Problem
The Merwe-Vierhaven area in the Rotterdam harbor zone faces a transformation from an old industrial based economy towards a knowledge economy. New types of businesses and startup hubs are necessary to help jumpstart this process. At the same time this project tries to solve a more universal problem of dealing with areas of rising water levels and the risk that this brings to the urban environment, which in the case of Rotterdam – but also numerous other cities – is substantial in the long run.

Research
My research for these problems focused on creating a floating ‘incubating community’. This would basically be a village that is built up of functions based on organic like complexity science to create the optimal knowledge flow. Furthermore, it could also take advantage of its lack of foundation to be able to reconfigure over time, according to demand change, as well as being flexible to change position if necessary.

The research questions that I asked are divided into four different categories:

• Main question: How can a building be designed to actively participate in the flow of knowledge and adapt to the change of flow over time?

• Scientific-theoretical question: What are complex systems or complexity science and how can it inform architecture to be adaptable to changing requirements and growth?

• Computational question: Why is complexity science and agent-based modeling beneficial for the creation of intelligent and adaptable architectures?
• Conceptual-design question:

*In what way can complexity science and computational techniques be translated in order to create intelligent and adaptable architecture designs?*

**Process**

In the process I used various tools to gain information over the site and the environment. I conducted water flow simulations to determine what the different directions and velocities are on my location. I also looked at the wind speeds and directions and the urban and economic analysis of the region.

To determine what the configuration based on this ‘complexity science’ should be I ended up using an multi-agent based system that looks at different parameters like relations to create different 3D function configurations of which I chose one based on its qualities. To determine the public space I used a Wooly Path simulation to find out the best type of routing, which is a minimal detour system.

On design research I have done numerous different experiments to find a geometry and concept that follows my wish for re-configurability and a transformative geometry. Those experiments eventually led to the final design

The design bridges the Merwehaven between the Rotterdam and Schiedam side enabling a flow of interactions that goes through the center of the building. It also houses a water taxi terminal connecting it with Rotterdam by river and is in close proximity of the Marconi towers, already housing a science center, both can be archipunctural projects that in themselves are not that big but whose influence can revive the entire area into a lively urban extension of Rotterdam.

**Reflection**

• Scientific-theoretical question:

*What are complex systems or complexity science and how can it inform architecture to be adaptable to changing requirements and growth?*

Complexity science investigates how relationships within one system inform the system and how it interacts or forms relations with its environment. In my case, I created a base of agents with different properties based on parameters. The system then configures them according to those relations from surrounding agents as well as external factors. It will change its configuration when new agents are added as the internal relations change so changing requirements and growth are incorporated in that system.
Computational question: Why is complexity science and agent-based modeling beneficial for the creation of intelligent and adaptable architectures?

It is beneficial for intelligent and adaptable architecture as it takes the top-down organizational approach from the architect and replaces it with a more organic system that is based on multiple relation parameters. It will change its configuration when new agents are added as the internal relations change. So if the building is able to reconfigure itself, it will always be able to transform according to new demands over time making it a more durable building that acts more like an organism. It doesn’t have to be torn down as it can change.

Conceptual-design question: In what way can complexity science and computational techniques be translated in order to create intelligent and adaptable architecture designs?

The Woolypath simulation can be translated in a network of paths that combined generate the public sphere as it was based on the initial multi-agent system. The agents can then be translated into spaces that are connected to this routing system. When the requirements change the agent spaces should follow this new configuration making it intelligent and adaptable.

Main question: How can a building be designed to actively participate in the flow of knowledge and adapt to the change of flow over time?

It can be done when creating two separate entities within the building. The first one is the core; this is the public realm that is the building at its minimum, nothing can be stripped away anymore, as this part is not transformable. The second part is the interface, the reconfigurable parts of the building. These are the functional units, or pods, that are attached to the core or the public route extensions. These are everything from businesses to housing and can be added, deleted, replaced or moved according to changing demands. These two combined create the entire building, using complexity science to be intelligent and the separated pods to be adaptable.

Conclusion

What became most apparent to me during this entire process is that it is not the computational side of the process that is hardest, but the translation from a computational framework into an architectural language for your project. When in the end, the design seems to follow a very simple evolutionary line from initial system to end result, it is very difficult to get this appearance of simplicity and clarity when working with complex systems and infinite ways to interpret this and design from it. The primary goals can easily get lost during this process.
While fighting through this process, my goals and concept did become clear. My design in its final shape is not that flexible in moving or rotating parts according to sun for instance, but the core ambition for this project was not that, so it became irrelevant in that sense.

What interests me about this project is that I can reimagine what an urban area of the future can be. In Holland, we’ve been fighting water, we’ve been controlling water; but with rising sea levels expected, in the future, we could very well have to live on water. And this project can envision that, how can we build future neighborhoods on water?

This project is about creating that floating urban community that is transformable over the long run, so as it can adapt to changing requirements, it can live a lot longer than a normal building. While I had to disregard certain aspects of my vision over the process, in the end – to me at least – it hit its mark.