got more transparency concerning their results then the national networks. The institutions within these networks need to contain certain skills in order to give contributions to the network.

6.3 The drivers and barriers in the development of the innovation capacity

As mentioned in chapter two, three and six, Portugal has yet not an established innovation capacity. Portugal is at the stage of developing a stable system of water use and improving the settled systems. The first steps are taken towards innovation in the Portuguese system of water use. In order to oversee this process in creating a suitable innovation climate within the first steps, resulting in the development of an innovation capacity within the system, various drivers and barriers are analyzed. These drivers and barriers show what activities in the system have a positive or negative effect in the innovation system of the system of water use. In the previous paragraphs increasing and decreasing effect on the innovation capacity in the Portuguese system of water use are analyzed and presented, out which the drivers and barriers are recognized. This means that the drivers and barriers are linked to the indicators for the decreasing or increasing effects on the innovation capacity in the system of water use, which are based on the theoretical framework.

Drivers

The drivers that are most noticeable in the Portuguese system of water use are:

European funds

The European funds provide national opportunities. The economic status of Portugal is slowly recovering from a recession. Even though it is recovering, Portugal still remains to be one of the poorest countries of the European Union. The bad economic situation of Portugal in comparison with the EU average, made the government take actions to recover the economic situation. The government needed to take actions in order to comply with the Stability and Grow pact which implicate all the EMU-countries. This is done by increasing inland investments into education and spatial infrastructure. These investments are possible, because of the EU aid, to be precise 22.5 milliard Euros. These aids provide the possibility of developing new projects to improve the education and the system of water use. As mentioned in paragraph 6.1.4 the innovation projects take place, not by the inland finances but by the financial aids from the EU.

Tourism

With tourism comes the need of providing qualified water. The international standards need to be respected in order to let the economy of tourism evolve. If the water standards are not complied with, the tourism is highly to decrease by the jeopardy of tourists coming into contact with unqualified water.

ADP

ADP is another driver within the process of innovation. This organization brings the national and local governmental levels on the regional level. By this working method the policy makers and the operational level are brought to getter to create an understanding of the current situation in the system of water use. Hereby the policy can be better adapted to the local situation. Not only is this working method positive for the understanding of the situation, but various parties are brought together in one setting, in which interaction takes place. Within this setting new relations are born and ideas are shared. This has a positive effect on the process to innovation.

International co operations

The international relations are of importance for the innovation process. By seeing what other countries do, in order to make their innovation climate possible, lessons can be drawn and used in their own country.

Public and private sector

The government is willing to create a climate, in which the involvement of private organizations is accepted. By accepting the private organizations within the public sector their specialized views is included within the system of water use. The involvement of the private organizations also makes it happen that challenges in the Portuguese system of water use are

analyzed by various parties. The knowledge that is than shared and created is a boost for the innovativeness in the system of water use.

Barriers
The barriers that are most noticeable in the Portuguese system of water use are:
Risk taking
The government has no intention to take risks. Portugal is one of the poorest EU countries, so there is not a lot of money available for the implementation of new projects, which can be innovative. Fear of losing the limited money that is available, causes the government to not be willing to take such risks. The innovation process concerns that of doing the innovation projects. Therefore, risks need to be taken.
Skills engineers
The education and skills of the engineers are not in compliance with the needs of the industry. The universities and the industry are not interwoven, which means that what students learn in college is not what is needed by the water industries. The skills that are needed focus on the improvement of the settled water systems. If the engineers do not have these skills improvements and innovations within the current water systems will not take place.
Top-down approach
There is a top-down approach instead of a bottom-up work method within the system of water use. The bottom-up approach is necessary to get all the available knowledge in order to create innovation; this approach also makes the acceptance of a new innovative project bigger amongst the involved organizations / institutions. This approach is not present within the Portuguese system of water use.
Technological plan
The Technological plan has measurements to stimulate and develop the innovation status in the Portuguese system of water use, but there is still no formal innovation policy present. This means that there is a lack of a consistent and clear coordination for the innovation in the Portuguese system of water use.

An extended version of the drivers and barriers is presented in Appendix G by the SWOT-analysis. This analysis gives an overall view of the status in the process of the Portuguese innovation system

6.4 Summary
This chapter has the main focus to analyze the Portuguese system of water use. The analysis is done by the use of the indicators of the conceptual mode in chapter three, based on the theoretical framework. All three the sections of the conceptual are analyzed in this chapter, by the use of the descriptions of the Portuguese system of water use in chapters four and five.
The WPO's were mainly recognized on the higher organizational levels, out which could be concluded that water policies are created on the top levels, without the influence of regional and local level. The IO's were recognized on various levels in the system but the focus for each IO is only on one type of water. The KO's are recognized on various levels in the system and the co-operations between the KO's are important facts to note. The IPO's are mainly recognized on top level, but the influences of other organizations form other clusters are wanted for their different points of view.

Looking at the relations of the Portuguese system of water use, it can be stated that the innovation capacity is low. The innovation is mainly pushed by the European Union guidelines and funding. The relation between the IO's and the two governmental policy organizations are of great importance. The knowledge transfer and knowledge development makes this relation important for the innovation capacity. This can in fact increase the innovation capacity of the Portuguese system of water use. Even thought the relation between the IO's and the governmental organizations is mainly based on a principal-agent, the governmental organizations are aware of the importance of the changing of this relation. By changing this relation new fundamentals and working methods can be created to make knowledge transfer possible.

Chapter 7 Conclusions and recommendations
The increasing and decreasing effects of the innovation capacity in the Portuguese system of water use depends on various factors. These factors are made clear in the three sections of the conceptual model, presented in figure 3.1. There are three sections represented in the conceptual model, namely: the country specific element, the clusters and the relations between the clusters. For these sections concepts are created so that the Portuguese system of water use is described. With the conceptual model indicators are presented, which enables the analysis of this research. The analysis of the Portuguese system of water use measures the decreasing or increasing effects on the innovation capacity. This analysis has shown that the Portuguese system of water use is dominated by the governmental organizations. Therefore, the roles of the governmental organizations effect the innovation climate for the gross part of the system and therefore the innovation capacity. If the government is not taking measures to create a suitable innovation climate, the development of an innovation capacity is hardly possible. As the governmental organizations being a dominating factor in the innovation climate, the input of the governmental organizations is needed to make change in the innovation capacity. So change can be made if a suitable innovation climate is created by the dominating factors, in the case of Portugal the dominating governmental organizations in the system of water use.

In this chapter the conclusion and recommendations will be formulated, which are based on the data from the previous six chapters. The model of the innovation system, presented in chapter three shows that the relation between the four clusters determine the innovation capacity within the system. The system of water use is a complex system, on which the country specific elements of Portugal have influence. The sub questions work towards the answer of the main question. The conclusion of this research will be given by reviewing the answers of the sub questions and the main question. As a result of this conclusion, problems / challenges are outlined concerning the innovation capacity. These problems are translated into recommendations for the Dutch and Portuguese government. Due to the limited time that was available for this research more specific details were not able to be researched and analyzed. Therefore recommendations for further research will also be given. By more specific details, the country specific elements are meant. The main question of this research is:

What generates the increasing and decreasing factors of the innovation capacity in the Portuguese system of water use?

The main question is divided in the following sub questions, which will answer the research question. There are several sub questions that will be answered:

1   *How are the clusters in the system of water use organized in Portugal?*
2   *How is the Portuguese innovation system organized?*
3   *How are innovations generated in the Portuguese system of water use?*
4   *What are the drivers and barriers in the process of innovation?*
5   *How can the government influence the drivers and barriers?*

7.1 The sub questions and the answers
The answers to the sub questions are formed by the enactment of the research design. The focus is on the decreasing and increasing effects on the innovation capacity in the system of water use. Throughout the previous chapters the answers are given to the sub questions, this paragraph will provide the same answers briefly.

Answer to Sub question 1: How are the clusters in the system of water use organized in Portugal?
The system of water use in Portugal is based on the following construction: upstream and downstream system. The upstream of the system of water use focuses on the organizations / institutions who are dealing with the water distribution and sewers in the process of the

system of water use. The downstream of the system of water use focuses on the organizations / institutions that are concerned with the water supply and wastewater treatment in the process of the system of water use. Even though there is a significant separation in the system of water use, the government and especially the municipalities are first and for most responsible for the entire system.

The system of water use has made a lot of transformations over the centuries, from a system of water use owned by private organizations to a system of water use that is under the responsibility of the government and municipalities with the wish to exclude the private organizations. By entering the European Union the system of water use also experienced a lot of changes within the regulations and processes. The regulations and processes focused a lot on the water quality standards. The EU and Portugal needed to make sure that coverage of drink water, storm water and sewerage would improve. Up till now Portugal is still not meeting up with the requirements and is one of the EU countries that have the lowest service coverage of the population. Hereby needs to be said that Portugal is working hard on making changes in the system in order to comply with the regulations and to improve the water quality service.

The system of water use consists of various organizations, mostly governmental organizations. The organizations within the system of water use are pointed out to be the Water Policy Organizations in this research. These organizations have the most influence in the organization of the system of water use and operate on various governmental levels: international, national, provincial, regional and local. The WPO's that were analyzed in the system of water use in Portugal were not to be found on the regional and local level. This made clear that the policy making is taking place on top level and the operational level is excluded in the policy making process. Therefore, a top-down approach is noted within the organization of the system of water use. This approach is not increasing for the innovation capacity, because of lack on adaption. The policy making and policy implementing take place on two levels that have their own views the situation in the system of water use. A big gap is noted in what is stated / measured in the policies and what the operational level wants, needs and is able to deliver.

The Portuguese water policy (PEASAAR) shows that the development of the policy is in hands of the Ministry for Environment. It is not only the ministry who is in charge of keeping the water policy under control. Also the European commission looks at the progress of water policy and they see if this still complies with the development of other EU countries. At the moment there is a second volume: the national water policy, also referred to as the national water master plan, is set up by INAG. This plan is an integrated document (based on actual data through diagnoses of the situation) that gives a national wide definition to the water resource management and to the objectives for water in accordance with the water regulation. INAG has the competence to co ordinate, plan, and license the management for the water resources. INAG is responsible for the water management on national level by keeping the water law in mind.

The execution of the water policy is done by various institutions working on national, regional and local level. The main institutions are EPAL, DGEA, IRAR (national), ADP (regional), the municipalities and private water organizations. These organizations / institutions will be explored in the following section. The evaluation of the water policy is done by regulators, IRAR and DGAE, by the use of indicators.

As mentioned earlier, the organization of the system of water use is dominated by the government organizations. The roles that the governmental organizations take are legislature and owner / proposer. The role of legislature is all about restricting and maintaining the regulations within the system by developing a policy which provides standards and indicators. These standards and indicators need to be obtained by the organizations / institutions within the system of water use in order to apply to laws. This governmental role that is taken by the WPO's has a decreasing effect on the innovation capacity, because limited space is given for

innovation projects. The WPO's are showing the tendency of changing their role towards owner / proposer. Within this role the WPO's focuses on its public tasks and is executing their tasks by letting the private sector interfere in the public sector. By this mixture the system of water use obtains more varieties in the organizational types. The various organizations have their own views on the system of water use, based on their experiences and work fields. The knowledge from the various organizations has different foundations and by sharing this knowledge and integrated base or network can settle. Within this base or network new knowledge can be created for the system of water use, based on the various organization types and their views. By taking the first step in letting the private organizations enter the public sector, other (new) views can be integrated with the existing views concerning the system of water use, by which knowledge is created. So taking this first step has an increasing effect on the innovation capacity.

Answer to sub question 2: How is the Portuguese innovation system organized?
The Portuguese governmental policy organizations have introduced an innovation policy that is applicable to the various governmental organizations. The ministry of Environment also makes use of the innovation policy, named Technological plan, for its system of water use. The goals that are submitted in the innovation policy are translated to the innovation goals for the system of water use. This is described and analyzed by the use of the conceptual model: the national innovation system model. The clusters and especially the relations between the clusters are of great importance for the analysis of the national innovation system, also the innovation capacity in the system of water use.
The innovation capacity within the Portuguese system of water use has everything to do with maintaining, improving and renewing the system of water use. In order to prevent failing the standards in the water policy and providing measurements on how these failures will be prevented, knowledge is needed. The expertise is coming from various places on international and national level. This expertise is coming from universities and professionals working in the system of water use. LNEC is a knowledge organization that is hired by the Ministry of Environment to do research on certain measurements, to see if it works. LNEC is a publicly owned company and performs most of their research based on the assignments that the government gives them. In the case of doing unsolicited research by an organization like LNEC, partly co-funding is possible through the National Research Foundation. The relation between the KO's and IO's is based upon knowledge transfer. The KO's, like LNEC, get a request from the IO's to do a research based on solving a problem concerning the system of water use within their district. This is a typical principal-agent relation which has a decreasing effect on the innovation capacity. This is also the case with the relation between the KO's and WPO's.
The Portuguese innovation system has a municipal system, which increases the innovation capacity in the system of water use. The municipal system is called the multi-municipal system. The multi municipal systems are the systems that have a large investment by the state and serve more than one municipality. The concessions that are made are contracts for 30 years, in some cases it may be for 15 or 20 years. The municipalities give concessions to private companies, who are the ones that sell the water to the municipalities and the municipalities sell the water to the consumers. This system provides a platform in which public and private organizations meet on a long term and where knowledge is shared. This platform has an increasing effect on the innovation capacity in the Portuguese system of water use, because knowledge is shared and created by organizations / institutions from various fields.
The innovation policy shows that the system of water use is stimulated by the governmental organizations to innovate. This is done by the instrument of the National Research foundation. This foundation is set up by the governmental organizations and uses the public money to do research in public works. The relation between the KO's and IPO's show that stimulations for innovations projects are provided. For example, the stimulation for the network of

HYDRONET PT is an important analysis for this relation.

The relation between the IO's and WPO's is strongly based on the regulations and indicators, concerning the maintaining the water quality. There is a top-down approach maintained by the WPO's so that the insurance to reach the water quality standard. The focus on this relation is on solving problems in case the indicators for the water quality are not reached. The stimulation to innovate is not recognized in this relation.

Even though there is an innovation policy present that is applicable in the system of water use, a lot of IO's are not aware of this policy. The relation between IO's and IPO's shows that the stimulation of the government to innovate by the use of the innovation policy is not recognized by the implementing organizations within the Portuguese system of water use, even though they are present. This absence of information shows that interaction is not taking place between the IPO's and IO's this has a decreasing effect on the innovation capacity.

The relation between the WPO's and IPO's show the significant role of the innovation policy. The Prime Minister of Portugal is first and far most responsible for the innovation governance system. This means that the actors who are active in the national innovation system have to answer to the Prime Minister, concerning the indicators from the national innovation policies. The Technological plan focuses on three pillars, which all have its impact on the Portuguese system of water use. These pillars are: knowledge, technology and innovation. The water policy and the innovation policy show that there is no cooperation present between the two ministers when it concerns innovation. The Ministry of Environment and the Ministry of Innovation are not corresponding, by which the policies are not well connected.

Answer to sub question 3: How are innovations generated in the Portuguese system of water use?

At this moment the innovation within the system of water use arises mainly throughout the principal-agent relation. By this is meant that the innovation comes out of the request of the IO's, WPO's and IPO's to solve a problem within the system. Throughout this problem solving, knowledge is transferred and gathered, which is the foundation of increasing the innovation capacity. The innovations are used in times that there is a problem detected throughout the process of the system of water use. Even though the innovation is generated from the market needs, the IO's are letting know that innovation is needed and wanted. The governmental organizations are now at the stage of generating innovations. Portugal has taken big steps in establishing stable clusters in the system of water use. Portugal is now looking at ways on improving and innovate the established clusters in the system of water use, because of the complaints of the IO's and the EU standards that need to be complied to. The EU standards for the water quality and service coverage also makes innovation generate in the Portuguese system of water use. Portugal can be fined by the EU if they do not reach the set up standards / goals by 2010. Therefore, steps are taken to make drastic changes in the system of water use in order to comply with the EU regulations. These changes are established by creating new relations; so that various views and specializations are brought together in order to generate innovation. This is done by sharing and creating knowledge, by which the system of water use will be more effective en efficient. Without the interference of the EU, the need to improve would not be outstanding as it is now. By the pressure of the EU standards Portugal is in the process of creating space and a climate in which new ideas and knowledge is shared and put into practice. To put the ideas into practice financial aids are needed. Therefore, new funding has been established over the years by the Ministry of Science, specifically for innovation projects. Even with the changes made over the years, Portugal is still lacking in their system of water use. Hereby, more innovations need to be generated and Portugal needs to work faster in establishing those innovations, as stated by the European commission and acknowledged by the Portuguese government.

Answer to sub question 4: What are the drivers and barriers in the process of innovation?

In order to oversee this process in creating a suitable innovation climate for the first steps, resulting in the development of an innovation capacity within the system various drivers and

barriers are analyzed. These drivers and barriers are selected by the data that is collected in the previous chapters. The drivers are the elements that stimulate the innovation process and the barriers are the elements that try to stop or slow down the innovation process. The drivers and barriers that are outlined in paragraph 6.4 are the ones that the respondents mentioned to be as most important. Throughout the analysis of documents more drivers and barriers were recognized which are presented in a SWOT-analysis in appendix G.

The most important drivers in the innovation process are:
European funds, which provide national opportunities. The national economics is not exceeding at the moment, therefore the European aids are very important and useful for the innovation process. The innovation projects in Portugal are for the most part possible by the EU aids.
Tourism, encounters the need for certain standards of water quality. This need creates a push in the innovation process to comply with the water quality standards. The risk of losing the economics of tourism is not willing to be taken.
ADP is an organization that is a driver in the innovation process. This organization brings the national and local governmental levels on the regional level. Within this setting new relations are born and ideas are shared from various views. ADP is providing a setting in which interaction can take place, and as is stated in the theory of Lundvall, interaction is needed to transfer knowledge. By transferring knowledge, knowledge can be created, by which the innovation process is stimulated and innovation can take place.
International co operations The international relations are of importance for the innovation process. By seeing what other countries do in order to make their innovation status possible lesson can be drawn from that and used in their own country.
Public and private sector The involvement of the private organizations makes it happen that challenges in the Portuguese system of water use are analyzed by various parties. The knowledge that is shared and created is a boost for the innovativeness in the system of water use.

The most important barriers in the innovation process are:
Risk taking The Fear of losing the limited money that is available causes the government to not be willing to take risks for innovation projects. The innovation process concerns that of doing the innovation projects. Therefore, risks need to be taken.
Skills engineers The universities and the industry are not interwoven, which means that what students learn in college is not what is needed by the water industries. The skills that are needed focus on the improvement of the settled water systems. If the engineers do not have these skills improvements and innovations within the current water systems will not take place.
Top-down approach The bottom-up approach is necessary to get all the available knowledge in order to create innovation; this approach also makes the acceptance of a new innovative project greater amongst the involved parties.
Technological plan
The Technological plan has measurements to stimulate and develop the innovation status in the Portuguese system of water use, but there is still no formal innovation policy present. This means that there is a lack of a consistent and clear coordination for the innovation in the Portuguese system of water use.

Answer to sub question 5: How can the government influence the drivers and barriers?
The government is able to influence the drivers and barriers by the use of their governmental power. The governmental organizations have taken up the role of legislature, in which the task to make decisions, concerning the national objectives, strategies, functions and services and

translate them to legislation is most important. By using the governmental power, the stimulation for the creation of new networks on all the governmental levels can be achieved. Proceeding with the plans of the private organization into the public sector of water enables the knowledge transfer from various fields. The zero-risk policy of the government causes investments in high risk innovation projects to be impossible. The government is taking steps in providing funding for innovation projects. Even though there are no high risk projects, the first steps are taken to stimulate innovation in the nation and the system. As mentioned in chapter two and three, financial aids are important to make innovation projects possible. Without funding new ideas and improvements in the system of water use cannot be put into practice. The government in Portugal is not willing to spend a lot of money on innovation projects, because these projects have uncertain outcomes and have high risks factors. If the government want to have a great influence on this barrier, they need to change their view on funding high risk innovation projects. Small steps have already been taken in funding innovation projects. These innovation projects are not considered to be high risked, because the outcomes of the funded projects cannot be uncertain. By this is meant that certain results, which were planned at the beginning of the funded projects, need to be reached in order to have the right to the entire fund. By changing the funding for only the certain innovation projects into providing funding for innovation projects with uncertain outcomes, the innovation is stimulated and influenced by the government.

The government also has the ability to stimulate international co-operations. By organizing international conferences, like LESAM 2007 (which is a conference held in Portugal concerning innovation), knowledge is shared, lessons from other countries are learned and relations are developed. Organizing more international conferences, like LESAM, the awareness of innovation in Portugal will be higher. By creating this awareness of innovation and the participation of the governmental organizations, may stimulate the other organizations in the system of water use to be part of such a conference. Such a conference can lead to an international co-operation.

Another important element that the government can influence is the cooperation between the ministries. The Ministry of Environment and the Ministry of Science are showing a lack on coherency. Looking at the way the innovation policy is created it can be stated that there is no clear coordination, concerning national innovation, present. The Ministry of Science has included parts of various governmental policies into the Technological plan without the interference / co-operation of other ministries. This has led to a situation that governmental organizations in the system of water use are not even aware that there is an innovation policy present that they can use. Hereby, opportunities can be lost and the innovation possibilities, that the innovation policy makes possible, are not fully used. This is a pity, considering the fact that Portugal is now at the stage that they need to make drastic changes in their system of water use in order to comply with the EU standards, by which all measures need to be used. The government can influence this barrier by providing the information, concerning the innovation policy. Educating the organizations / institutions in the system of water use about the innovation policy, by which the government provides an overall view of the possibilities for innovation. Hereby, the risk of not using all the opportunities for innovation is turned into a driver to inform the organizations / institutions about innovation and stimulates them to be innovative.

7.2 The answer to the main question

The clusters, the relations and the interaction types within the conceptual model of the national innovation system are the sections for the determination of the innovation capacity in the Portuguese system of water use. In the introduction of this report it has been made clear that the Portuguese system of water use is in the stage of changing and developing an innovation capacity. The organizations / institutions in the system of water use are not speaking of an innovation capacity yet but there is a strong need for innovation. Therefore this research has described and analysed the elements that have effect on the innovation capacity

in the system of water use, by researching the innovation climate. The researched innovation climate provides insights in the current innovation process. The country specific elements of Portugal that influences the innovation capacity, is part of the conceptual model and is also analyzed. The indicators that determine and influence the innovation capacity in the Portuguese system of water use have been researched, described and analysed, based on the theoretical framework. In addition the answers of the sub questions make it possible to answer the main question:

What generates the increasing and decreasing factors of the innovation capacity in the Portuguese system of water use?

The innovation in the Portuguese system of water use is formed by the elements that construct the national innovation system and the governmental organizations. The innovation in the Portuguese system of water is, at this moment, based on international interference. The need to innovate is present and mainly pushed by the European Union, but the willingness to take the risks that come along with innovation is a step that the Portuguese governmental organizations has not taken yet. Therefore, the Portuguese system of water use is not speaking of an innovation capacity yet. At this moment, Portugal is still building a stable water system on national level. The water systems are present but the organization of these systems is going through a lot of changes. These changes are made, because the system of water use was divided into various municipalities, but the new EU standards for the water quality and service coverage made it necessary to create a national system, which is linked to all the implementing organizations. These EU standards result in the creation of a demand for innovation. The cultural aspect of Portugal influences the innovation process. The consensus culture focuses on the consensus reached to the objective point of what is wanted and needed. But reaching consensus about how to get to the objective is an ongoing and slow process. This has a negative influence on the development of the innovation capacity in the system of water use, because time is of the essence, considering the fact that Portugal can be fined by the EU if they do not reach the set up standards / goals by 2010. Even though, the innovation capacity is not present in the system of water use, the innovation process is taking place, slowly. In the innovation process, innovation is developed based on the creation of a demand. This demand is a result of the EU standards, which pushes the Portuguese system of water use in developing and creating new work methods in the system.

The developing and creation of innovation is taking place, currently. The knowledge organizations, like LNEC, are used by the governmental organizations to assist in the developing and creation of innovation. The Ministry of Environment makes use of the services of LNEC when new policies need to be created, existing policies need to be reviewed or when problems within the Portuguese system of water use need to be resolved. LNEC is able to provide the knowledge and professionals to review the assignments and make useful recommendation. The employees of LNEC and other knowledge organizations have the knowledge and specialization to develop and create the innovation. They are the ones who are used to address new items in the system of water ruse, by the assignments they get from the Ministry of Environment. Knowledge organizations, like LNEC, are aware of their position in the Portuguese system of water use and understand that they have an important position in the innovation process. They are in fact the carriers of the knowledge and they have the possibilities to decide to share knowledge, which can result in the development of innovation. This means that the knowledge organizations are also the carriers of innovation in the innovation process. The governmental organizations are than the enablers of innovation. The Ministry of Environment, the Ministry of Science and the municipalities are the ones who create the demand. Without their demand the KO's would not have the financial capacity to do the innovation projects. Also, the funding of the ministries enables the KNO's to do

unsolicited research for innovation projects. There is not a lot of unsolicited research taking place, considering the fact that the funding only provides financial aids for a part of the research, the KO's need to finance the other part. In the last years it has been noted that the KO's are making use of their possibilities in developing innovations, by participating in networks. These networks are on national and international level. International networks like IWA are well known by the KO's and they take part in this network, by sharing knowledge through the writing of papers for IWA, participating in conferences and construct new co-operations. The knowledge that is shared through such networks makes it happen that ideas are spread and that there is a climate where innovations can be born. Networks on national level, like Hydronet PT, show that the organizations / institutions in the system of water use understand the need to obtain knowledge. Not only is the awareness present but action is taken to comply with those need by establishing new networks. These elements indicate that the KO's have an increasing effect on the innovation capacity in the system of water use. Their specialization and input in the system of water use enables the sharing of knowledge and the creating of innovation in the innovation process.

The Technological plan is an instrument that is used to generate innovations on national level, as well for the Portuguese system of water use. The Technological plan is the national innovation policy created by the Ministry of Science, Technology and Higher Education. This policy provides possibilities to improve the national innovation system, by describing objectives and providing funding for innovation projects. Even though, the innovation policy provides clear cut objectives and funding for innovation projects, this policy does not have an increasing effect on the developing of the innovation capacity in the system of water use. The opportunities are present but the opportunities are not seized. The way in which the Technological plan is constructed damages the use of this policy. The innovation policy is constructed without cooperation between the WPO's and IPO's. The policies of the Ministry of Environment and the Ministry of Science are not adjusted to each other. Better yet the Technological plan is developed by reviewing elements of various policies without the interference / involvement of the other ministries. This means that the innovation policy is not designed specifically for one system and is not made applicable for the system of water use. This policy is not transparent and is not increasing for the innovation capacity in the system. The system of water use shows organizations within the clusters that are not aware of the innovation policy and the possibilities, which the government creates, concerning the funding of innovation projects. Without this awareness the idea will be remained that the innovation capacity is not stimulated by the governmental organizations. The separation does not end with the governmental organizations but goes further to the implementation organizations, which has a decreasing effect on the development of the innovation capacity. The strong separation between the IO's and the governmental policy organizations, concerning the policy making, makes it happen that there is a lack of adaption and acceptance of new policy. The policy is created on the national level and the implementation takes place on the operational level, by not interacting with each other the views on the current situation differs. The top-down approach that is maintained in the system of water use by the governmental policy organizations does not make the policy process effective for developing innovation. The bottom-up approach is necessary to get all the available knowledge in order to create innovation; this approach also makes the acceptance of a new policy and innovation projects greater amongst the involved organizations / institutions.

The municipalities in the Portuguese system of water use have been through a lot of changes in the last years. The introduction and implementing of the multi-municipal systems changed the organization of the municipalities. This system provides a network in which relations are obtained. Smaller municipalities get the chance to improve their system with the help of other municipalities. Such cooperation provides the opportunity to enlarge the system on a higher governmental level, the increasing of the knowledge stock and the increasing of the service

coverage. This new work method is increasing the development of the innovation capacity in the system of water use.

Based on the results of the analysis of the three sections, the main conclusion is that the innovation capacity in the Portuguese system of water use is low. By the low innovative class is meant that the innovation is taking place by small improvements in the systems. The Portuguese system of water use is taking small steps in improving their current system. The need to take the step into big improvements in the system is present by the new EU standards. The innovation capacity in Portugal is driven by the EU interference. The EU needs Portugal to comply with the EU guidelines concerning the water quality and service coverage. The gap between the EU average and the Portuguese status of the system of water use is so big that drastic changes need to be made. These changes need to be made in the clusters of the system of water use and in the process of the system of water use. Reviewing the organizations / institution of the clusters in the system of water use, it can be said that changes have been made, namely the multi municipal system and of course the willingness to include the private organizations in the public sector of water use. Even though these institutional changes have been made the Portuguese government is still working on these changes, because they are still not where they need to be. According to the EU the changes are not going as fast as it should be. The process of the system of water use has also been changing and applying new instruments to improve the system of water use in an effective and efficient matter. These changes are minimal, considering that the changes, within the innovation process, mean innovation projects by which knowledge can be transferred. These projects need to be funded and the government states that Portugal is one of the poorest EU countries, so there is not a lot of money available for the implementation of new projects, which can be innovative. Fear of losing the limited money that is available is very high and therefore the governmental organizations are not willing to take such risks.

7.3 Recommendations
The goal of this study is to create a comprehension in the innovation capacity the system of water use in Portugal. This goal provides the ability to give recommendations to the Netherlands and Portugal. In this paragraph the recommendations will be outlined.

7.3.1 Recommendations for Portugal
The recommendations that are made for Portugal are based on the problems that have been noted during this research. The recommendations can influence these problems based on what is found on the scientific theories, which are presented in chapter two the theoretical framework. The Portuguese system of water use is now in the process of developing an innovation capacity; therefore, these recommendations are made for the governmental organizations, as they have the dominating position and the dominating influence on the innovation climate in the system of water use. The recommendations are to be reconsidered within the innovation process of the Portuguese system of water use.

Awareness
By making sure that awareness and clarity is given within the system of water use a lot of organizations will know where they stand and where they can be headed to improve the innovation capacity with the help of the other organizations / institutions. Throughout the research it was noticeable that the respondents did not know that there is an innovation policy present that is applicable for the system of water use. By making sure that awareness and clarity is given within the system of water use a lot of organizations will know where they stand and where they can be headed to improve the innovation capacity with the help of other organizations / institutions. By having an organization that is responsible for creating awareness and clarity, an increasing effect on the innovation capacity in the system of water

use is stimulated, because now the organizations will know with whom they can share their knowledge and where they can gather the knowledge. As mentioned in chapter two, knowledge transfer is one of the key factors for innovation. In the theory of Gibbons et al. (1994) knowledge transfer is mentioned in all three types of Triple Helix. In this theory it has been made clear that knowledge transfer is an important factor in the innovation process. By creating the awareness amongst the organizations / institutions, knowledge transfer is stimulated, resulting in stimulating the innovation process

Transnational policy learning
The transition of knowledge and the learning process amongst the institutions in the system of water use is of great importance. Even more important is making sure that the policies concerning water and innovation have an overlap and that the ministers know what they are doing, so that the risk of doing the same work twice is avoided. Making use of a transnational policy learning the elements that are deled within the policy will be transferred. The focus will be for the most part on creating an overlap of the policies by the measurements and indicators. This means that the governmental organizations need to be more transparent towards each other and create a new interaction pattern. This pattern than focuses on the learning processes, which is an important factor in the innovation system, as is stated by Lundvall (1992) In his theory interaction and the learning processes take great part in the national innovation system.

Collaboration
Managing the system of water use by the interwoven management styles of business management, engineering management and information management makes the stimulation of the network relation more wanted. By the mixing of the management styles various views of the system of water use is needed in which new collaborations will be born. Stimulating the network / relation by the use of the interwoven management style shows that the mixture of various views creates more possibilities and advantages then using the one management style or view; better known as the synergy-effect. Also an important matter with this is the links of the needs of the market and the available engineers. The gap between the education and skills of the professionals and the current needs in the market can be overcome by managing the system of water use throughout various views. The theory of Gibbons (1994) makes clear that relations are a fundament factor for innovation. In these relations knowledge, from various views, is shared whereby a setting is created in which the innovation process can develop. This recommendation is based on the thought of this theory. Creating a setting in which various management styles are implemented, various views are shared and the innovation process is stimulated.

Responsibility
Having a clear-cut message to the organizations and leading persons who are responsible for the increasing of the innovation capacity in the system of water use creates the awareness by the organizations that the government is working on the innovation capacity in the system of water use. The term 'blaming and shaming' is appropriate with this. If the innovation capacity indeed increases the organization or leading figure that is responsible will get the props for it but if it goes wrong the responsible person will be asked to explain where it went wrong. Trust and openness is the key issue in this matter. By making the responsible organization / institution known in the system, trust in the system will be increased. The organizations / institutions know which actor they need to address, when it concerns innovation. According to the theory of Ekvall (1980) by developing this trust the organizations / institutions will be more open about their possibilities and skills. So trust leads to openness, according to his theory, by which this recommendation is made.

Risk taking
To stimulate the organizations in the system of water use in innovation, funding need to be

made available for the innovation projects. By taking the risks the government also takes chances to create incremental or fundamental innovations. With risks come chances. One of the dimensions in the theory of Ekvall (1980) is risk taking. According to his theory innovation also means: being willing to take risk and overcoming the uncertainty. This is an important dimension that is recommended to the Portuguese system of water use to change, in order to have a suitable innovation climate.

7.3.2 Recommendations for the Netherlands

The recommendations for the Netherlands throughout the Portuguese case are hard to make. In comparison with the Portuguese system of water use the Dutch system of water use is outstanding and an example that is followed by Portugal, in the institutional as the technical matters. Therefore, two recommendations are made. The first recommendation is based on a problem that the Portuguese system of water use is facing. This recommendation focuses on what should be kept in mind during the making of the innovation agenda. The second recommendation is based on a driver in the innovation process of the Portuguese system of water use. The second recommendation is creating innovation by demand, which takes place in the Portuguese system of water use and is not as common (any more) in the Netherlands.

Innovation agenda

As mentioned earlier the Dutch ministries have plans to create an innovation agenda that would stand for the long term. By making sure that the operational level of the system of water use are included by the making of the agenda the acceptance will be increased. Hereby the success factor of the innovation agenda also increases not only because of the acceptance but also regarding the approach of the agenda throughout various views. The learning process then start form the beginning, the various views brings the knowledge sharing to life. This lack of cooperation in the Portuguese system of water use has caused a lot of problems and a decreasing effect on the innovation capacity.

Creating innovation

In comparison with the Portuguese system of water use the Dutch system of water use is outstanding and an example that is followed by Portugal, in the institutional ass the technical matters. There could be said that the system of water use in the Netherland is one of the leading ones in the world. Innovation should not only arise from unsolicited research but creating a new demand on innovation is a new approach that should be followed by the Dutch government. By creating a new demand is not meant creating a new system of water use but is meant creating the demand on improving the current system of water use. By reviewing the possibilities of a more efficient and effective way of the process in the system of water use, new innovations can be put on the map. These innovations can be used to review the problems of for example water pollution.

7.3.3 Further research

This research has focused mainly on the direct element which has an effect on the national innovation system. These elements are researched and analysed on a profound matter. Due to the timetable other elements that also can influence the system of water use have not been brought to attention.

During the comparative research, a lot of difficulties were faced during the process of creating a conceptual model. This had everything to do with the huge differences in the status of the four countries. Comparing the Netherlands and Canada to the countries Portugal and South-Africa is, considering their different status in education and system of water use, very difficult. The research subject is very interesting and will be of more value when countries are compared within the same status range in education and system of water use. Therefore, I would like to advice DHV Netherlands to do further research on this matter but comparing countries in the same range.

The country specific elements of Portugal have been reviewed briefly. Looking at the context variable of the political status of the country and the way in which the political system work needs to be research further. The current status of the system of water use has an important link age with the political aspects of the country. This statement has been made clear with his research, but the reason why the political system has an influence on the system of water use is a matter that is interesting to research profoundly by DHV Netherlands.

Abbreviations

ADP	Águas de Portugal (Water of Portugal)
APA	Advance Prising Agreements
CAL	Comphania Águas Lisboa (Lisbon Water Company)
CCDR	Commissão de Coordenação e Desenvolvimento Regional (Commision and Co-ordenance of the Disenvolvement Regional)
DECO	Defesa do Consumidor (Defense for the Consumers)
DGAE	Direcção-Geral das Actividades Económicas (Direction-General for the Economical Activities)
EC	European Commission
EPAL	Empresa Portuguesa da Livres (Company of the Free Portuguese)
ERSA	European Congress of the Regional Science Association
EU	European Union
FEDER	European Fund for Regional Development
HYDRONET PT	Hydronet Portugal
INAG	Instituto Da Agua (Water Institute)
IWA	International Water Association
IO	Implementing Organization
IPO	Innovation Policy Organization
IRAR	Instituto Regulador de Águas e Resíduos (Institute of the Regulator of Water and Waste)
KO	Knowledge Organization
LNEC	Laboratório Nacional de Engenharia Civil (National Laboratory of Civil Engineering)
NIS	National Innovation System
OECD	Organization for Economic and Co-operation Development
PEAASAAR	Plano Estrategico de Água e de Saneamento de Águas Residuais (Strategic Water Plan for the Sanitation of Waste Water)
PERSU	Plano Estrategico de Resíduos Sólidos Urbanos (Strategic plan for Urban Solid Waste)
QUERCUS	Associação Nacional de Conservação da Natureza (National Association for the Conservation of the Nature)
RASARP	Relatório Anual do Sector de Águas e Resíduos em Portugal (Annual Report of the Water and Waste Sector)
R&D	Research & Development
SWOT	Strengths, Weaknesses, Opportunities and Threats
WPO	Water Policy Organization

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Appendix A

Table 2.1 Triple Helix

Characteristics	Triple Helix I	Triple Helix II	Triple Helix III
Network	Industry, university and government	Industry, university and a discussable role of the government	University, spin-off firms and tri-lateral initiatives
Innovation	On assignment / demand	Focused on technological innovation	Local innovation, made possible by own initiative.
Relation	Only within the set up boundaries of the assignment, focused on knowledge flows	The role of the industry has been increasing, the role of the controlling government decreases	The roles of the various parties are overflowing and interwoven
Policy	Policy based on the contract, which is set in a higher level and agreed on a lower level	Laissez-faire policy	None
Financing	By the contract, so for the work that is delivered	By the contract	Government is the financial supporter but the private sector is also a money shooter

Triple Helix I; consists of the three pillars industry, university and government, also mentioned to be institutions. Interaction and communication within the boundaries take place by contract offices, industrial liaison, and technology transfers. The interaction types make it possible for the strict boundaries between the three institutions to fade and cross over. The most important thing between the three spheres in this Triple Helix is the knowledge flow amongst them, which forms the reason for interaction. A well known factor within this Triple Helix is that initiatives and innovation are mostly suggested top-down and there is little space and encouragement for bottom up initiatives, because innovation comes true the assignments by contract.

Triple Helix II; consists of different kinds of communication possibilities (systems) and they consist of technological innovations, operations of markets and control at the interfaces. It is a dynamic network on its own. (Nelson & Winter 1982 en Leydesdorff 1997) New ways of communication exist and this happens in the case of patent legislation and of sustained technology transfer. (Loet Leydesdorff & Henry Etzkowitz 1998) The most important change, analyzing the agency by the innovativeness of a transformation of the relations, has been made on the industrial side. A well known factor within this Triple Helix is the role of the state and the participation of the institutes. The firms try to decrease the role of the state by applying the laissez-faire policy, in which the firms determine and act by their own economic laws. The governmental influences will be then kept by a minimum interference.

Triple Helix III; consists of assuming that the three different spheres perform their traditional functions and of the others. It is possible that a university is performing a quasi-governmental role by organizing local innovation. This is the result of the complex environment (relations) of the three spheres and the knowledge flows amongst the clusters. The three spheres are connected and overlapping each other and that increasingly elides the boundaries between them. Leydesdorff and Etzkowitz call it an "evaluation of new patterns of collaboration" (Loet Leydesdorff & Henry Etzkowitz 1998). An important factor for this helix is an innovative environment where all the institutes play their own role (university, spin-off firms, and tri-lateral initiatives). With this role they try to improve the economic developments and the strategic alliances amongst firms. The role of the government will be reduced to initiator and financial supporter instead of controller.

Appendix B
Question form
Introduction
- Students Erasmus University, master thesis public management
- Assignment DHV Netherlands
- Short description of the international comparative research innovation system in the water chain (four countries: Canada, Netherlands, Portugal and South-Africa)
- Indicate how long the interview will take and what topics will be discussed
- Ask the interviewed what is his / her function and how he / she is connected to the innovation system and / or water chain, how long he works there (what did he do before) / is the person member of a network association? And why>??

The organization
- What does the organization and where does it consists of?
- What is the vision and mission of the organization?
- Which parties are involved with this and what is their role? (Concerning policy, knowledge and innovation)
- What is the role of the organization in the national innovation system or water system? What is the added value of your organization to the innovative capacity of the water system? Are you able to explain it to me by giving me an example?
- What is the definition of to the water system according to your organization?
- Is the organization member of a platform? What kind of platforms and what is it functions and the meaning of this platform for the innovation capacity? What do you think is the most important platform for the innovation capacity in the water system? How come (example)? What is the role of the platform then?
- Can you draw your network of connections to give me an insight in your network? If it is possible can you be more specific and give me a good insight of the most important parties in your network concerning the innovation capacity?
- How are the relations between the organizations in this cluster/network? (Cooperation or are they depending on each other, how do they steer the cluster/network and what is the importance of trust?)

Innovation
- Does your organization prefer an innovation policy or not?
- What do you think of the present innovation and the innovation capacity of your organization and network? Is there any innovation at the moment? Are you positive or negative about the present innovations and how come?
- What explains the great innovativeness of the system of water use? Or what explains that the system of water use is falling behind concerning innovations compared to other sectors?
- What are the latest innovations (what kind of innovation? Product, process or system)? How have these innovations been achieved? Was it planned or by accident and what does this tell you and me about the innovation system?
- What are the threats for the future are there possibilities for innovations? Is the economy and the market open for new innovations or are they slowing it down?
- What is your organization going to do to stimulate innovations in your organization or network? To what are innovations the answer?

Case specific
- Can you give a clear and good representative example of a case in which innovation in the water system has taken place? I like to have an overview how the system works! (Describe the case, what were the significant parties, how was it funded?)
- What was the organizations role your own role in this innovation?
- What was driving the organization(s) to make sure this innovation was created?

Innovation policy and water policy
- What is the established water policy by the government? Has she also established an innovation policy?
- What is the result of that? Are these water and innovation policy stimulating or slowing down the innovations in the system of water use? Can you give me an example of that?
- Is this policy binding or are organizations free to do what they like as long as it stays between boundaries, concerning water and innovation?

Connections Knowledge organizations
- What role do communication / interaction play in the innovation system and the spread of innovations in the water chain?
- Is your organization member of a network in the national innovation system?
- Who is asking/demanding for new knowledge and how come? How does this knowledge demanding rise? What is your role in giving it to them and why are you able to produce it? Why is this type of knowledge or innovation produced?
- (Does your organization get commissions / assignments from the other institutions, if yes what type of commissions / assignments are they? [probeer vraagsturing duidelijk te krijgen: wie vraagt kennis, waarom, waarom wordt bepaalde kennis geproduceerd, hoe komen kennisvragen tot stand?]
- What type of research does your organization perform and which parties are involved (and how are they composed)?
- How does your organization interact with the other organizations in this system?

Connection Government
- Is there official contact with all the players in the network to influence the policy process? I mean departments, knowledge organizations and implementing organizations. Are there structures for this contact and how they organize these moments of contact?

Expectations and improvements (do's and don'ts)
- What could be done differently in the network in order to improve its innovative capacity? Who should do this?
- What should other organizations change in order to improve the functioning of the network?
- What changes should be made by your own organization in order to improve the functioning of the network?
- What expectations do you have concerning the innovation system and / or water chain and what part does your organization play in these expectation
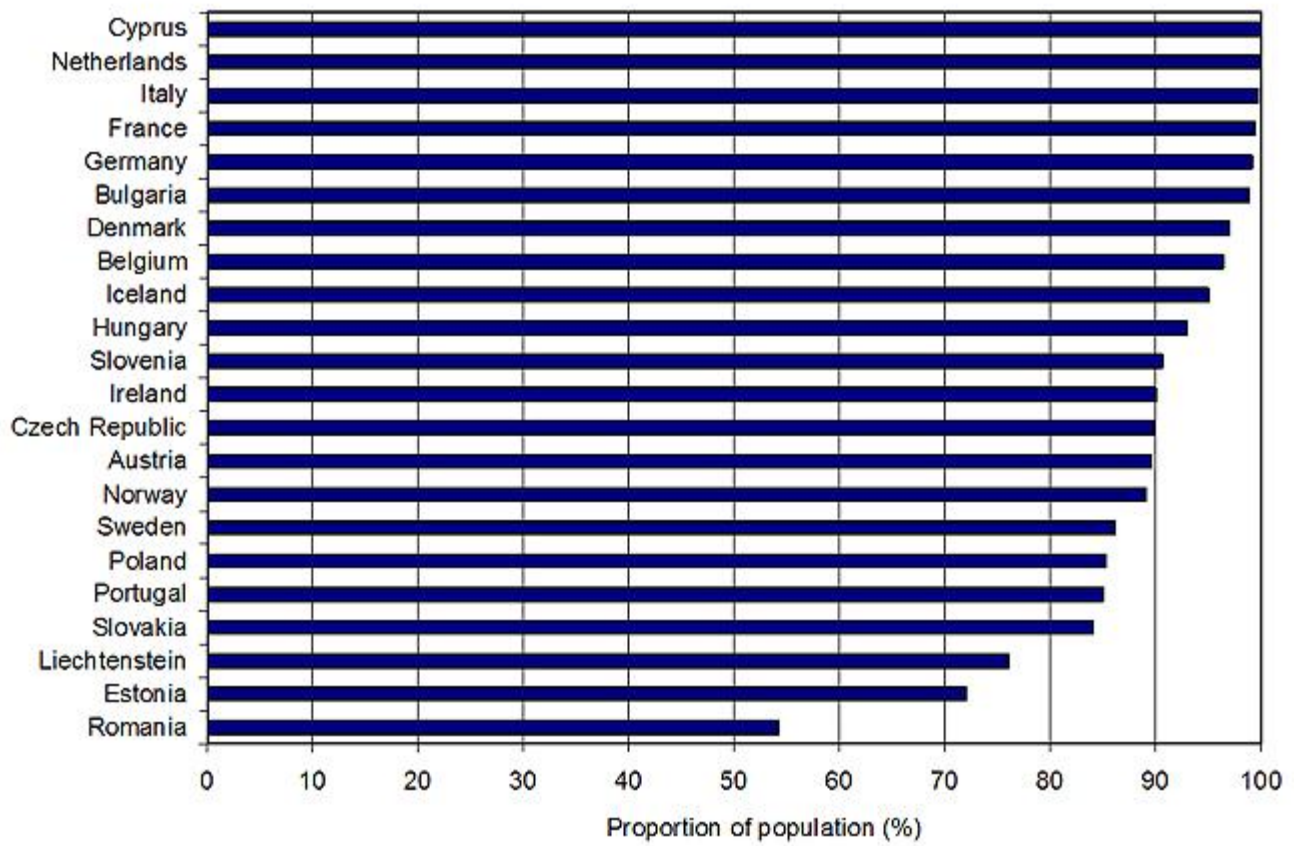
Appendix C

**Climate
in Portugal**

Typical regional
climates on the
mainland
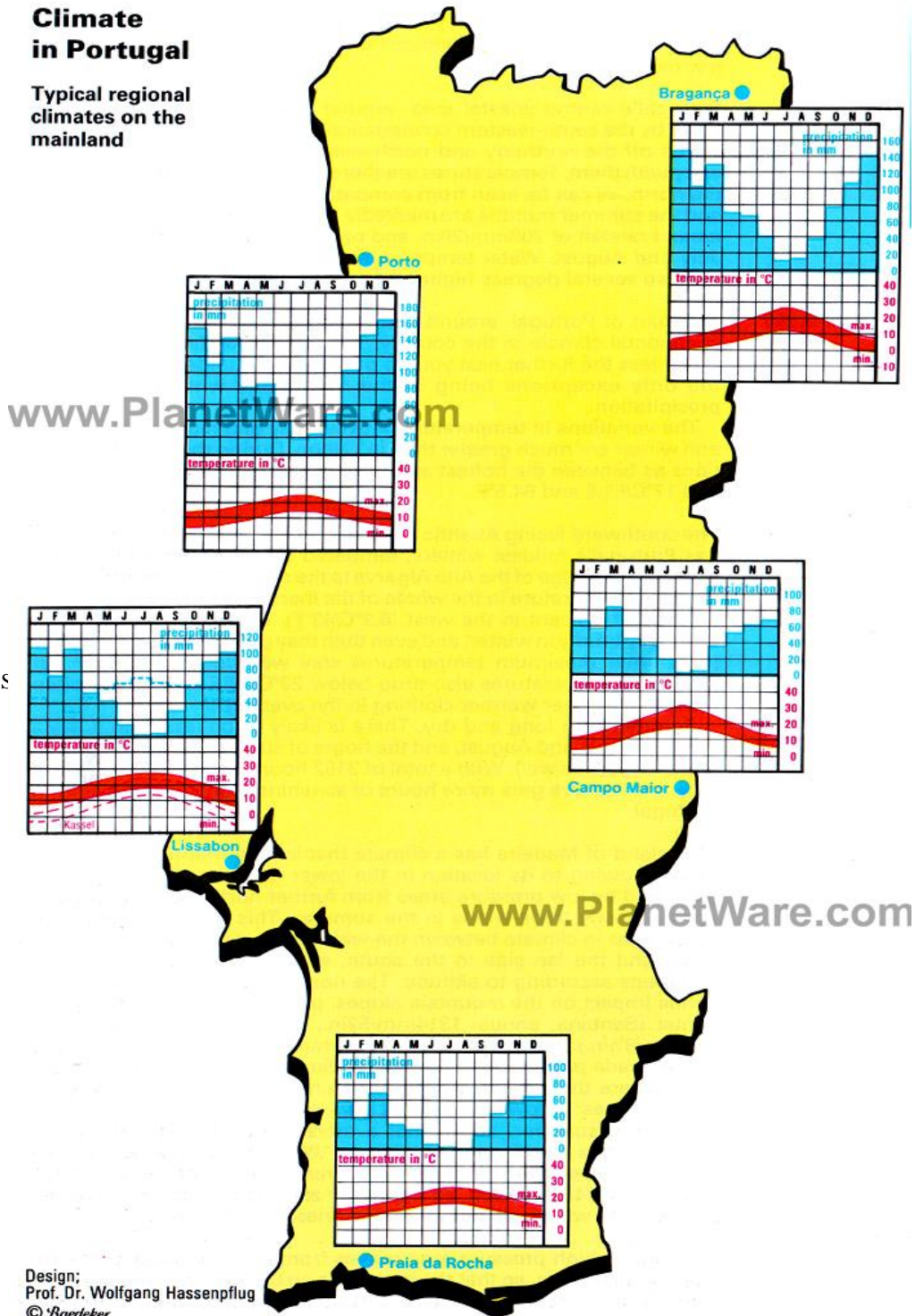
Design;
Prof. Dr. Wolfgang Hassenpflug
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Appendix D
Figure 1 Proportion of population connected to public water supply in Europe, 2002, or last available year

Appendix E

National Innovation Policy objectives

Objective	Quantitative Target (if set)	To be achieved By (year)
1. Population with tertiary education degree (as a percentage of the 25-64 age groups)	15%	2010
2. Population having completed secondary education (as a percentage of the 20-24 age group)	65%	2010
3. Population with a degree in S&T fields per thousand inhabitants (in the 20-29 age group)	12	2010
4. Researches as a share of employed population (per thousand)	5.3	2010
5. Percentage of families with broadband internet connection	50%	2010
6. Lifelong training	12.5%	2010
7. New S&T PhDs per thousand population (in the 25-34 age cohort)	0.45	2010
8. Scientific output per million population	609	2010
9. Full time equivalent people engaged in R&D activities (per thousand active population	7.5	2010
10. Full time equivalent researches (per thousand active population)	6.0	2010
11. Public R&D expenditures as a percentage of GDP	1.0%	2010
12. Business enterprise R&D expenditures as a percentage of GDP	0.8%	2010
13. Employment in medium hi-tech manufacturing (as a percentage of total employment)	4.7%	2010
14. Employment in hi-tech services (as a percentage of total employment)	1.8%	2010
15. Medium-high and High-tech manufacturing value added	6.2%	2010
16. High-tech services value added	6%	2010
17. High-tech product exports (as a percentage of total exports)	11.4%	2010
18. Firms created in medium-hi and high-tech industries (as a percentage of total number of firms created in the year)	12.5%	2010
19. EPO patents per million population	12	2010
20. Community trademarks per million population	50	2010
21. Venture capital investment as a percentage of GDP	0.15%	2010

Source: Annual Innovation Policy, 2006: 36

Appendix F

Measurements of the Technological plan

Key challenge	Measures responding to the challenge
1: Improving human resources capabilities, to enhance competitiveness in an increasingly globalised knowledge economy	PT 15 – Small Company Initiatives System (SIPIE) PT 16 – Company Modernization Incentive System (SIME) PT 22 – Integration of Doctors and Masters in Companies and Technology Centers PT 27 – PME Digital (Digital SME) PT 43 – Support to the Creation of New Technology Training and Quality Infrastructures (Technological Schools) PT 44 – Doctoral Grants in Companies PT 45- Training and Human Resources PT 52 – SIED - System of Incentives for the digital economy
2: Promoting systemic connections and cooperation among the NOS players	PT 23 – Mobilizing Projects for Technological Development PT 26 – Industrial Property Support Offices (GAPI) PT 33 – IDEIA Applied Research and Development in Companies PT 37 – DEMTEC Incentive System for Undertaking Pilot Projects Concerning Technologically Innovative Products and Processes PT 42 – SICE - Incentive System on Firm Cooperation PT 44 – Doctoral Grants In Companies PT 49 – Centers of Excellence - Development of Competence Centers in ICT. PT 50 – OTIC - Technology and Knowledge Transfer Offices
3: Improving business firms capabilities as well as their commitment to innovation and stimulating the emergence of new players	PT 4 – Tax Incentives for Company Investments in R&D (SIFIDE) PT 18 – Industrial Property Use Incentive System (SIUPI) PT 22 – Integration of Doctors and Masters in Companies and Technology Centers PT 27 – PME Digital (Digital SME) PT 30 – Programme GERRIR - Formation and Consultancy in the Public Sector for Small-sized Organizations PT 33 – IDEIA Applied Research and Development in Companies PT 34 – NEST New Technology Based Companies PT 35 – QUADROS Programme PT 36 – NITEC Incentive System for Creating R&D Nuclei in the Company Sector PT 37 – DEMTEC Incentive System for Undertaking Pilot Projects Concerning Technologically Innovative Products and Processes PT 51 – NEOTECT Initiative PT 52 – SIED - System of Incentives for the digital economy PT 53 – INOV_JOVEM PT 54* – SIME I&DT PT 55* – FINICIA

Source: Annual Innovation Policy, 2006: 36

Appendix G
SWOT-analysis of the National Innovation System
This analysis gives an overall view of how the Portuguese innovation system status is.

Strengths	Weaknesses
▪ The last ten years the government was willing to take risks and make steps to improve their country's innovation status by implementing and applying clear cut measurements. ▪ The national innovation system within the system of water use gets support from the European Union, both institutional and financial support. ▪ Portugal is aware of its capacity and knowledge building, in order to improve the innovation status. This is not only awareness but the institutions within the Portuguese system of water use take actions to improve their knowledge status, for example the training course of Hydronet PT. ▪ At the moment the Technological plan is embraced and supported by the Portuguese government. The EU can now see that the government is investing in the innovation status of the country. By the implementation of this plan there is a responsible countable who is in charge of the management and guiding of this plan (which is the Prime minister) ▪ The institutions within the Portuguese system of water use are aware of the need to interact; the sharing of knowledge creates synergy and decreases the change of doing the same work twice.	▪ Interaction amongst the players in the system of water use field is still very low, in order to develop innovation, knowledge transfer has to be made. ▪ The Technological plan has measurements to stimulate and develop the innovation status in the Portuguese system of water use, but there is still no formal innovation policy present. This means that there is a lack of a consistent and clear coordination for the innovation in the Portuguese system of water use. ▪ There is a lack of knowledge intensive institutions. ▪ The bottom-up approach is necessary to get all the available knowledge in order to create innovation; this approach also makes the acceptance of a new innovative project greater amongst the involved parties. This approach is not present within the Portuguese system of water use. ▪ The national and local view on the system of water use characterizes a great gap, bringing these two views together is still not reasonable. ▪ The universities and the industry are not interwoven, which means that what students learn in college is not what is needed by the water industries.
Opportunities	**Threats**
▪ The European legislation, "The Water Framework Law also sets out rules and imposes obligations for the use of water resources, in accordance with the principles of precaution and of promoting sustainable and efficient use of water resources." (www.mirandalawfirm.com, 10/06/2008) These rules are guidelines for the institutions in the Portuguese system of water use, so they know what is expected of them for a period of time. ▪ The measurements of the Technological Plan are set out for duration of three years, in which the involved institutions know what their goals are for that period of time and what should be reached by the end of this period. ▪ The European funds make it possible to develop and implement certain projects, which are too expensive for the Portuguese government to fund. ▪ International co operations can boost up the Portuguese innovation status, by seeing what other countries do in order to make their innovation status possible. Lessons can be drawn from that and used in their own country. ▪ A lot of water systems are already constructed, meaning that the first steps have already been taken. ▪ Tourism, people from abroad, has higher standards concerning the quality of water. The Portuguese government needs to respect these quality standards in order to keep tourism alive ▪ The willingness of the Ministry for Environment Increased involvement of non-governmental parties within they are used	▪ The gap between the EU average and the Portuguese innovation status can be too big to cross, so organizations / institutions within the system of water use can give up hope and demotivate them. ▪ The education and skills of the professionals in the system of water use, does not fit with the current situation. ▪ Portugal is one of the poorest EU countries, so there is not a lot of money available for the implementation of new projects, which can be innovative. Fear of losing the little money that is available is very high, causes the government to not be willing to take such risks. ▪ There is not one organization present that is in charge of the national water management. ▪ The political game is more important than the effectiveness of a new project. Especially around election times. ▪ The top-down approaches concerning the policy making and implementing is not the most effective way for the development of innovation. ▪ There are still a lot of old water systems present which are very locally orientated.

▪ ADP, the organization who is bringing the national and local perspectives together on a regional level.	