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The relational geometry of the port-city interface: Case studies of Amsterdam, the Netherlands, and Ghent, Belgium

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ABSTRACT

The aim of this paper is to operationalize a relational approach to the study of port-city interfaces. A relational approach allows for the analysis of how actors are connected, transact, and assign meaning and value to regional development. Much of the literature on port-city interfaces has primarily focussed on late 20th century transformation processes at the urban waterfront. This fails to appreciate the often-continued presence of port activity within cities and falls short in understanding how the development agendas of port cities are relationally constituted. In this paper, first we argue that the port-city interface is a relational geometry through which heterogeneous flows of actors, assets, and structures are coupled. Second, we present an analytical framework capable of operationalizing such relational approach. The contemporary relational geometries in the bio-based sectors within the port cities of Amsterdam and Ghent are taken as starting points. Analysing these reveal how different coupling mechanisms result in particular development trajectories of the port city, setting the scene for future coupling mechanisms. This paper concludes with a discussion on the value of a relational approach to the study of port-city interfaces.

1. Introduction

The aim of this paper is to operationalize the relational approach to the port-city interface. As a concept, the port-city interface is over three decades old and was introduced during the 1980s to understand contemporary transformations at the urban waterfront. It was based upon the observation that port and urban economies became increasingly disconnected (Hayuth, 1982; Hoyle, 1989). The introduction of the concept at the time built upon earlier conceptions within geographical literature on the evolution of ports, most notably James Bird (1963). It deviated from studies that addressed the role of port cities as transport gateways and trading hubs in shaping urban fortunes (for an overview see Ng et al., 2014). As containerization and automation decreased demand for manual labour and as port-industrial activities increasingly became incompatible with inner-city waterfront locations, a disruption was identified in a once symbiotic relationship. This manifested itself in the interface of ports and cities. Indeed, the port-city interface became a developers' window of opportunity for urban renewal, arguably starting in Baltimore and Boston (Bruttomesso, 1993).

Waterfront redevelopment became a real planning concern in many places across the world (Hein, 2013). However, transport and economic geographers formulated a critique to this 'dual' and 'universal' (cf. any port) biased view on port cities and called for a reconnection between port geography and (urban) economic geography (see Ducruet, 2011; Hall and Hesse, 2012; Hall and Jacobs, 2012). The critique is at least fourfold. Firstly, although warehouses and transhipment quays became obsolete in city cores, this did not at all imply an end of distribution activity. Large-scale warehouses moved to greenfield locations in the hinterlands of port cities, while cargo handling terminals moved to sites with blue-water access, rescaling the port-city interface to the region, yet with major cargo handling still moving through primary ports (Notteboom and Rodrigue, 2005). Secondly, much of the policy discourse and academic studies have focussed on only one element of the interface, namely the 'geographical… area of transition between port land uses and urban land uses', more known as the 'waterfront', ignoring the interface as 'an interactive economic system' (Hoyle, 1989, p. 429). Understanding the port-city interface as such implies the existence of positive and negative feedback loops between port activity and the wider urban economy. These interactions transcend administrative boundaries and the use of land (cf. Slack, 1989). Defining the port-city interface purely in terms of (in-)compatible land uses fails to account for how, for example, specialized business services in the city connect with port and shipping operations through all kinds of transactions, e.g. finance, risk management etc. (Jacobs et al., 2010; Zhao

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et al., 2017), and how entrepreneurship and startups related to maritime activity are facilitated by dynamic urbanization externalities (Hall and Jacobs, 2012; Witte et al., 2017). Thirdly, one needs to take into account how innovations redefine the way logistics and production networks are organised and how these impact upon globalized metropolitan regions (Beyers and Fowler, 2012; Hall, 2009; O'Connor et al., 2016). These points are congruent to a fourth, more general critique, which concerns the lack of theoretical and empirical understanding within the studies on the port-city interface of how actors possess *agency* capable of coupling the various logics that drive both port and urban development into effective policy and planning (Jacobs and Lagendijk, 2014; Jacobs and Notteboom, 2011).

In this paper we therefore propose a relational approach to the port-city interface (see also Hesse, 2017). A relational approach allows us to focus on how the development of port cities is constituted through dynamic actor-relational practices and processes across territorial scales and along different institutionalized structures (cf. Storper, 1997). This relational approach has been applied to analyse the way actors strategically couple seaport assets with globalized flows of freight, and how such place-based strategies are articulated within evolving 'structures of provision' (Jacobs and Lagendijk, 2014). This leads to the following proposition: if we accept that the port-city interface is an interactive economic system, we are required to take into account the various coupling mechanisms creating different (inter-)relationships within this system. More specifically, we need to accept that particular forms of coordination and relational ties with a stake in the port-city interface operate and are articulated at various spatial levels of aggregation, from the local to the global. Most importantly, we need to realize that the port-city interface is a self-organizing system consisting of many subsystems (e.g. origins and destinations of goods handled in the port, cultural diasporas in the city, style of local leadership etc.), in which particular outcomes - relational geometries-emerge from 'structural couplings' (Luhmann, 1982). Consequently, every port-city interface is unique, as juxtaposed with the Anyport (-city interface) Model (cf. Hall and Jacobs, 2012).The purpose of this paper is therefore to operationalize a relational approach of the port-city interface in order to understand how coupling mechanisms occur and determine regional development.

For that purpose, the outline of this paper is as follows. Section 2 will discuss the relational approach and its application towards the port-city interface. This will result in an analytical framework for studying the regional development of the port-city interface. Section 3 presents and analyses the port-city interfaces of Amsterdam and Ghent by focussing on the bio-based sector. In Section 4 we discuss the value of a relational approach to the study of port-city interfaces.

2. An analytical framework to examine coupling mechanisms

Tracing back to the works of Massey (1979) and Thrift (1983), the relational approach within economic geography gained ground during the last two decades (Bathelt and Glückler, 2003; Sunley, 2008; Varró and Lagendijk, 2013; Yeung, 2015). As defined by Yeung (2005, p. 48):

> *A relational approach to regional development seeks to identify the complex relational geometry comprising local and non-local actors, tangible and intangible assets, formal and informal institutional structures, and their interactive power relations. […] The analytical focus is on the inherent tension in producing regional development outcomes.*

Likewise, within spatial planning, Davoudi (2006) called for an 'evidence-informed' strategic planning that looks at the relational causal coupling mechanisms that might become activated upon the enactment of policy. In other words, the premise of spatial planning is not a preferred end-result (e.g. blueprint planning), but rather a focus on the causal coupling mechanisms that steer regional development towards an 'undefined becoming' (Boelens and de Roo, 2014). As explained by Jacobs and Lagendijk (2014, pp. 45–46) 'relationality' is more than only an ontological term, presuming that economic entities and the scale at which they operate and are articulated (from the local to the global) do not have fixed inherent properties. Instead, they are the result of networked forms of relational processes that produce locations and assign meaning and value, through which they become embedded in different contexts (Sunley, 2008). Actors, assets and structures are thus only significant when they are articulated within activities (Bathelt and Glückler, 2003; Coe et al., 2004), hence constituting relational geometries.

A relational geometry as observed at a certain moment should be understood as a spatial-temporal phenomenon expressing the crystallization of power and structural capacities in particular institutions and actors. Understanding how a relational geometry exist, entails one needs 'to go back into time' (Sayer, 2000). Indeed, a relational geometry emerges as the outcome of continuous (re-)alignments and (de-)couplings of interests, assets and activities within actor-networks with the aim of securing 'spaces of dependence' (Cox, 1998; Jacobs and Lagendijk, 2014). In these processes, actors hold various degrees of power which materialize in relational 'spaces of engagement' articulated at various territorial scales. Power in this sense is a relational capacity exercised through the employment of resources to achieve desirable outcomes in multi-actor games (Allen, 2003). Applied to the port-city interface, such interactions can result in conflict and antagonisms between port and urban stakeholders (Wiegmans and Louw, 2011) or they can work in concert to articulate particular qualities of places, for example to attract foreign direct investments or secure government support at higher levels of governance.

Three different reciprocal coupling processes can be distinguished: tactical, strategic, and structural. Within economic geography, strategic coupling is the most well-known (Coe et al., 2004; Jacobs and Lagendijk, 2014; Sunley, 2008; Yeung, 2015). It refers to the process of matching local assets with global network demands. In line with Raimbault et al. (2016), we discern three inter-related forms of strategic coupling: physical/material, discursive and institutional. The most straightforward of these is firstly physical/material, in which coupling typically deals with the provision of infrastructure, the built environment and land use. The availability of land or the geographical access to markets via ports is a well-understood form of strategic coupling. Secondly, strategic coupling can be discursive. Such coupling deals with framing (Faludi, 1996) and typically invokes certain discourses, narratives and metaphors about investment objects or places that will align various actors around a common development agenda. Examples are the Dutch 'Mainport'-policy (van Gils et al., 2009) and the positioning of the Dutch inland port of Venlo and the Netherlands as a 'Greenport' (Raimbault et al., 2016). Lastly, strategic coupling can be institutional and deal with the employment of institutional assets (e.g. tax rulings) and the possible stretching of institutional arrangements (Martin, 2008), for example by formalizing and rearticulating specific mandates of (re)development agencies such as port authorities to engage with business (Notteboom et al., 2012).The political formalization of strategic spatial plans within (national) planning systems, for example, is an institutional form of coupling whereby the administrative-territorial aspects of collectively defined goals are combined with discursive and physical material aspects (Albrechts et al., 2003).

However, as in its original military connotation, the success of strategy is closely aligned with the employment of tactics. Thus, in order to achieve strategic couplings, coalitions or actors within coalitions employ tactics that serve the overall strategy. These tactics might involve the deliberate attempt to convince potential opponents to a particular project or development to engage in collaborative planning (Healey, 1997) what has been referred to as 'co-optation' (cf. Cox, 1998) or, alternatively, to block other stakeholders to join the coalition and influence the agenda. Such tactics can be backed-up by studies or expert opinions but may result into 'cherry-picking' (Davoudi, 2006). Following the distinctions described above, we distinguish three forms of tactical coupling. Discursive tactics are for example endorsements

during meetings or conferences (Hajer, 1995). Port-city celebration days, during which port areas are temporarily used for cultural events (van Hooydonk, 2007), can be understood as physical tactical couplings. Lastly, when independent companies, government agencies and knowledge institutes form a consortium (triple helix) they are tactically coupling in an institutional manner.

While tactical coupling is instrumental to strategic coupling, in which self-interests are articulated deliberately in collective actions and governance, such couplings may eventually result in a more fundamental 'structural coupling' (Luhmann, 1982). Structural coupling implies a profound change of the very nature or essence of the interacting entities (chemical formulae, actors, assets, institutions, societies and economies) involved and can be considered a *systemic* outcome, or what planning theorists refer to as an 'undefined becoming' (Boelens and de Roo, 2014). In structural coupling various 'subsystems' become connected, accumulate strength and accelerate towards a new equilibrium without any over-arching authority governing this process (Arthur et al., 1997). A new 'system' self-emerges (cf. Martin and Sunley, 2015) out of structural coupling that locks-in a development process. Within historical capitalist relationships we can think of the spatial-temporal fix of the Fordist means of production that became regulated under a Keynesian distributive welfare state as a form of structural coupling (Jessop, 2001; Lauria, 1997) or as a 'hegemonic discourse' (Hajer, 1995) on the commanding heights of the economy.

Using the three coupling processes and their discursive, physical, and institutional forms, we present the following analytical framework, which is capable of articulating the different and reciprocal coupling mechanisms constituting the contemporary relational geometry as observed (Table 1).

In our empirical research, we start with the premise that a certain form of structural coupling has taken place, in our case the emergence of the bio-based sector. The bio-based sector can be regarded as the outcome of a structural coupling in which different entities-the grain and oilseeds business and the organic waste business - have become coupled with the energy and chemical processing industry, eventually creating an economic sector with distinct (bio-)products (e.g. fuel, electricity, chemicals), production processes and business models. Again, structural couplings do not appear out of nowhere; they have emergent, self-organizing properties (Holland, 1998), yet rarely are they the pre-defined outcome of deliberate planning or governance; they are outcomes of undefined becoming. They are the aggregated result of tactical and strategic couplings that match more structural changes, in which: all coupling processes constantly condition and are conditioned by each other (Paasi, 2010).

2.1. Methods and data collection

Our empirical research has two related parts: (a) the identification and visualization of the contemporary relational geometry ('snapshot') and (b) the analysis and comparison of the relevant coupling mechanisms creating the relational geometry. For the identification and visualization of the relational geometry we focussed on six types of relations (Table 2).

Subsequently, we were able to visualize[1] the contemporary relational geometry of the port-city interface (Fig. 1). This informs us who are the relevant stakeholders, what their assets are, in which institutional structure they are situated and foremost in what way the relational geometry is constructed (cf. Yeung, 2005). Subsequently, we go back into time to find the relevant coupling mechanisms, our step 2. Different data sources can be used, such as press articles, annual reports or former studies, however, more effective are interviews with the relevant stakeholders, as a primary source, but also to triangulate and improve the former obtained quantitative and qualitative results. To select the relevant actors for our second step, the first step is our guide. Using our (quantitative) visualization, interviewees were selected based on first their assets, explaining the difference between for example multinationals or non-profit local research institutions, second their location within the several involved institutional structures, in this case port and city, third their position within the relational geometry, explaining the current crystallization of power and structural capacities in particular institutions and actors, and fourth their 'memory' to cover as much as possible the relevant time period (see Appendix A). Hence, between January 2017 and October 2017 the first author conducted 12 in-depth interviews with the main stakeholders in Ghent and Amsterdam to trace the relevant coupling mechanisms. The response rate was high, only the CEO of Simadan declined. However, much information was retrieved by the CEO of Orgaworld[2] The interviews were semi-structured letting the interviewee speak for him/herself and making it possible he/she could support, inform or even challenge an earlier version of the visualization or information retrieved from other interviewees. Eventually, we were possible on the one hand to adequately visualize our first step and on the other hand to recreate and compare the 'trajectory of coupling mechanisms', our second step.

3. The relational geometries of the port-city interfaces of Amsterdam and Ghent

We selected the port cities of Ghent and Amsterdam for three reasons. First, within the Hamburg-Le Havre port range, both Amsterdam and Ghent do not have a well-established maritime container sector, but they do feature more diverse industrial profiles. As they are more likely to be dependent on urban-led innovations, they have more opportunities for extended port-city interfaces. Second, we specifically focused on the bio-based sector, which has been present in both Amsterdam and Ghent for almost a decade (Kuipers et al., 2015; Vandermeulen et al., 2010). Third, the port authorities (PA) of both Amsterdam and Ghent have a landlord governance model with a corporatized structure in which the city of Amsterdam and the city of Ghent act as the sole or most important shareholder respectively (Havenbedrijf Amsterdam NV, 2017; Havenbedrijf Gent NV, 2017).

3.1. Amsterdam

As shown on Fig. 2, in Amsterdam the focal point of the bio-based sector is a group of bio-based companies sharing different input- and output-relations through pipelines, hence creating a cluster. This cluster is called 'Greenmills' and is located next to the Horndock (Kuipers et al., 2015). Within this cluster, the Dutch Simadan/Kuminda (owning most companies of Greenmills) and Orgaworld are the main actors. The main input for Greenmills is waste collection (e.g. used cooking oils or organic waste). The used cooking oils are collected and processed by Rotie. Out of this, on the one hand Rotie transfers organic oil to Biodiesel Amsterdam, producing biofuel from it, and on the other hand Rotie transfers organic waste to Orgaworld. Together with all other organic waste inflows, Orgaworld's main product is electricity. Biodiesel's biofuels are sold to oil terminals or stored at Simadan's Tank Storage.

The relational geometry does not reveal any important direct relations between the bio-based firms and urban actors in Amsterdam, the latter being for example research facilities. Two reasons explain this. First, Orgaworld as a standalone firm operates a significant R&D facility itself. Second, Amsterdam does not have a university with important bio-based activities. This is illustrated by the location of the main Dutch bioprocess pilot facility at the Technical University of Delft, 60 km south of Amsterdam.

[1] The visualization was performed using Esri ArcGIS 10.3 and its extension Schematics http://www.esri.com/software/arcgis/extensions/schematics

[2] Until the acquisition of Shanks in 2007, Orgaworld was a subsidiary of Simadan.

Table 1
Analytical framework to examine the different coupling mechanisms and their different forms (source: authors).

Coupling mechanisms	Coupling forms: Discursive	Physical/material	Institutional
Tactical	Endorsements	Temporary change use of the built enviroment	Temporary coalitions
Strategic	Framing	Long term investment projects	Stretching and layering of institutional arrangements
Structural	Hegemonic discourses	Spatio-temporal fix of social systems of production	Regulatory regimes

Table 2
The different relations taken into consideration.
Sources: Kuipers et al. (2015); Vandermeulen et al. (2010); annual company reports; company websites; Orbis/Belfirst Bureau van Dijk (Amsterdam/Ghent); Knack Top Trends (Ghent); LISA (Amsterdam)

	Relational type	Explanation	Examples
1	Input/output	For the production of goods	Grains, diesel, organic waste
2	Energetic	Used as input for support of production of goods	Electricity, diesel, heat
3	R&D	The (fundamental) research and development of production of goods or production processes (de Langen, 2002)	Processes in (lab-) environments
4	Advanced producer services	Services in support of (maritime) production/transport activities (Jacobs et al., 2010)	Engineering, IT services, insurance, legal advice
5	Membership/association	Organization in which companies/institutions meet each other (de Langen, 2002)	Association, labour union, chamber of commerce
6	Shareholder	Full or partial ownership of shares	Mother/daughter companies

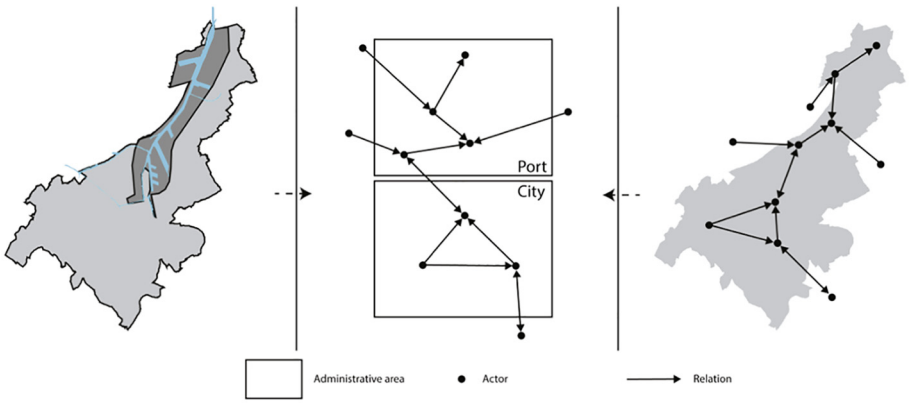

Fig. 1. Methodology for visualization of the relational geometry of the port-city interface.

I would not say that Orgaworld for its daily operations misses a closely located university, but it is nevertheless a disadvantage for the bio-based sector in Amsterdam. Occasionally, we work together with the universities of Delft or Wageningen. Hence, meetings have to be scheduled and distances have to be covered. (Orgaworld).

Out of the collaboration with Wageningen University, start-up Chaincraft moved to the R&D facilities of Orgaworld to elaborate its fermentation processes. Recently, in 2017, Chaincraft received financial support from the 'Kansen voor West'-development fund to build a medium-chain fatty acids (MCFA) demonstration factory (Verbraeken, 2017). The availability of joint-financing arrangements of Shift Invest and Kansen voor West within the relational geometry demonstrates the public and private intentions towards the bio-based sector. However, except for the upcoming MCFA factory, these funds have not yet led to significant new bio-based activities.

3.2. Ghent

The port of Ghent holds three important bio-based production processes (Fig. 3). The first is the production of bio-chemicals (Oleon). The second is the production of electricity within the wood pellet biomass facility of Max Green. The third is the production of biodiesel and ethanol gas at Rodenhuize. Similar to Greenmills, Rodenhuize functions as a cluster in which biofuels are integrally produced. For that reason, we focus primarily on Rodenhuize.

Different than Greenmills, Rodenhuize produces biofuels from renewable agriculture products. On the one hand Eurosilo transfers

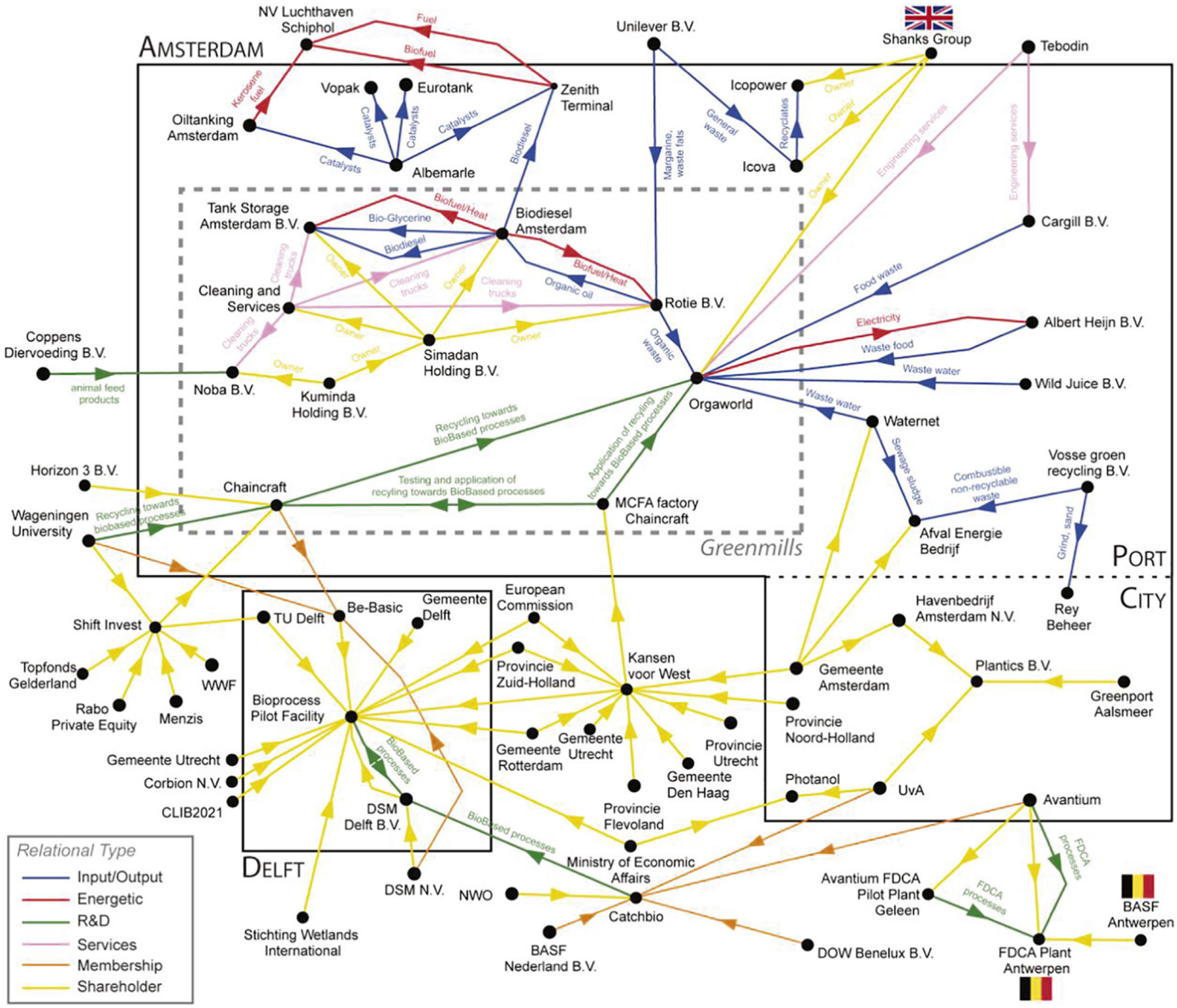

Fig. 2. The relational geometry of the bio-based sector in Amsterdam.

rapeseed to Cargill. Cargill processes these to oil, which is used to produce biodiesel by Bioro. On the other hand, Eurosilo transfers wheat to Alco Bio Fuel to produce bio-ethanol. The biodiesel and–ethanol are stored at Oiltanking. The financial (in)direct relations reveal that the American company Cargill and the Belgian company Vanden Avenne are the main shareholders. Next, the relational geometry shows strong connections between the industrial firms and urban actors within Ghent. These centralize in Flanders Biobased Valley (FBBV), a non-profit organization aimed at representing and managing the bio-based lobbying and research activities in Ghent. FBBV, led by Professor Wim Soetaert, is located within the bioengineering faculty of Ghent University. Both the research facility Bio Base Europe Pilot Plant in Ghent and the training facility BioPark in the Dutch port of Terneuzen are important hereby. The aim of both is to do innovative research and training in the region, in close collaboration with the Ghent University and other (inter)national biotech firms.

3.3. Case comparison

As visualised in Fig. 4, in the premise of the biobased sector, both in Amsterdam as in Ghent a discursive strategic coupling occurred, illustrating the ambition and opportunities of the region. These were both couplings between private companies and public institutions. In Amsterdam this was Simadan, Orgaworld and the PA Amsterdam. In Ghent this was Eurosilo, Cargill, Vanden Avenne, Oiltanking, the Ghent University and the PA and city of Ghent. The difference between both during this initial period is the lobbying, managing and scientific goal the discursive coupling was endowed with in Ghent. This discursive coupling became strategically institutionalized as Ghent Biobased Economy Valley (GBEV), while the discursive coupling in Amsterdam was merely in terms of promotion.

In the first years, this difference did not altered the development of the biobased sector. Both in Amsterdam and Ghent, a strategic physical/material coupling occurred, establishing a biobased economic cluster (“Rodenhuize”, “Greenmills”). The scientific goal of GBEV, being thus the difference with Amsterdam, eventually resulted in the approval of an EU Interreg program. Being a requirement of Interreg, the GBEV applied together with the Dutch Zeeland Seaports which borders the port of Ghent.

The port of Ghent, the city of Ghent and Zeeland Seaports not only

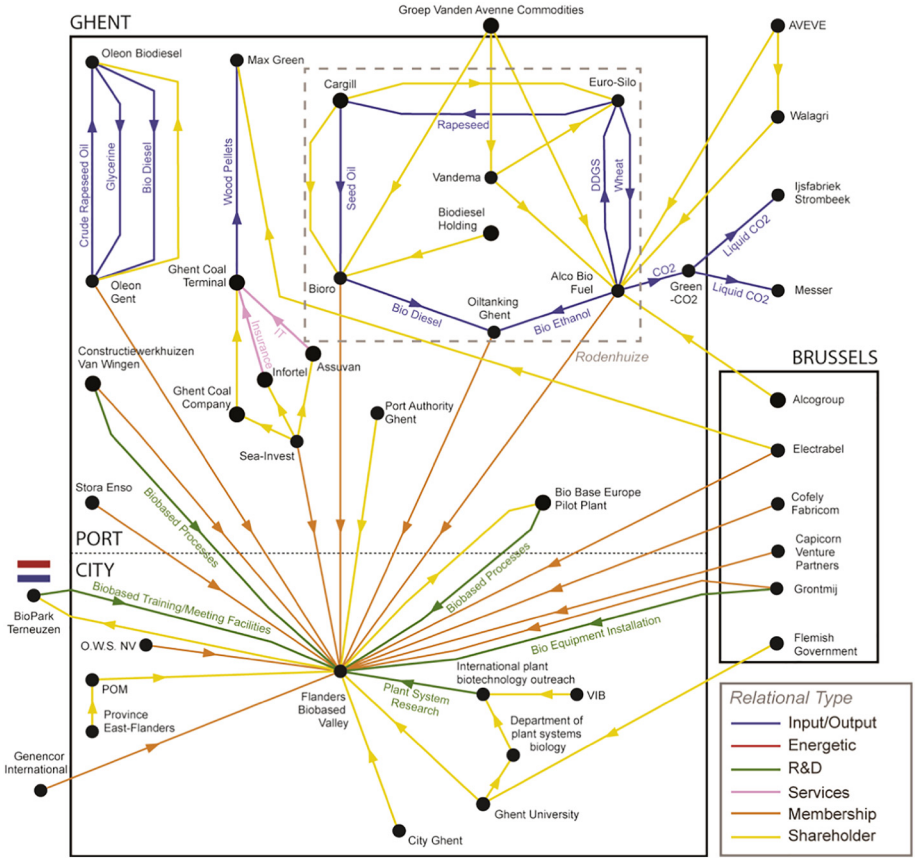

Fig. 3. The relational geometry of the bio-based sector in Ghent.

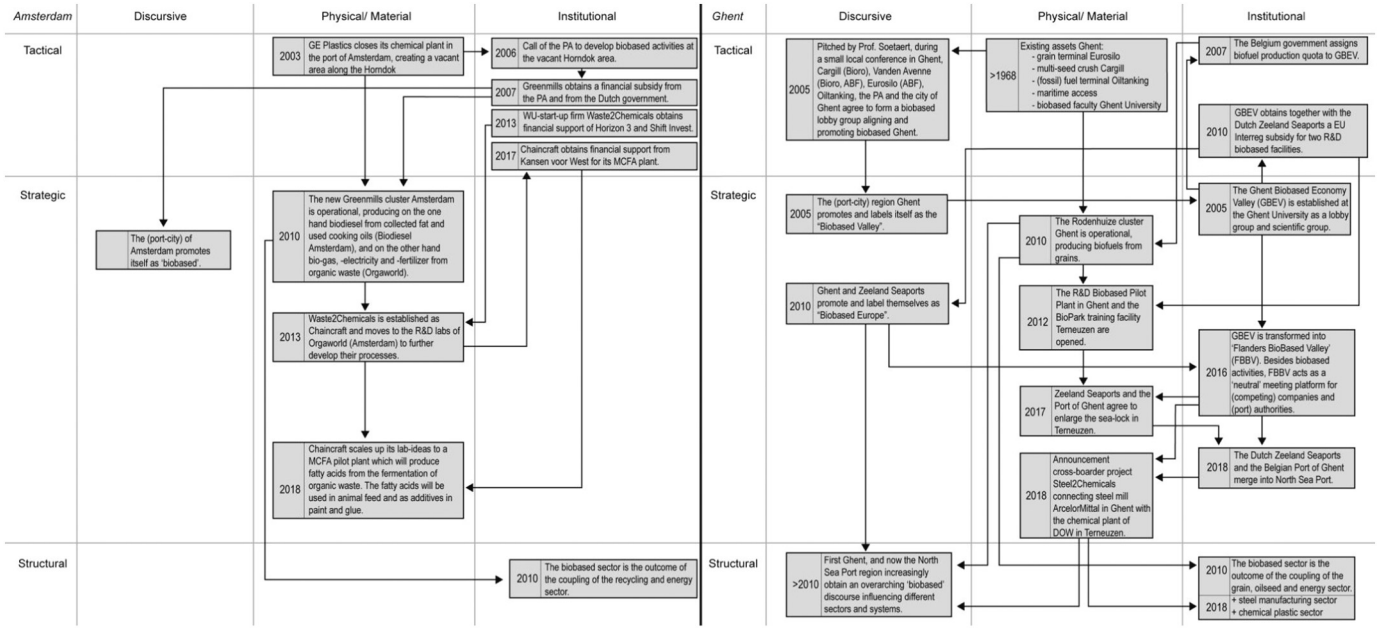

Fig. 4. The different coupling mechanism trajectories explaining the current relational geometries of the bio-based sector in Amsterdam (left) and Ghent (right).

became strategically labelled as "biobased Europe", but also strategic institutional coupled. Out of the interviews we learned that GBEV/FBBV played a crucial role for the coupling mechanisms since then:

> *Maybe the most important aspect of GBEV is that it became a neutral discussion platform for companies and public authorities to discuss much more than only bio-based ideas. For example, for many years, during the GBEV meetings the new sea lock in Terneuzen or the merge between the port of Ghent and Zeeland Seaports were discussed.* (Professor Wim Soetaert).

Indeed, since the 1st of January 2018, the Belgian Port of Ghent and

the Dutch Zeeland Seaports merged into North Sea Port. This strategic institutional coupling can be seen as a 'contingent necessity' (Sayer, 2000, p. 16). The coupling that occurred through FBBV and the border crossing bio-based label, created new conditions which demanded new coupling mechanisms to arise. In other words, the strategic institutional FBBV coupling conditioned (and is also becoming increasingly conditioned by) a strategic physical/material coupling (the new sea-lock) as well as a strategic institutional coupling (North Sea Port).

> *Prior to 2005, we focussed foremost on throughput. This is still important, but the bio-based success has convinced us of the importance of having a well-connected economy. Not only between companies, but also between economic sectors and also with Zeeland Seaports.* (Port authority Ghent).

The structural coupling of the bio-based sector in 2010 in Ghent and the succeeding couplings since then, is also triggering new strategic economic couplings, such as the ongoing Steel2Chemicals program. Steel2Chemicals aims at converting the CO2-emission gasses from the steel mill ArcelorMittal in Ghent to Naphtha, which can be used as input resources by the DOW chemical plastic plant in Terneuzen. Although both ArcelorMittal and DOW are already present in Ghent and Terneuzen respectively for a few decades, Steel2Chemicals is possible because first FBBV brought the two companies together during their meetings, and second the North Sea Port authority can now more easily foresee the necessary transboundary infrastructure to implement this program. Hence, if this coupling succeeds, it would reinforce the structural emergence of the biobased sector within the region. In other words, it will 'add' new economic sectors (steel manufacturing and plastics) to the overarching 'bio-based' sector.

4. Discussion and conclusion

This paper contributes to ongoing debates on the port-city interface by operationalizing a relational approach, conceptually and methodologically. Our starting point is, in line with Hoyle (1989), the proposition that the port-city interface is 'an interactive economic system'; one that consist of continuously changing relational geometries. This resonates with the suggestion of Hall and Jacobs (2012) and Hesse (2017) to look beyond the spatial-synthetic models in explaining the evolution of port cities.

Conceptually, then, we draw attention on various coupling mechanisms (tactical, strategic and structural) and coupling forms (discursively, physical-material and institutional) that can be employed by agency and through which relational geometries change. Methodologically, we proposed a two-step iterative and reflexive methodology (Sayer, 2000). The first step is to visualize the current relational geometry, in our case the structural coupling of the bio-based sector in Amsterdam and Ghent, based upon various company-level data sources and secondary material. The second step is to identify and analyse the coupling mechanisms which have created the current relational geometries, in a more qualitative fashion through interviews with representatives of coupling agents. A critical point here is the background of the people interviewed, since they can have different temporal 'institutional memories' on their roles and those of others in what essentially is a reconstruction. The further back in time, the less likely it is that this can be achieved (since people make career changes, become more selective in their memories, or simply passed away). Closely related is the nature of the cases, which in our case are admittedly quite harmonious. In more conflictual situations, and in cases where couplings fail to materialize or when there is a de-coupling (cf. MacKinnon, 2012), key people are less acceptable to discuss past failures or are simply frustrated.

Nonetheless, the two case studies demonstrated the value of our approach. Relational geometries are spatial-temporal phenomenon which are not simple assemblages, but express the crystallization of power and structural capacities in particular institutions and actors. The approach taken in this paper has also implications beyond the confines of transport geography, in particular with regards the 'strategic coupling' of places and networks as studied in GPN-studies (Yeung and Coe, 2015). We have argued that strategic coupling can have particular forms, which we heuristically have categorized as physical-material, institutional and discursive. While within GPN studies these forms of coupling are recognized in one way or another, our approach allows for further nuance on the question what is coupled and how. We furthermore argued that 'strategic' is just one, albeit important, mechanism of coupling but one that is supported by tactics and tactical couplings. This implies an empirically closer look at what it is that actors do in support of strategic coupling. More fundamentally, we have identified 'structural coupling' as a higher-level emerging outcome, beyond the control of those involved, which deserve further inquiry. Emergency implies that larger entities arise through the complex interactions among smaller or simpler entities and that exhibit properties that those smaller entities do not have (Sunley, 2008). In our case, we have identified the emergence of bio-based industry as a structural coupling. The cases show how such coupling materializes in physical form. However, in more discursive and institutional forms it remains still an open path whether a true structural coupling will take place, despite all kinds of policy framing on the 'circular economy' and 'bio-based economy' and at what scale (beyond the local) such couplings takes shape.

This latter issue puts focus on viewing the port-city interface as an interactive *complex* system, one that is characterized by self-organization, non-linearity and adaptation. Such perspective is needed, we have argued, to study the evolution of port-cities beyond the simple waterfront redevelopment stage. Indeed, while Norcliffe et al. (1996) have found what we could interpret as structural de-coupling of the port and city in a postmodern era, we now find ourselves in a period of major transitions that puts more emphasis on the way ports and transport networks are part of larger urbanized ecosystems which drive change.

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Appendix A. List of interviewees

Amsterdam			Ghent		
Name	Main task/role	Date	Name	Main task/role	Date
Orgaworld (CEO Klaas van den Berg)–since 2012	Biodiesel production	12-1-2017	City of Ghent (Lieven Tusschans)–since 1990	Economy department	14-3-2017
Port Authority of Amsterdam (Micha Hes)–since 2009	Bio-based/circular responsible	27-1-2017	Cargill Ghent/Bioro Ghent (Luc Malysse)–since 1989	Biodiesel production	2-8-2017
Chaincraft (CEO Niels van Stralen)–since 2010	R&D fermentation processes	3-2-2017	Eurosilo Ghent/alco Bio Fuel (Daniel Matthys)–since 1976	Bio-ethanol production/ Grain storage	17-8-2017
City of Amsterdam (Eveline Jonkhoff)–since 2011	Bio-based/circular department	6-2-2017	Oiltanking Ghent (Director Koen Van Kerkhove)–since 1986	(bio)fuels storage	21-8-2017
City of Amsterdam (Director Martijn van Vliet)–since 2000	Economy department	13-3-2017	Professor Wim Soetaert–since 2004	Ghent University, FBBV	7-9-2017
Amsterdam Economic Board (Marjolein Brasz)–since 2016	Bio-based economy association	27-3-2017	Port authority of Ghent (Director Daan Schalck)–since 2009	Landlord	1-9-2017

References

Albrechts, L., Healey, P., Kunzmann, K.R., 2003. Strategic spatial planning and regional governance in Europe. J. Am. Plan. Assoc. 69, 113. http://dx.doi.org/10.1080/01944360308976301.

Allen, J., 2003. Lost Geographies of Power. John Wiley & Sons.

Arthur, W.B., Durlauf, S.N., Lane, D.A., 1997. The Economy as an Evolving Complex System II. Addison-Wesley, Reading, MA.

Bathelt, H., Glückler, J., 2003. Toward a relational economic geography. J. Econ. Geogr. 3, 117–144. http://dx.doi.org/10.1093/jeg/3.2.117.

Beyers, W.B., Fowler, C.S., 2012. In: Hall, P., Hesse, M. (Eds.), Economic structure, technological change and location theory. The evolution of models explaining the link between cities and flows. Cities, Regions and Flows. Routledge, London, pp. 23–41.

Bird, J., 1963. The Major Seaports of the United Kingdom. Hutchinson.

Boelens, L., de Roo, G., 2014. Planning of undefined becoming: first encounters of planners beyond the plan. Plan. Theory 15, 31. http://dx.doi.org/10.1177/1473095214542631.

Bruttomesso, R., 1993. Waterfronts: a New Frontier for Cities on Water. International Centre Cities on Water, Venice.

Coe, N.M., Hess, M., Yeung, H.W.-c., Dicken, P., Henderson, J., 2004. Globalizing'regional development: a global production networks perspective. Trans. Inst. Br. Geogr. 29, 468–484. http://dx.doi.org/10.1111/j.0020-2754.2004.00142.x.

Cox, K.R., 1998. Spaces of dependence, spaces of 1-26.10.1111. Polit. Geogr. 17, 1–23. http://dx.doi.org/10.1016/S0962-6298(97)00048-6.

Davoudi, S., 2006. Evidence-based planning. disP-Plan. Rev. 42, 14–24. http://dx.doi.org/10.1080/02513625.2006.10556951.

de Langen, P., 2002. Clustering and performance: the case of maritime clustering in The Netherlands. Marit. Policy Manag. 29, 209–221. http://dx.doi.org/10.1080/03088830210132605.

Ducruet, C., 2011. The port city in multidisciplinary analysis. In: Joan, A., Rinio, B. (Eds.), The Port City in the XXIst Century: New Challenges in the Relationship between Port and City. RETE, pp. 32–48.

Faludi, A., 1996. Framing with images. Environ. Plan. B 23, 93–108. http://dx.doi.org/10.1068/b230093.

Hajer, M.A., 1995. The Politics of Environmental Discourse: Ecological Modernization and the Policy Process. Clarendon Press.

Hall, P., 2009. Container ports, local benefits and transportation worker earnings. GeoJournal 74, 67–83. http://dx.doi.org/10.1007/s10708-008-9215-z.

Hall, P., Hesse, M., 2012. Cities, Regions and Flows. Routledge, London.

Hall, P., Jacobs, W., 2012. Why are maritime ports (still) urban, and why should policy-makers care? Marit. Policy Manag. 39, 189–206. http://dx.doi.org/10.1080/03088839.2011.650721.

Havenbedrijf Amsterdam NV, 2017. Annu. Rep. 1 (2016, 96 pages).

Havenbedrijf Gent NV, 2017. Annu. Rep. 1 (2016, 28 pages).

Hayuth, Y., 1982. The port-urban Interface-an area in transition. Area 14, 219–224. http://www.jstor.org/stable/20001825.

Healey, P., 1997. Collaborative Planning: Shaping Places in Fragmented Societies. Macmillan Press, London.

Hein, C., 2013. Port cities. In: Clark, P. (Ed.), The Oxford Handbook of Cities in World History, 1st ed. Oxford University Press, Oxford.

Hesse, M., 2017. Approaching the relational nature of the port-city interface in Europe: ties and tensions between seaports and the urban. Tijdschr. Econ. Soc. Geogr. http://dx.doi.org/10.1111/tesg.12282.

Holland, J., 1998. Emergence: From Chaos to Order. Oxford University Press, Oxford.

Hoyle, B.S., 1989. The Port City Interface-trends, problems and examples. Geoforum 20, 429–435. http://dx.doi.org/10.1016/0016-7185(89)90026-2.

Jacobs, W., Lagendijk, A., 2014. Strategic coupling as capacity: how seaports connect to global flows of containerized transport. Glob. Netw. 14, 44–62. http://dx.doi.org/10.1111/glob.12035.

Jacobs, W., Notteboom, T., 2011. An evolutionary perspective on regional port systems: the role of windows of opportunity in shaping seaport competition. Environ. Plan. A 43, 1674–1692. http://dx.doi.org/10.1068/a43417.

Jacobs, W., Ducruet, C., De Langen, P., 2010. Integrating world cities into production networks: the case of port cities. Glob. Netw. 10, 92–113. http://dx.doi.org/10.1111/j.1471-0374.2010.00276.x.

Jessop, B., 2001. Regulationist and autopoieticist reflections on Polanyi's account of market economies and the market society. New Polit. Econ. 6, 213–232. http://dx.doi.org/10.1080/13563460120060616.

Kuipers, B., De Jong, O., van Raak, R., Samders, F., Meesters, K., van Dam, J., 2015. De Amsterdamse haven draait (groen) door: Op weg naar duurzaam concurrentievoordeel door inzet op de biobased en circulaire economie. Erasmus Universiteit Rotterdam, Rotterdam.

Lauria, M., 1997. Reconstructing Urban Regime Theory. SAGE Publications.

Luhmann, N., 1982. The world society as a social system. Int. J. Gen. Syst. 8, 131–138. http://dx.doi.org/10.1080/03081078208547442.

MacKinnon, D., 2012. Beyond strategic coupling: reassessing the firm-region nexus in global production networks. J. Econ. Geogr. 12, 227–245. http://dx.doi.org/10.1093/jeg/lbr009.

Martin, R., 2008. National growth versus spatial equality? A cautionary note on the new 'trade-off' thinking in regional policy discourse. Reg. Sci. Policy Pract. 1, 3–13. http://dx.doi.org/10.1111/j.1757-7802.2008.00003.x.

Martin, R., Sunley, P., 2015. Towards a developmental turn in evolutionary economic geography? Reg. Stud. 49, 712–732. http://dx.doi.org/10.1080/00343404.2014.899431.

Massey, D., 1979. In what sense a regional problem? Reg. Stud. 13, 233–243. http://dx.doi.org/10.1080/09595237900185191.

Ng, A.K.Y., Ducruet, C., Jacobs, W., Monios, J., Notteboom, T., Rodrigue, J.-P., Slack, B., Tam, K.-c., Wilmsmeier, G., 2014. Port geography at the crossroads with human geography: between flows and spaces. J. Transp. Geogr. 41, 84–96. http://dx.doi.org/10.1016/j.jtrangeo.2014.08.012.

Norcliffe, G., Bassett, K., Hoare, T., 1996. The emergence of postmodernism on the urban waterfront. J. Transp. Geogr. 4, 123–134. http://dx.doi.org/10.1016/0966-6923(96)00005-1.

Notteboom, T., Rodrigue, J.-P., 2005. Port regionalization: towards a new phase in port development. Marit. Policy Manag. 32, 297–313. http://dx.doi.org/10.1080/03088830500139885.

Notteboom, T., Verhoeven, P., Fontanet, M., 2012. Current practices in European ports on the awarding of seaport terminals to private operators: towards an industry good practice guide. Marit. Policy Manag. 39, 107–123. http://dx.doi.org/10.1080/03088839.2011.642315.

O'Connor, K., Derudder, B., Witlox, F., 2016. Logistics services: global functions and global cities. Growth Chang. 47, 481–496. http://dx.doi.org/10.1111/grow.12136.

Paasi, A., 2010. Commentary. Environ. Plan. A 42, 2296–2301. http://dx.doi.org/10.1068/a42232.

Raimbault, N., Jacobs, W., van Dongen, F., 2016. Port regionalisation from a relational perspective: the rise of Venlo as Dutch international logistics hub. Tijdschr. Econ. Soc. Geogr. 107. http://dx.doi.org/10.1111/tesg.12134.

Sayer, A., 2000. Realism and social science. Sage 1http://dx.doi.org/10.4135/9781446218730. (224 pages, ISBN: 9780761961246).

Slack, B., 1989. The port service industry in an environment of change. Geoforum 20, 447–457. http://dx.doi.org/10.1016/0016-7185(89)90028-6.

Storper, M., 1997. The Regional World: Territorial Development in a Global Economy. Guilford Press, New York.

Sunley, P., 2008. Relational economic geography: a partial understanding or a new paradigm? Econ. Geogr. 84, 1–26. http://dx.doi.org/10.1111/j.1944-8287.2008.tb00389.x.

Thrift, N., 1983. On the determination of social action in space and time. Environ. Plan. D 1, 23–57. http://dx.doi.org/10.1068/d010023.
van Gils, M., Huijs, M., de Jong, B., 2009. De Nederlandse Mainport Onder Druk: Speuren Naar Ontwikkelkracht. Spectrum, Houten.
van Hooydonk, E., 2007. Soft Values of Seaports: A Strategy for the Restoration of Public Support for Seaports. Coronet Books Incorporated.
Vandermeulen, V., Nolte, S., Van Huylenbroeck, G., 2010. Hoe biobased is de Vlaamse economie? Departement Landbouw en Visserij. Afdeling Monitoring en Studie, UGent, Brussel, pp. 132.
Varró, K., Lagendijk, A., 2013. Conceptualizing the region–in what sense relational? Reg. Stud. 47, 18–28. http://dx.doi.org/10.1080/00343404.2011.602334.
Verbraeken, H., 2017. Chaincraft schaalt op bij productie biologische vetzuren. (Financieel Dagblad).
Wiegmans, B.W., Louw, E., 2011. Changing port–city relations at Amsterdam: a new phase at the interface? J. Transp. Geogr. 19, 575–583. http://dx.doi.org/10.1016/j.jtrangeo.2010.06.007.
Witte, P., Slack, B., Keesman, M., Jugie, J.-H., Wiegmans, B., 2017. Facilitating start-ups in port-city innovation ecosystems: a case study of Montreal and Rotterdam. J. Transp. Geogr. http://dx.doi.org/10.1016/j.jtrangeo.2017.03.006.
Yeung, H.W.-c., 2005. Rethinking relational economic geography. Trans. Inst. Br. Geogr. 30, 37–51. http://dx.doi.org/10.1111/j.1475-5661.2005.00150.x.
Yeung, H.W.-c., 2015. Regional development in the global economy: a dynamic perspective of strategic coupling in global production networks. Reg. Sci. Policy Pract. 7, 1–23. http://dx.doi.org/10.1111/rsp3.12055.
Yeung, H.W.-c., Coe, N.M., 2015. Toward a dynamic theory of global production networks. Econ. Geogr. 91, 29–58. http://dx.doi.org/10.1111/ecge.12063.
Zhao, Q., Xu, H., Wall, R.S., Stavropoulos, S., 2017. Building a bridge between port and city: improving the urban competitiveness of port cities. J. Transp. Geogr. 59. http://dx.doi.org/10.1016/j.jtrangeo.2017.01.014.