Industrial riverscapes and climate change in the Dutch delta area

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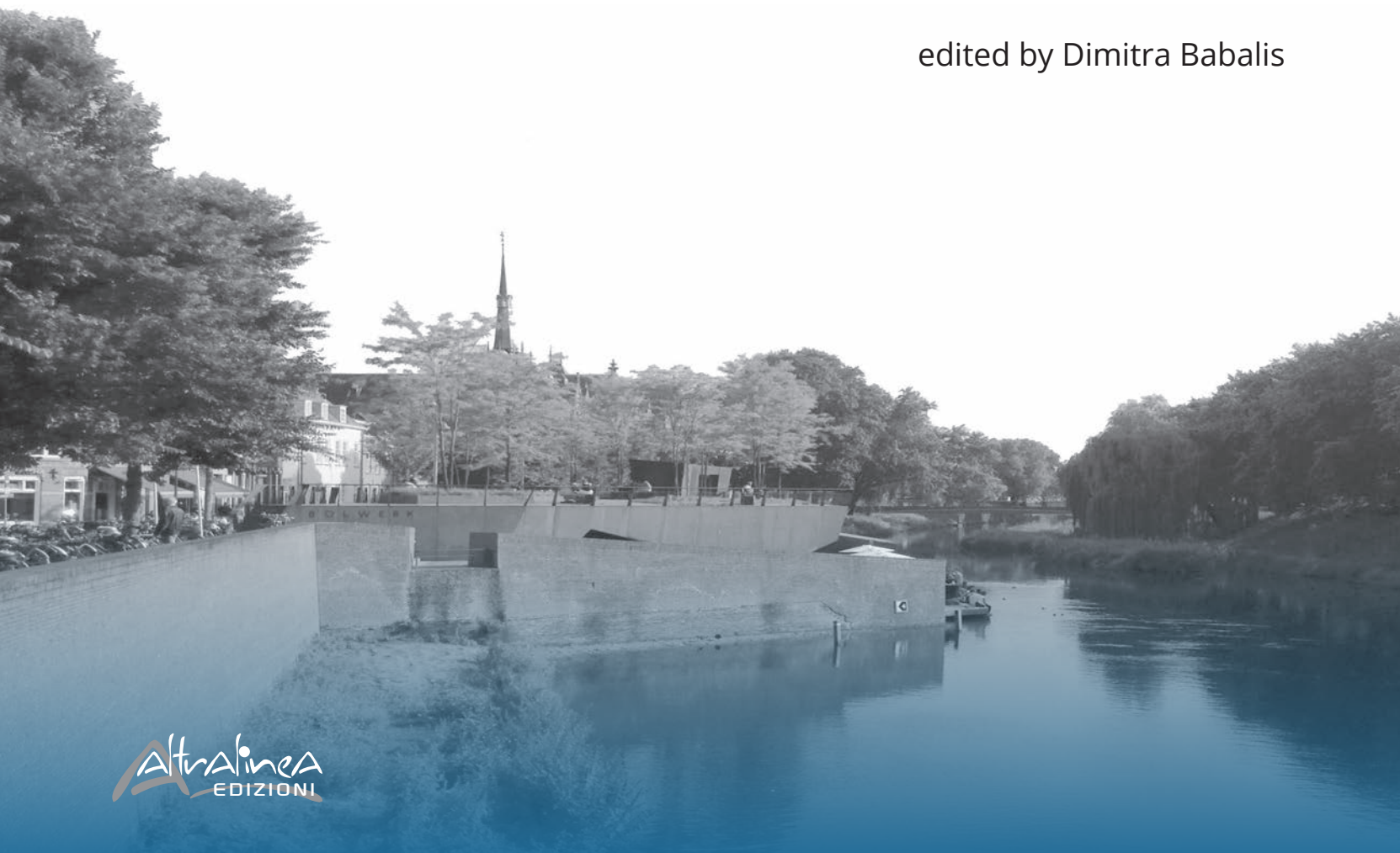
WATERFRONT URBAN SPACE

Designing for Blue-Green Places

edited by Dimitra Babalis



Altralinea EDIZIONI

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Cities, Design&Sustainability. The New Series / 2

This Series seeks to present some new concepts concerning current and future roles of cities in supporting sustainable communities. It will discuss the latest issues in planning, designing and building a better future, achieving sustainability through urban and architecture design. CITIES, DESIGN&SUSTAINABILITY. THE NEW SERIES attempts to understand better some factors and principles that condition a range of choices about future urban life. It will address new ways of managing cities and responding to current issues that are key to urban change. The making of real sustainable cities has to be considered as a cultural issue concerning the reconciliation between community living, urban environment and nature. Evolving themes on urban, architectural and climate change matters will be further explored in order to share insights and build a more integrative urban environment.

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CITIES, DESIGN AND SUSTAINABILITY. THE NEW SERIES

Volume I: The Integrative City. The Dynamics of Urban Space / 1
Dimitra Babalis (edited by) (2016)

Cities, Design and Sustainability. The New Series is a peer-reviewed Series. It cooperates with a qualified International Scientific Committee with high standards of advice that each member acts with competence and integrity in order to set out an excellent approach to the wider scientific research.
This Series includes special editions of INTEGRO UAD Annual Meetings, International Conferences and brings together all the fundamental scientific topics on eco-sustainable urban and architecture design from a comparative and advantageous international perspective.

CONTENTS

Industrial Riverscapes and Climate Change in the Dutch Delta Area. Ecological Resilient Strategies: Coping with the Future Noord River's Urban Waterfront

Irene Curulli

Water is everywhere in the urban milieu, from riverfront and seafronts to water supply. Moreover and throughout history, the relationship between city and water has changed considerably and the past has left a significant heritage to deal with. As a matter of fact, this relationship has shaped our approaches to designing the urban landscape.
With the increasing scarcity of this resource and in relationship to its extreme quantities, due to climate changes and the rising sea level, one should start considering whether it is high time to reflect on the cities-water-edge in a more strategic, integrative and inventive way, beyond the technical solutions and multiple techniques that are available nowadays.

Resilience thinking seems to be a necessary step to take in order to comprehend the profound human imprint on nature (i.e. water) and deal with the resulting challenges. 'Resilience thinking is about understanding and engaging with a changing world. By understanding how and why the system as a whole is changing, we are better placed to build a capacity to work with change, as opposed to being a victims of it.'[1]

The concept of resilience has many interpretations and it sounds a bit like another threatening popular word, namely 'sustainability'[2] . On the contrary, resilience can be considered a key concept for operationalizing sustainability. While sustainability is a set of socially derived goals based on its three pillars (environmental-ecological integrity, social well-being and economic feasibility), resilience is a conceptual and modelling framework that indicates the phenomena that facilitate or inhibit the achievement of normative sustainability goals.[3]
In general, the mainstream thoughts on sustainability revolves around the notion of 'efficiency' (maximum productivity with minimum waste of our resources or expense) that is definitely necessary but is not the solution when dealing with the continuous global changes and unexpected events, either natural or economic. This is 'because the more you optimize elements of a complex system of humans and nature for some specific goal, the more you diminish that system's resilience. A drive for an efficient optimal state outcome has the effect of making the total system more vulnerable to shocks and disturbances.'[4]
This might sound like a paradox, but if we borrow the terms diversity, redundancy, plasticity from the vocabulary of ecology, that has been an important source of thinking about resilience, the logic link between sustainability and ecological resilience, or better their complementarity, becomes more evident.
In fact, we should refer to the concept of resilience from the perspective of

[1] Walker, B., Salt, D. (2006). Resilient Thinking. Sustaining Ecosystems and People in a Changing World. Washington, Island Press, p.14.
[2] Pickett, S.T.A., McGrath, B., Cadenasso, M.L. & Felson, A. J., (2014). Ecological resilience and resilient cities. Building Research & Information, nr.42, vol.2, p.143.
[3] Ibidem, p.143.
[4] Walker et al., (2006), work cited, p.9.
[5] Pickett et al., (2014), work cited, p.146.
[6] Pickett et al., (2014), work cited, p.143.
[7] Pickett, et al., (2014), work cited p.146.
[8] NAP is the level between average high and low tides and it relates to the standard to which all water levels in the country are measured. The city centre of Amsterdam lies 2 meters above the NAP, while Schiphol airport lies 10 meters below, making it the world's lowest-lying airport.
[9] PBL (2012) Climate adaptation in the Dutch Delta; available at: http://www.pbl.nl/en/publications/2012/climate-adaptation-in-the-dutch-delta p.16, retrieved on March 20, 2013.
[10] Government of the Netherlands, National Water Plan 2016-2021. Available at: https://www.government.nl/documents/policy-notes/2015/12/14/national-water-plan-2016-2021; retrieved on September 03, 2016; p.9.
[11] PBL (2012) Climate adaptation in the Dutch Delta; available at: http://www.pbl.nl/en/publications/2012/climate-adaptation-in-the-dutch-delta p.1, retrieved on March 20, 2013.

The Dutch Delta area. Dots indicate the location of shipyards in the area.

contemporary ecological science that highlights the dynamism, historical contingency and multiple pathways of change within ecosystems.[5] Thus, ecological resilience includes continual or periodic evolution (or shifts of ecological systems) and it emphasizes the capacity of a site to adjust to external shocks and changes in controlling interactions[6] and continuing to develop.
Therefore, the equilibrium view (as the return to the same stable point or level after some disturbance, named engineering resilience and as in the more classical definition of resilience) is replaced by a more inclusive, non-equilibrium set of assumptions.[7]
Thus, the term expresses an open-ended nature of changes that is also the main characteristic of the urban system, making ecological resilience particularly appropriate in exploring urban-adaptive strategies.

Concerning the issue of urban riverfronts and water level rise, The Netherlands's relationship with water is unlike that of any other country in the world. Water has shaped the Dutch landscape, culture and lifestyle.
Moreover, in light of the climate change, resilience thinking is more than a strategic option for a climate-proof development of the country. We should remember that one third of the Dutch territory (26%) is actually below sea level (up to 7 meters), while another one third is very close to the official zero-measuring (NAP) level[8]. In terms of risk, 60% of the country is susceptible to flooding, either from the sea or from the rivers, and moreover new urbanisation is expected over the coming decades primarily in flood-sensitive areas.[9] Finally, the KNMI (Royal Netherlands Meteorological Institute) has provided a pessimistic forecast of the new climate scenario that will see more and heavier rainfall in the country, a 25-80 cm rise in sea levels by 2085, drier summers and more regional variations.[10]

Building 'unbreachable dikes' and managing new development in the Rhine-Meuse floodplain will make the Netherlands safer and more climate-resilient, according to the PBL Netherlands Environmental Assessment Agency[11]. Most probably this action will structurally reduce the flood risk in the country even though it is not enough.

In this chapter, I will discuss the current approaches to cope with water in the Dutch Delta area and I will show how strategies of ecological resilience, including industrial heritage, can highly contribute to providing a new scenario for living along the water.
I will start with a historical overview of the floods occurred in the Delta region, and then I will focus on the specific area along the Noord River, where large and historical shipyards characterise the riverfront. Two site-specific projects will be our case studies and their analysis will help to demonstrate the above-mentioned strategies of resilience. The paper will conclude with the evaluation of these strategies and it will highlight the need of a structured integration of (water) natural events when shaping the contemporary urban landscape.

The Dutch Delta area and a brief history of floods

The so-called Delta area is the large territory formed by the deposition of sediments carried by four European river basins that meet here and flow into the North Sea. They are: the Rhine, Meuse and Scheldt. There are several cross-border catchment areas and the land use and water management in the upstream countries Germany, Switzerland, Austria, Belgium, Luxembourg and France heavily influences the quantity and quality of the Dutch

national waters. As such, the flood risk management plans for the country are made of both of an international and national component. Moreover, on the estuaries of these rivers are located large cities as Rotterdam, Nijmegen, Dordrecht and many others.
Considering the division of the Dutch water system into three areas, namely sea dominated, river dominated and transitional areas, the Dutch Delta occupies the latter where both the sea and the rivers have influence on the water level of the rivers.[12]
The Dutch Delta area has been subject to river flooding over the centuries and in the future, flood risks are expected to increase further as sea levels rise, as consequence of higher temperature, and river discharges increase due to heavy rain or snow-melt upstream. Therefore, valuable land will be submerged and consequently it will raise the level of vulnerability of the country.
This vulnerability is illustrated by a rich flood history occurred in the area, from which we can recall three main flood events, respectively dated 1421, 1809 and 1953.

During the first flood, known as the St. Elizabeth's flood, severe storms broke the Zeeland dykes in several parts, causing the death of thousands people and profound changes into the landscape. Firstly, the Biesbosch, a large natural area that currently serves as a national park and as a large sweet water tidal area, resulted from this flood. Secondly, the flooding of the Groote Waard polder, located between two regions of the southwest of the country, reshaped the setting of the city of Dordrecht into an island. In the years following the storm, inhabitants were unable to reclaim the lost land and eventually most people left the area.

The period between the first and second flood was not without risks. In fact, between 1740 and 1860 the overflow of the rivers of the Delta area caused multiple and large floods due to the disposal of river silt on the flood plains, thus reducing their storing capacity. Risks increased also during the winter periods when the distribution of water among the rivers branches was fluctuating due to icing effects.

Between 19th and early 20th Century floods were part of everyday life. 'Each generation living in the Delta has experienced during its lifespan at least three to four major floods.'[13]

The second destructive flood in the history of the country occurred in 1809 and it was caused by the overflow of the Rhine and it led to enormous damage and numerous dike breaks.
Usually, river floods penetrated far inland because of the high water pressure on the dyke and the constant flow of water. Therefore in order to stabilize the water distribution, next to the obvious clearing of the winter bed, overflows areas were created. These were intentionally low dikes where the excess water could be diverted downstream. The land in such diversion channel (called green rivers) was kept empty and used only for grazing cattle. Results of these works were the Bergsche Maas, the Nieuwe Merwede and the Nieuwe Waterweg, realised in the 19th century, aiming at the optimization of river flows by allowing the rapid discharge of water.

The third extreme floods in the Dutch history took place in 1953. A combination of a high tide and a severe windstorm overwhelmed the sea defence structures on the North Sea coast: the dykes in Zeeland, West-Brabant and the islands of Zuid- Holland broke and 1800 people died, 72,000 lost their homes and 200,000 hectares of land was flooded, the damage to infrastructure was enormous.
To protect the Netherlands from such disastrous floods the Delta works were build some years later. In principle, all of the sea arms between the islands were dammed, while sea-and river dykes were strengthened: the goal was to shorten the Dutch coastline, thus reducing the number of dikes that had to be raised. However, some variations were applied to the rule, as for the well-known sea barrier of Oosterschelde that had some openings, which could be closed in emergency situations.

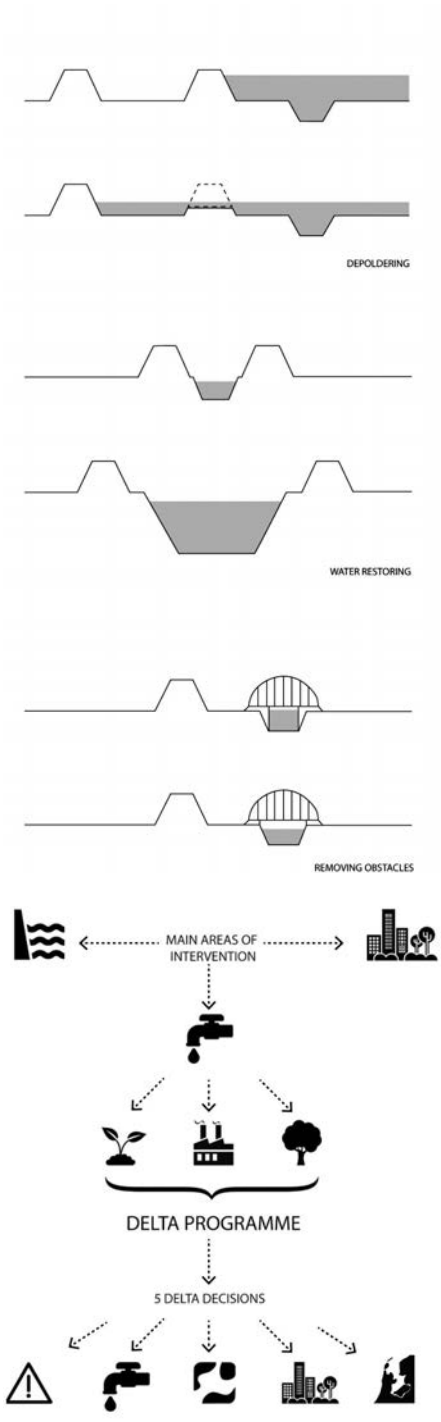
Water / Climate Adaptation Programs

More recently, flooding on the Rhine and Meuse rivers in 1993 and 1995 caused hundreds of thousands of people to

[12] Government of the Netherlands, National Water Plan 2016-2021. Available at: https://www.government.nl/documents/policy-notes/2015/12/14/national-water-plan-2016-2021; retrieved on September 03, 2016; p.4.
[13] Nienhuis, P. H., (2008). Environmental History of the Rhine-Meuse Delta: An ecological story on evolving human-environmental relations coping with climate change and sea-level rise. Dordrecht, Springer Science + Business Media B.V, p.252.
[14] UNESCO (2009).Water in the Netherlands: Case Studies in Europe and North America. Companion volume to the third edition of the World Water Development Report. Available at: http://webworld.unesco.org/water/wwap/wwdr/wwdr3/case_studies/pdf/Case_Studies_EuropeNorthAmerica.pdf#page=9; retrieved on May 23, 2015, p.57.
[15] PBL (2012) Climate adaptation in the Dutch Delta; available at: http://www.pbl.nl/sites/default/files/cms/publicaties/PBL-2012-Climate-Adaptation-in-the-Dutch-Delt-500193002.pdf p.5, retrieved on March 20, 2013.
[16] Deltacommissaris (2016).Deltaprogramme - Rijnmond-Drechtsteden, Advies Deltaprogrammema Rijnmond-Drechtsteden, Stuurgroep Rijn¬mond-Drechtsteden, available at: www.deltacommissaris.nl; retrieved on March 12, 2016.
[17] Government of the Netherlands, National Water Plan 2016-2021. Available at: https://www.government.nl/documents/policy-notes/2015/12/14/national-water-plan-2016-2021; retrieved on September 03, 2016; p.6.
[18] Beek (van) E. , Engel, H., Gooijer (de) G. C., (2009) Integrated water planning in the Netherlands. In UN World Water Development Report 3. Water in a changing world. Unesco Press p.245.

Room for the River: measures and techniques to create more available room for the rivers. Source: Adapted drawings from the official website of Room for the River.

The Delta Program: structure and strategic decision.



evacuate homes in low lying areas. Similarly, excessive rainfall in 1998, 2001 and 2002 caused problems in certain areas. These events served as a warning that future floods could have even more disastrous results due to their increasing frequency, magnitude and intensity combined with the very dense land use and population behind the embankments.[14] Such considerations led the government to take a new approach and make spatial planning an integral part of water management. Two significant results followed from this new approach: the program 'Room for the River' (2006) and the Delta Program (starting from 2012).

The first one, aims at increasing bed lateral spaces, which rivers can occupy when a flood occurs: a sort of 'comfort zone' for the river that also improves the quality of the immediate surroundings. By doing so, the space for water storage and the capacity to discharge it are implemented through a set of measures and techniques, such as: deepening the flood plains, dyke strengthening, dyke relocation, water re-storage, obstacles removal and de-poldering. The latter three methods are most applied in the case-study area of the Noord River. During the past years, all these measures have been applied in about 30 locations in the delta area and the program has been completed in 2016.

The second one, the Delta Program, is a national program involving the Dutch Government, provinces, water boards and municipalities. Social organizations, knowledge institutes and the business community are actively involved, as well.
The program resulted from the first report 'Roadmap to a Climate-Proof Netherlands' from the PBL Netherlands Environmental Assessment Agency, in 2009. That report set out the main challenges for adapting to climate change and indicated the types of policies needed to tackle these challenges. Therefore, the first Delta Programme focused on analysing the main national and regional bottlenecks with respect to safety against flooding and freshwater availability.[15]

It must be kept in mind that there is not a fixed way of dealing with flood problems but solutions must be able to work with new and changing scenarios. Therefore, flexibility and a variety of strategies, together with investment in spatial planning, natural environment and water safety, are considered to be key elements of the program.

The Delta Program[16] is drawn up every year and it is structured around three main issues: the setting of new flood protection standards that ensure freshwater for agriculture; industry and nature; and climate-proof/ water-robust spatial planning.
The practical interventions follow the strategies of the so-called "five decisions", which are:
• *Flood Risk Management*: it aims at protecting people and the economy, reducing flood probability and improving safety. It defines necessary standard heights of dykes, estimates the probability of flooding and the impact severity.
• *Freshwater strategy*: it aims at increasing the supplies of freshwater for specific regions of the Netherlands.
• *Spatial adaptation*: it aims at designing a climate-resilient environment considering potential impact of flooding.
• *Ijsselmeer Region*: it aims at installing water pumps before 2050 in the discharge sluices in the Afsluitdijk to discharge water into the Wadden Sea.
• *Rhine-Maas Delt*a: it concerns the flood risk management of the Delta area.

Nine sub-programmes, divided into three national and six regional parts, support the "five decisions". The national segments take care of safety, freshwater and new urban development; the regional ones regard the coast, Wadden region, rivers, Ijsselmeer, Rijnmond, Drechtsteden and the Southwest Delta.

In general terms and as specified in the National Waterplan 2016-2012, the national goal is to adopt a comprehensive approach by developing nature, shipping, agriculture, energy, housing, recreation, cultural heritage and the economy (including earning potential), as much as possible in conjunction with water tasking.[17] Moreover, The Netherlands makes use of scenario-based planning to help make decisions on water management options and country is preparing its fifth integrated water management plan[18], where the possible consequences of climate change are high on the agenda.

The challenges of the present: the Noord River waterfront

Located in the transitional region of the Delta Area, the Noord River is a tidal river between the cities of Dordrecht and Rotterdam. In the near future, the banks of the river will undergo to spatial adaptations according to the implementation of the measures required by the National Delta Program.

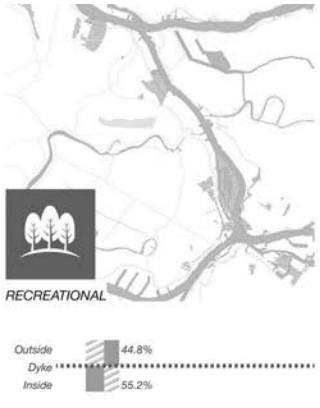
Ever since the 17th century, the region was known for the ship building industry. Thus, the river was a busy shipping route connecting the greater part of the inland water transport 'binnenvaart' (inland water route) of Europe to the harbors of Rotterdam. Due to the increase in demand for water transport, the outer dike areas along the riverbanks were purposefully used for water related industry; which used the river, with its tide, to their full advantage.

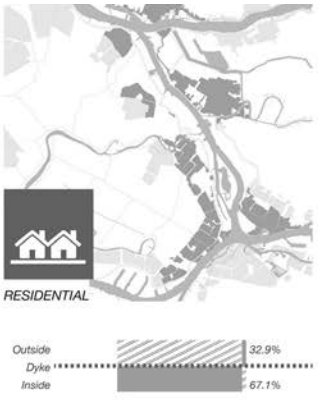
The former shipyards provided jobs for the residents of the adjacent villages and cities, determining their growth. In fact adjacent cities started to grow rapidly and provided the industry with an adequate level of employees. In turn, the amount of employees grew in order to fulfill the increasing demand of ship supplies. Moreover, close by villages grew rapidly and new ones were built. In short, the ever-increasing water related industry assured an economic impulse to the region and determined its rapid and large development.

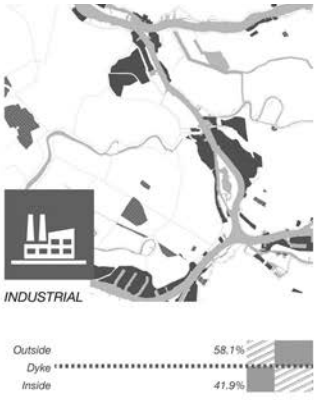
The Noord River is enclosed by two completely different types of land: the Alblasserwaard on the east side of the bank and the IJsselmonde, on the west. The first one, the Alblasserwaard, is a region that struggled through time with the water that entered the land. Land was not fertile enough to provide vegetables and meat for the inhabitants and people were directly dependent from trade, which was mainly carried on the river. Many of the inhabitants worked in the ship industry or in the related activities.
The second one, the IJsselmonde, has almost opposite characteristics from the Alblasserwaard. This region started relatively small and it grew as people poldered the land that was connected to the island. The soil was fertile, due to all the sludge of the river that covered the land, and fruits and vegetables were sold and transported with ships to other places, resulting in a large and thriving market. This region is still well known for the rich productivity of agriculture. Although the ship industry had minor presence on this side of the bank, it also had an impact on the architecture of the riverfront and in the economy of this region.
Nowadays, the difference between the two sides of the riverbanks is still noticeable.

Lastly, at a close distance from the Noord River is Kinderdijk, a small village where the polder system started in the 13th Century. Canals and 19 windmills, dating from 1500s, still exist in the area, which is an open-air museum and listed UNESCO Worlds Heritage Site in 1976.

As previously mentioned, the shipyards played a major role in the definition







Kinderdijk, Unesco World Heritage area.
(photo by I. Curulli)

Depth of the land, recreational areas and location of current shipyards and water-related industry.

OPPOSITE PAGE
The Noord River at the confluence with the Meuse and Rhine rivers.
View of some shipyards along the riverfront. Houses behind the dike.
(photos by I. Curulli)

Land use of the areas along the Noord River.

of the landscape along the riverbanks of the Noord. The Smit family was the main protagonist in the field (since the 17th Century) and four generations of it succeeded in the management of this large business that marked the Dutch shipbuilding history.
The shipyards dominated the skyline of the riverfront but also the activities inside the yards were heard far into their surroundings. Therefore, their scale, sound and smell jointly confirmed that the shipyards were clearly perceptible from afar. Visually, they took the role of churches in the villages, with a 'strange' orientation twist towards the water, which was essential for their existence.
The activities of these shipyards ranged from building new ships, their demolition or repair of existing ones. In the shipyards combined mobile activities (ships and related trade and traffic) and static-spatial elements (shipyards, docks, quays, warehouses, cranes, etc.) These two elements formed the characteristic maritime landscape of the Noord River banks, and which elements alternated with tidal nature and occasionally with residential areas.
Originally, the tidal nature areas along the Noord were man made in order to cultivate willows, as there was a high demand for their branches for numerous applications.

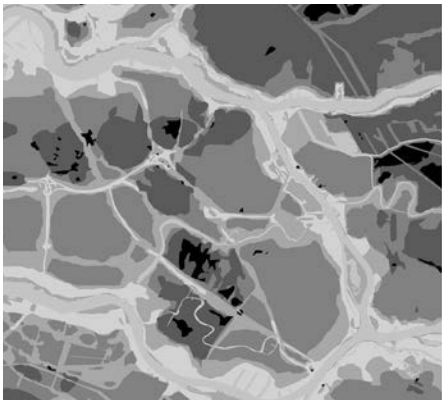
However, this maritime landscape was not only fascinating and making prosperous the region. Its downside was the self-seclusion from the inhabited areas due to the vast scale of the industrial structures and activities within the shipyards. Consequently the riverfront became a privatized area.

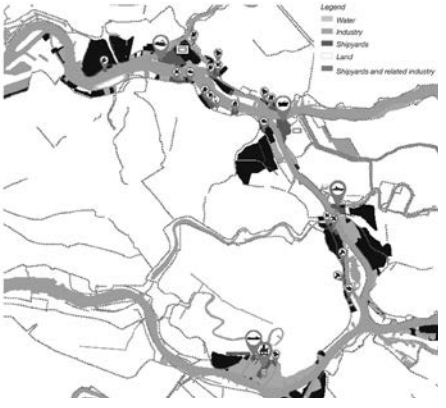
A landscape of events

Over the past 30 years the riverfront has undergone to large changes. Shipyards had to adapt to changing conditions and had to specialize to survive. The production of 'regular' vessels moved to competitors in low-wage countries as Asia, China and Vietnam. Nowadays, the current shipbuilding industry along river the Noord consists of companies that focus in niche markets and build custom-made vessels to the very specific needs of their clients.

The effect of this change is the abandonment of many shipyards and the consequent fading of the identity of the area.
Accordingly, the current landscape of the Noord River is dotted by many dismissed shipyards and is characterized by unique riverine wetland areas. In the near future, some dikes will be partially removed to receive the excess of water from the river, while offering opportunities for new and alternative developments. Therefore, the reuse of the shipyard areas has multiple roles: firstly, to connect the existing urban areas to the river, as they are now sitting back from it; secondly, to preserve the historical heritage values of the riverfront; and finally, to become stopovers of a cultural and naturalistic route that offers the experience of a unique riverfront Dutch landscape to local citizens and tourists that daily take the water route to reach their work or to visit the UNESCO site.

How to design this landscape of events along the Noord River? Which ecological resilient strategies should be adopted in the transformation of the riverfront?





Which new activities can be implemented so as to highlight the shipbuilding history of the area? What can we learn from the resilient characteristics of the riverfront?
These questions formed the basis for the elaboration of the landscape of events along the Noord River, carried out by the graduation design studio 'Resilient Architecture' at the Eindhoven University of Technology, in The Netherlands.
Based on the specific case on the Noord River and on the relevant ecological, engineering and social paradigms of resilience, 5 maxims were formulated:

- *Being durable and robust to withstand the threats over time*
- *Absorb and re-direct the energy of the threat into utility/benefit*
- *Being able to foresee and adapt to possible scenarios*
- *Redundancy in order to distribute the threat*
- *Social cooperation and awareness to deal with changing conditions.*

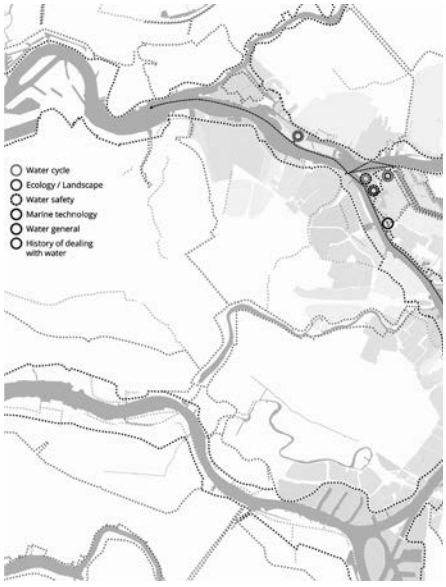
Each maxim represented a different strategy within the topic of resilience. The maxims served as design guidelines and were used to test design decisions during the entire design process. It was possible to simply follow one of the maxims or to incorporate several maxims in the design.
The two following projects tackle two of the main problems of the area, namely its fading shipping history and the disappearing of the delta/tidal nature. Therefore, the first project revolves around the transformation of a dismissed shipyard, one of the oldest, which stands on a strategic site that is destined to new development. The second one, focus on a tidal area that will partially disappear in the future, due to the removal of a section of an existing dike in order to create more space for the river to flow in.

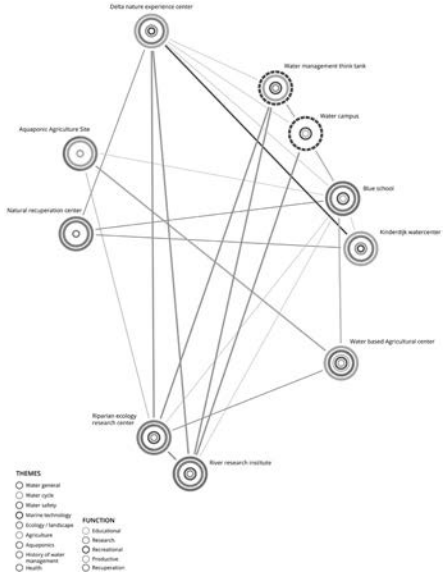
Both sites of design are outside the dyke area, thus open to possible flooding, and are not listed as heritage locations. However, they should be both considered cultural heritage that stand for the identity of the area and its historical value. They are expression of the development of shipyards industrial architecture and its relationship with the landscape that it impacted and from which both benefitted of.
These areas are still fairly inaccessible today and consequently they create a gap in the relationship between the existing cities/villages and the waterfront. Local inhabitants consider these areas as 'non-spaces'.

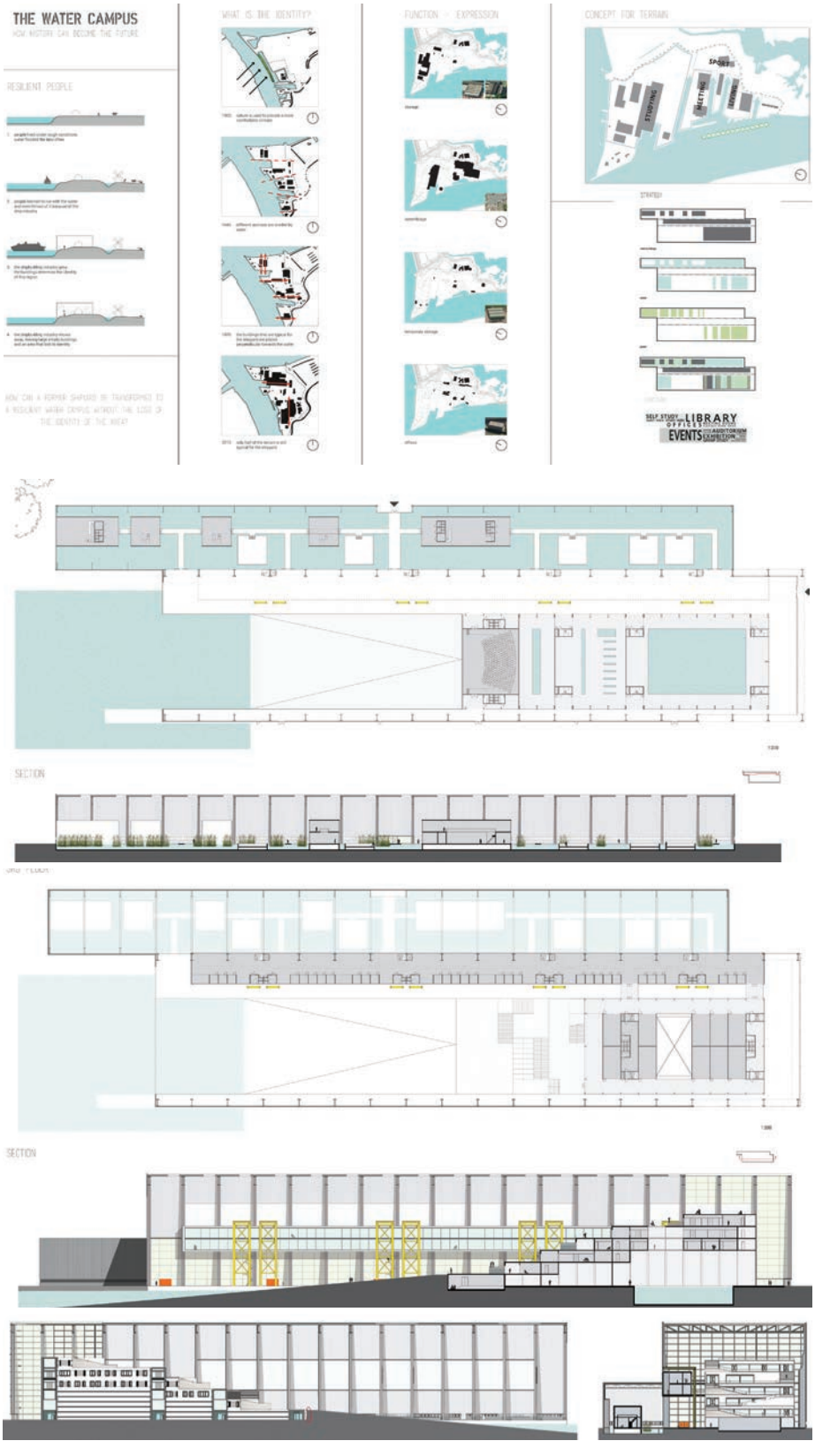
Aerial view of the IHC shipyard in Kinderdijk, dated 1964. The company belonged to the J&K Smit family.
(Source: http://www.willemsmithistorie.nl/images/Kinderdijkzondercentrale.jpg provided by the Historische Vereniging West-Alblasserwaard).

The cultural and naturalistic route and program of the different stopovers.

NEXT PAGE
Design proposal for the Water Campus, which reuses a former shipyard area along the Noord River. Design by Marije Kortekaas.







The core concept of the first project focuses on the transformation of the Royal IHC shipyard into a water- resilient university campus and it aims at establishing a relationship with the surrounding context by engaging its unique orientation towards the water, its impressive scale and unique architectural expression. The location, at the confluence of the three rivers (that afterwards widens up in the delta) is both a gateway to the Noord River but also a place at a close reach from the Unesco heritage site of Kinderdijk, expression of high level of water management in the history.
Moreover, the shipyard itself is a community of its own, as in the heydays of the shipyard there were more employees working at the shipyard, than people living in the village. Built in the early 1900s, the shipyard grew up from two buildings to a large set of ancillary structures occupying a very large riverfront area.
The design reuses the existing shipyard structures and serves both cultural and historical values for the entire region that will benefit of the new water campus-management purpose.

The uniqueness of the site location highlights also its vulnerability: water can easily flood it and wind can freely roam over, as buildings take the same direction of the wind.
And the design incorporates these natural elements into the architectural proposal. In fact, water does not only provide the future function of the campus, but its dynamics are key components of the design. River rising water enters into the buildings; it moves freely among the buildings and intertwines one with the other. In the slipway building, were is located the library, offices and the school, water enters freely into it. This building is the most impressive one for its size (50x200meters) and steel structure of columns and trusses: water makes the library a sort of reservoir, as it creates its floor and roof and plants filter the water for new use in the laboratories; water creates the atmosphere of the place, a sound in it and as a mirror, it reflects and dims the light. Moreover, water excess is collected in the school, into water storages located under the extended slipway and where laboratory experiments are conducted. The building encloses here the water. Outside, water creates a variegated tidal landscape

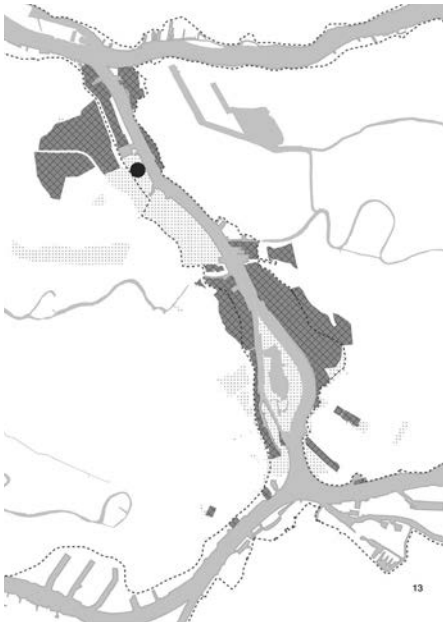
and many architectural tools make the students aware of the many possibilities of experiencing and using water. The water campus will provide space for students to experiment with water.
If the project might sound a triumph of water, it should not be underestimated how water serves as an instrument of mediation. Water helps to mediate the huge size of the shipyard and human scale and by considering water not as constraints and threatening element, water also contributes in creating a design of continuity between the old existing building and its unique structure with the new design, including the surrounding landscape. Symbiosis is than not only an ecological/nature term, but also it can be translated into an architectural fact, a pertinent reality.

Therefore, the ecological resilient strategy adopted in this project aims at *'absorbing and re-directing the energy of the threat into utility/benefit'* as stated in the third maxim of resilience. It is about resilience in the non-equilibrium context, which is able to adjust to changing, locally unstable conditions.[19] External disturbances, such as those that can result from storms and floods, and that can have major structuring effects, are integrated components of an architectural and landscape design and are part of the livelihood of the place and its surroundings.

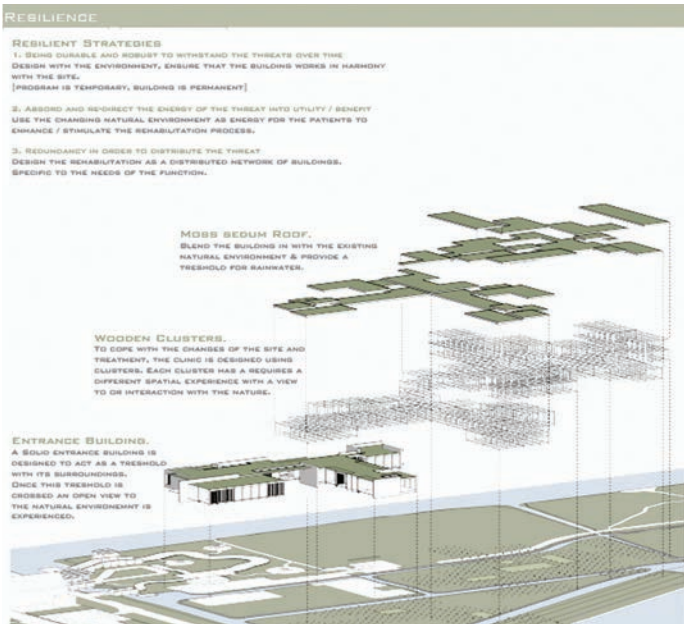
Similarly, these principles apply to the second project which context is very different from the previous one. In fact, the site is mainly formed by tidal nature, with water flowing in and out twice per day, and that is characterized by a rich biodiversity due to the changing water tide that develops scattered mud flats and salt marshes.
Compared to the past, these tidal nature areas are scarce nowadays along the Noord riverbanks. This is due to the diminished demand of willow plantations leading to the repurposing or abandonment of the previously cultivated areas.
Consequently, the riverbanks of the Noord River show a mixed and fragmented landscape composition where tidal natural areas alternate with (abandoned) maritime industry sites.
The design project takes advantage of this 'negative' condition by proposing a specialized health care facility where contact with nature and natural elements are key factors in the healing process. The project introduces a fresh impulse to the area, and while respecting the cultural heritage of the riverbanks, it fulfills an economical demand, which has a spatial attachment to the water and to the unique natural environment it creates along the riverbanks.
Conceived as scattered system of pavilions into the natural landscape, the design deals with the contingent and unpredictable, but challenging, future purposes. It is contemporary revision of the Dutch structuralism of Aldo van Eyck (Orphanage in Amsterdam, 1960) that strives for the creation of both a *home* and small *city*, paraphrasing Van Eyck statement on the architectural discipline.[20]
The modules form decentralized nodes or open clusters around courtyards that are not hierarchical spaces, but offer many moments of interaction with nature: each individual unit is then neighbored by its own outdoor space.
Within the tidal nature of the site, the health facility is a place to discover and the fluidity of connection among all spaces allows and ensures that the building works in harmony with the site. The design is a continuous place-making process that works *with* the environment ('being durable and robust to withstand the threats over time' as in the maxim 1). It uses the changing natural environment as energy for the patients to enhance / stimulate the recuperation process ('absorb and re-direct the energy of the threat into utility / benefits' as in the maxim 2). The design conceives the health facility center as a distributed network of buildings where parts can be replaced over time, according to locally changing needs ('redundancy in order to distribute the threat' as in the maxim 4).
This ecological resilience strategy originates from a deep understanding of natural processes, and while enhancing an alternative healthcare-therapeutic relationship, it creates a balanced environment where humans and nature are strongly coupled and are almost conceived as one social-ecological system. This makes the design proposal not a simply vision of a 'balanced' community, but it is also aware of 'direct effects of interactions'

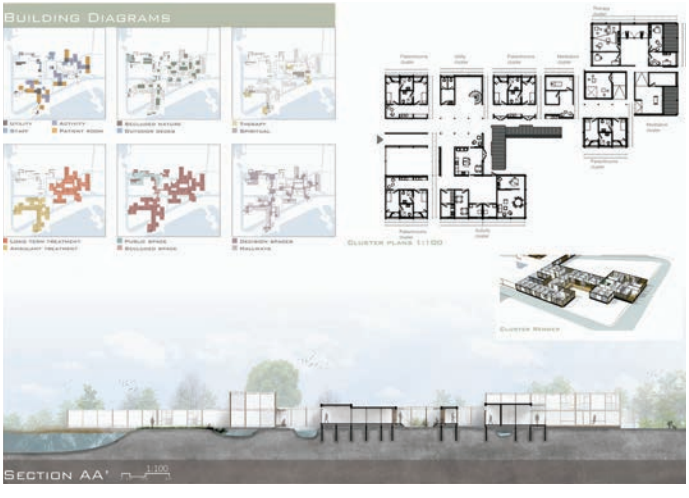
Diagram of the existing natural areas and industries along the Noord River.

[19] Pickett et al., (2014), work cited, p.147.
[20] Eyck, (van) A., (1962). Steps towards a configurative discipline. In Forum, August 1962, p.328.



Design proposal for the Health Care Center, located on a tidal landscape along the Noord River. Design by Remco van den Heuvel.





that take time to ramify through the system and drive its instability. Therefore this adopted design strategy is inclusive of those unexpected 'disruptions' that may destabilize an otherwise sustainable system. Accordingly, 'the ability to adjust to such shifting condition is the very essence of resilience, under the contemporary non-equilibrium paradigm.'[21]

Conclusion

Over the past few hundred years, the Dutch Delta has undergone continual change and adaptation, both in terms of demands made by the geographical system and demands and capacities of the society.
Although surrounded by many uncertainties, the expected changes in the climate make it necessary to reconsider the future spatial development of the Delta Area in combination with the expected economic and social developments and also to investigate how to reduce its vulnerability.

'Resilience thinking' seems to be a necessary step to take in order to deal with unexpected events, the stress caused by climate change and other aspects of global change. In fact, 'resilience thinking presents an approach to managing natural resources that embraces human and natural systems as complex systems continually adapting through cycles of change.'[22]
Thus, resilience approaches systems are to be regarded as complex, potentially adaptive and self-organizing. 'Resilience thinking' is not normative but a scientific tool, whose greatest value is to promote sustainability by allowing us to understand how systems adjust to radical and sudden change. Thus, resilience is complementary to sustainability.
Therefore, the basis for the achievement of sustainable goals and their active engagement lies in the identification of the mechanisms of resilience.

The abandoned industrial shipyards along the Noord River, expression of an historical industrial past and of an historical memory that is slowly fading away, offer an opportunity to safeguard their heritage value for the future; but also a chance to undertake resilient strategies to explore adaptive processes and contribute to achieving successful adaptive cycles that are suited to urban transformations.
The two open-end projects I have previously discussed show how the dynamics of water and living nature can be the creative sources that inform the design. Through ecological resilient approach it is possible to understand contingencies and overcome unexpected changes.
To put it simply, this teaches us that ecological resilient strategies must start from the basic idea that internal and external drivers of system structure and activities is a changing template to which successful systems must adjust. This is of critical importance considering future uncertainty and limited understanding of the vulnerability generated by human-induced change. It also means that the problem lies in the 'lack of recognition that ecosystems and social systems are dynamic and inextricably linked'.[23] which is the core matter of resilient thinking.

To conclude, ecological resilient strategies that nurture (water) adaptive transformations can act as a life support system and allow cities not only to survive in a harsh environment, but also to create productive and beautiful human habitats along riverfronts

Acknowledgements

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[21] *Pickett et al., (2014), work cited, p.147.*
[22] *Walker, (2006), work quoted, p.10 .*
[23] *Moberg F., Simonsen, S.H., (2014). What is resilience? An introduction to social-ecological research. Stockholm Resilience Centre, Stockholm University. p. 6. Available at: http://www.stockholmresilience.org/download/18.10119fc11455d3c557d6d21/1459560242299/SU_SRC_whatisresilience_sidaApril2014.pdf; retrieved on March10, 2016.*

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