DeltaSync 04

Floating City IJmeer

Accelerator for Delta Technology

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deltacompetition
2006

God created the earth - except for Holland
which was created by the Dutch.
Voltaire

TU Delft

DeltaSync 04

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ABSTRACT

Climate change, sea level rise, population growth and ongoing urbanization result in higher vulnerability of the Rhine delta because it will result in increased flooding frequency, increasing investments and increased use of water, energy and other resources. The Rhine Delta also faces strong competition from thriving economies such as China and India. After agriculture and industry, services are moving away to low cost countries as well. Conventional urbanization increases flood risk. This study presents a more self-supporting, non risk increasing concept of urbanization in the Almere-Amsterdam region, that will contribute to further economic and technological development of the Rhine Delta. This transition experiment aims to learn and build experience with non risk increasing modes of urbanization in order to contribute to the societal change to a sustainable Rhine delta. It uses local water and energy resources instead of external resources only. Moreover, its addition to housing capacity does not result in an equal addition to economic damage in case of flooding. The floating city is an accelerator for delta technology; it offers a testing ground for pilots of new water, energy and floating technology. It will enhance knowledge based activities in the Amsterdam-Almere region, a unique area with high economic potential. The testing ground in this region will attract knowledge intensive hi-tech companies as well as highly educated knowledge workers. The development of the floating city is combined with large scale wetland development in the IJmeer to create an ecological improvement. Moreover, Floating City IJmeer contributes to reducing regional mobility and housing problems and anticipates on an expected increased demand for water recreation. The transition management governance model is used to place the floating city in a broader perspective and offers guidance on turning this concept into reality.

1 INTRODUCTION

The Rhine Delta is of high economic and geographic importance; Europe's largest harbour Rotterdam and an economic engine of high importance, the Amsterdam-Almere area, are located in this delta. The IJsselmeer-Waddenzee area is a wetland of European importance for ecology. The Amsterdam-Almere area is selected as a specific case study because in this region, balancing economy, ecology, recreation, housing and mobility requires development of innovative delta concepts.

Water engineering made economic development of this once marshy delta possible, but also resulted in an area that is largely located below sea level. High investments and population density have made this area highly vulnerable to extreme flooding events with low probability (Graaf and Ven, submitted). Estimated damage in case of sea defense failure is 400 billion euros, an amount larger than the Dutch yearly available national budget (Ale, 2006).

Climate change, sea level rise, population growth and ongoing urbanization result in higher vulnerability of the Rhine delta because it will result in increased flooding frequency, increased investments and increased use of water, energy and other resources. These resources are extracted from increasingly remote areas. As a result dependence of external areas, including politically unstable areas, will increase. The Rhine Delta also faces strong competition from thriving economies such as China and India. After agriculture and industry, services are moving away to low cost countries as well. Making the switch to knowledge-intensive high value added economic activities is therefore of vital importance for the Rhine Delta.

Conventional urbanization increases flood risk. The aim of this study is to develop a more self supporting, non risk increasing concept of urbanization in the Almere Amsterdam region that will contribute to further economic and technological development in the Rhine Delta. In this paper we analyze national trends, developments in the Amsterdam region and technical innovations. We present a transition experiment of a more self-supporting floating city in the IJmeer. This transition experiment aims to learn and build experience with non risk increasing modes of urbanization in order to contribute to the societal change to a sustainable Rhine delta. The floating city is an accelerator for delta technology; it offers a testing ground for pilots of new technology.

Fig. 1 - Dutch areas below sea level (AHN)

2 SCIENTIFIC BACKGROUND

2.1 Sustainability

Since the publication of the UN report 'Our common future' of the Brundtland commission (WCED, 1987), sustainability is considered primarily in terms of continuing to improve human well being, whilst not undermining the natural resource base on which future generations will have to depend. There is no common agreement on the exact definition of sustainability. However, most approaches on sustainability mention balancing of interests between social, ecological and economical aspects. (Elkington, 2001; Rotmans, 2003; Butler, 2006)

2.2 Transitions to more sustainable urban areas

More sustainable urban areas means balancing economic developments (mobility), social developments (flood security, housing demand) and ecological developments. Urbanization that also uses local resources of water and energy and which results in no further increase of expected damage (risk times impact) in case of flooding, contributes to sustainability. However, changing to other modes of urbanization by system innovation is a long term process, impeded by long expected lifetime of urban infrastructure (Butler, 1997; Hiessl et al., 2001), high levels of invested capital, high levels of uncertainty and institutional problems (Czemiel and Hyvonen, 2002). One of the main institutional problems is the number of institutions that are involved in urban development.

Future developments in the Rhine Delta, such as climate change and economic, technological and demographical developments, are characterized by wide margins of uncertainty, creating fundamental problems for policy makers and water managers. Decisions are made without knowing the exact consequences or knowing future societal demands. A management approach to deal with complex problems under conditions of high uncertainty is transition management (Rotmans, 2003), which is aimed at realization of societal transformations to increase sustainability. A transition is a structural change in the way a societal system operates, and as such a long-term process (25-50 years) (Rotmans, 2003).

Transition management thus is a governance model for long-term policies, since transitions typically take a generation or more to unfold. It starts from the recognition that for these highly complex and uncertain problems, blueprint solutions are impossible to develop on beforehand. Therefore, experimenting and learning-by-doing are crucial. Executing transition experiments is about learning new modes of urbanization (system innovation) rather than optimizing existing infrastructure. The information and experience gained by these experiments are used to improve other experiments, knowledge and skills until there is enough know-how and preparedness to transform current urban structure.

3 ANALYSIS

For a successful transition, the condition is that developments on macro, meso and micro scale have an enhancing effect on each other (Rotmans, 2003). Therefore, developments on three levels will be evaluated. National developments on macro scale, regional developments on meso scale and technical innovations on micro scale. Based on a workshop meeting with all Deltasync teams, we selected trends that are particularly important for the Rhine Delta.

3.1 Macro level

Demographic developments

Population growth will probably continue until 2035 and stabilize just below 18 million inhabitants (CBS, 2006). Slow population decrease will start around 2040 according to the average scenario. Moreover, the number of inhabitants per house will also decrease from 2.31 now to 2.17 in 2020. (CBS, 2006) This will cause continued growing of housing demand in the Netherlands for the coming decades. In the Dutch urban delta, the expected rise in households will be much higher than the average Dutch level. As a result, housing demand in this area will be very high.

Another important demographic development is aging of the Dutch population. The percentage of people of 65 years and older will rise from 14.4% to around 20% in 2025 (CBS, 2006). The worker-pensioner ratio currently is 4 to 1. However, in 2040 this will have increased to 2.5 to 1. As a result the financial burden for the working part of the population will increase. Innovation and development of the knowledge economy will be important to sustain the social system by increasing competitive capacity of the economy and production efficiency.

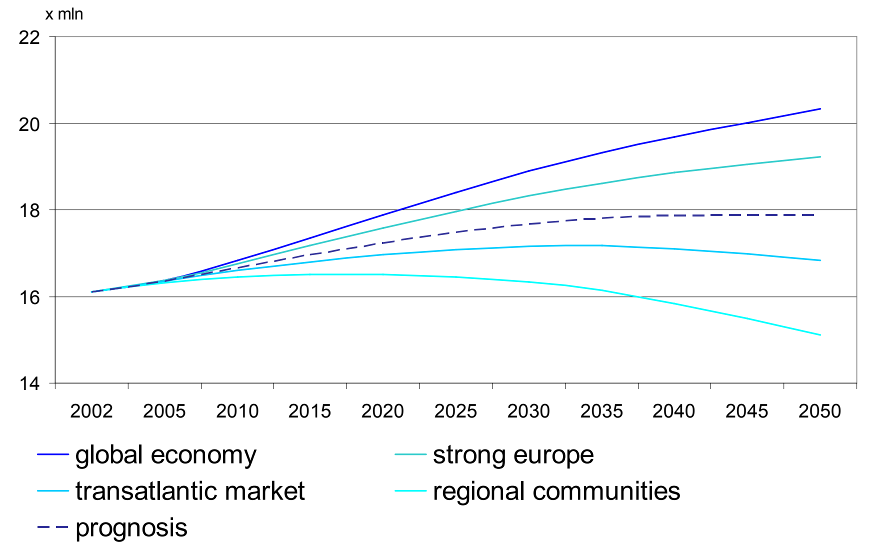

Fig. 2 – Long term population growth according to various scenarios (Jong, 2004)

Climate change

Climate projections in Table 1 (KNMI, 2006) indicate that in the Netherlands more rainfall can be expected in winter whereas the summers become drier. Droughts will occur more frequently and the variation of water resources increases. The expected summer discharge of the Rhine will decrease with 10% in an average climate scenario and even 60% in a dry scenario (NMP, 2005). Another effect of climate change is sea level rise, this effect combined with land subsidence and lower river discharge in summer can result in problems with salinity and increases flooding frequency. Consequently, water intake from rivers in delta areas becomes more difficult, the chance of water shortage increases. The frequency, at which years with very high salinity in the delta (like 1976) occur, increases with 80% in an average climate scenario (RIZA, 2005). Overall, creating space for water storage will be increasingly important as well as developing building technology that contributes to reduced flooding vulnerability.

2050		G	G+	W	W+
Global temperature rise		+1°C	+1°C	+2°C	+2°C
Change air circulation pattern in Western Europe		no	yes	no	yes
Winter	Average temperature	+0,9°C	+1,1°C	+1,8°C	+2,3°C
	Average precipitation amount	4%	7%	7%	14%
	10 days precipitation sum with expected exceeding frequency of once in 10 years	4%	6%	8%	12%
	Highest daily average wind velocity per year	0%	2%	-1%	4%
Summer	Average temperature	+0,9°C	+1,4°C	+1,7°C	+2,8°C
	Average precipitation amount	3%	-10%	6%	-19%
	10 days precipitation sum with expected exceeding frequency of once in 10 years	13%	5%	27%	10%
	Potential Evaporation	3%	8%	7%	15%
Sea level	Absolute increase	15-25 cm	15-25 cm	20-35 cm	20-35 cm

Table 1 - Climate scenarios for the Netherlands (KNMI, 2006)

Knowledge based economy

After agriculture and manufacturing, services are also being 'outsourced' to low cost countries such as India and China. In the IT sector, for instance, outsourcing is expected to grow 44% this year (Ernst&Young, 2006). As set out in the Lisbon strategy in 2000, the European Union should focus its efforts in the realms of science, technology and sustainability to create growth and jobs. Europe seems to be experiencing a brain drain however, as there is a net migration of people with a tertiary education to the US (EC, 2003).

A renewed effort is required to reach the Lisbon-strategy goals (EC, 2006), either by means of funding or by projects. The Amsterdam-Almere region includes two universities, several research institutes and numerous high-tech companies, making it an area of interest for Dutch efforts in reaching these goals. At this moment, however, the Amsterdam area is rated at place 11 in Europe for public and private R&D investments as percentage of Gross Regional Product (Regio Randstad, 2005). In addition, to make the step from science and knowledge towards economic impacts, applying science in practice is necessary. Starting small scale transition experiments where all kinds of innovative technologies can be applied, tested and further developed will enhance knowledge based activities in this region. This testing ground will attract knowledge intensive hi-tech companies as well as highly educated knowledge workers.

3.2 Meso level

Development of recreation and tourism

Both Amsterdam and Almere are expanding towards the IJmeer. Population increase in the region will result in additional pressure on existing recreational locations and a demand for new ones. This is not necessarily a negative influence on local ecology, according to a collective of nine interest groups (both governmental and non-governmental) combined (Stuurgroep Verkenning IJmeer, 2005), because it can be combined with ecological enrichment. Additionally, recreational activities with a low environmental impact (like sailing) can be stimulated by building additional facilities in the region.

Development of the Amsterdam-Almere area

The IJmeer region is part of the Dutch ecological main structure, and plays an important role in bird migration in Europe. 'Stuurgroep Verkenning IJmeer', has ascertained that the ecosystem in the region has been rapidly declining since the early nineties, and that *not* intervening will result in a continuation of this process.

On the other hand, the city of Almere is continuing to grow, and next to the added pressure of housing projects, the increase in population requires additional recreational functions in the area.

However, these two demands are not necessarily mutually exclusive. A balance needs to be found between ecological preservation demands and housing needs. Urban and recreational developments in the IJmeer combined with large scale nature development can strengthen both economic and ecological values in this region. (Stuurgroep Verkenning IJmeer, 2005).

The presence of Schiphol - one of Europe's main air hubs, the Netherlands' second largest seaport and a prestigious business district on the Zuidas makes the so-called Randstad 'Noordvleugel' an economic centre of national importance. At this moment, the Amsterdam region is listed in the top-5 favourite places to locate a business in Europe. (Regio Randstad, 2005). To continue growth and attract more expat knowledge workers, the Zuidas business district would also benefit from additional high quality housing. Its unique location and innovative nature will make the floating city a growth catalyst in the region.

The VROM council and the V&W council argue that for continued growth of Amsterdam and Almere, these main cities in the Noordvleugel should be developed not separately but as a conjoined urban area, a twin city. The opportunities for housing growth in Amsterdam are limited, whereas Almere can still expand to the west. (VROM/V&W, 2006).

Demand for housing

The estimated shortage of houses in the Amsterdam Almere area was 65.700 in 2002 (Vermazen, 2002). Building locations in the direct vicinity of Amsterdam are necessary to reach the ambitious targets set by the municipal board of Amsterdam. In the period to 2010, 20.000 new houses will have to be built in the Amsterdam Area. According to the head of the Housing Corporations in Amsterdam, new building sites are essential to reach those targets. (Peijs, 2006)
Because of its location between the two large cities, the IJmeer is an area of interest in this matter. With IJburg, Amsterdam has already created a new housing project in the area, and Almere is soon to follow with Almere Pampus and Almere Poort along the IJmeer's rim (Fig. 3).

Fig. 3 - Urban development of Amsterdam and Almere (Stuurgroep, 2006)

Demand for infrastructure

The economic damage caused by traffic congestion in the Netherlands is estimated to be €650 million in 2006, most of which originates from urban beltways and main traffic axes (RWS-AVV, 2004).
According to Rijkswaterstaat, the province of Flevoland has the longest living-working distances in the Netherlands and that performance of the A6 connection between Almere and Amsterdam is among the lowest (Rijkswaterstaat, 2005).

The ministry of Economic Affairs considers motor vehicle accessibility in the Randstad's North Wing to be of national priority (EZ, 2006). A preliminary study published by the ROA (Regional Body of Amsterdam) in April of 2006 suggests an improved public transportation connection between Almere and Amsterdam is a necessity for continued development of the region. It also suggests an additional road connection over the IJmeer, while not strictly necessary, will improve current traffic conditions in the region (ROA, 2006).

3.3 Micro level

Small scale transition experiments can contribute in achieving sustainable development and can stimulate the development of a knowledge based economy. In this paragraph some innovative technologies with particular opportunities for Dutch delta technology are further elaborated.

Floating structure technology

Current floating homes are constructed using concrete pontoons as a basis, due to inherent stability, low cost, no required maintenance (Hendriks, 1999) and the ability to use the pontoon itself as a living space (Aqua Struenda, 2004).

With a few adaptations this technology should be able to provide a basis for an entire city. To this end either large quantities of pontoons need to be prefabricated, or fewer, larger elements in a dry-dock near the site (specially constructed for this purpose). It's possible to create elements up to 150 meters long and wide in this fashion (Kuijper, 2006).

Joining elements brings the added benefit of a fail-safe mechanism to the structure, because even if an accident causes one element to lose buoyancy, its neighbours can still distribute its load. Larger elements can benefit from this fail-safe mechanism by internal compartmentalization. The resulting compartments can be utilized, for example as storage rooms, parking garages or building engineering spaces.

A recent alternative to this technology is the combined use of EP-foam and concrete. EP-foam can be moulded into complex shapes, and by shaping these in such a way that concrete can be poured into the openings between the blocks, the result is an unsinkable float with a concrete framework (Rijcken, 2003). The flexibility of this system allows for creation of complex, organically shaped floats, making it possible to create more natural settings within the floating city.

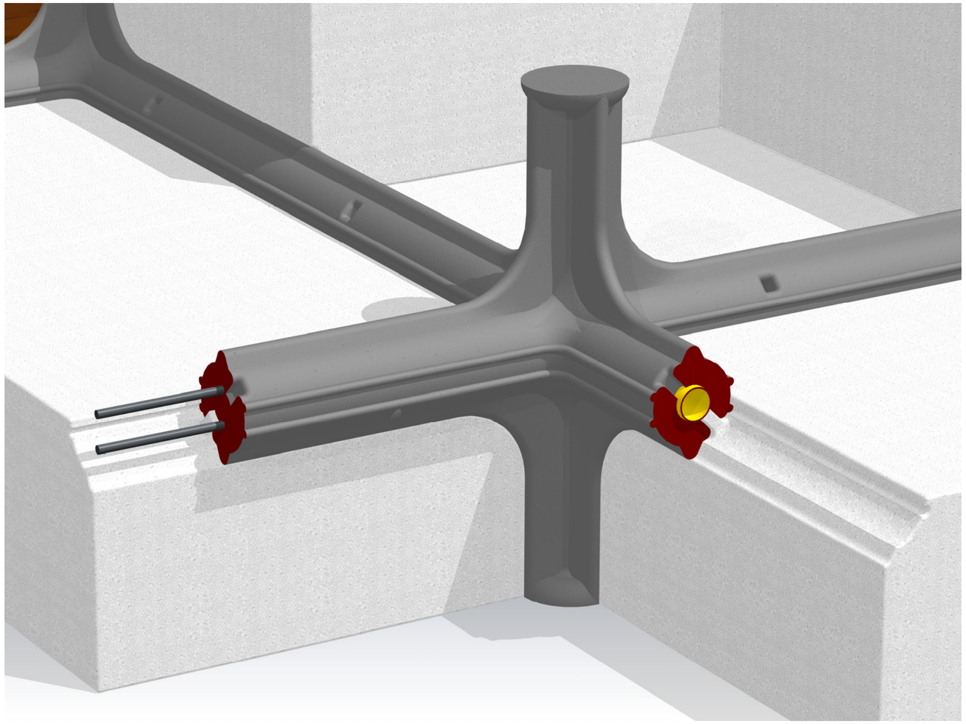

Fig. 4 - Floating element (Rijcken, 2003)

Water technology

Cities currently still rely on a centralized and energy intensive water supply infrastructure. Rainfall in urban areas is a relatively clean source, which could be used as resource for local drinking water production. Instead, storm water is transported as wastewater in combined sewer systems.

For new urban development, research in the Netherlands shows that local rainfall can fulfill residential water requirements in an average year (Graaf and Ven, 2005). In the IJmeer, storm water shouldn't be drained off by sewer systems, but instead be reverted back to the IJmeer.

Useful application of wastewater effluent will become more feasible as wastewater treatment technology continues to improve. Separation of storm water and sewage also results in more efficient water treatment plants. Like storm water, treated waste water can be reverted back to the IJmeer. Effluent is no longer waste that needs disposing of, but can instead be considered a valuable resource, because local wastewater treatment facilities can be used as a biogas energy source for the new urban development (Jong, 2006).

For the floating city in the IJmeer, applying water technology means that it won't be connected to a large centralized water infrastructure. Instead, local drinking water production and decentralized wastewater treatment will be applied and tested in this city. Experiments with many types of decentralized water technology can take place, adding to the development of these systems. The focus on local solutions means that no expensive infrastructure and energy intensive transportation of water and wastewater are necessary.

Energy technology

Even though dependence on fossil fuels is still dominant, energy generation technologies are now available that are capable of significantly reducing this. The first step towards a sustainable energy policy was set by ratification of the Kyoto protocol in 2004, which focuses on reducing greenhouse gas output.

The importance of a sustainable energy policy is twofold. First of all fossil fuels are in relatively limited supply and will at some point cease to be available – crude oil around 40 years, natural gas around 65 years (Stofberg et al, 2000). Secondly, using fossil fuels for power generation has had a negative environmental impact over the past years, both in mining/processing and in expenditure.

Reducing dependence on fossil fuels is required, and the Trias Ecologica (Duijvestein, 2002) is a three step strategy to achieve this. The first step is to prevent unnecessary energy usage, for example by clustering buildings, improving thermal insulation properties and application of Low Temperature heating systems. The second step is to apply sustainable energy where possible. This is not limited to power generation; using sunlight for space and water heating, applying shading during summer and more effective use of daylight are also considered to be 'applying of sustainable energy'. The last step is to use the remaining non-sustainable energy sources as efficiently as possible.

Because the floating city is located in the Dutch Ecological Main Structure, there are some restrictions to deployment of power generation technologies like wind turbines, although this can be overcome by displacing part of the production, for example to Flevoland or the North Sea.

A development worth mentioning in this respect is that of the Osmaal, which uses the difference in potential between the fresh water of the IJsselmeer and the salt water of the North Sea to generate a significant amount of power (Huisman, 2006).

4.1 Strategy

Based on the analysis, a strategy towards a design can be devised with a number of key elements – those that will have the most influence in the design stage itself. The goal of this project being both a relatively short term solution for certain regional problems as well as a breeding ground for (long-term) future solutions, means that the initial size will be moderate – approximately 10.000 inhabitants. The city will be modular both in planning and construction, so it can be expanded or its elements upgraded.

Urban and ecological development

Current Amsterdam and Almere housing projects and plans towards the IJmeer mainly turn water into land, reducing capacity of the main Dutch fresh water storage, as well as decreasing wet nature area. Using floating structures does not reduce that capacity and creates housing which anticipates on climate change projections.
Using floating, constructed wetlands as breakwaters improves the role of the IJmeer as part of the European Ecological Main Structure, by increasing appeal to migratory birds.

Technology

Another short term goal of the project is to put together new and existing technologies to show that the concept of a floating city is a viable one, and a solution to many problems. The long term goal however is to create a testing ground for future technologies, thus accelerating floating technology development and contributing toward a knowledge based economy.

Sustainability

The floating city uses as much local resources as possible where power and water supply are concerned. The structures themselves are designed to make efficient use of daylight and the heat of the sun. Where local resources are not an option (for example during the construction phase), an effort should be made to apply either sustainable, or durable non-local resources. Modularity of the project will increase adaptability, itself a feature of sustainability.

Transportation

The IJmeer bridge will not only improve the connection between the two main urban areas in the region, but also act as an on-ramp for the floating city. Providing a road connection (both vehicles and public transportation) next to ferry services and water taxis will improve short-term acceptance of this project, both for its inhabitants and visitors.

Tourism and economy

The project itself should prove to be a regional landmark, not just because it's a floating city but also because of the surrounding wetlands and facilities with tourist appeal, like a marina, a floating hotel and a floating theater. Not only will increased tourist revenue be beneficial to the regional economy, public interest from abroad also helps the floating city become an export product in its own regard, just like the Delta Works helped export Dutch delta technology.

Characteristics

The combination of these elements results in a project with the following characteristics:

- a living space for thousands, reducing the need to claim water area
- a positive influence on regional ecology
- a landmark, further increasing tourist appeal of the IJmeer
- a pilot project for larger floating cities
- a testing ground or accelerator for floating technology, resulting in knowledge and products that can be exported

The next paragraphs will go into more detail about implementation of this concept.

4.2 Concept

Combining the elements of the strategy is not intended to have a single, definitive result. The purpose of the project of course is to be a living, breathing testing ground in which new delta technologies can be applied, so after ten years the floating city will look different from when it started. This is a vision of its first incarnation.

A highway bridge (1, numbers refer to the next two pages) connects the cities of Amsterdam and Almere. The structure is a hollow vessel with a lowered road surface, where the sides act as noise barriers, and an open top. The road surface has enough buoyancy to support its dead load, which means that the road will not sink even after sustaining damage. The low super-surface profile of the bridge allows vehicles to stay out of sight reducing noise pollution as well. Where the floating bridge crosses the shipping lane, a high overpass bridge allows for vessels to pass.

Along the highway bridge, a floating city is moored, surrounded by floating vegetation. This outer ring serves both as a breakwater and a constructed wetland, reducing wave height in the city and cleaning its affluent at the same time. Part of the ring is meant to become valuable 'wetland' nature, compensating for use of the water surface. Openings in the wetlands allow boats and yachts to enter and leave.

The transport hub on the floating bridge provides two highway exits, parking facilities (5) and a metro station (3), as well as a dock (6) for numerous single-vehicle, automated ferries capable of carrying inhabitants' cars to their homes – catering for those who prefer that over using the transit hub's parking facilities.
As opposed to large ferries this system is not a batch process, but rather a continuous mechanism of ferries departing and arriving, so there is no waiting time. During transit, driver and passengers can stay in their vehicle resulting in a streamlined means to get from shore to floating home with maximum use of the potentials of water – both as an infrastructure and as open space.

Within the city, residents can move about using floating pathways (7) (8), either on foot or by bike. Car access is only allowed in case of emergencies.

There are two groups of pathways perpendicular to one another on different levels, effectively creating long waterways which allow for water based traffic. These pathways intersect inside the larger living clusters (9) with a 3D bridge connection (10).
Within the city, the means of transport are small (6) and big ferries (4), private boats (4), walking and biking.

Spacious courtyards (12) within the clusters provide access to people's homes. These courtyards fill the need for public space, something that requires careful attention in floating cities. An ETFE canopy similar to the iris dome (Hoberman, 1994) covers the courtyard, acting as a rain screen and helping maintain a desirable temperature. A natural airflow will ventilate the atrium. The rolling doughnut-stream effect (14) will increase the Venturi (15) and Bernouilly (16) effects on top of the dome combined with thermal effects (Baldwin, 1977). Additional cooling within the structure can be provided with a closed loop water heat exchanger (16).
Spatial dimensions and flexibility of the structure's interior are designed with disabled and elderly in mind (17).

Emergo Zuid
A'dam
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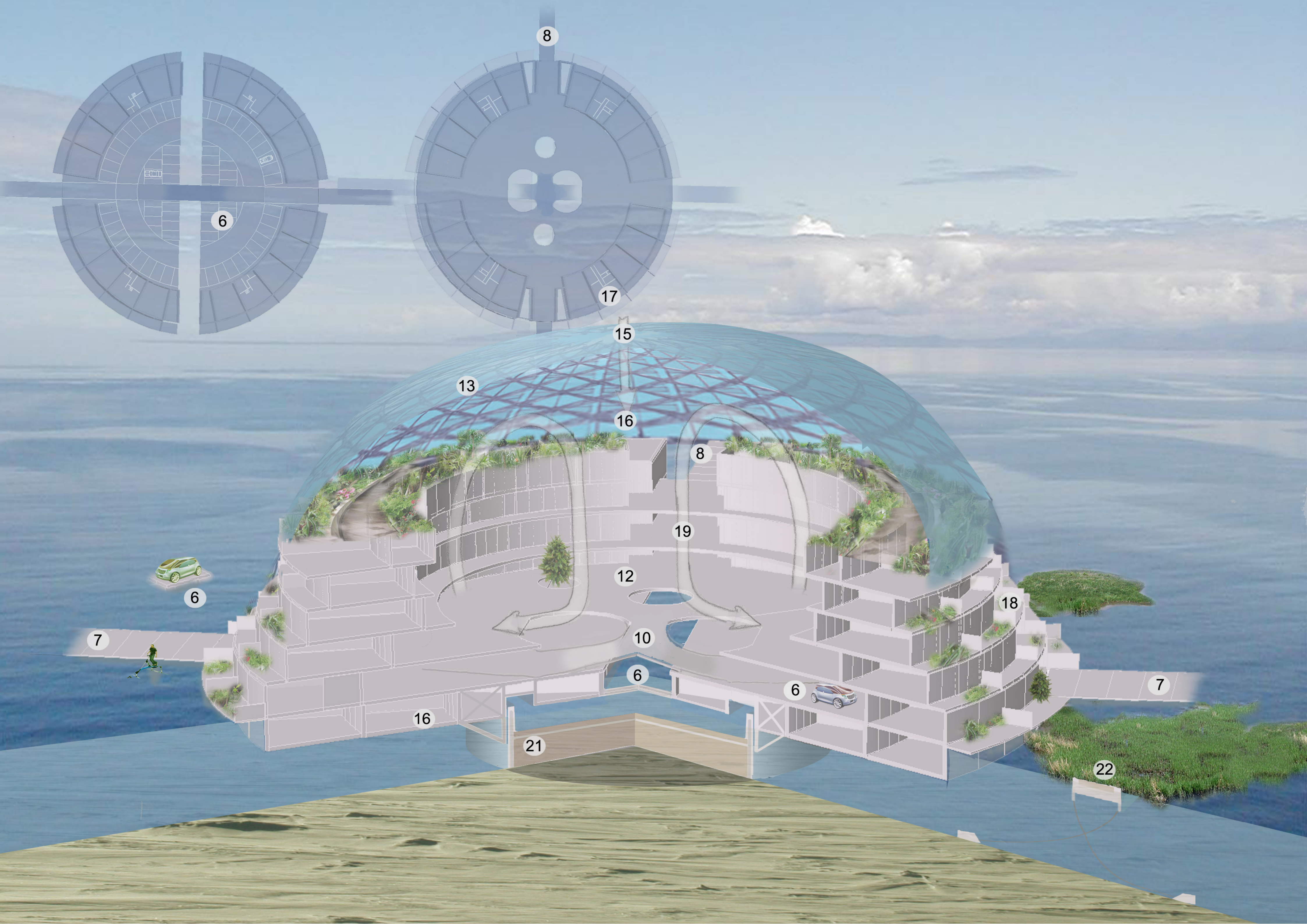
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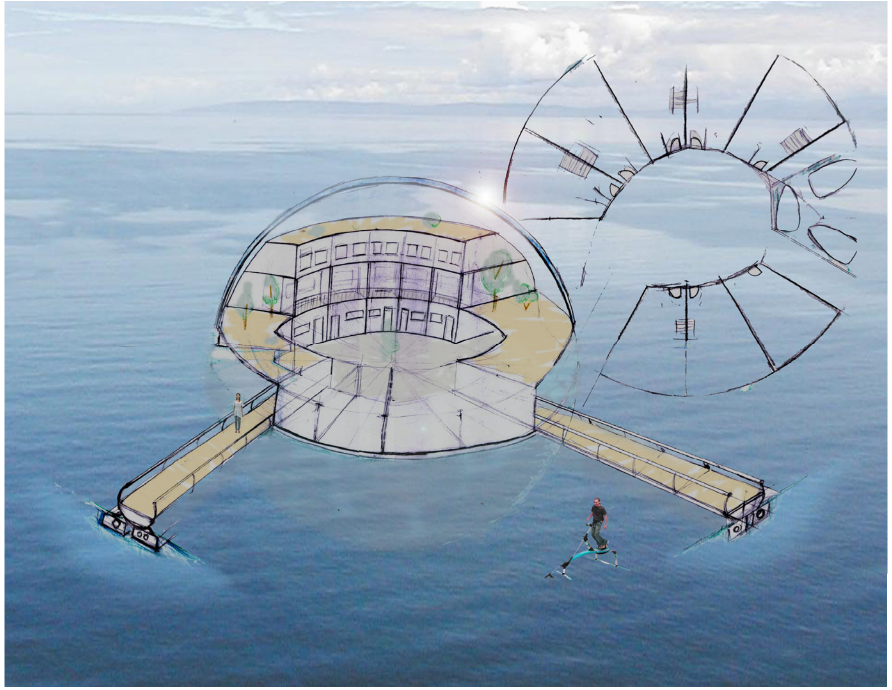

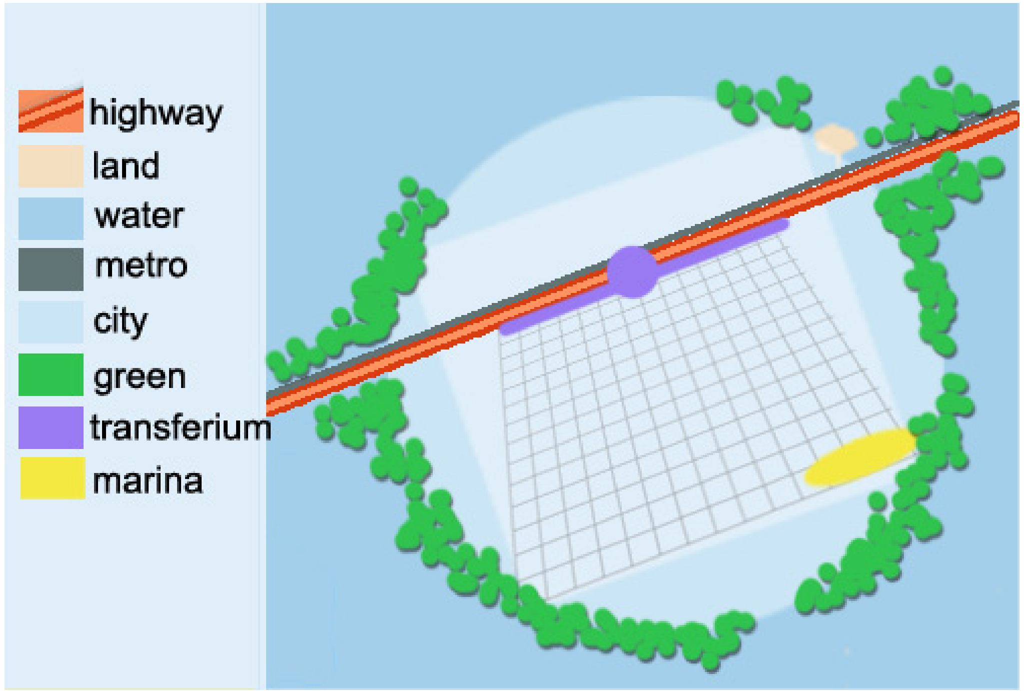

Its circular nature allows for all homes to be provided with the delightful water diorama (18) surrounding the structure.

A spherical shape is the optimal ratio for surface and volume. This saves on materials and energy loss. By flattening the volume, internal spaces become more practical in use. The large living clusters consist of 60 houses with corresponding public and parking space (9). Smaller clusters contain up to 12 houses (19), and are basically set up in the same way. This approach of an architecture with strong references to water invites more daring designs (Tang, 2006) (20). A single 'foot' on the water floor fixes the structure's horizontal position while allowing for vertical movement, a method of mooring currently subject of further development (Attika, 1994) (21). Because of a minimum of connections to both water floor and city infrastructure, all units and clusters can be prefabricated, and moved to and from locations for a dynamic urban planning. City densities and capacities are easy to alter.

4.3 Design of the regional connections

Connecting the floating city with its surroundings is the floating bridge, which provides for a motorway and metro line between Amsterdam and Almere. The motorway will be an extension of the secondary Amsterdam beltway A9, originating from the A1-A9 junction and connecting to the S101 in Almere.
The metro line will connect to the Amsterdam metro network in Diemen Zuid station (8 minutes from the floating city) and stretches from the Zuidas to Almere (26 minutes for a single trip).

Recent research shows that around 60% of commuters use cars for work-related travel (RWS-AVV, 2004), so a road connection will improve short-term social acceptance of the floating city by potential residents.

The bridge will be a good impulse for further development of the Almere region, given its relationship with Amsterdam (Heijden, 2006) and is an alternative to the proposed, controversial Naardermeer traverse.

The third means of regional transportation will be a (fast) ferry connecting the floating city to Amsterdam Central Station (20 minutes).

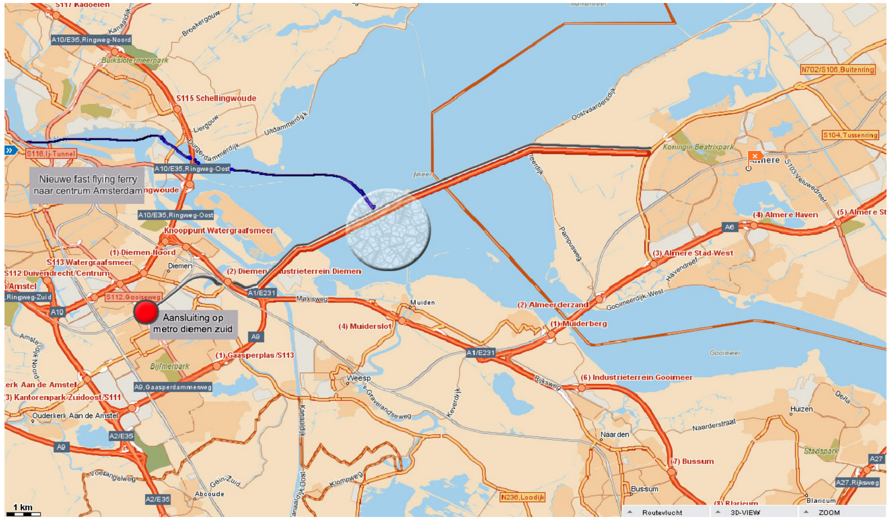

Fig. 5 - Regional connections

5 THE TRANSITION: FROM VISION TO REALITY

In this paper a governance model of transition management is used to contribute to making the step from vision to reality (Kemp and Loorbach, 2005). Transition management consists of the phases illustrated in Fig. 6.

1. Establishing a transition arena and vision development
2. Developing coalitions and transition agendas
3. Mobilizing actors and executing transition experiments
4. Evaluating, monitoring and learning

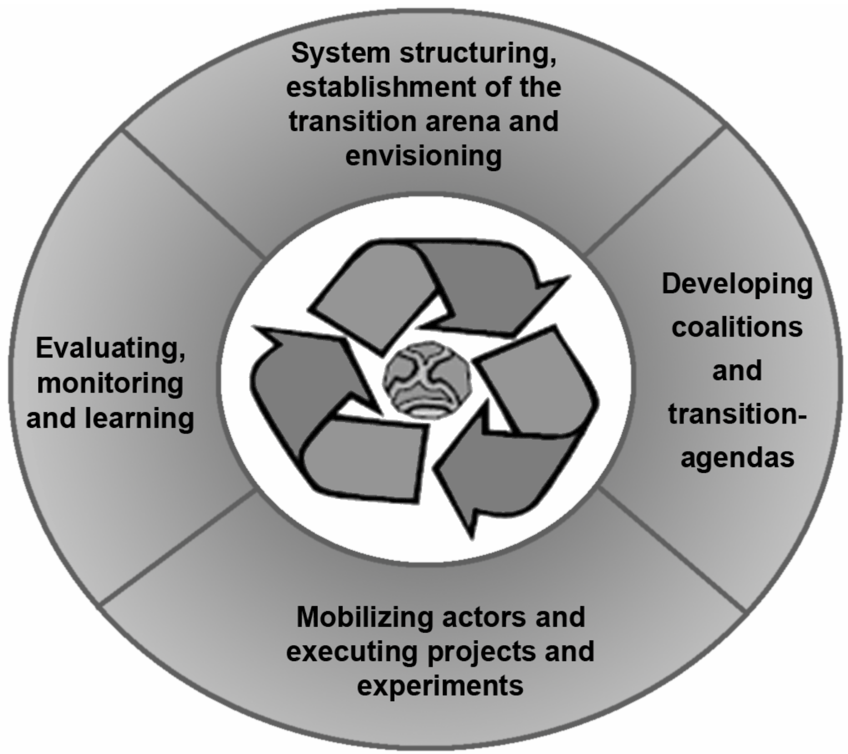

Fig. 6 - Phases in transition management (Kemp and Loorbach, 2005)

5.1 Establishing a transition arena and vision development

The first step in transition management is the development of a transition arena. This is a group of people, able to think creatively across domains and towards the future, and together developing a vision on sustainable urbanization. Preferably, the group consists of people from companies, NGOs, governments and research institutions. Many disciplines, for instance spatial planning, engineering, ecology, architecture and recreation expertise should be involved to develop an ‘out of the box’, ‘multi-domain’ vision.

5.2 Developing coalitions and transition agendas

The problems described in this paper are not limited to one domain. On the contrary; problems of mobility, demography, ecology, economy and flood control interlock in the densely populated area of the Amsterdam-Almere region. The strategy of the floating city aims to contribute to a solution for all these delta problems. This means multiple domains will have to be integrated and many actors will have to be involved in the plan. Transition management aims to establish a broad societal coalition of governments, research institutes, universities, companies, developers and consultants, to bring knowledge together in an innovative transition experiment. The vision frame of the first phase will be used to develop coalitions and a transition agenda. The actors in could be involved in the transition coalition. Participation can be consultation, cooperation and informing.

Actor	Main Problem/Objective in Amsterdam Almere area	Means for developing a floating city in IJmeer
European Government	Environmental quality	Issue of permission for developments based on Bird and Habitat Directive Funding
National Government		
Ministry of transport, public works and water management	Congestion of traffic Flood control	Funding Technical knowledge Decision power
Ministry of housing, spatial planning and the environment	Housing demand Sustainable development Shortage of space	Funding Spatial knowledge Decision power
Ministry of economic affairs	Economic growth Competitive knowledge based economy	Funding Economic knowledge Decision power
Provincial government		
Provinces of Flevoland and Noord-Holland.	Economic position Traffic problems	Funding Regional knowledge
Municipal Government		
Municipalities of Amsterdam and Almere	Availability of housing locations Accessibility, connection Almere-Amsterdam-Schiphol	Funding Local knowledge
Environmental Organizations		
Natuurmonumenten, Staatsbosbeheer, Milieudefensie e.a.	Decrease of ecological quality	Ecological knowledge
Recreational and mobility Organizations		
ANWB, Watersportverbond e.a.	Insufficient possibilities for recreation	Recreation and mobility knowledge
Economic Organizations		
Projectbureau Zuidas	Development of international business location Housing location for expat knowledge workers Regional connections	Corporate knowledge
Airport Schiphol	Expansion Regional connections	Investment capacity for connections
Public Utilities		
Energy company	Reliable, cost effective energy supply	Investments, knowledge
Water company	Reliable, cost effective water supply	Investments, knowledge
Public transport company	Reliable cost effective public transport	Investments, knowledge
Project Developers		
NEPROM	Availability of new housing and company locations	Investments, knowledge of projects, technical knowledge
Inhabitants		
	Availability of houses Quality living environment Jobs	Knowledge on demands of target group
Research Institutes		
Universities Knowledge institutes	Investments in R&D	Innovations, creative ideas, designs for floating cities
Consultants	New projects	Knowledge of projects area developments, innovation and technology
Architects	New projects	Designs
Constructors	New projects	Technical knowledge of floating structures

Table 2 – possible participating actors, objectives and means in the floating city project

5.3 Executing the transition experiment

By cooperation of public and private parties a balance between economic, ecological and social development can be accomplished. This means that both experimenting with new technologies and learning by doing are important.

The development of the Amsterdam-Almere region is a matter of national importance; firstly the national government should issue a decree to initiate this process. Government efforts should be focused on improving accessibility, ecology, economy and knowledge development by constructing a floating city in the IJmeer. Important in the execution of the pilot project is the fact that this project should start with creating ecological surplus by constructing new nature areas. This is necessary to make other developments possible within the limits of European legislation (Bird and Habitat Directive). Because the project is a multi-domain one, funds for infrastructure, economic development, ecologic development and research funding can be combined in this project increasing the feasibility of reaching the required budget.

5.4 Evaluating, monitoring and learning

The transition experiment should be continuously monitored and evaluated. A collective memory about combining ecology, mobility, housing and recreation will need to be built. One floating city is not yet a sustainable delta. Therefore experiences from the floating city should be used to start and improve other transition experiments in the Rhine delta and worldwide to obtain knowledge and skills until there is enough know-how and preparedness to transform the urban delta system to a lower risk, more self supporting area.

6 DISCUSSION

Building in the IJmeer has recently attracted a lot of public attention. On June 30th the cabinet made a decision on building in the IJmeer. These plans partly have the same background as our vision. However, our focus is more on developing new building technologies such as floating structures, rather than applying the proven conventional concept of raising terrain by hydraulic fill. Developing a floating city contributes to the national objective of strengthening the knowledge based economy while reducing its vulnerability to flooding.

For a maximized learning experience in the floating city, it would be useful to do experiments with radical new technologies. However, a city is built for people. Therefore, in the floating city on the IJmeer, a balance should be found between testing for technological development and making an urban area where it is good for people to live. In practice it will be partly state-of-the-art technology and new technology that is applied in the floating city. Moreover, the floating city will attract people that like the idea of innovation and technology development. This in turn will create room for the transition experiments.

Many delta areas all over the world have problems similar to the Rhine Delta. Technology developed in the IJmeer floating city may prove to become a valuable export product.

7 CONCLUSIONS

The aim of this study as introduced in the beginning of this paper is to develop a more self supporting, non risk increasing concept of urbanization in the Almere Amsterdam region that will contribute to further economic and technological development of the Rhine Delta. For this purpose a combination of analysis, strategy and concept development has been applied. National trends, developments in the Amsterdam region and technical innovations have been analyzed. These developments are characterized by wide margins of uncertainty. A management approach to deal with complex problems under conditions of high uncertainty is transition management. A transition experiment of a more self-supporting floating city in the IJmeer has been presented. It uses local water and energy resources instead of external resources only. Moreover, it does not result in increased expected damage in case of flooding. Next to being more self-supporting and non risk increasing, this floating city is an accelerator for delta technology; it offers a testing ground for pilots with new water, energy and floating technology. It will enhance knowledge based activities in the Amsterdam-Almere region, a unique area with high economic potential. The floating city is a high quality living area that will attract highly educated knowledge workers. The development of the floating city is combined with large scale wetland development in the IJmeer to create an ecological improvement. Moreover, it contributes to reducing the mobility and housing problems in the region, stimulates the regional economy and anticipates on an expected increased demand for water recreation. Overall, the floating city IJmeer anticipates on multiple trends and contributes to development of a knowledge based economy and new technolgies while not further increasing flood risks.

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