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Seawater District Heating in the Hague: Assembling Energy Futures

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Abstract: This chapter explores the application of assemblage theory to analyse the development of an innovative seawater district heating system near The Hague, in the Netherlands. In doing so, we argue that the story of a stable technological system, moulded and shaped into a final obdurate form by social and political interests is a narrative that conceals as much as it reveals. By following the fluidity of the design and development process that twists and turns as the system emerges and changes shape, the case study highlights the potential contribution of the assemblage perspective and its ability to reveal the complexity and context specificity of sociotechnical system building. In this way, the chapter argues that the relational framing of systems as they are assembled, maintained and disassembled, encourages us to look beyond the naive certainties of best practice policy toward a richer engagement with the practices, politics and places of urban network development.

> “The electrical power grid is a good example of an assemblage. It is a material cluster of charged parts that have indeed affiliated, remaining in sufficient proximity and coordination to function as a (flowing) system. The coherence of this system endures alongside energies and factions that fly out from it and disturb it from within. And, most important for my purposes here, the elements of this assemblage, while they include humans and their constructions, also include some very active and powerful nonhumans: electrons, trees, wind, electromagnetic fields (Bennett 2005: 446).

Introduction

As this book clearly evidences, ‘ANT thinking’ has been receiving growing attention in fields of design, geography and planning as part of an on-going intellectual project to develop a more relational and contextual understanding of technological innovation. As the editors illustrate in their introduction, this relational thinking has much to offer planning studies, in particular by providing a different way of looking at the world and a sense that the material world of cities and the infrastructure systems that underpin them are not as obdurate as they might first appear. This emphasis on interpretive flexibility and plasticity opens up new perspectives and positions for researchers, policy-makers and professional practitioners who recognise the productive challenge of reconceptualising technological change. However, this conceptual challenge is not new, as Jane Summerton’s seminal attempt to follow the emergence of a district heating project demonstrates:

> “At first glance, heat plants and pipelines *per se* may seem of little interest from a social science perspective. What makes them truly intriguing is what they embody: the tensions and tactics behind their emergence, the complexity of the social organization that supports them, and their long-term implications for the actors they link and the communities they serve” (Summerton 1992: 62).

Summerton drew heavily on the work of Thomas Hughes in his magisterial ‘Networks of Power’, to understand what Hughes termed the ‘seamless web’ of social, economic and technical issues that coalesced to produce large scale technical systems (Guy and Karvonen 2015). Inspired by Hughes, Summerton’s work pointed towards a more networked understanding of large technical systems in which the social and technical co-evolved in ways that resisted easy demarcation between them. Seen this way, the materiality of large technical systems emerges from this analysis not as passive background context, but as an active agent in the weaving of the web. Taking this cue, researchers analytically resourced by ANT have been busily exploring the situated system building through which networks form, transform, grow, fail and mutate. As the debate has grown more ambitious, researchers have moved forward to explore cities as urban systems and in doing so have begun to draw additional inspiration from Assemblage theory, to help capture the notion of cities as situationally specific hybrids of human and non-human actors, constantly in flux, co-producing new forms of urban order (Farias, 2010). Looking back to the work of Thomas Hughes, assemblage thinking can arguably be understood as a progressive response to the totality of the 'seamless web' (Anderson et al. 2012, p. 178), by acknowledging the interconnectivity of urban systems whilst also recognising that cities are composed of 'sites of continuous organisation and disorganisation' (Hillier 2009) into that gathers disparate elements into a functioning system. This way, a city or technical network is 'not a whole' but a 'composite entity' (Farias, 2010, p. 14), an 'active assemblage of assemblages' (Bender 2010), with the notion of assemblage providing a conceptualisation of the networked nature of the city whilst providing a sense of operational units within which different elements of the system can be understood. Farias argues that assemblage thinking is a 'conceptual tool to grasp the city as a multiple object, to convey a sense of its multiple enactments,' (Farias, 2010, p. 15) and to address the challenge of 'identifying, describing and analysing these multiple enactments of the city and understanding how they are articulated, concealed, exposed, and made present or absent' (Farias, 2010, p. 14). The empirical tools provided by ANT are essential to the development of this conceptual tool, providing methods to trace the alignments, controversies and ordering work that underpin the building of an urban assemblage.

We explore the application of this conceptual tool in relation to the development of a technical system that might otherwise be seen as a largely technological project, an innovative Seawater district heating system near the Hague. The case is distinctive in that it highlights the inter-relationships between the development of an energy technology system utilising the sea as a natural element and critical social dimensions in terms of people's relationships both to the technology and the sea, invoking cultural understandings of domestic comfort, local history and cultural heritage. Through the paper we ask what insights an assemblage approach can bring to the emergence and operation of this hybrid ensemble and what this understanding might mean for policy implementation (Hill, 1997), and for process of network building and network maintenance that proceeds from the identification of a technological or environmental problem to the implementation of an appropriate solution (Goodchild & Walshaw, 2011). In doing so, we hope to illustrate the productive power of an assembledge tool and to show how it opens up new analytial framings of the processes and practices of urban system building.

The empirical research that informs this paper was conducted as part of the Challenging Lock-in through Urban Energy Systems (CLUES) project, funded by the Engineering and Physical Science Research Council in the United Kingdom. CLUES aimed to critically assess the development of urban energy initiatives, including decentralised systems such as this case study, within the context of national decarbonisation targets and urban sustainability goals. The project combined UK and international case study research with the development of energy scenarios to 2050.

The case studies and scenarios from the project are presented in 'Energy: looking to the future', (Sherriff and Turcu 2012).

One element of CLUES research strategy was a study of four cases outside of the UK, carried out through desk research, site visit and (Goodier and Chmutina 2014). interviewers. For the case study reported in this chapter, stakeholders in the Netherlands were interviewed as well as actors from a case study in Portsmouth, United Kingdom, who have also developed a seawater district heating system. Users of the seawater district heating system, i.e. the residents of the houses, were not interviewed due to cost and time constraints and also language issues: stakeholder from the key stakeholder organisations were confortable conducting interviews in English, whereas this proved more challenging when engaging with residents. Where appropriate, the researchers therefore inferred the perspectives and experiences of the residents from the stakeholder interviews, which is an approach the researchers recognise may have limitations.

The chapter is in three sections; in the first we outline the context and methodlogical approach for the research and describe the technical aspects of the system and its claims to be innovative; in the second we adopt assemblage thinking as a framing tool, revealing the fluid and contextual nature of the system by introducing novel lines of enquiry, namely; Elements, Territories, Ecologies and Rhythms; and finally in the concluding section we explore the efficacy of adopting an assemblage frame.

The Case Study: Seawater District Heating in the Netherlands

Our case study is an innovative district heating system in Duindorp, a coastal village in The Hague, The Netherlands. Part of The Hague, Duindorp is an area along the North Sea Coast consisting mainly of small former fishermen family houses built between 1915 and 1931. The project utilised the temperature of seawater as a source of heating and cooling using a heat exchanger and heat pump connected to a district heating network. The system was installed as part of the reconstruction of 800 houses (to replace 1200 original houses), with the aim of creating homes that perform highly in terms of energy efficiency. In terms of environmental performance, it is claimed that the system is more than 50% more efficient in comparison to conventional high-efficiency boilers and that it can be associated with a 50% reduction in CO_2 emissions (Goodier & Chmutina, 2013).

The idea was first discussed in 2001, but delays, discussed below, meant that implementation did not commence until 2007. Later, in 2009, The Hague signed the Covenant of Mayors, and approved their Climate Plan, aiming to become carbon neutral by 2040 based on a range of energy-related measures, including the expansion of district heating.

The technologies involved are not new: the innovation lies in their combination. It is claimed that this enables the construction of a system for making seawater or surface water the source of energy for heating homes as well as heating water all year round (Figure 1) (Stoelinga, 2011).

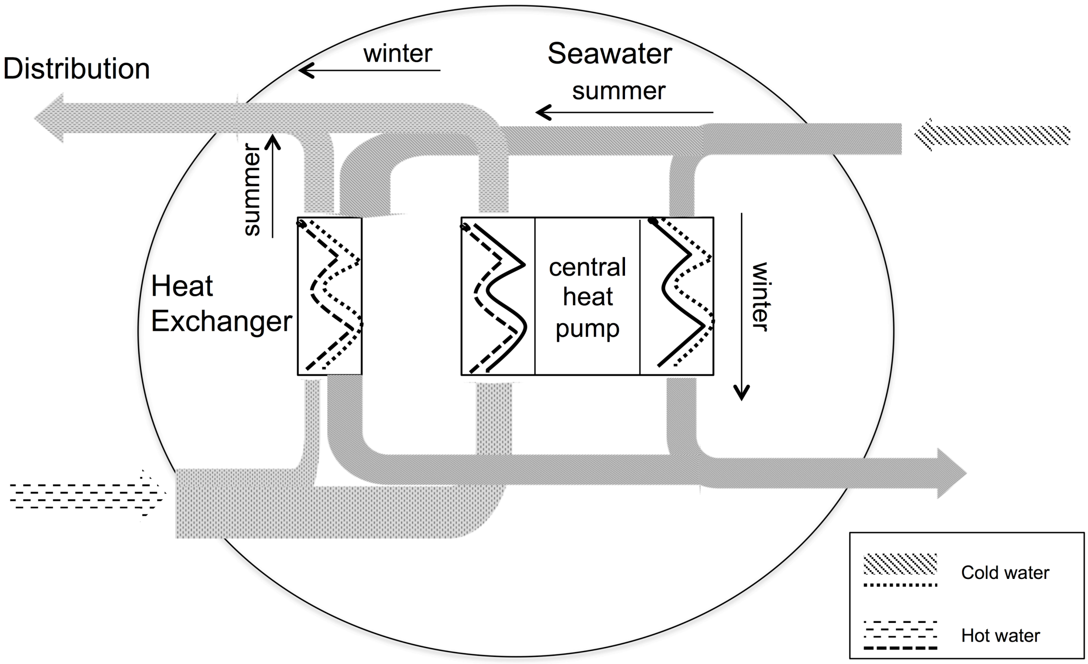

Figure 1 Schematic representation of the way the seawater heating system in The Hague (adapted from Stoelinga, 2011)

The seawater heating system extracts seawater and then processes it either via a heat exchanger or a heat pump to supply the residential area with space heating and hot water. A central industrial unit located by the harbour contains both the central heat exchanger and heat pump. Smaller individual heat pumps are installed in each home for additional heating when required. In summer, when the temperature of seawater is more than 11°C, only the heat exchanger is used. The heat exchanger feeds heated water to the local district heating, drawing enough heat from the seawater to cover residents' need and sending it around a five-mile network of insulated pipes to serve the 800 homes (Foster, 2014). In the winter, when the water temperature is less than 4°C (but above 0°C), the heat pump is used. Using electricity, the heat pump works to move thermal energy from the cold source to a warmer heat sink. The ammonia heat pump has an output of 2.7 MW and warms the water to approximately 11°C, which is then fed into the local grid. Upon reaching each household, the water is further heated by each home's own heat pump to either 65°C for hot water of 45°C for space heating. Pipes take in between 25,000 and 50,000 litres in the summer and more, about 190,000, in the winter of seawater each hour, with filters ensuring no sealife is sucked into the plant (Foster, 2014).

A central industrial unit located by the harbour contains both the central heat exchanger and heat pump. Smaller individual heat pumps are installed in each home for additional heating when required. Similar systems can be installed anywhere close to a large body of water. It would also be cheaper if fresh water was employed, as there would be no need to protect the heat pump, heat exchanger and water pumps against salt corrosion (Interview), a significant task considering that a substantial part of the engineering work was directly concerned with 'battling the problem of corrosive seawater' (Foster, 2014).

There are a few examples of similar approaches internationally. At Purdy's Wharf in Halifax Canada, a commercial development uses seawater as a heat sink in a variable air volume system to provide its cooling requirements (Zimmerman and Andersson, 1998). In Dalian, a port city in China, a seawater heat pump system provided heating and cooling for the city (Li Zhen et al, 2007). In Portsmouth, UK, the Continental Ferry Terminal, the sea is used as a heat resource for heating and cooling (Halcrow, 2011).

The Project as an Assemblage

Energy projects such as Duindorp would typically be viewed through a narrow techno-economic lens, which focused on aspects of technological innovation or efficiency, or as exemplars of progressive policy, both perspectives designed to replicate what is often termed best practice, often irrespective of the particular context of implementation (Guy 2006). Here we adopt assemblage thinking as a framing tool, to open up new perspectives on the development of the system as a heterogeneous assembly of different elements, drawing upon our interview data. We have also developed a number of visualisations to help map these relations and how they shift over time through the project, revealing the fluid and contextual nature of the system.

Mapping the Elements of the System

When viewing this project through the lens of assemblage theory, it is possible to identify an array of interacting elements, and to explore the ways in which their relationships change over time. Our first task is to map out the assemblage.

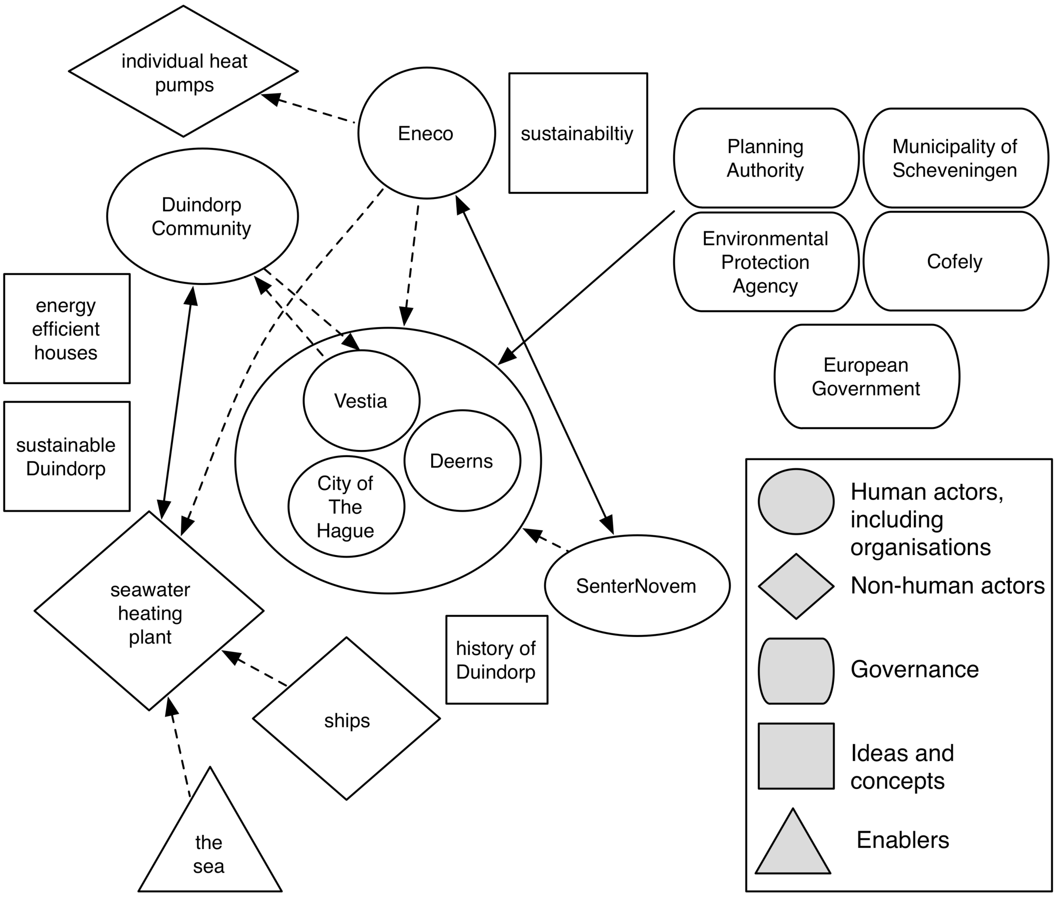

Figure 2: Human and non-human actors involved in the Hague case study project

A starting point for mapping out the assemblage is to identify the stakeholders, understood in a conventional sense as a person or organisation that affects or can be affected by the project. At the core were three organisations. Deerns, a large engineering consultancy, was the main delivery body. Vestia, a social housing provider in the area who owned the renovated housing, and became increasingly important further into the project. Vestia had been owned by the local authority but were sold and made independent. The City of the Hague supported the plans and played a crucial role in getting permission for the old harbour site to be used for the heat pump, as well as making a modest financial contribution. In doing so, the City of the Hague was influenced by national debates on energy and the role of cities, and in interview referred to a national level and city level awareness of needing to do something about heating systems particularly in relation to their dependence on oil and gas.

The interviews suggest that each of the key partners had different drivers for their involvement. Vestia, the housing corporation who owns the social housing, were seen as bringing a strong sustainability concern to the table, beyond what the regulations demanded of them. Another stakeholder commented that ‘It has always amazed me actually that Vestia themselves had the initiative to be energy efficient. They were miles ahead of regulations, miles ahead of what the municipality asked then and actually wanted’. The seawater district heating system is owned by Vestia, but associated projects, including geothermal energy, are owned in partnership with other utility companies operating locally.

Deerns, on the other hand, whilst interested in sustainability, was seen to be primarily motivated by the prospect of demonstrating that this particular technological approach could be successful. Energy company Cofely GDF-Seuz led on plant and heat pump installation and continues to manage the technical maintenance of the plant.

Energy company Eneco were a major player in the early part of the project, and prepared to contribute a significant proportion of the finances. As discussed further below they withdrew support, and finances, having reportedly expressed a lack of confidence that the system would be able to achieve a sufficient cost-benefit ratio. SenterNovem, now Agentschap, was also approached for funding but declined, despite later granting the project an Climate Star 2009 award in recognition of its innovative nature[1]. Research organisation TNO were brought in, and it was explained in interview that this was to make the case that the project would be able to achieve the required amount of energy at the available cost.

In addition to this stakeholder network, it is possible to identify a range of non-human actors. They include the houses, their heating, cooling and cooking systems, the sea, the boats and ships using the harbour, the harbour itself, the plant, which included the heat pump, exchanger and piping. We can also invite ideas into the assemblage as there are many that shaped the initiative. These would include energy efficiency, local energy security, sustainability and the notion of low carbon, but also technological innovation and notions of comfort in the home.

Tracing territories of the System

Having identified the elements, can we draw the boundaries of the assemblage? In our example, the boundaries of the assemblage could be drawn in multiple, overlapping ways.

Perhaps the simplest is the technical apparatus of the district heating system in the context of its operation. This assemblage would include not only the heat exchanger and pumps but also the units in the individual homes, it's social elements would be the operators of the equipment and the residents of the houses as they make use of the heating provided by the system.

Whilst this assemblage could be locally bounded at this community scale, it could also be 'projected' outwards along different trajectories. The simplest would be spatially: from the local housing area, to the village of Duindorp, to the City of the Hague, to the province of South Holland, to The Netherlands, to the region of Western Europe, and so on. The literature on Assemblages does not suggested a specific limit in physical size of an assemblage although

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[1] http://www.klimabuendnis.org/667.html

it could be argued that conceptualising an assemblage at such a large scale could limit its utility. However, certain endeavours may benefit from such an understanding, for example understanding the spread of policy ideas between neighbouring countries.

The assemblage would clearly interface with the housing of the village, which could be considered another assemblage, or an extension of it, with its buildings, residents, staff, and grounds, and would connect to other utility networks such as electricity and water. Households would no longer be connected to the wider gas networks and have their own boiler, yet they would be connected to the district heating system. Their scale of reference, then, was at once contracting – from the national gas supply to the local network – and growing – from the individual boiler to the centralised heat exchanger: ‘No, you’re not going to have your own gas boiler anymore. You’re going to be part of a district heating system’ (workshop participant).

Another possible arrangement is to consider the role of the port of Duindorp. It is connected physically by the sea and through the passage of ships to other ports, but also in terms of dialogue and knowledge exchange: for example, if other ports decided to adopt a similar approach this could be considered evidence of ideas circulating around a larger assemblage.

In understanding assemblage as not only the product but also the process, and therefore as a temporal as well as spatial phenomenon, a boundary around the temporal assemblage could also be drawn. An important question then is, when could the initiative be considered to have begun? Whilst in one sense it began when the work started, there was a period of negotiation and claim-making in the lead up, including the task of demonstrating the feasibility of the project. Before this there were more general discussions about the future of the port and the area. During the project implementation, the city of The Hague put in place its plan for climate neutrality, arguably ‘stretching’ the assemblage still further by connecting it with another assemblage of activity into which it could be adopted and taken further forward.

Exploring the Ecologies of the System

This particular case study, then, can be seen as a number of overlapping assemblages that can be demarcated in a range of ways, both spatially and temporally. Each of these approaches can be seen to have value and to contribute to different scales and foci of analysis. In seeking to understand these, we must look not only at the spatial scales and connections between elements, but also at the time spans and rhythms of the interlocking stages of the evolving assemblage. Below we draw out some of these ecological elements in terms of four key analytical frames; Elements, Territories, Ecologies and Rhythms.

The Sea

The sea brings a range of meanings and potentialities to the assemblage. In an immediate technical sense, the sea is an enabler of the district heating system. It presented an opportunity: “We have the sea here and there’s a lot of energy in it and we can try to get this energy out of the sea and bring it into the houses so that we can reduce CO2 in energy waste” (Interview). Although in principle any source of water could be used, whether seawater or fresh water, not all settlements have a nearby source. An interviewee observed that fresh water in the Netherlands can freeze during colder winters, thereby reducing its utility for district heating. The harbour area had also recently been subject to a change of use, resulting in lower marine traffic. The location of the sea relative to the project, the year round suitability of the water for the task, and the availability of the harbour, therefore, were enablers of the approach.

This is not to claim that without the sea there could be no district heating system, as other sources of heat could clearly be found, but it is clear that the sea was one of the combination of elements that enabled this assemblage to transition from an idea to a working heating system. In fact, other technical approaches were explored but one in particular, ground source heat pumps for the houses, were made difficult by other natural conditions: ‘They wanted to work with a heat pump in the houses, but the ground is all sand and they have to make a very deep well to use this and it’s also salt for the heat pumps in the houses and it’s not possible in this location, so they have to use a conventional gas boiler. This was one of the reasons they developed this whole system with a heat exchange from seawater… into the houses.’ (Interview)

Despite it’s essential role, for many of the residents, it appears that the crucial enabling status of the seawater was an unknown: ‘they are hardly aware that they’re utilising heat from seawater’ (Interview). Whilst there were a few instances of confusion – ‘[Residents were asking] doesn’t it harm my house if there’s seawater going through my house?’ (Interview). The provision of heating and cooling, rather than its source, were seen to be the concern: ‘they feel that they have very comfortable houses… they’re very happy about that’ (Interview).

The sea also provides a socio-historical context for the project. The area consists primarily of small family houses between 1915 and 1931 originally occupied by fishermen. Fishing had long been the main industry of the area, and the nearby harbour of Scheveningen is busy with fishing and freight vessels. This was something that the developers were aware of, particularly in terms of communicating the work: ‘the social background of the people who live in Duindorp was with roots in fishermen families and there was an old [combination] with the sea, and in some marketing we used that old combination in the new combination with the sea' (Workshop participant). In addition to communicating with residents, the connection of the area with the sea also has potential resonance outside of the area: ‘…that you deal more with the sea than only for touristic or recreational reasons is an extra argument' (Interview).

Clearly, as a low lying country coastal defences are an important issue to the Netherlands and therefore the sea also creates a governance and planning challenge. In this context, the sea is, as Hillier argues (Hillier, 2009, p. 645), a 'dynamic multiple actant', and the harbour and its operations can be seen as a component assemblage. At the time of project design, this assemblage was changing; large container transport was being moved to another harbour, freeing up capacity in the Scheveningen Harbour area. An interviewee recounted the response of the planning authority, which was to say 'Wait. We have to think again about totally restructuring the harbour site. So no seawater power station in the middle of it because we don't know if it hurts our totally new plans' (Interview). This delayed implementation for a number of years, but by presenting the argument that the seawater district heating apparatus would be temporary, up 20 years in this case, the planning authority were able to see that this relatively localised project could potentially fit into a larger project, encompassing a larger territory, in coming decades: 'Well, when we are finished with the definitive plans, then we start with a completely new energy power station, but then for the whole plan, not only for Duindorp' (Interview).

Another assemblage that has the sea and the coastline as elements is the coastal defence system, linking to 'ebbing, flowing and flooding' of the ocean (Hillier, 2009, p. 645). This had implications for the construction of the plant: 'It's part of the coastal defence system against flooding – so that you can't do anything... So for instance, you cannot build… You can't move any sand around between October and April' (Interview). Furthermore, the area is an important tourism location, which made it difficult to do significant work during the summer.

Hillier (2009, p. 645) argues that a ship itself is an assemblage, and one that 'performed along networked trajectories during their working lives and beyond', in ports, oceans and ship breakers, for example. They exemplify, she continues, Latour's concept of 'immutable mobiles' that move around whilst holding their form. Larger ships have a particular influence on the assemblage of the plant and heating network at an operational level: 'When one of the big ships is going out, he starts his engines and he's swirling the water in the harbour. At that moment we have to shut up the process because it's better for the filters. You can wait for an hour and when the sand goes down then you start it up again, no problem' (Interview).

Finally, the sea also accommodates non-human actants, which influence operations. An example is sea shells: 'That's one of the problems we have at this moment, but not so much: sea life.' (Interview). This was dealt with by adding a small amount of chemical into the salt water to reduce the biological film to avoid the shells growing in the tubes and in the strainers. Initially pollution in the form of bacteria and other organic material from the water entered the circulation system and 'every valve in the housing was immediately blocked by stuff' (Interview). This was solved by utilising resources outside the immediate assemblage: ‘We called in an expert on water treatment and he did a trick with replacing the water and doing some additions to the water… but happily that was a long time ago’ (Interview).

The Rhythms of the System

The seasons and fluctuations of the sea and harbour therefore influenced the construction of the plant, and continue to influence the operation of the heating system. Through these, one can observe a range of rhythms and temporalities that shape the assemblage over time. The history of fishing in the village and area illustrates that the ‘root’ of the assemblage can be traced back centuries, in the sense that elements that continue to be important were (arguably even more) prominent centuries ago. In comparison, the changes in operation of the harbour occurred more recently and within a decade. Within the period of each year, there are seasonal fluctuations associated with the coastal defence function of the area, and it’s tourism role. Day by day and week by week, there are operational challenges and technical issues.

Stakeholders also hinted at the need to consider developments and changing contexts in subsequent decades, indicating the continually evolving nature of the assemblage: ‘developments with that kind of technology are going very fast and with climate change going on there might be more questions of how to cool these houses than how to heat them.’ (Interview)

The new heating technology altered the timescales of the way residents negotiate thermal comfort since the houses are ‘slow houses’, in the sense that they could not be heated up or cooled down quickly: ‘if you are used to a house where you can switch up the temperature within a quarter of an hour or so, it’s not good in these houses, it doesn’t work… So you have to learn to live in a slow temperature house… Some like it, others have to adjust to it’ (Interview).

There were other aspects to which individuals needed to become accustomed, and which were communicated by Vestia in brochures. It is believed not to be appropriate, for example, to use certain types of, highly resistant, carpets, since these render the low temperature heating ineffective (Interview). Another difference was that, with the houses no longer connected to the main gas network, the kitchens were equipped with ovens powered by electric instead of gas. Vestia made available an introductory set of pots and pans better suited to electric hobs. A ‘simple gift [that] if you buy them in their thousands, costs nothing’ but help to ensure a smoother transition to the new system and foster more positive publicity: ‘If they have a bad story then you go out. If the first stories are successful, even with giving gifts, the story continues’ (workshop participant). The housing corporation ‘made a point of special information for newcomers in the area for buyers and owners’ (workshop participant) and such information, and free gifts arguably became stabilising factors.

Conclusions: The Seamed Web?

> There was never a time when human agency was anything other than an interfolding network of humanity and nonhumanity. What is perhaps different today is that the higher degree of infrastructural and technological complexity has rendered this harder to deny" (Bennett, 2005, p. 463).

As this case of a Seawater District Heating system illustrates, the image of a stable technological system, moulded and shaped into a final obdurate form by social and political interests is a narrative that conceals as much as it reveals. In particular we can see the fluidity of the development process that twists and turns as the system emerges and changes shape. For example, the experience of Eneco leaving the consortium relatively early in the process because they believed it would not be effective and that their financial return would be insufficient: 'Eneco didn't believe it, and they caused us quite some trouble. They retreated, so then we had this gap' (Interview). Vestia were able to fill the gap, and additional funds, of around 0.5 million Euros were provided by the city of The Hague. At this stage, the number of houses on the project was reduced, with the implication that the pay back period for Vestia would be longer.

Similarly, the team also tried to engage with a national organisation that assessed energy projects but, according to the interviews, they appeared to share Eneco's lack of faith in the ability of the project to meet its goals. According the interviews, Eneco's and this organisations dominance and respected position in the energy market had implications for the way others perceived it: 'at the time [they] gave a very bad image to the project and that caused a lot of trouble in convincing people that it would work and could work and that it was worth financing' (Interview), indicating the relative weight of Eneco and this national organisation within the assemblage. Deerns brought in research organisation TNC to make the case for the project's potential. Later Star Alliance, with the recommendation the project was given an award to recognise its innovative nature, arguably having a stabilising effect on the assemblage by recognising Vestia's role within it.

In these ways the Duindorp case, then, provides a useful account of the situationally specific dynamics through which urban systems emerge, mutate and stabilise (at least for a time). The case also evidences the value of assemblage thinking in describing and understanding the contextual practices and processes of system building, and here the link to ANT and its value to urban studies is made clear. However, we would argue that as a conceptual tool the notion of an urban system as an assemblage encourages us to look beyond the twists and turns, connections, mediations and displacements that characterise many ANT accounts, in order to explore novel themes and associations that help constitute the assembly. In this case we took an ecological turn to explore the multiple roles of the sea and ships as actors and how they act as multiple objects; cultural, historical, economic, risk, logistical, biological and so on. This in turn nudged us to consider the idea of flows of time in terms of rhythm, of the tides, of the heating profile of houses, of historical domestic practices and so on. All of these elements were framed by competing ideas of territory; domestic, community and national. Figure 2 shows these interconnecting elements which highlights the relational complexity and situational specificity of the system which leads us to perhaps invert Thomas Hughes notion of a ‘seamless web’ into a ‘seamed web’ through which an ever present process of weaving and re weaving is central to the assembly of the system.

However, we do need to be wary of over romanticising the interpretive framework provided by the conceptual toll of Assemblage and to avoid over-privileging the fluidity or contextual basis of system building. Wachsmuth et al (Wachsmuth et al., 2011, p. 742) warn of a tendency of assemblage theory to try to be all encompassing, which they attribute to a ‘failure to define the concept of assemblage with appropriate precision’. They also suggest that there has been a ‘fetishization of micro-level interactions and sites with cities’ (Wachsmuth et al., 2011, p. 742), an undertheorization of structural and institutional power relationships, and an ‘unreflexive embrace of descriptive modes of analysis’. They argue that ‘unless assemblage-based approaches are carefully defined and precisely articulated… they risk being mobilised in less productive, less illuminating and, ultimately, less critical ways than might otherwise be possible.’

To return to the themes of this collection, we have shown how our case study highlights the potential contribution of the assemblage perspective and its ability to reveal complexity and context specificity and what the Editors have described as the “nuanced ways in which plan and policy creation and implementation relationships are developed and nurtured (or not)”. We can also see the enduring relevance of Jane Summerton’s description of the implementation of Swedish District heating system in 1990s and the “tensions and tactics behind their emergence” and “the complexity of the social organization that supports them” (Summerton 1992: 62). If this book is help to create a “launching pad” for progressive agendas then the alternative, relational frame of how systems are assembled, maintained and disassembled illustrated by this case, surely encourages us to look beyond the naive certainties of best practice policy toward a richer engagement with the practices, politics and places of system building.

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