Keeping the focus on sustainability: a challenge for governance
Liber Amicorum presented to Prof.dr. Harry Geerlings

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Erasmus School of
Social and
Behavioural Sciences

Keeping the focus on sustainability: a challenge for governance

Liber Amicorum presented to Prof.dr. Harry Geerlings

Erasmus University Rotterdam
Making Minds Matter

Colophon

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Keeping the focus on sustainability: a challenge for governance

Liber Amicorum presented to Prof.dr. Harry Geerlings

Editors
Jos Vroomans
Bart Kuipers
Ron van Duin

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Preface

The lines in the text box on this page, taken from the traditional folk song, "The leaving of Liverpool" and made famous by the Dubliners, could express the feelings one may have when retiring from a job one has done with so much joy, effort, and passion. It shows that it's not really the building or the institution where you've spent all these years that you will miss, but it is for the people that your feelings can get mixed up. You start missing the moments when you discussed a topic with your colleagues, your students, people you met at conferences or even those in business life where your academic insights sometimes might meet a certain aloofness.

Because yes, when you are a professor, there are so many opportunities to meet so many interesting people. And all those moments give inspiration and needed debate for thoughts and research questions that lead to many research projects and publications.

This introduction is needed to set the scene for this book which is a liber amicorum for prof.dr. Harry Geerlings, Port Professor at Erasmus University Rotterdam who has the status of emeritus from this moment on. When someone like Harry says farewell to the academic institute Erasmus University Rotterdam, many people want to show that although he is saying farewell to the institute, they are not saying farewell to him.

This liber amicorum shows that Harry's research covered several fields of knowledge and that colleagues want to show their insights in those fields by writing about an adjacent (or central) topic. And they did this wholeheartedly for Harry. At the end of each contribution, the author has written a personal message for him, and in these messages, you will get an insight how well he was appreciated. Appreciation for his continuous efforts to raise attention for the need for a transition to sustainability in ports and the responsibility of academics to pay attention to this. Words as 'responsible, kindness, integrity, and modesty'. But also the ability to create a team spirit. Some authors have worked so closely with Harry that this personal note is intertwined within the text, when they reflect on a project they've done with Harry.

There is one person that must be mentioned in particular but who has not written a contribution. It is the eminence grise of port studies in Rotterdam, the former Rotterdam port authority director and professor at the Erasmus University, Henk Molenaar. He has been a mentor to Harry and regarded it more personal to have conversations with Harry in which he could express his appreciation for the work he delivered during the past decades.

It's not the leaving of Liverpool that grieves me
But my darling when I think of thee
From: The Leaving of Liverpool (Traditional)

The contributions in this liber amicorum can be grouped together around the themes Harry has been researching. These themes are Logistics, the Maritime sector, Governance and Sustainability. Of course, some contributions cover more than one theme, so the editors made a decision about where to put it in this book. If an author disagrees, we apologize upfront, but it will not harm the contribution in itself.

The next figure shows the distribution of the authors over the themes:

Author	Theme			
	governance	sustainability	logistics	maritime
Acciaro, M.				1
Castelein, B.	1			
Cullinane, K./Haralambides, H./Notteboom, T.	1			1
Dekker, R.				1
Froese, J.				1
Hafkamp, W.	1	1		
Klemann, H.			1	
Kuipers, B.		1	1	
Nijkamp, P./Kourtit, K.		1		
Ongkittikul, S.	1			
Van Ast, J.	1	1		
Van Duin, R./Wiegmans, B.		1	1	
Van Nispen, F.	1			
Vanelslander, T./Pauwels, M.				1
Veenstra, A./Zuidwijk, R.			1	
Visser, J.			1	
Vloemans, P./Fernandez, F.				1
Vroomans, J.	1			
	7	**5**	**5**	**6**

As you can see, 25 authors, two of them with short personal notes, 23 of them author of an article covering one or more of these themes.

The authors were approached to write a contribution because they collaborated with Harry on a research project, or they were a co-author for a book or paper. Some were involved in supervising a PhD student and Harry's own promotor also contributed to this book. Three former PhD students contributed. Harry was the promotor for two of them, and co-promotor for one of them. Two employees of ABB had such a good experience with Harry, that they wanted to make a personal note. These two short contributions are included as well. And of course, as he was appointed as a Port Professor, some of his fellow Port Professors made a contribution.

The next section of this liber amicorum presents a short profile of Harry and his work. An overview of his various activities is presented. This is followed by the articles. At the end of the book, the section 'About the authors' presents the background of those who consider themselves an 'amice'.

Harry, it has been a pleasure to compose this liber amicorum. We hope it's fun to read, just as we know it was a pleasure for the contributors as well.

The editors
Jos Vroomans, Bart Kuipers, Ron van Duin

Profile prof.dr. Harry Geerlings

Harry Geerlings was professor in the Governance of Sustainable Mobility at the Department of Public Administration and Sociology of the Erasmus University Rotterdam. Furthermore, as he was one of the seven port professors of Erasmus Smart Port Rotterdam, he continued his work with port research being a dominant topic after this organization transferred into SmartPort 2.0, a cooperation between the Rotterdam port community, Erasmus University Rotterdam and other key stakeholders in port related research.

For more than 25 years he specialized in research in the domain of sustainable transport, the interaction with environment and spatial planning and the need for change (in modern vocabulary: transition management). Valorization (getting the maximum value and usefulness out of projects), was one of his key priorities.

His teaching covered a wide range of topics, varying from energy consumption on container terminals, to the cultural and institutional aspect in port governance. He has been the chair of the Examination Board of his faculty that stands for the quality of the education and examination in his faculty.

For years, his monthly columns, often covering issues concerning sustainability, that were published in the Nieuwsblad Transport were reason to think things over, agree, disagree or even being upset about. For that, he delivered a necessary mirror for the maritime and marine sectors.

His activities cover an impressive variety from books to software as this wrap up of his publications shows:

Publications, etc.	Academic	Professional	Popular	Σ
Article	57	15	24	96
Book	6	2	1	9
Book editing	2	2		4
Book/fim/article review	2	1		3
Chapters				44
Conference contribution	15	5		20
Conference proceeding	15	2		17
Paper				15
Report	30	59		89
Research case				1
Software				3
Media				1
Oral presentation	4	1		5
Inaugural speech				1
Doctoral thesis				1
Retirement speech				1
				310

Harry Geerlings holds a Ph.D. in economics (1997) from the Free University in Amsterdam with Peter Nijkamp, Piet Rietveld and Bert van der Knaap as his promotors. He himself was promotor of 3 PhD's and is currently supervising 6 PhD candidates. Since its foundation in 1992, he is member the PhD research school TRAIL that offers programs for postgraduate Ph.D. students in the fields of mobility, transport, logistics, traffic and infrastructure.

Short outlines of the contributions

Castelein *Agriculture and logistics in the Netherlands – Limits to scale and finding the Dutch competitive edge*

Dutch society and the Dutch economy seem to have reached their limits to growth. This is visible in virtually all domains, including housing, the energy transition, public transport, healthcare, and education, where public demands seem to have outpaced the available resources for the time being. In this contribution the author reflects on the limits to growth in two domains in particular: Agriculture and (port) logistics – two domains in which the Netherlands has since long prided itself on its performance, innovativeness, and international competitiveness.

Hafkamp *The Death and Resurrection of Dutch Environmental Policy Elections in the 2020's: Europe or no Europe, environment or no environment?*

Hafkamp's paper concentrates on the challenges the Dutch governments face regarding policies to be made on environmental issues. There is the deepening gap between those who see climate change as a non-problem and others who now see the last chance to work on solutions. The second gap is between those who want 'less Europe' and others who want 'more Europe'. For the author, these two gaps are at odds with each other. In this contribution examines what has been going on with Dutch environmental policy in recent years. How and why this has disappeared and what can be done about it.

Ongkittikul *Behavioral Changes and Learning of Public Transport Agents in the Bus Regulatory Reform Process: A Case of Bangkok*

In this contribution, the author analyses regulatory reform using cognitive frames and learning as a conceptual framework to research the behavioral changes of public transport. This article shows the bus regulatory reform in Bangkok as a case study. Public transport agents in developing countries, like Bangkok, seem to have a low learning capability and are slow to adapt to regulatory change.

Van Nispen tot Pannerden *The European Semester: from Governability to Sustainability*

" The contribution of Van Nispen is constructed around his intensive collaboration with Harry Geerlings. Instead of a separate personal note, his affection for Harry is the start of this contribution. The paper continues with the story of that collaboration; followed by the topic of the recycling of waste about an unfinished research project on economic governance in the European context and ending with the topic of the green transition and, more precisely, sustainable mobility and by doing so referring to the mission ('leeropdracht') of Harry's endowed chair. "

Vroomans *New Public Management and Networks as simultaneously applied organizational structures: a tricky combination.*

" This paper researches the increasing lack of trust in public governance. It is stated that the unbalance in influence between the general public and business life on government policies could be contributing to this. This unbalance is generated due to a belief in New Public management and achieving that by the appliance of the Network Approach as a means of regulating society and achieving defined goals. As a result, there is a government that does not govern. "

Kuipers *Being sewn into the suit: Transumo A15 container study*

" Transumo A15 project From Maasvlakte to Hinterland; sustainable transport as a challenge' was an important, multidisciplinary research project, carried out in 2006-2009, with Harry Geerlings as project leader. The goal of Transumo A15 was to facilitate the expected growth of container flows to and from the Maasvlakte area in the port of Rotterdam and the hinterland of the port through a number of policy packages, aimed at limiting the growth of road transport especially by modal shift, making transport operations more sustainable and increasing of the quality of the environment in the Rotterdam port region. This article is devoted an assessment of this project. How realistic were the established policy measures as seen from the current perspective, 13 years later? The author concludes that some policies did indeed have the results intended, but that generally speaking, this project did not get the follow up it deserved. "

Nijkamp and Kourtit *Culture and Tourism: A sustainable Dilemma?*

" Their paper is dealing with sustainability in perspective of tourism: an outline of a new methodological framework on the importance of local culture for place-based sustainable development. It aims to develop a framework to map out systematically the critical success factors for a sustainable harmony between people and places, including tourists and local culture. "

Van Ast *The State of Environment & Policy*

" The paper of Van Ast reflects his longstanding working together with Harry Geerlings. Referring to their co-authored book 'Milieukunde en Milieubeleid, een introductie' (Environment and Policy, an introduction), in this contribution he describes the various challenges environment had and has to cope with and what kind of policies were defined and more or less applied to handle them. His conclusion about the willingness of policy makers to save the suicide bomber (read the paper!), is not a positive one. "

Van Duin and Wiegmans *The greening of hinterland corridors: towards a research agenda*

" This contribution proposes a future research agenda for the sustainable development of the freight corridors for the next five years. This is done by discussing three themes. i.e. (1) use of capacity, (2) lower impact modalities and (3) digitalization of the supply chain. As the corridors can be seen as the connecting lifelines of our ports and our cities (respectively distribution centres), the research topics in the agenda are quite important for the development and wellbeing of our future generation. "

Klemann *Rotterdam, the Rhine and Germany*

" His paper is describing the development of the relationship between The Netherlands and Germany, specifically Rotterdam and the Ruhr-region and the role of Rhine navigation in this. His paper shows the decline of the relation between these regions and researches a possible explanation for this decline and the results for Rhine shipping. "

Veenstra and Zuidwijk *Sustainable Global Supply Chains: From voluntary to regulated responsibility*

" Their paper tries to answer the research question if formal regulation of responsible practices in the supply chain can be effective and if yes, to what extent such an effective approach can be inferred from our understanding of voluntary schemes, existing regulations, and enforcement practices. It is argued that complexity in global supply chains challenges the validation of sustainability claims, whether those claims are based on voluntary or enforced programs. "

Visser *A View through a Window of Technological Opportunity: Going Underground with Freight*

In 2001, Visser and Geerlings explored the opportunities for underground freight transport. Now, twenty-one years later, this paper discusses whether the window of opportunity for underground freight transportation has improved. The conclusion is that circumstances have improved since 2001, especially due to the level of automation in logistics, but that this type of transportation is not part of long term policy visions.

Acciaro *Reducing greenhouse gas (GHG) emissions at ports: The need for new governance approaches*

As ports are major economic clusters and occupy a central position in global supply chain networks. Their role in transport networks also make them a site of significant negative environmental impacts. While direct port activities, such as cargo operations, may be limited in terms of carbon emissions compared to other industries, emissions from the entire port cluster can be significant. There has been growing interest in the role that ports, and with them port management companies (PMCs), can play in accelerating the development of a low-carbon economy. This paper provides some reflections on the strategic significance of this development in Europe and shows how the current green focus is the result of a decades-long process intertwined with and shaped by economic and historical events.

Dekker *The Ultra Large Container Vessel: A blessing or a curse*

In this contribution Dekker researches the increase of container ship sizes over time. There are advantages and disadvantages connected to this development, for shipping lines as for terminals. Shipping lines have invested in these ships for economic and competitive reasons. The larger ships also reduced the CO_2 footprint per container transported. On the downside, terminals had to invest in larger cranes and more handling and storage capacity. Yet also these investments were also used as a competitive action against smaller terminals. Illustrative is the case of Airbus 380 that is used as an analogy for demonstrating the decisions made for larger or smaller capacities. The author argues that a further increase in ship size is not foreseeable in the near future.

Froese *Navigation – Risk and Sustainability*

In this contribution Froese explores the possibilities of assessing the risks of navigation. Reducing risks of navigation is important as one single navigational casualty can easily wipe off the positive results of many years of efforts to improve sustainability in sea transport. There are methods available to conduct a quantitative risk assessment, but it is difficult. Globally collecting relevant empirical data to allow a statical determination could make risk analysis results less questionable and provide a sound basis for safe management of navigation.

Pauwels and Vanelslander *Green investments in non-European seaports: a comparison of major seaports*

This paper focuses on green investments in non-European seaports. It aims to find out to what extent non-European seaports differ from each other in terms of green investments. For this, it examines whether a pattern can be observed regarding green investments, the economic profitability with or without government support, what the future will bring regarding green investments in seaports and what the best practices are.

Cullinane, Haralambides and Notteboom *Weathering the COVID-19 pandemic towards the 'new normal': potential longer-term impacts on port and shipping governance, performance, and infrastructure geopolitics*

The objective of this contribution is to identify the effects and implications of the COVID-19 pandemic on the activities, operations, management structure and performance of the international ports industry. The analysis is undertaken by positioning the immediate impact and potential longer-term implications of this significant disruptor within the wider context of contemporary research in the field of port economics. It provides an assessment of some of the key issues and themes in port economics research, attempting at the same time to propose new thought avenues for further port research in a post COVID-19 era. The overview of the literature used is a fine example of the extensive port research of the last decades, especially on port governance.

Vloemans and Fernandez *Salutation to Harry Geerlings from the perspective of ABB team members*

Two short descriptions of memories of working with Harry.

Agriculture and logistics in the Netherlands – Limits to scale and finding the Dutch competitive edge

Bob Castelein[1]

1. Introduction

Writing this in 2022, Dutch society and the Dutch economy seem to have reached their limits to growth. This is visible in virtually all domains, including housing, the energy transition, public transport, healthcare, and education, where public demands seem to have outpaced the available resources for the time being. In this chapter I reflect on the limits to growth in two domains in particular: Agriculture and (port) logistics – two domains in which the Netherlands has since long prided itself on its performance, innovativeness, and international competitiveness. Also here it seems that now something has to give.

In agriculture, intensive livestock farming with significant nitrogen emissions, cannot continue at the current scale (Adviescollege Stikstofproblematiek, 2020). Although the negative external effects of intensive livestock farming have occasionally made national headlines, and also scientific debate has addressed market failures in this domain (e.g., Pretty et al., 2001), only since the imperative of diminishing the sector has become unavoidable has this come to large-scale – and heavily contested – public debate.

Regarding the logistics sector – and in particular the Port of Rotterdam, the main logistics hub in the Netherland – a somewhat different dynamic can be observed. Critical reflection on the sustainability and resilience of current business models in the sector was recently spurred by supply chain disruptions during the COVID19 pandemic, and a brief obstruction of the Suez Canal. From policy and society there is a pressure (albeit still soft) on the sector to become more sustainable, but to a large extent port processes are a 'black box' when it comes to quantifying emissions and their main drivers and despite scientific efforts to improve this insight (Geerlings & Van Duin, 2012) not a main part of the public debate. Regarding both sectors, public deliberation is necessary on their impact and a more sustainable way forward. This is complicated by the fact that in the past decades or even centuries, the Netherlands has become extremely successful in both sectors, being a global leader in agricultural production and logistics efficiency. The Netherlands being the second-largest agricultural exporter in the world (Jukema et al, 2021) is evidence of both the agricultural and logistics prowess of a small and dense country. How has this come about, and what kind of transition is necessary for resilience and sustainability?

1 Wageningen Food & Biobased Research.

2. History and current context[2]

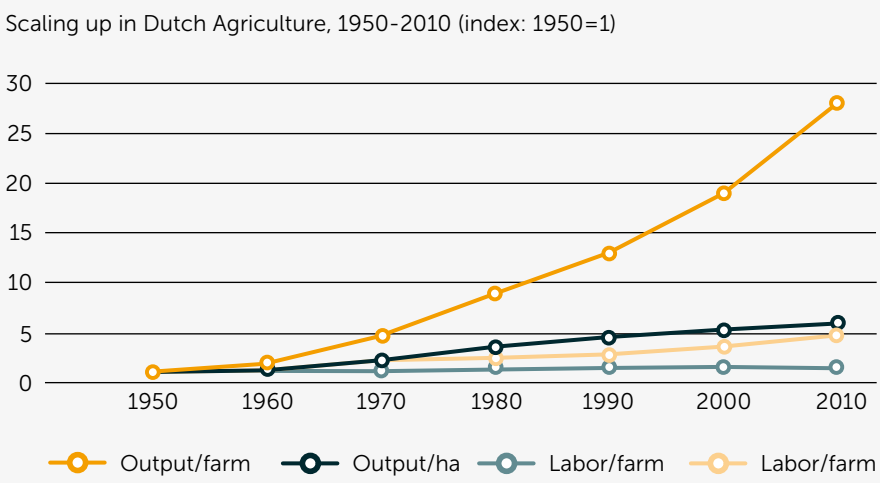
Both Dutch agriculture and (port) logistics have been characterized by similar trends in the post-war period. The most important ones being:

- Scaling up
- Mechanization and automation
- Innovation and productivity growth
- State support for international competitiveness

The Dutch agro sector has since long been the focus of policymakers, for a variety of reasons ranging from food security to competitiveness to sustainability (De Haas, 2013). In a long-term historical overview however, farmers in the Netherlands were already specialized, export-oriented and competitive before the state took an active interest in the sector. During most of the 19th century, state involvement remained limited, but the agro sector did organize itself strongly through trade unions and cooperatives. In the late 1800s and early 1900s state involvement increased again due to threats to the competitiveness of the sector. This involvement followed the example of input policies already existing abroad (focusing on knowledge infrastructure, credit availability, and high-quality inputs to boost export competitiveness) but doing relatively little in regulating markets and prices. Only after the Second World War, the state directly intervened in the agro sector, successfully pushing for consolidation and mechanization of the sector, still with a focus on productivity and (international) competitiveness. The development since of the Dutch agricultural sector is illustrative of the success of this policy (see Figure 1): Farms grew significantly in size, with steadily increasing output per hectare, all without requiring more farm labor. This trend of scaling up and labor-saving created domestic demand for mechanized and automated equipment, stimulating innovation in the development of technologies and complementary products and services that could efficiently harvest, handle, and process large volumes of agri-food products.

2 Part based on Castelein, Kok & Snels (2022).

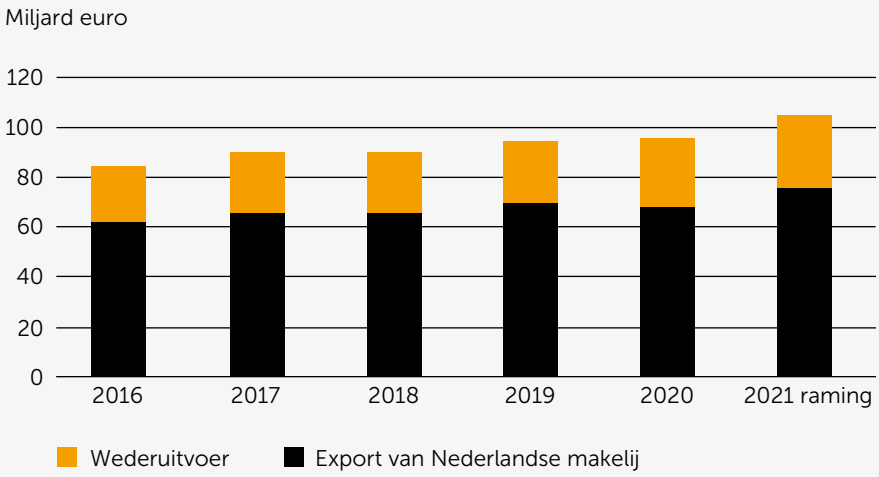
Figure 1 Development of the Dutch agricultural sector, 1950-2010 (De Haas, 2013)



This was the period in which Dutch agriculture grew to a major global exporter. Fairly recently – from the end of the 20th century – has the singular policy focus on productivity, scale and competitiveness shifted to include more attention for sustainability and innovation, with also a departure from the previous directive approach to a more hands-off type of support emphasizing initiative from the sector in 'triple helix' cooperation with knowledge institutes and government organizations.

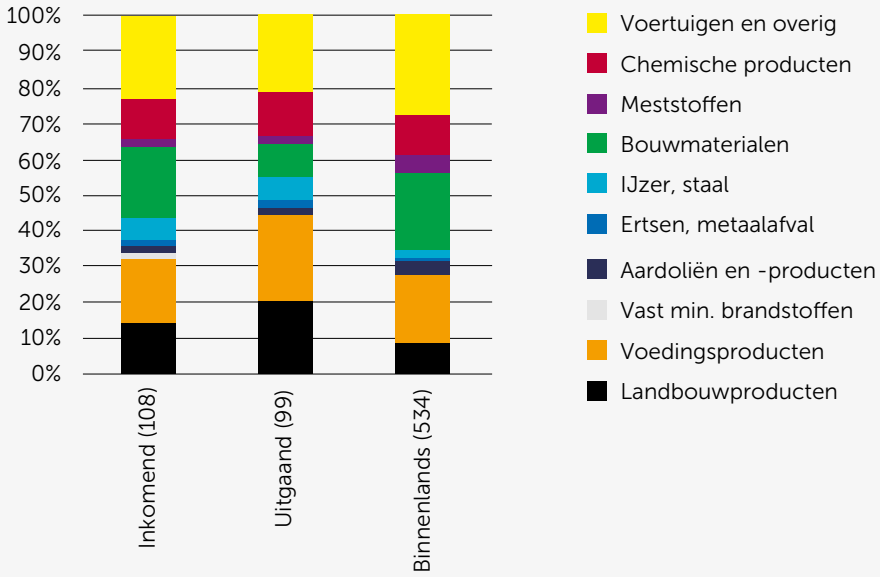
Nowadays, the Netherlands is the second-largest exporter of agricultural and agriculture-related products worldwide (the US being the largest). In 2020, Dutch agricultural exports amounted to a total value of 95,6bln euros (Jukema et al. 2021). This is a matter of agricultural prowess as well as trade and logistics. Figure 2 shows how this has grown steadily over the past years, and how re-exports of imported products constitute a significant share of Dutch exports. This illustrates not only the significance of the Dutch agricultural sector (Dutch exports), but also the significance of the Netherlands as a (European) hub for trade in agricultural and agriculture-related products.

Figure 2 Dutch exports of agricultural and agriculture-related products, distinguishing Dutch-made (black) and re-exports of imported (and sometimes processed) goods (orange) (Jukema et al. 2021)



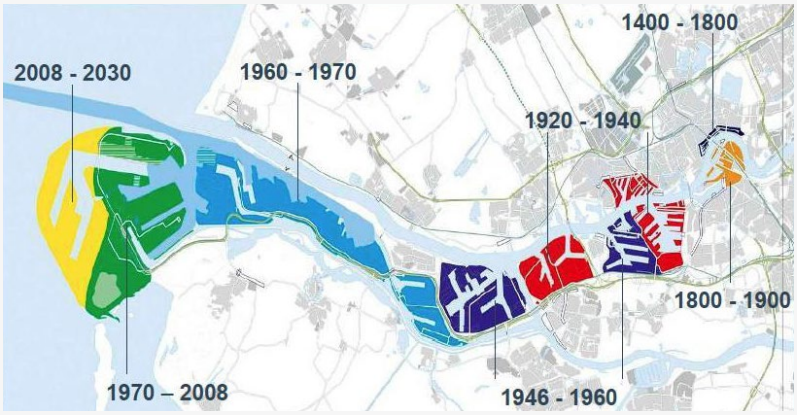
The (international) performance of the Dutch agro complex and agrologistics can also partly be explained by the degree of development of the logistics sector in the Netherlands. Agrologistics is a domain spanning both the logistics sector and the agro sector, and conditions that favor logistics activities in general (e.g., location, connectivity, infrastructure) are also conducive to agrologistics performance. For the Netherlands, these conditions are definitely present, with high quality infrastructure, well-developed mainports in the Port of Rotterdam and Schiphol Airport that connect the Netherlands to agri- and foodtrade worldwide, as well as good connections to major production and consumer clusters in Europe. Historically, these conditions allowed a strong logistics sector and related ecosystem to develop, with capabilities that are easily leveraged to support logistics functions in agro chains as well. At present, the international competitiveness of the Dutch agro-sector depends on the Netherlands' role as a major logistics hub, and vice versa, the Dutch transportation and logistics sector is strongly dependent on the transportation demand from agro chains. Figure 3 (in Dutch) below illustrates this symbiosis: Around one-third of all cargo transported by road in the Netherlands is related to agricultural and food products (Landbouwproducten (black) and Voedingsproducten (orange)).

Figure 3 Composition of cargo in Dutch road transportation (Agricultural products (black) and Food products (orange)) (Kindt et al. 2020)



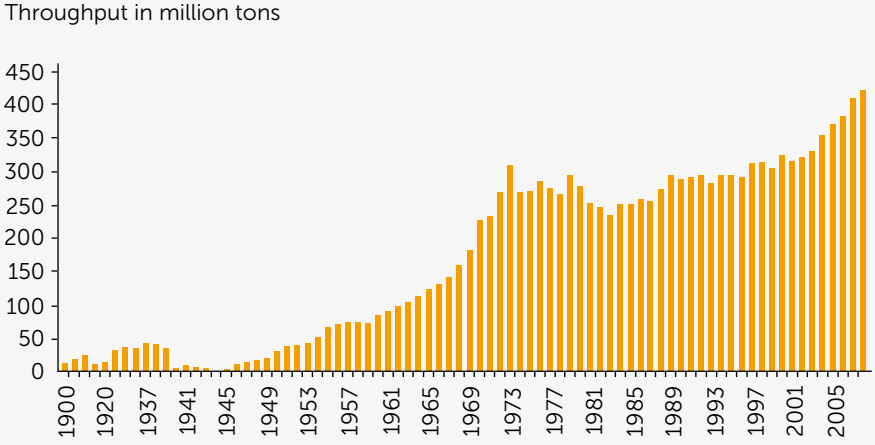
Currently being strongly intertwined, the historical development of port logistics also mirrors the trends observed in the agricultural sector. First of all, scaling up. Figure 4 below shows the geographical development of the Port of Rotterdam, starting from small operations in or close to the city, and rapidly expanding outwards to the coast in the postwar period. Also here, considerable state involvement – though not uncontested – made the development of the Maasvlaktes possible (Koppenol, 2017).

Figure 4 Historical development of the Port of Rotterdam (Effting, 2011)



Similar to agriculture, the Port of Rotterdam has shown almost exponential growth in the period after 1945; first due to a boom in oil (Botlek), and from the 1980s and 1990s onwards due to millions of shipping containers (Maasvlakte). This is visible in terms of space (above) and throughput statistics (Figure 5 below).

Figure 5 Throughput development in the Port of Rotterdam (De Gijt et al., 2010)



This explosive throughput growth was made possible by the commitment of land, but especially also by rapid advances in handling productivity. Starting from a strong reliance on manual labor in the 'old' port, the modern terminals at Maasvlakte 2 are to a large extent automated.

In sum, the two sectors under consideration here – agriculture and port logistics – have over time scaled up dramatically while the number of people directly, physically involved in the primary process has diminished. As a result, what exactly is involved in this primary process is largely unknown to the general public. For example, up until the Second World War port processes in Rotterdam were located in or close to the city, with citizens being able to see firsthand the ships and the cargo that came out, and a considerable number of them being directly involved in the port processes. Nowadays however, port activities have shifted to locations far from the city itself, and to most citizens of the port-city of Rotterdam the container logistics at the Maasvlaktes will speak to the imagination, rather than them being aware of what is loaded or unloaded and what this process entails. In a similar vein, a century ago a substantial part of the Dutch population worked in agriculture whereas nowadays some 2% of the population is employed in the agricultural sector. As a result of the scaling up and mechanization of agriculture, most of the general public is not aware of what happens in crop cultivation or intensive livestock farming.

3. Conclusions

Almost miraculously, despite abovementioned lack of awareness, we are accustomed to having a wide variety of domestic and foreign food products available in supermarkets – a testament to advances in both agriculture and (agro)logistics. On the other hand, due to this development developments in the agricultural and logistics sectors only become part of the public debate when their negative aspects or limits to their growth become apparent. In these cases, the debate is likely based on limited and imperfect information, and seemingly basic questions need to be answered: What determines the environmental (carbon) footprint of different port and logistics processes? What determines the environmental (nitrogen) footprint of different agricultural production systems?

In a time when limits to growth are apparent, a decision needs to be made on what to retain and what to phase out. This paves the way for a new research agenda: The advances that underpinned the optimization of the system in the past are not sufficient to support the difficult decision-making needed for the future. The intuition of such a transition is seemingly simple: We should ensure that the needs of current and future generations are met (sustainability), and therefore limit our footprint while retaining what's valuable. The question of what to retain is particularly interesting as it invites discussion and concrete proposals. The challenge for research here is to inform the debate and sensitize the public as well as policy makers on systemic relationships and inevitable tradeoffs.

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Personal note

Dear Harry,

This chapter was part inspired by what I consider to be some of the important tenets of your work as an academic. First, the realization that simply continuing business as usual is not sustainable, and that some kind of transition (or set of transitions) is necessary. Secondly, that important issues can exist largely outside the view of policymakers and the general public (be it the carbon footprint of port operations, or the environmental impact of 'de-gassing' of inland barges), and academia has a responsibility to shed light on the existence and magnitude of these issues. In our time working together I have seen you take up these challenges, highlighting relevant issues that may not be directly apparent and that people might not find convenient to learn about. This was also reflected in a question you asked me when I decided to join Wageningen University & Research after my PhD at Erasmus University: You enquired along the lines of "research from Wageningen has brought us where we are now in agriculture, but do you see it contributing in the same way to addressing the problems of today?" As you can read in this short chapter, the question is still on my mind every now and then, and my honest answer would be that it is still work in progress; very interesting work I should add, and I'm glad that our line of work in EURECA has been the basis for me in that.

The Death and Resurrection of Dutch Environmental Policy Elections in the 2020's: Europe or no Europe, environment or no environment?

Wim Hafkamp

1. Introduction

The election campaigns, and even more so the results of the elections, show that governments, parliament and residents of the Netherlands face some serious environmental challenges. The first is the deepening gap between those who see climate change as a 'whipped-up non-problem' with nothing but priceless non-solutions and others who now see the last chance to work on solutions, "before it's too late," and the lack of action "can no longer be explained to children and grandchildren." Other environmental issues are also thought of very differently on both sides of the divide. Think of agriculture, windmills, and solar parks. Also think of the commotion around PAS and PFAS, which seemed to continue to put the entire construction sector of The Netherlands 'in lockdown', or simply put, brought construction to a standstill. The second is the gap between those who want 'less Europe' and others who want 'more Europe'. On one side of the divide, people do not want to even here about nature conservation, let alone Natura 2000. And on the other side those who demand that Dutch climate policy go much further than the European or Paris Agreement. One side does not want to know about further interference, regulation or interference from Brussels, nor from The Hague. On the other hand, it is precisely in the EU context that new opportunities are seen, such as with the European Green Deal, on which European Commissioner Frans Timmermans and former PvdA leader Diederik Samson have been working for years.

So, it's about two fissures, which are pretty much at odds with each other. In this contribution I do not want to immediately plunge into a further exploration of the contradictions, but take a step back, and examine what has been going on with Dutch environmental policy in recent years. That has pretty much disappeared (section. 2), and the question is how and why (section. 3), and what can be done about it now (section. 4).

2. The Decline

We run the risk that environmental policy will continue to be a matter of putting out fires in the coming years, and that climate policy will become a matter of haggling and fighting over even more ambitious goals with no prospect of realistically attaining those goals. That is why we have to look at the decline of Dutch environmental policy in the past 20 years. At the end of the last century, this environmental policy was still very much alive, with its integrated thematic approach, target group policy, horizontal and vertical integration. It had an open process approach and worked with a wide range of policy instruments. The law stipulated that the government cabinet must publish a national environmental policy plan once every four years. As a result a series of National Environmental Policy Plans (NEPP) were issued between 1989 and 2002. This policy was widely supported, both in politics and in society, and it also received a lot of appreciation from abroad.

The forward-looking work of Geerlings et al. (2002) on the long-term prospects of sustainable transport is exemplary in this tradition. The academic and policy discourse seemed to mostly be about the finer points. This is illustrated by the discussions between colleagues, including Harry Geerlings, and myself about an advisory report by the VROM-raad (1999). The VROM-raad of which I was a member, had concluded that land use planning had little influence on automobile emissions as compared to automobile emission standards. Lively discussions focused on if and how this was so, which implications -if any- it should have on environmental policy, and on what constituted effective environmental policy in the first place.

From across the globe policymakers, students, researchers, politicians would come in droves, on excursions and field trips, to study up close this famous Dutch Environmental Polder Model. It was a policy that seemed to be so effective in achieving its goals that with NEPP 4 it was proposed to move to transition management. Transition to an intrinsically sustainable economy. That was 2002.

Twenty years later, there is little left of that much-vaunted, effective, sustainable development-oriented Dutch environmental policy. The demise of that policy deserves a more detailed study than I can provide here. Here are some symptoms I see, evidence of the demise.

The firefighting approach, instead of environmental policy

The series of NEPPs has been aborted. The NMP 5, which according to the law should have appeared in 2005, never came about. The relevant article of the law has been deleted. At this time, an interdepartmental task force should have been now working on the NMP 8, as a spider in a network of parties and experts in all sectors of the economy, in connection with provinces and municipalities as well as consumer organisations and the NGO world of sustainable development. Not so. Insofar as the Netherlands still has an environmental policy, it is ad hoc firefighting that creates monstrums, such as the series of evasive responses to the nitrogen problem. These include an off-setting policy for nitrate emissions in cattle farming (PAS), which was deemed illegal in court, and an exemption policy for the construction sector which was also thrown out by the courts. The Urgenda case received global attention when the highest

court convicted the Dutch government for lack of climate change policy. Similar failures exist for air traffic (Schiphol, Lelystad, Maastricht), waste policy, the Dutch large steel industry and the approach to PFAS.

Negligence continued by 8 successive governments: Balkenende I-IV and Rutte I-III

Climate policy increasingly became an absentee in the course of this century. What catches the eye is the case that Urgenda filed against the State of the Netherlands. Successfully. According to the judge, the State fails to protect the Dutch against the far-reaching consequences of climate change.

The Minister of the Environment was cancelled

The Netherlands no longer has an environment minister. In the cabinet formations at the beginning of this century, the environment minister briefly became state secretary, but later this figure disappeared altogether. Since 2019, there has been a State Secretary for the Environment and Housing, who is housed in the Ministry of Infrastructure and Water Management. There are the remains of the former Directorate-General for the Environment. At the turn of the century this directorate-general had a staff of 1,000 civil servants, with some difficulty it is possible to now find about 250, scattered across various government departments.

Independent advice undesirable

The government no longer needs independent advice this century. For example, the Advisory Council on Housing, Land Use and Environment (itself a merger of the Council for the Environment, the Council for Housing and the Council for rural areas; I use the term VROM-raad) has been merged with the Advisory Council on Transport and Infrastructure. The RMNO, the Council for the Environment and Nature Research, has been dissolved. The national planning agencies have been made two sizes smaller, with the integration of the Nature and Environment Planning Bureau and the Spatial Planning Bureau. When one of the directors of the planning agencies acted independently, a government intervention followed which limits their maximum term of appointment. This term is not necessarily enforced when such a director is obedient.

Waste policy is at a standstill

The supervision and control of the import, export and treatment of waste appears to be largely absent in the meantime. The consumer pays in the store, when purchasing refrigerators and TVs, for example, for a responsible processing of them after use. However, discarded refrigerators, printers and other electronics are popping up here and there in developing countries. Between the rubbish heaps, children's fingers pick out the valuable materials, in the fumes of the fire in which the plastic remains are burned. The policy for packaging waste (plastic soup, heavy metals, and the like) seemed to be successful in establishing the packaging covenant in the mid-nineties. However, little has come of the implementation. After years of tug-of-war between government and business, littering remains a persistent problem. Finally, soon, there will be a deposit on cans.

The rest of the stray trap, a multiple, remains. The European rules for international waste shipments allow export for 'beneficial use', or recovery, in another country. This means that almost all waste that is not landfilled can go abroad, while millions of tons of waste from abroad are shipped to the Netherlands to be incinerated here.

Supervision and enforcement fall short

With the abolition of the environment minister and the Ministry of Housing, Spatial Planning and the Environment, not only environmental policy and spatial planning were sidelined, supervision and enforcement were also put on the back burner. The environmental inspectorate has been slimmed down and integrated into a new human environment policy inspectorate, part of the aforementioned Ministry of Infrastructure and Water Management.

The industry can take its course

Large companies, such as Tata Steel, are in the news as major polluters. The responsible authorities cannot get a grip on it. Logical, because supervision and enforcement have been curtailed. Around the chemical industry in the Rotterdam port area, there have been serious concerns for years about the state of maintenance of the installations, the capacity, and the expertise of the chemical companies to keep that maintenance up to date. The corporate offices are now located elsewhere, often outside Europe. In the steel industry, Tata Steel is an example of this. This also plays a role in chemistry. The president of the Association of the Chemical Industry (VNCI) argued a few years ago that the end of chemistry in Europe is in sight. The growth markets are elsewhere, mainly in Asia, but also in the Middle East. The big investments are taking place there, and not in Europe. Little innovation can be expected from such companies in Europe, let alone in the Netherlands.

3. Explanation

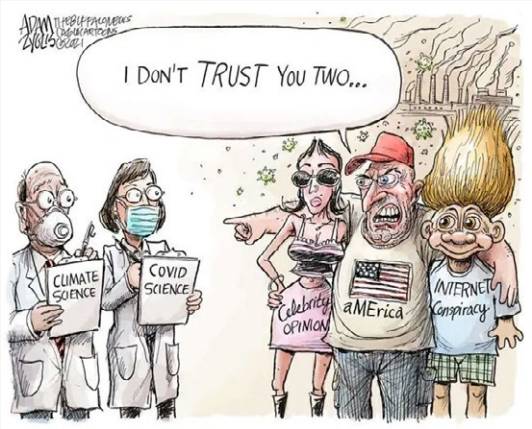
We are not there yet with these observations. Do we need more Europe now, or not? And do we now need an integrated environmental policy again? These questions are difficult to answer against the background of the above. It seems to me that a good analysis is first needed of the how and why of the decline of Dutch environmental policy. So we have to take a step back. I see two possible explanations for this decline.

Environment had to sing a different tune, preferably no tune

The first, and most obvious explanation, is that at the turn of the century with the rise of and the murder of Pim Fortuyn, the electoral victories of LPF and Leefbaar Rotterdam, the first Balkenende cabinets took a 'shift to the right' that the Netherlands had not known in 50 years. At the end of the nineties, the Netherlands not only had a successful environmental policy, but it also experienced economic growth that seemed to have no end in sight. The economists spoke of an economy that no longer had recessions. The national budget had a surplus, and the national debt was at a post-war minimum. However, there was a strong sense of dissatisfaction among the population. The analyses of NFO/Trendbox and later also the PBL,

showed that many people were rather conservative, and focused on their own situation, while there were no political parties that stood up for them. This is illustrated to some extent by the cartoon in figure 1.

Figure 1 Cartoon drawn by Adam Zyglis's for the *The Buffalo News*, as discussed by Michael Svoboda in Yale Climate Connections (Svoboda, 2021)

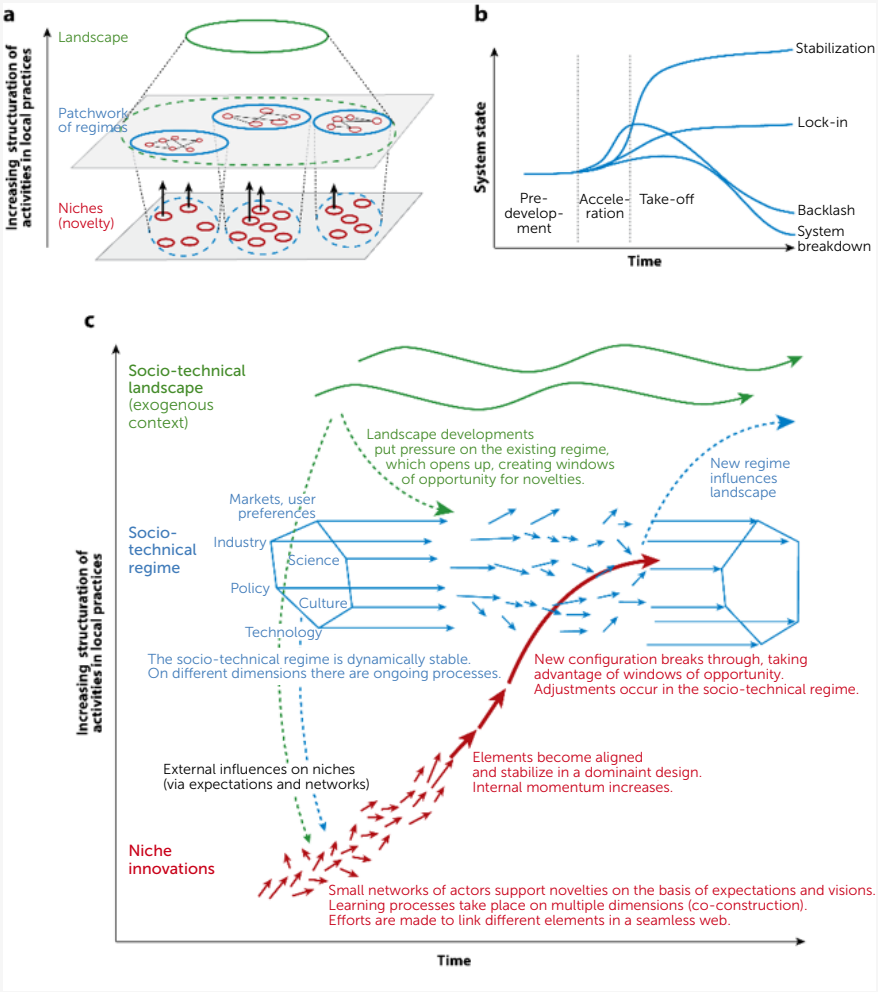


During a panel session in Rotterdam, a council member of Leefbaar Rotterdam took the view that the environment was very important, and that environmental policy should first focus on the issues that directly affect people's health. He cited as an example the emissions of particulate matter along the Rotterdam beltway, also known as 'De Ruit'. He did not see climate change as an important policy issue. With emissions of particulate matter he did have a point. The question then is whether politicians and policymakers should not first have put things in order closer to home (PM, odor, noise), instead of using the 'emission space' to be created by cleaner and quieter cars in the future for more and wider roads in the present.

From environmental policy to transition management

The second explanation lies with the first. In the optimism of the late nineties, it seemed that the Netherlands was pretty much 'finished'. With the NEPP's, the environmental policy was also seemed to be 'finished'. Only climate change still required new policies. That seemed to be at the forefront of the first part of the fourth and final NEPP. The second and final part proposed to bring about transitions for truly sustainable development.

Figure 2 Transition Management provided a new way of thinking, and a new language about the shift from conventional economic growth to sustainable development



Source: Loorbach, D., Frantzeskaki, N., and Avelino, F. (2017) Sustainability Transitions Research: Transforming Science and Practice for Societal Change. Annual Review of Environment and Resources, 42(1), 599-626

Three transitions were targeted: energy, biodiversity and mobility. In the VROM council there was serious criticism. One of the members argued in an essay that the switch from the NEPP policy pursued until then to transition policy was risky and even elusive. In this explanation, it is not so much the 'jerk to the right', but the 'implosion' of environmental policy itself. The transition thinking, as illustrated in figure 2, found a lot of resonance in policy, politics and society, but it definitely did not fit with that 'move to the right'. In a private meeting where sustainable development was discussed, a prominent seasoned conservative politician once looked at me with squinted eyes and spoke with articulation: 'Sustainable development, sir, that's a toy of the left'. Against this background, it is hardly surprising that a national, voluntary agreement on energy is so difficult to reach, and may not lead to the desired result. Consumers, residents, travelers, more generally 'the people' were not at the table. Parliament looked the other way, while the contractors and outfitters were willing to make a 180 degree turn for sustainability. But only if the price was right.....

The two possible explanations I outline above deserve further investigation. It may well be that more explanations are found, and other factors, processes that have influenced the decline of Dutch environmental policy. It is important to know these well before the Netherlands decides whether and how it wants to work on the European Green Deal.

4. Restart

It may be a bit premature, but I think at least the following seven actions are needed:

1. **Restore monitoring, enforcement and policy development**
   Against the background of the above, it is therefore first of all important to put environmental policy back in order, with adequate implementation, monitoring and enforcement of existing laws and regulations, with a broadly supported strategic policy cycle, all carried out by an organization that has sufficient capacity and quality, under the responsibility of an environment minister.

2. **Update environmental policy on themes**
   In addition, it is important to tackle neglected themes and topics with priority. This is to be done with the actors involved: business, agriculture, local governments, environmental organizations. In addition, the lessons need to be drawn from some of the failed participatory processes in the past, which are now characterized as 'muddling in the polder'. These processes ended up in voluntary, yet empty agreements. Think of themes such as
   - climate policy (greenhouse gas emissions down, but also adaptation);
   - waste (prevention, separation and recycling, industrial ecology and circular economy packaging, electronic waste, litter);
   - soil quality (compaction, phosphate saturation, salinization, desiccation);
   - biodiversity (nature, insects and bees, endangered species);
   - urban air quality (particulate matter, NOx; traffic and airplane noise).

3. Use of financial incentives

It has been more than 20 years since a committee on greening the taxes advised the government on the use of financial incentives. At the time, the goal was to replace taxes on labor by taxes on the environment. Now it should be about financial incentives which motivate the 'laggards' in the fossil, linear economy to adapt, while rewarding the 'frontrunners' in organic farming, sustainable construction, industrial ecology and the circular economy. This can be done with ecotaxes, CO2 levies, or tradable emission rights.

4. Good governance of existing transition processes

No groups or sectors should be left out of the picture. That was the case in the climate agreement and the energy agreement, where the end users had no voice in the drafting of the agreements. As a result, 'energy poverty' became a political problem in the aftermath. When it comes to construction and residential, the Dutch housing corporations have been curtailed so much (both financially and in terms of competences) that they can now hardly contribute to making their housing stock more sustainable. Similarly, they have lost a lot of their capacity to strengthen social support in the neighborhoods where their home ownership is concentrated.

5. Starting new transition processes

There are many initiatives going on in areas such as construction and housing, agriculture and food, mobility and infrastructure, and integrated water management. These initiatives could be incorporated into new transition processes where in the 'second line', the learning processes take place, the variation and selection processes, the policy of governments that focuses on forerunners, and laggards. In any case with recognition of the initiatives by forerunners, both in business and among households. Here a great field of social and economic action can be created that is important at the next point.

6. With businesses and citizens in the European Green Deal

So we should look very carefully at the above, and fully commit to it, every time. And certainly, we should also be working on international coalitions, not only in business and with environmental organizations, but also in political terms, with governments and parties in other EU countries. Anyone who says that parliament can only watch from the back seat as European policy erodes the autonomy of the member states is wrong. National parliaments have done so, but it doesn't have to stay that way. European and national laws and regulations can be very effective, transparent, two-sided processes.

7. A minister of the environment in the next cabinet

All this calls for an environment minister in the next cabinet. A minister with broad powers in the field of the environment (including climate change), a portfolio, a budget, and an adequate professional staff for policy development, implementation, monitoring and enforcement.

5. Epilogue

At the end of the eighties, I participated in a project of the RMNO that tried to visualize the 'long lines' in environmental policy. It was about the long term, looking well into the 21st century, way beyond the twenty to thirty years within which government said it wanted to solve the most important environmental issues. And so it was about climate, biodiversity, scarcity of raw materials. It was not about the fact that the poldering, participatory policy development in the environmental field would lose as much support among the Dutch as has happened in recent years. That turned out to be fatal. The most important thing that should and should happen now is that the Dutch, from *woke* to *wappie*, are really involved in tackling important environmental questions. This can be done, among other things, with the citizens' forums that the House of Representatives wants to set up. Government needs to establish a 'rapport' with citizens. At the same time it will need to stay an active participant in Europe, since practically all environmental topics have an international dimension: from climate and energy, to packaging and waste, water quality and biodiversity.

In a similar way, 'Europe' will need to come to The Netherlands in order to explain, for example, what the European Green Deal already means for citizens and businesses. The Dutch are responsible citizens. Windmills, solar panels and electric cars are hot topics, at home and at birthday parties. Meanwhile, energy demand is only growing, and environmental problems are becoming more urgent. For most people, the 'shirt is closer than the skirt'. This has become apparent in recent years. Most people see themselves as responsible citizens. However, behind their statements about the importance of healthy life on a healthy planet are follow-up questions, such as 'why should we save the earth?', and 'what has the future done for us? Considerations such as 'windmills run on subsidy and ruin the view'.

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Personal note

Harry, it was always a pleasure to be with you, to work with you, and to reflect with you on the goings on in Rotterdam region, as well as the wider world. I remember the energetic and inspiring meetings of the Rotterdamse Duurzaamheidsclub, where many innovative solutions were introduced on sustainable transport. In the late nineties and early this century especially, we shared an interest in sustainable infrastructure. There was the 'workshop in the sky' on this topic that took place in the Euromast. And much bigger than that: the conference on sustainable mobility with the wonderful edited volume that was the result of work that you did with Gerard Peters. There were several other projects, of which I cannot reproduce the names now. Some of them never came off the ground, such as the one on turning the Rotterdamse Ruit into an underground beltway, a 21st century equivalent of the Boulevard Périphérique in Paris. Other projects were a success, but the big 'Fade Away' has started. No doubt this has to do with the fact that I retired a few years ago. And now you will be going into retirement, become an emeritus as well. I am sure we will find the time go sit 'on the dock of the bay', commemorating Otis Redding as well as your favorite Rolling Stones song. With deep sympathy ☺ I remember the party you threw after you defended your dissertation!

Behavioral Changes and Learning of Public Transport Agents in the Bus Regulatory Reform Process: A Case of Bangkok

Sumet Ongkittikul[1]

Abstract

This article aims to analyse regulatory reform using cognitive frames and learning as a conceptual framework. The behavioral changes of public transport agents can be explained using cognitive frames and learning. This article shows the bus regulatory reform in Bangkok as a case study. Public transport agents in developing countries, like Bangkok, seem to have a low learning capability and are slow to adapt to regulatory change. The article concludes that agents who do not prepare to learn and adapt, whose beliefs are very conservative, will not survive the regulatory reform process.

Keywords

Bangkok Bus Reform, Public Transport, Behavioral Change, Cognitive Frames

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1. Introduction

Buses are the most important form of transport in major cities in the world. In the past several decades, bus industries in both developed and developing countries have gone through regulatory reform process such as deregulation and privatization. However, the capabilities of both public agencies and private operators are not merely the same. Each agent had their knowledge and capabilities which allowed them to react to the changing environment and regulatory reform that took place in each city.

The regulatory reform in public transport that took place in developing countries is more complex and difficult to anticipate due to the lag in planning and regulation. Furthermore, the behavior of public transport agencies is not prepared to change and adapt to regulatory reform. They usually have their beliefs and frame that resist the reform process. However, once the reform process begins, many private operators may suffer from not accepting this change, and the results of these behaviors would be interesting to examine.

This article examines the behavioral changes of public transport agents to the regulatory reform process. The theoretical concepts for the analytical framework based on the behavioral changes were developed in Ongkittikul and Geerlings (2007) together with the cognitive frame and learning in Stiglitz and Greenwald (2014). Their beliefs and frames of public transport agents are discussed and analyzed to understand their rationalities and possible consequences of their actions in the regulatory reform process. This article uses bus regulatory reform in Bangkok as a case study to illustrate this concept.

The structure of the rest of this article is as follows. Section 2 presents the analytical framework based on behavioral changes of public transport organisations, beliefs and frames. Section 3 describes the Bangkok bus situation before and during the regulatory reform process. Section 4 analyses the behavioral changes of the public transport agents, their beliefs and frames according to the theoretical framework. Finally, Section 5 gives conclusions and recommendations for further research.

2. Behavioral Changes of Public Transport Agents: Cognitive Frames and Learning

From an organizational standpoint, the public transport industry is in a transition period. The regulatory reforms in the sector have radically changed the industry structure in past decade. We have seen many new organizational forms, both public and private, that have emerged. In case of privatization industries, Willman et al. (2003) identify distinct phases in the evolution of the regulatory function: (1) an ad-hoc phase; (2) a phase characterized by the emergence of a formal regulatory role; (3) the emergence of more strategic regulatory management. This case suggested that the regulatory reform process is significant, and it takes time to reconcile the system (Ongkittikul and Geerlings, 2007).

Organizational changes play an important part in explaining the behavior of actors in the public transport sector. The capability and learning elements are of importance in this respect. To respond to the changing environment, organizations search and acquire knowledge and capabilities to better adapt (Ongkittikul and Geerlings, 2007). In theory, public transport firms will innovate to increase their competitiveness, which is usually a service innovation, rather than a product innovation (Ongkittikul and Geerlings, 2006). Ongkittikul (2006) concludes that the bus regulatory reforms in the Netherlands and London cases lead to service innovation. However, as in developed countries, both public and private organizations are more capable of acquiring knowledge and building their capabilities to innovate, namely dynamic capabilities as stated by Teece and Pisano (1994) and Teece et al. (1997). Although, in developing countries, it seems to be a different story.

The concept of cognitive frames and learning developed by Stiglitz and Greenwald (2014) gives interesting ideas on how we could explain the different learning capabilities in developing countries. They suggested that in some societies (in some firms), there is an attempt to constantly assess whether what is being observed is consistent with prior beliefs and models, and when it is not, to change beliefs and models. Other societies (firms) are far more conservative. More weight is given to inherited truths, and such societies resist evidence that contradicts those truths. Cognitive frames can be troublesome for change, especially in public transport regulatory reform. Regulatory reform as a change process can produce both winners and losers, and losers have an incentive to challenge and resist any change.

These concepts above are especially useful to understand public transport organizational behaviors under a changing regulatory environment. The main point is that regulatory reforms cause institutional and organizational changes in the system. The actors in the system, in turn, change, adapt, or react to those changes in many ways. However, cognitive frames hamper and resist any change, which could delay the change process, and may lead to self-destruction as well. This paper presents this concept using the Bangkok bus regulatory reform as a case study described in the next section.

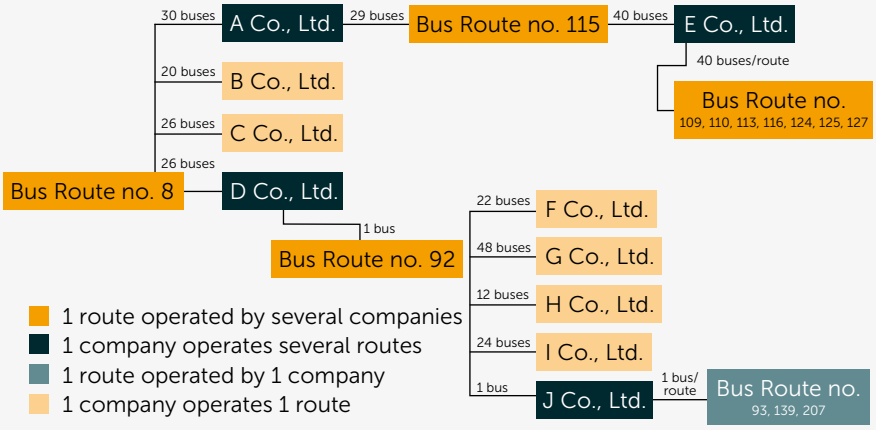
Setting the Scene: Bangkok Bus Reform

Bangkok Bus Before Reform (Pre-2016)

In 1983, the Bangkok Mass Transit Authority (BMTA) was granted an exclusive license to operate bus routes in Bangkok and the local vicinity by a cabinet resolution. While private bus companies including minibuses, microbuses, and passenger vans, were not monopolized and continued to operate as joint-service operators under subsidiary agreements with the BMTA. In effect, the BMTA maintains a monopoly on bus operating rights in Bangkok.

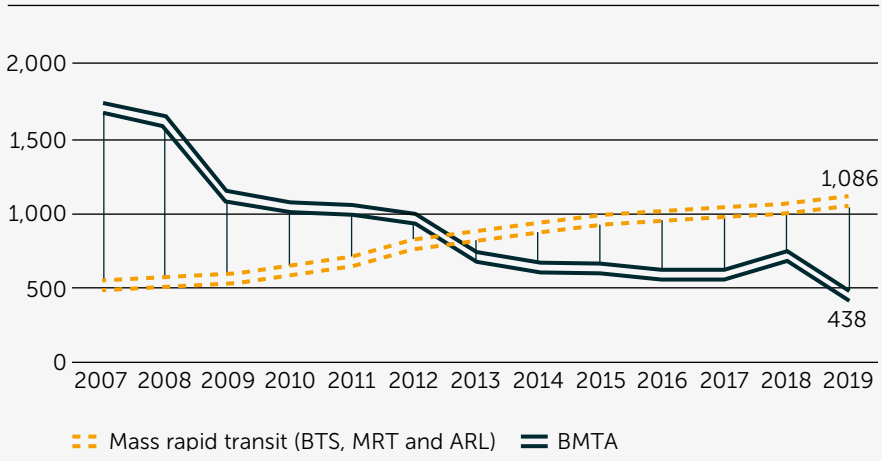
However, private joint-services were troublesome especially in terms of quality. The BMTA did not have a clear mandate on how to control the private joint-services, which resulted in unorganized bus services in the Bangkok area. In this setting, each bus route may have BMTA provided services, or BMTA jointly provided services with a private operator (or operators) services too. With regards to this setting, together with the fact that there was no direct subsidy for bus services operated by private operators, resulted in these private operators providing poor bus services, where the rate of passenger complaints was high. Figure 1 shows the unorganized bus services in the Bangkok area where there are routes that have several operators jointly operating on several routes. The sizes of the private operators were rather small, which ranged from less than a hundred buses to only a single bus operator.

Figure 1 Example of the unorganised operation of the joint-operating bus services
Source: Author based on Department of Land Transport information



Furthermore, due to the expansion of alternative forms of public transit, the BMTA's buses are competing with an increasing number of vehicles on the same routes. In addition, passengers have more options for travel that are more convenient and require less time, especially after the implementation of mass rapid transit. Consequently, the number of BMTA passengers have declined significantly as shown in Figure 2.

Figure 2 Public transportation ridership in Bangkok and vicinity from 2007 to 2019
(Unit: thousand people per day)



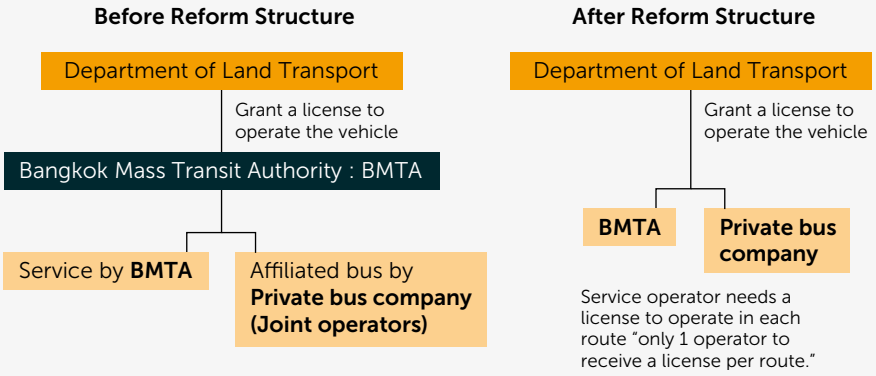
Source: ICT Center, Office of the Permanent Secretary (2019)[2]

2 Exclude 2020-2021 trend due to the impact of the covid pandemic on passenger travel.

3. The Bangkok Bus Reform Process

Nonetheless, the September 2016 cabinet resolution mandated that the Department of Land Transport (DLT) supervises the redefinition of the bus route network, the allocation of new routes, and the establishment of requirements for acquiring a license. In addition, the DLT facilitates the selection of qualified entrepreneurs, the establishment of standards for public bus drivers, and the issuing of new bus route licenses. Furthermore, the regulatory reform plan assigns regulator and operator responsibilities separately and allows that one route will be operated by one operator, not jointly by multiple operators, as it used to be. In this context, private operators are required to obtain a license directly from the DLT. As a result, the BMTA was degraded as one of the bus operators, which may entitle the BMTA to receive bus route licenses from the DLT but the BMTA themselves cannot grant joint-operating contracts to private operators anymore. Figure 3 presents the comparison between before and after the reform of the regulatory structure of the bus sector in Bangkok.

Figure 3 The comparison before and after reform of the bus regulatory structure
Source: Author (2022)



The bus regulatory reform process started in 2016 and is continuing in the present day. It can be considered that this is a slow process, but the analysis in Section 4 will elaborate more on the organizational resistance to the change. In 2019, phase one of the reformation plan of the bus system in Bangkok and the local vicinity was implemented. The DLT announced the issuance of licenses for 269 routes, 107 of which are operated by the BMTA and the remaining by the private sector. However, it is important to mention that the processes that are difficult to implement in this

reform are the processes of transferring the operating licenses from the current joint-operating services to the new license operator. To mitigate the impact for current operators who are operating on the joint-operating contract, the DLT decided that the current operators who hold the joint-operating contracts can apply for a new license without any competition. In addition, the DLT requires current private operators who intend to continue operating to be informed and certified by the BMTA, pay all BMTA debts, and be consolidated into one operator per route as well. The condition to apply for licenses is that the operators on the same route must come together as a company through mergers or joint ventures to be able to get the license for their current routes. This proved to be difficult for current small operator to form joint ventures. The result of this process is that the current operators were awarded the licenses in only 41 percent of all licenses that they are entitled to. And most of the operators who got the licenses were brought by the new company (Smart Bus Co. Ltd.: SMB) that wanted to enter the bus market. Table 1 presents timeline of the Bangkok bus reform process.

Table 1 The Timeline of the Bangkok Bus Reform Process

Year	Key Activities
2016	Cabinet Resolution to Abolish the Cabinet Resolution Year 1983 that Granted to Bus Operating License to BMTA only
2017	Cabinet Resolution to Approved the Bangkok Bus Reroute Plan (269 Routes) 2 Pilot Routes was granted to private operators
2019	Transition period plan to grant the licenses to current operators. 53 Routes was granted to private operators
2022	77 Routes was granted to new private operators

Source: Author based on Department of Land Transport information

In 2022, The reformation plan for phase two was announced for a total of 77 routes, including 40 routes for which existing operators did not submit licensing applications. According to a study conducted by the Thailand Development Research Institute (2020), 37 new routes have been modified to be more feasible, which is networked to provide access to mass rapid transit and residential areas. The result of this licensing process is that a new operator, Thai Smile Bus (TSB), has acquired licenses for 71 routes. Following these two phases, two new operators emerged, namely SMB and TSM. These two companies account more than half of the bus market, in terms of number of licences, in Bangkok. Table 2 shows the number of routes and buses following the reform process.

Table 2 Bus Routes and Number Buses after the Reform (2022)

	Number of routes	Number of buses
Bangkok Mass Transit Authority (BMTA)	107	2,293 - 3,196
Thai Smile Bus Co., Ltd. (TSB)	71	758 - 2,130
Operators (Joint service with TSB)	8	208 - 289
Raja Road Co., Ltd.	4	23 - 64
Extra Miles logistics services Co., Ltd.	2	19 - 53
Smart Bus Co., Ltd. (SMB)	31	866 - 1,147
Operators (Joint service with SMB)	6	150 - 209
Other operators	10	236 - 337

Source: Data form Department of Land Transport (2022)

The bus regulatory reform in Bangkok is now in a dynamic phase. The new operators are now starting to operate, and the old operators are phasing out. However, the transition period seems not so smooth as the services are hampered by the COVID-19 situation, which results in reduced services. As COVID-19 restrictions were relaxed, the services of the old operators were reduced, and the new operators are not able to provide the new services. Nevertheless, the new operators can bring in a number of new buses to replace the old buses of the operators.

4. Analysis of Cognitive Frames, Learning, and Outcomes

The analysis of the cognitive frames, learning, and outcomes of the agents can be divided into four groups, namely the public authority (DLT), the BMTA, the old operators, and the new operators. This analysis then divided each agent period into pre- and post-reforms. This will help understand their cognitive frames, their learning ability, and the outcomes that each agent faced in each period. The interpretation of each element was from the author observations throughout the period of pre- and post-reforms, since 2007. Table 3 shows the analysis of cognitive frames, learning and outcomes of the regulatory reform.

Table 3 Analysis of Cognitive Frames, Learning, and Outcomes

Agent		Cognitive Frames	Learning	Outcomes
Public Authority (DLT)	Pre-Reform	BMTA is egulator. Bus is profitable business	Low learning ability	Low bus quality leads to the reform
	Post-Reform	DLT is Regulator	Try to build up the capability to regulate Still lag of planning for transition period	Bus services seems to be improved
BMTA	Pre-Reform	BMTA is regulator	Low learning ability and resistance to change	BMTA services seems to be consistent but diminishing
	Post-Reform	Government must support BMTA	Still lag of learning ability	BMTA will diminish further
Old Operators	Pre-Reform	Reform will not succeed	Low learning ability and resistant to change	Bus services were poor
	Post-Reform	-	-	Disappear from the market
New Operators	Pre-Reform	-	-	-
	Post-Reform	Bus can be profitable	Highly innovative and adapting quickly	Gain market share significantly. Profitability is still questionable

Source: Author (2022)

It is interesting to point out that the learning ability of public agents, namely the DLT and the BMTA, are low throughout the reform period. However, the DLT seems to build up their capability as a regulator in a short period of time. This is a challenging period as the dynamics of the market are fast. On the other hand, the BMTA are still slow to react to any change. Their cognitive frame is that the central government still supports their organization, but limited resources are allocated to build up the BMTA learning ability. It seems evitable that the BMTA will diminish further, as things stand.

The most important outcome of this regulatory reform is the near extinction of the old private operators. In the beginning of the reform process, the old operators seemed not convinced that the reforms would succeed or were prepared to leave the market anyway. It has proved that the low learning ability of the old operators was key for this outcome.

The final outcomes regarding the new operators are still difficult to anticipate. The new operators are hopeful that bus services in Bangkok are potentially profitable. They have bought in innovations, such as electronic ticketing systems and fully electric buses. But it is hard to see the bus services in Bangkok can be profitable due the current fare regulation. However, this regulatory reform is bringing about a positive outcome towards better bus services at this moment.

5. Conclusion

Regulatory reform is a process of change. The behavioral changes of organisations in the system are obviously expected. This article presents the cognitive frames and learning concept to analyse the behavioral changes, learning, and outcomes of the reform process.

The bus regulatory reform in Bangkok is presented as a case study. This regulatory reform process took more than 7 years and is still going on. This article shows that the regulatory reform affects the cognitive frames and learning of public transport organisations in the system. The cognitive frames of each agent have also affected the outcomes of each agent greatly. Remarkedly, the agents who did not prepare to learn and adapt, whose beliefs are very conservative, have not survived the regulatory reform process. Although a positive outcome cannot yet be claimed, the early outcome suggests that the new operators are more willing to innovate and invest in innovation.

The author has observed and been actively involved in the Bangkok bus reform process since 2007. It was unfortunate that none or very little literature was reviewed and analysed in the Bangkok reform process academically. This article addresses a unique case of a bus system in a developing country whereby bus operators and public authorities do not have adequately dynamic capabilities to execute the regulator reform of the bus system. Future research is urgently needed as the bus system in developing countries can learn and adapt from experiences like this.

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Personal Remarks

Harry is a very nice person, anyone who know Harry personally would agree on this. I am very fortunate that Harry accepted me for a PhD study in 2002. The period that I worked on my PhD under Harry's supervision between 2002 and 2006 was an influential period for me that I still benefit today. His easy going and positive attitude was unique and very helpful throughout my stay in Rotterdam. At that time, we developed a framework for innovative capabilities of the public transport organisation, which I have used to carry on analysing the situation in Thailand as well. As I mentioned previously in this article, I have observed and been involved in bus and railway reform, in Thailand. I am sure that my contribution toward this subject in Thailand is a result of Harry's influence, which I believe Harry can be very proud of.

The European Semester: from Governability to Sustainability

Frans van Nispen tot Pannerden

1. Introduction

A farewell speech inevitable means time of reflection. Reflection on what if cooperation mainly consisted of supervision of students? What exactly is our common ground that ultimately cumulated in friendship? I have come to the conclusion that the concept of governance binds us together. I have been working on European fiscal governance for years, while Harry has a record on governance in the field of sustainable mobility. Now the limitations of the concept of governance have become clear, it is friendship that lives on. In retrospect, one may say that it was the dean of the then faculty that brought us together, but our sabbatical leave in Austria, respectively Italy that turned us from colleagues into friends.

The remaining of this occasional paper is composed of three building blocks: (1) a garbage can, containing the story of our collaboration (2) the recycling of waste about an unfinished research project on economic governance in the European context and (3) the green transition and, more precisely, sustainable mobility is referring to the mission ('leeropdracht') of Harry's endowed chair.

2. On collaboration

The first encounter with Harry must have been at the premises of the Woudenstein campus of the Erasmus University Rotterdam. We were both located in the M-building at a different floor. Friendly as he is, we said hello to each other in the corridors and the elevator, but had apparently further not much in common. At that time, he worked for the Erasmus Centre for Sustainability and Management (ESM) and myself for the PA-department.

Not much changed when the curtain fell for the ESM and the remaining five scholars opted for the warm bath of the PA-department (Van der Graaf 2013: 38)[1]. One of those was Harry Geerlings, who kindly volunteered to teach a course in the English stream for which I was responsible.

1 Founded in 1984, its fifth anniversary coincided with the end of the ESM as an independent research institute to become part of Governance of Complex Systems (GOCS) in the PA-department.

The appointment of Harry to endowed professor of 'Sustainable mobility, in particular the governance aspects' (Geerlings 2012) basically created a choice opportunity, which may be conceptualized as a garbage can:

> To understand processes in organizations, one can view a choice opportunity as a garbage can into which various kinds of problems and solutions are dumped by participants as they are generated.
> *(Cohen et al., 1972: 2).*

A decision is the outcome of three more or less independent streams – actors, problems and solutions – which flow together – either coincidently or deliberately – in the fourth stream of organizational choice.

The garbage can model is typical for universities (Cohen et al., 1972:11), which brings us back to Harry's mission. He was sitting on a bag of money (= a solution is search of problem), while I was peddling with a PhD-candidate with an interest in European economic governance (= a problem in search of a solution). It was the dean of the Faculty of Social Sciences who opened the 'policy window' and, by such, coupled the streams of actors, problems and solutions (Kingdon 2003).

The focus on governance remained, but the locus faded away to make place for environmental issues in the harbor. Consequently, the study on the European semester continued 'work in process' and largely incomplete, becoming obsolete when the pandemic hit the world. A new impulse though may be provided by the monitoring of the progress that the European member states make towards their RRPs, which is attributed to the European semester (see below).

The academic cooperation intensified rapidly during our sabbatical leave at the European University Institute in San Domenico di Fiesole and the University of Vienna respectively when we had contact about the supervision of PhD-students, almost every other day by phone. Back home in The Netherlands the professional discourse turned into social get-togethers, adding value to work.

Looking backwards it seems to be appropriate to recycle some of the trash – 'problems without solutions; solutions without problems' – which are never collected or left behind at the dump.

3. European Governance

The concept of governance, risen from the confrontation of top-down and bottom-up policy making, is a notorious slippery concept, which is especially true when applied to the process of European integration or rather cooperation across various levels as well as sectors (Van Kersbergen & Van Waarden 2004: 149-150)[2]. The concept of multi-level governance (MLG) was coined by Gary Marks in 1993 and originally defined as

> "... a system of continuous negotiation among nested governments at several territorial tiers — supranational, national, regional, and local — as the result of a broad process of institutional creation and decisional reallocation
> *(Marks 1993: 392).*"

The term MLG implies geographical as well as spatial distinctions and, more importantly, the connections and influence in the interplay among these levels (Stephenson, 2013: 817).

Since then, Marks has specified this definition further by including non-state actors, which is in line with the description of EU governance as 'a unique set of multi-level, non-hierarchical and regulatory institutions, and a hybrid mix of state and non-state actors' (Hix 1998: 39). In this paper we adopt this view on MLG as a hybrid mode of governance, combining the traditional top-down mode with a bottom-up mode of governance.

In essence, MLG has replaced neo-functionalism as the alternative theory to inter-governmentalism. It incorporates all the main elements of the neo-functionalists' theory, except for their central emphasis on functional spill-over (George 2004)[3]. However, one may question if governance constitutes a theory (Jordan 2001: 201), i.e., whether hypotheses can be drawn from MLG that will help to explain how the EU operates.

The concept of MLG could be further clarified by making a distinction between two along (not necessarily exclusive) lines of directions emerging from the literature: (1) MLG as a theory of state transformation and (2) MLG as a theory of public policy (Tortola 2017: 11-13). Following Jordan, MLG may provide an explanation for transfer of sovereignty, but 'lacks a causal motor integration or set of testable hypotheses' (Jordan 2001: 201).

2 A widely used definition of governance is talking about a new way of governing society (Rhodes, 1996: 652-653). It induced a wide array of views on governance, which place less emphasis than did their predecessors on hierarchy and the state, and more on markets and networks (Bevir 2011: 1).

3 As stated correctly by Piattoni MLG is more than a 'mere' replacement for neo-functionalism because of the extension to non-governmental actors (Piattoni 2010).

In response, George claims that MLG is a theory with testable hypotheses, indicating independent variables that may help to explain why national governments have let decision-making authority slip out of their hands (George 2004). The result is a shift of authority from the national level 'upwards' to the European level, and 'downwards' to the subnational level (Marks 1993: 407). In fact, the nation state is hollowed out from above and below. The empirical support though for the hypothesis remains at least ambiguous (Walzenbach 2006: 3).

The value of MLG lies in providing a framework to explore complex issues, and as such it is not a theory (Bache & Flinders, 2004: 204). All too often used as a descriptive rather than as an analytical tool (Smith 2007: 626). Rather it should be considered as a conceptual model or a metaphor (Rosamond 2000: 197; Bartolini 2011: 7-12), which 'needs to be fleshed out with causal accounts drawn from other theoretical traditions' (Jordan 2001: 201). He points, inter alia, to historical institutionalism which emphasizes path dependency and critical junctions. One of those critical junctions is the sovereign debt crisis and, more recently, the pandemic that brought several institutional changes to the European economic governance[4].

4. European Economic Governance

The economic governance framework of the European Union is largely centered around the Stability and Growth Pact (SGP), a set of rules designed to ensure that countries in the European Union pursue sound public finances and coordinate their fiscal and economic policies. It has gone through two major revisions since its existence. The first made the SGP country-specific by taking into account the economic characteristics of each country, the latter brought, inter alia, the European semester (Van Nispen 2017: 3-5; EFB 2022: 70)[5]. More recently, the pandemic brought several changes to the framework of European economic governance.

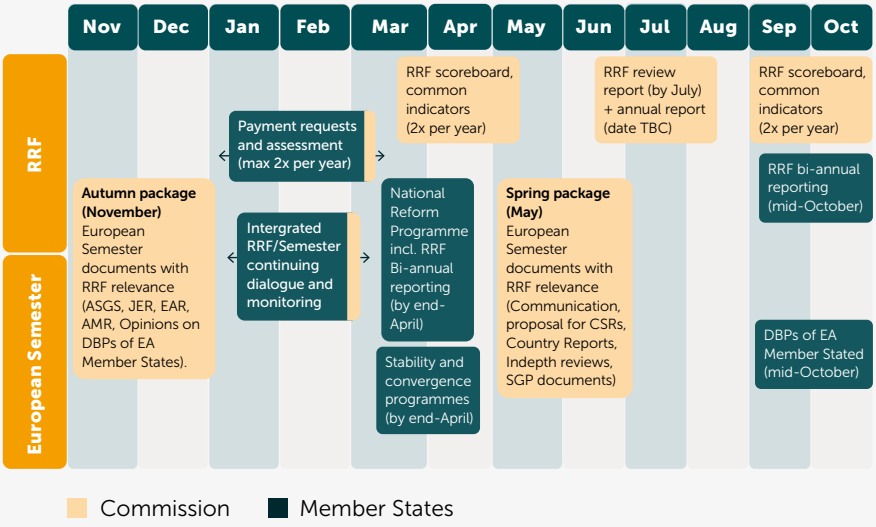
First and foremost, the Commission activated the general escape clause of the Stability and Growth Pact (SGP), allowing member states to depart temporarily from the adjustment path towards the medium-term budgetary objective (MTBO) in order to deal with the consequences of the Covid-19 crisis (COM(2020) 123 final)[6].

The reference value for the budget deficit and gross debt are kept in place. The same applies to the preventive and corrective arm of the SGP, but the general escape clause only suspends enforcement the fiscal rules[7]. Meanwhile, the general escape clause has been extended throughout 2014 due to the Russian invasion of the Ukraine and following energy crisis.

4 The sovereign debt crisis is followed by the pandemic and energy crisis due to the Russian invasion of the Ukraine.
5 The revision of the SGP brought a collection of new laws, known as the 'Six Pack' (2011), followed by the 'Two-Pack' (2013), reinforcing economic coordination.
6 The clause was introduced as part of the 'Six-Pack' reform of the Stability and Growth Pact in 2011, which drew the lessons of the economic and financial crisis.
7 Consequently, no country reports were made, neither country-specific recommendations were issued in the 2021 European semester.

Second, the assessment of the progress that the member states make towards their Reform and Resilience Plans (RRPs) is attributed to the European semester that basically coordinates fiscal and economic policy[8]. The progress of the member states towards their RRPs is monitored twice a year, once in combination with the assessment of the NRPs that play a dual role.

Figure 1 The 2022 European Semester



* *ASGS: Annual Sustainable Growth Survey, EAR: Euro Area Recommendation, JER: Joint Employment Report, AMR: Alert Mechanism Report, DBP: Draft Budgetary Plans, EA: euro area, RRF: Recovery and Resilience Facility, SGP: Stability and Growth Pact.*

8 The same applies to the monitoring of the Sustainable Developments Goals (SDG) that are integrated in the European semester.

The pandemic also affected the CSRs that complete the Commission's mid-term review of the national plans. The member states had to pay due attention to the CSRs of 2019 and 2020 in their RPPs, but the score is not very telling: some progress is made. Besides, no *structural* CSRs have been issued in 2021[9] and only targeted CSRs, addressing a limited number of additional reform and investment challenges, are made in 2022[10]. Above all, priority is given to the timely implementation of the RRPs rather than the CSRs that rather open-ended (COM(2022) 600 final).

Finally, the Commission re-launched the debate of European Economic Governance on October 19, 2021, combining the earlier findings of the Commission with the lessons from the crisis:

> Lastly, a word on the European Semester, which is set to remain our reference framework for economic policy coordination in the EU. While the Semester is not formally part of the review process, it is undergoing significant changes thanks to the introduction of the Recovery and Resilience Facility
> *(Gentiloni 2021).*

A public survey among academics, professionals and stakeholders culminated in a wide set of views, which could be summarized along six themes, such as the sustainability of public finances to the improvement of governance, i.e. stronger national ownership, improving compliance and better enforcement (SWD(2022) 104 final).

The debate on European economic governance will be completed in time for next year with orientations by the Commission on possible changes to the economic governance framework with the objective of achieving a broad-based consensus on the way forward (COM(2022) 85 final).

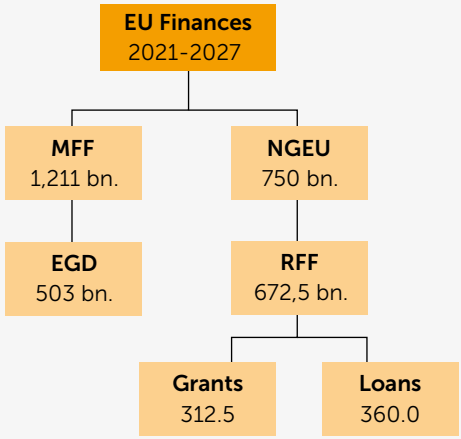
9 The fiscal CSRs have been assessed by the Commission in an Omnibus Law, which analyses compliance of the member states with the deficit and debt criteria.

10 The scope of the CSRs is larger for member states without RRPs that has been approved and endorsed.

5. Reform and Resilience facility

A couple of years ago the French president tabled a plan to borrow 500 bn. on the financial market, thereby increasing the own resources of the European Union, to help member states to recover from the pandemic. Building on the so-called Juncker plan (COM(2014) 903 final)[11], he called for a large scale investment vehicle to be distributed in grants among the member states hit most by the crisis. The plan met opposition from the so-called 'frugal states' – Austria, Denmark, Finland, The Netherlands and Sweden[12] – that issued a non-paper in which they called for 'loans for loans' in order to avoid debt mutualisation. The final deal reflects the trade-off (Cameron 2020; Verdun 2022: 313) the amount has been increased to 750 bn., roughly equally divided between grants (360 bn.) and loans (312.5 bn.).

Figure 2 The Architecture of EU Finances (2012-2027)



* *The NGEU/RRF covers 2021-2016 (in bn. euros)*

11 The Juncker plan aimed at public and private investments of at least € 315 bn. over three years (2015-2017). He claimed that it added 1.7 million jobs to the EU labor market and increased EU GDP by 1.8% by 2022 (Juncker 24/10/2019).

12 Initially, the German government backed frugal states at first, but changed horses during the race.

The investment vehicle is presented by the European Commission as part of its New Generation European Union (NGEU) of which the RFF is by far the largest component. The investments come on top of the amount of 503 bn. for climate and environment, already foreseen in the MFF as part of the European Green Deal (EGD) that the incoming European Commission issued at the start of its term[13].The support provided by the RRF is additional to other European programs and instruments and may 'do no significant harm' to any environmental objective.

In order to become eligible for support, member states had to submit a Recovery and Resilience Plans (RRP), outlining and specifying their investments in terms of milestones and targets as well as a timetable of their reforms to be completed by 31 August 2026[14].

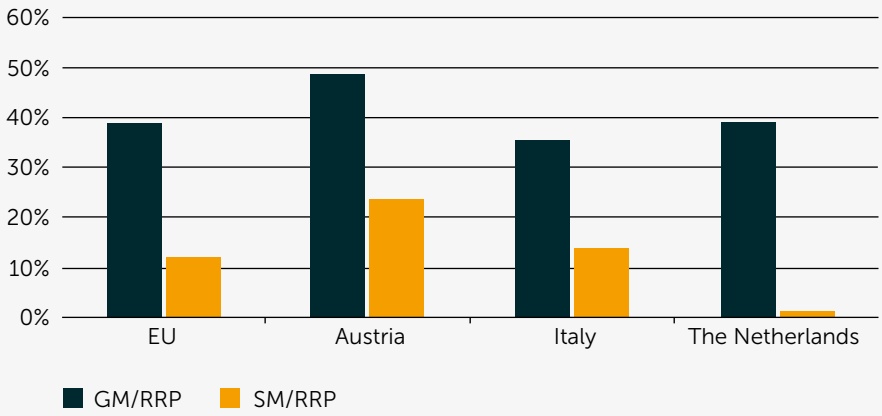
First and foremost, RRPs should contribute at least 37% to the climate objective[15], which in turn refers back the EGD to reduce the greenhouse gas emission in the EU by at least 50% in 2030 and make the EU climate neutral in 2050. The progress of the member states is monitored by the European Commission twice a year as part of the European semester[16]. The first report on the implementation of the RRPs indicates that all meet the test (COM(2022) 75 final).

Second, the investments and reforms are structured in six pillars[17] of which the green transition, i.e., biodiversity, renewable energy and sustainable mobility, stands for 38,84% of the grants and loans and even more if spill-over effects are taken into account. A break-down of the expenditures for the green transition reveals that sustainable mobility stands for a third (31.1%) of the budget, which equals 12,1% overall as measure to the current state of play[18].

The figure below illustrates the relative share of the green transition, respectively the sustainable mobility in the RRPs in three member states[19]. The variety is high: sustainable mobility happens to be the core of the Austrian investments geared towards green transition, but is only a small portion of the Dutch plans for green transition with Italy taking the middle ground.

13 In addition, the EGD is supposed to mobilize about € 279 bn. of private and public climate and environment related investments over the period 2021-2030.
14 The milestones and targets measure the progress of the member states towards their RRPs with milestones being qualitative achievements and targets being quantitative achievements.
15 The member states had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on climate objectives (RRF Regulation, Annex 6).
16 The data are taken from the Recovery and Resilience Scoreboard (own calculations). The data are supplemented with the Dutch RRP, which has been endorsed by the Council on October 4, 2022.
17 The six pillars cover (1) Green Transition, (2) Digital Transition, (3) Smart, Sustainable and Inclusive Growth, (4) Social and Territorial Cohesion, (5) Health and Economic, Social and Institutional Resilience, (6) Policies for the Next Generation.
18 Note that that the numbers regarding climate objectives and green transition are not compatible due to a different methodology. Furthermore, green transition includes the contribution to the environmental objectives that are wider than climate objectives.
19 Note that the selection of countries is not at random whatsoever, but is guided by our sabbatical leave.

Figure 3 The relative share of Green Transition (GT) and Sustainable Mobility (SM) in the RRPs of selected member states*



* *The data are taken from Recovery and Resilience Scoreboard, which accounts for the state of play by June 30, 2022. At that time 25 out of 27 RRPs were available.*[20]

A few months back the European Commission issued its first implementation report as part of the European semester. Although it is far too early to access the 'return on investment', it shows the potential to create a virtuous circle between national ownership and enforcement (Kaag & Calviño 2022). However, if the comparison of RRPs makes anything thing clear, then it is why Harry – contrary to common belief – was so keen spending his sabbatical leave in Austria and not ...

20 The Dutch RRP is delayed by the negotiation about formation of a new coalition, while the endorsement of the Hungarian RRP is postponed due to the concern about the respect of the rule of law.

6. Conclusion and Discussion

The pandemic brought several changes, although temporarily, to the framework of European economic governance[21]. A couple of weeks ago, the president of the European Fiscal Board (EFB) emphasized, once again, the urgent need to return to rules-based fiscal framework and some normality as the de facto suspension of the fiscal rules is undermining sound fiscal policy making (Thygesen 2022). One may question though if the genie is not out of the bottle.

The creation of the RRF as part of the NGEU marks a shift from austerity to growth (de la Porte & Jensen 2021: 389) or, to put it differently, from the numerator to the denominator of the equation being used for the calculation the budget deficit and public debt. It could lay the ax to the roots of the SGP at least in the short run, although the outcome may be the same in the long run. The budget deficit and public debt will disappear as snow under the sun when growth picks-up, as being pursuit from the very start of the SGP by the French government.

At some moment in time, the recovery of the member states from the pandemic and transition of the economy may be over, but not the pursuit of the climate objectives. The climate objectives are at the heart of the EGD, which is advertised as the 'new growth strategy' that will cut emissions while also creating jobs and improving our quality of life (Von der Leyen 2019). It is not very likely that European Commission will give up its newfound achievements by effectively framing the EGD as the way-out of the crisis (Bongardt & Torres 2022: 177)[22].

Moreover, the pandemic also weakened the position of the so-called frugal states as the grants are almost exhausted, although not yet disbursed (97.3%), while the take-up of loans is relatively low (42.9%) with Italy as the main beneficiary of the investment vehicle. Rather than sheer quantity, it is the structural features of the RRF which can lay claim to be path-breaking (Watts 2020).

In an effort to bridge the gap between the frugal states and a coalition led by the French government the Dutch and Spanish minister of Finance issued a joint paper called for a 'completely new EU fiscal framework that is fit for current and future challenges'. It would require high quality public investments and an improved composition of public finances to ensure that debt reduction is not just dependent on budgetary consolidation (Kaag & Calviño 2022).

However, the EGD is more than an exit strategy to the pandemic. It could even evolve into a third building block, alongside the Common Market and the EMU, of the European economic model (Bongardt & Torres 2022: 171). As such, the impact of the EGD on the EMU and SGP may be twofold. On the one hand, the EGD will flesh-out the G-pillar of the SGP. On the other hand, the EGD will come at the price of the S-pillar of the SGP (Van Nispen & Blankenstein 2013: 246), inducing a paradigm shift that will require a make-over of the European semester, if not the Amsterdam treaty.

21 The general escape clause and subsequent suspension of the enforcement of the SGP as well as the extension of the domain of the European semester are both said to be temporarily.

22 To be honest, the acceleration of the green and digital transition as part of the EGD was already in the joint French-German initiative (European Union 2022).

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New Public Management and Networks as simultaneously applied organizational structures: a tricky combination

Jos Vroomans

1. Introduction

The contribution in this chapter pays attention to the stepping back attitude of governance dating back more than 40 years ago, known as New Public management, combined with a network structure as a way to implement changes which led to a distrust of the public in governance. It is argued that the bonds between government and business life was stronger than between government and the people they represent and should govern. This confronts us with a reality that increasingly asks for an active and more driver seat role of (national) governance to cope with the problems society is confronted with, and to restore trust in governance. It is an overview of how governance has had an impact on public services and trust of the public in government. As sustainability is the topic of Harry's interest and research, it ends with an observation that must be welcomed by him.

2. Manifestations of neo-liberal approaches to governance

The spirit of neo-liberalism, with its muse Ayn Rand (see e.g., her novels Atlas Shrugged and The Fountainhead (Rand, 1957 and 1943) inspiring Milton Friedman (backed by the philosophies of Friedrich von Hayek) to his monetary driven economic philosophy (Friedman, 2002), got a threshold in Europe in the 80's in the United Kingdom with Margaret Thatcher and in The Netherlands with the administrations of Ruud Lubbers. Much more interesting was the effect on labour party prime ministers in the 90's like Tony Blair in the UK (1997-2007), and Wim Kok in The Netherlands (1994-2002). During their terms, despite their labour party background, they were driving forces behind what was later called the Third Way, a combination of centre-right economic policies and centre-left social policies (Bobbio & Cameron, 1997). This can also be seen as a variety of New Public Management (NPM) as described by Osborne and Gaebler (1993).

Three forces can be distinguished: privatization of public services, deregulation, and decentralization. In case of privatization, the result was that many former governmental organizations were liberalized and privatized with effects on the number of employees needed and implications for the service level delivered. The intention was to be market driven, so operating in a competitive environment and a drive to reduce costs. But in many instances there hardly was a mature market or any market at all which had implications for the customer orientation: service level decreased and in fact costs increased in longer term. Examples are public transport, telecommunications, postal services, waste collection services, housing corporations (Tweede Kamer der Staten-Generaal, 2009). Besides privatization, deregulation also was a manifestation of a retreating national government. The free market should do its job without too many constraints and market players were supposed to take their responsibilities to perform well and provide the best for their customers. This should lead to less regulations and more trust in governments (De Ridder & Van Doorn, 2015). The government should not try to steer economic processes with laws and regulations.

The goals for deregulation were worth pursuing and sounded reasonable:

- an improvement of the entrepreneurial climate
- reducing administrative costs
- reducing governmental costs
- increasing trust in government
- reducing administrative rules and regulations and as a result an improvement to comply to them
- improving the possibilities for companies and citizens to undertake and to arrange their lives to one's own aspirations (De Ridder & Van Doorn, 2015, pp. 8,9)

The third factor, decentralization, attributed more responsibilities to lower governments, especially on a municipality level. This meant that the decentralized institutions were seen as being capable of performing former centralized public duties in a more cost-effective way, due to the supposed forces of market driven competition. But as mentioned above, in many cases such a competition did not exist. Examples of these decentralized public duties are health care, psychic care for young people, the payments of social benefits.

As long as economic growth was booming, apparently this combination seemed to work well. But below the surface society grumbled and at the moment that social policies were questioned (the rebellion against too much "empathy" for non-western immigrants) and centre-right financial policies were tightened due to hampering economies, this combination showed that it had a crueller face to society. For many people it seemed that for government, economy appeared to be the most important focal point that needed to be stimulated accompanied by much less attention for the needs of society in which the harsh and cold winds of globalization became more apparent. The world had an impact on life in The Netherlands. Financial problems with banks in the United Stated had a global impact and affected Dutch economy too. Immigration due to wars far away became more and more visible in refugees seeking a safe place to stay. And it seemed that European Union played a role that was far more important than was pretended by national politicians. Many citizens felt that they were not represented by politicians anymore. Apparently, power was located elsewhere.

3. Of Hierarchies, Markets and Networks

During this period, it appeared that governance had changed. The public sector had shifted away from bureaucratic hierarchy towards markets and networks. The new governance combined "established administrative arrangements with features of the market" (Bevir, 2012, p. 5). This led to certain characteristics (Bevir, 2012, pp. 6-7):

- novel forms of mixed public-private or entirely private forms of regulation
- stakeholders are linked together in (formal and informal) networks
- It is multi-jurisdictional and often transnational
- Increasing range and plurality of stakeholders

Society became more and more complex. The goal was market orientation, and the method was based on the concept of a network society. In the 21st century, succeeding governments in The Netherlands have stressed that 'we as a society should do it together': government (on all levels), the business life and citizens. Society was seen as a network in which all players were linked together. So, the organizational structure is inclined to be a network structure. But the organizational structure of networks with its huge complexity is very hard to govern and asks for an eye for all stakeholders with their interests, anxieties and needs as is expressed by table 1 that compares these three organizational structures. For each stakeholder this complexity makes it hard to determine one's position and responsibilities. New responsibilities were sometimes hard to fulfil and problems in execution occurred. This complexity made it hard to fulfil the goals set by this neo-liberal philosophy and led to question its value for society.

Vital in the network-approach are the elements trust and reciprocity, to make the organizational structure successful. It is worth noticing that the goals for deregulation as mentioned above in section 2, have their pendant in Networks but also in Markets (independent, competition and self-inflicting).

Table 1 A typology of organizational structure

	Hierarchies	Markets	Networks
Governance	Authority	Price	Trust
Basis of relations among members	Employment	Contracts and property rights	Exchange of resources
Degree of dependence among members	Dependent	Independent	Interdependent
Means of conflict resolution and coordination	Rules and commands	Haggling	Diplomacy
Culture	Subordination	Competition	Reciprocity
Accountability	Clear and strong: punishing	Self-inflicting: the market corrects	Diffuse: hard to pinpoint responsibilities

Source: adapted from Bevir (2012), last row added by author

So, it is questionable that the goals (stemming from markets) and the method (based on networks) reinforce each other. In fact, they probably have reached the opposite. These questions are about privatization: e.g., do we really have a free market for postal services in which financially healthy companies exist? Has less regulations really enhanced quality of services: e.g., of housing corporations. There are questions about deregulation: has less administrations led to smoother processes, more trust and less costs? Is there more trust in government, are people more capable of directing their own lives? (De Ridder & Van Doorn, 2015, p. 9). And there are questions about decentralization: is quality and quantity of services at the same or even better level now these tasks have been directed to lower government levels like municipalities?

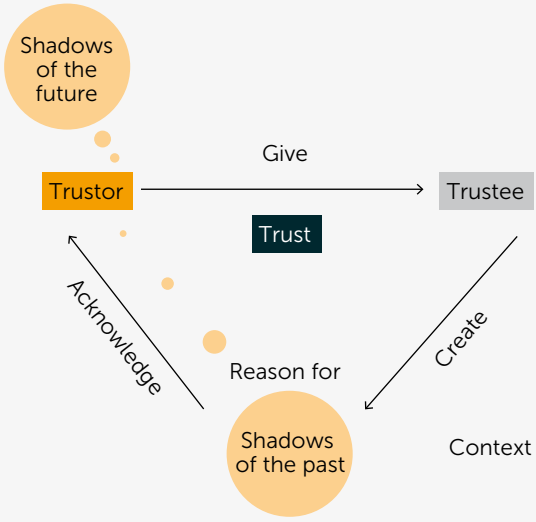
So, the underlying question arises, did the network structure really empower the people or, given the (lack of) competences needed to steer network processes, has this led to a widening gap between government structures (on all levels) and the governed?

4. Crises as feeders of distrust in governance

Trust and government are two sides of the same medal. In the discussions about governmental reforms, gaining and sustaining trust is considered vital (Bouckaert & Oomsels, 2012) (Eshuis, 2006) (Rhodes, 2007, p. 1246). Table 1 shows that the characteristics of networks, compared to the other two organizational structures, ask for difficult processes as trust, diplomacy, and reciprocity.

Trust comes on foot and leaves on horseback is an old Dutch saying that expresses that it takes time to build trust, but it can be lost in a moment. Building trust is based on experiences. Actions in the past (shadows of the past) determine if trustful actions in future can be expected (shadows of the future), so trust can be given (Poppo, Zheng Zhou, & Sungmin, 2008). The trustor will give trust to the trustee if he creates reasons for that by his trustful actions, as is illustrated by figure 1.

Figure 1 A model of trust-creating relationships



Source: (Vroomans, 2021)

And the actions (that created shadows of the past) taken by consecutive governments in the '90's, the 00's and 010's have not been acknowledged as positive to create positive shadows of the future to citizens so that trust in governments could be given.

The NPM approach of the national government was based on market thinking where the discipline of the market would be the regulator. In the years 2010 it became more apparent that the market for former public services was not a perfect one. Price was not a differentiator, and the culture of the new institutions were not sharpened by competition at all. And as for accountability, the market did not correct, e.g., unlawful actions within and between companies in the energy market, telecom market, construction industry, and pharmacy (Autoriteit Consument en Markt, 2020). Governance got more dispersed. Tasks, in former days planned and guided on a national level, were taken over by local authorities. This led to excesses like a small village deciding to house a data center for Facebook with the energy consumption of a big city (Zeewolde in 2022). Besides governmental organizations, companies got more involved in the performance of governmental tasks. In many cases the devolution of public services was a failure. Youth care, the financial support services, the environmental care, they all did not meet up to expectations. And on top of that, the labor market changed with more and more people having so-called flexible jobs, which in fact meant lack of security, underpayment, and a loss of real labor contracts.

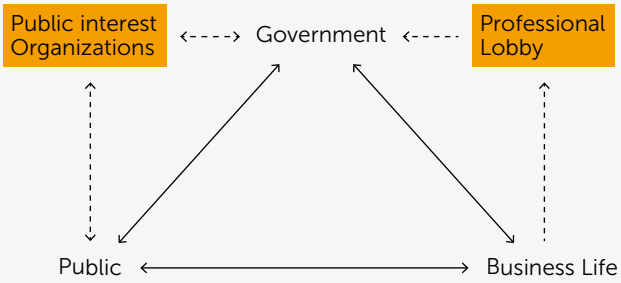
The saying of making it small, independent, self-supporting, responsible, and accountable, being market driven, became a failure. This was a process that was going on for decades. But then the years 2020 had to come.

In the 2020's it all seemed to come together as a perfect storm: a derailed labor market, a disrupting pandemic, increasing migration, environmental crises (nitrogen, CO2, quality of water, climate change), a lack of spatial planning, a quantitative and qualitative lack of personnel in health care, education, and other public services. The feeling was that the negative impacts burdening the many, while positive effects were for the few. Companies flourished, shareholders prospered, but most individuals did not experience an improvement in their living conditions, being it financially, mentally, or socially. Incomes did not increase while capital accumulated (Piketty, 2014). This is combined with an increasing distrust from governmental organizations (surcharges affairs, the acknowledgement of the needs of the victims of gas exploitation in Groningen). No wonder that the public lost its trust in the willingness and capabilities of governments to deal with these problems. Especially because entrance to government is not easy.

The relationships between the different actors in a political system: Public, Business Life and Government are complicated by the activities of intermediaries. To support the interests of the public, all kind of organizations try to give public a voice. Sometimes very professional like 'De Consumentenbond'[1], Natuurmonumenten[2] or Greenpeace, but very often also organised in a more amateurish way, especially when more local interests are at stake.

The lobbying from the side of the companies[3] is done by very professional organizations that have their influence in all kinds of governmental departments and levels. Very often also empowered by ex-politicians on their payroll[4]. Four out of ten ex-politicians find their way in private companies as a lobbyist[5]. This shows that there is an unbalance between the degree of securing one's interest towards intended governmental policies when the public and companies are compared. The bonds between government (including the public administrative institutions) and business life are much stronger and influential than between the public and its government. This has been the fundamental flaw in handling the effects of gas extraction in Groningen in the Northeastern part of The Netherlands. The interests of the NAM (Shell and Exxon) to continue to extract gas were considered far more vital than the interests of the people regarding their housing.

Figure 2 Actors in a network organizational structure



(Source: author)

1 Consumer Organization.
2 A nature conservation organization.
3 The activities executed by former public agencies but that are privatized are included in this category.
4 People like ex-prime minister Balkenende, Van Nieuwenhuizen.
5 Dagblad Trouw, October 13, 2021.

For handling the crises mentioned, cooperation between the actors as depicted in figure 2 is crucial as there is interdependency between them. But how to cope with these crises as the performance of governments and business life of the last decades did not meet expectations of the public? The shadows of the past will shed shadows in the future and as such prohibit a trust creating attitude (Poppo et al., 2008). Especially the experienced unbalance between how interests between are secured created distrust. Public has taken the first step by expressing its displeasures. The rise of a fragmented parliament is an example of a feeling that incumbent political parties failed. New smaller parties with a one issue agenda show that people feel that their specific need is not met. This is becoming unworkable, as the crises at hand ask for a nuanced approaches in which some needs will be met, but other needs will be overruled for the sake of the higher interest. Conflicts between the needed speed of measures, the range of their impacts, the overruling of the Not In My Backyard attitude at one side and the basic attitude of a distrustful public on the other side, will arise. Given the complexity, magnitude, and urgency of problems, the question arises if the current network approach is the right one.

5. The need for centralization of decisions and control of implementation

The crises mentioned above are accumulating, increasing, and enhancing each other. The nature of the climate crisis shows that the problems ahead are of an unforeseeable complexity and magnitude. Especially, drought, flooding, and storms, connected to climate change, are increasing (Van Loenhout, Below, & McClean, 2020). In the years 2020, 2021 and 2022, more people are getting aware of the problem. Migration, spurred by the war in Ukraine, (and with a further growth ahead due to climate problems), is burdening people's consciousness. Action needs to be taken in a formidable speed and magnitude.

In the Netherlands, the flows of influence as depicted in figure 2, has the inherent problem that it does not generate trust on the side of the public. People experience that their power is less and not safeguarded against companies' actions, but also not against government itself. Politicians tend to react on accusations that they do not listen to the public with proclamations that they will be more transparent and more responsive to public needs. But the problems society experiences need actions that in first sight are contrary to the individuals need. Until now, governance hardly had the guts to act that way. Important decisions with negative impact on companies, individuals or organizations were taken by courts as the court decisions as Urgenda[6], the nitrogen emissions of farms and the tax surcharges show. In fact, in the last decades government does not govern anymore due to privatization and deregulation (Chavannes, 2009). This attitude culminated in the Rutte administrations (Prime Minister since 2010) during the 010's. Living the way companies and people are used to is at stake and coping with the various crises means that a change is needed in the business and individual behaviour.

6 Urgenda is the 'protecting-the-environment' organization that started a legal procedure against the national government for reducing greenhouse gasses.

But who will tell and how will it be communicated? On the one hand distrust in government needs to be overcome, on the other hand actions need to be taken fast and successful. Actions that will not always be welcomed by the public. This asks for an approach where there is an understanding of the impact for the people and at the same time the courage to do what is to be done with a clear eye on the effects of the execution. Implementation of such an approach must be characterized by a kind of 'Deltaplan' program[7]. Centralization is needed in terms of planning, responsibility, and accountability. The Dutch government seems to acknowledge the need for a more central planning[8] with a change in spatial planning policy (Minister van Volkshuisvesting en Ruimtelijke Ordening, 2022). Centralization is needed to enhance planning and coordination to prohibit the NIMBY attitude of organizations, companies, groups of interest, cities, neighbourhoods, and individuals. Decisions can then be taken with an eye for (inter) national interests and to weigh to pro's and con's of the outcome of decisions. That needs a backup in a jurisdictional way where legal procedures must be designed in such a way that procedures have a shorter lead time as nowadays.

This also means that self-regulation, as was the way that government trusted businesses to do what was needed to be done for the sake of society, is not applied anymore. Experiences with self-regulation from the past show that nothing can be expected when impactful measures and speed is needed. Government must be directive in this. When the public sees that the degrees of freedom for companies are restricted as much as the public is restrained in its behaviour, acceptance of these policies may be more obvious.

6. To a new paradigm of a political economy: in control again to restore trust

As mentioned above, the neo-liberal attitude of the Dutch administrations was perfected in the last decade (since 2010). Markets determine the balances between government, business life and public. But something has changed. During the Covid pandemic the role of public administrations became more important. Companies needed to be helped by the government to survive the consequences of governmental decisions. At the same time, it appeared that deregulation was the cause of a fragmented national care and that hampered the implementation of a fast and effective vaccination campaign[9]. And with this, deregulation and privatization became more under criticism, not only from outsiders [10],[11] but also from government itself. There is a need for a government that takes actions and takes responsibilities for implementation (Tijdelijke Comissie

7 The project in the 1950's and 1970's where the Dutch government closed sea estuary and built dams to protect the land from the sea after the flooding of large parts of Zeeland and Holland in 1953.

8 From 1960 to 2001 there were national plans of Spatial Planning in which national government set the frame in which spatial planning of more detailed character should occur. The last one (5th) never had this prescriptive intention.

9 25 national health service regions (GGD's) that have a high level of autonomy.

10 https://www.ruimteenwonen.nl/ruimte-en-wonen-als-publieke-zaak (Retrieved: September 2022).

11 Minister of Public health in an interview in Algemeen Dagblad, March 2019. https://www.ad.nl/politiek/marktwerking-in-de-zorg-is-doorgeslagen~acd16e4e/ (Retrieved September 2019).

Uitvoeringsorganisaties, 2021). In the balance between public, business life and government, much more attention and acceptance of the interests of the public, often represented by public interest organisations, is needed. At the same time the influence of professional lobbying must be mitigated. It would certainly help if there is more transparency about who on behalf of which business organization is talking to which department. And the role of former politicians in these organizations needs to be prohibited: no lobby position for former politicians for an extensive period, so that situations like that of the minister of transport who exchanged politics (during her term) for a job representing the energy industry, will not occur anymore. It is that kind of behavior that feeds distrust of the public. Government needs to be back in control of former privatized and deregulated activities. Topical at this moment (September 2022) is the role national government could play in the energy sector by intervening in the energy prices due to geo-political conduct of Russian gas providers. The health sector is under the looking glass again as it comes to profit making as a goal perse. And the higher education sector with its influx of foreign students (driven by financial goals) that got out of hand are may probably be subject for more regulation by a numerus fixus.

7. The future: taking back control of environmental sustainability as a lever

The national tendency of intervening in economic processes is often backed up by EU regulations. Especially in preserving nature and taking care of the environment, it is the EU that sets the scene, and it is the national government that must implement. Taking care of this job has been done reluctantly or not at all. In fact, for 30 years The Netherlands have not complied to EU regulations concerning environmental issues[12] (nitrogen deposits, the amount of manure as fertilizer). As national government is rediscovering its responsibilities by acknowledging that that is the way to regain trust and effectiveness, it is also positioning itself within the agreements that were made on the EU level. That is a task that needs to be communicated well to the public as the Rutte administrations have not failed to question EU policies that suddenly are leading in measures that are impactful for public and business life. As such, this environmental sustainability domain is the obvious one in which government should take back control, but as shown, there are other domains that need to be freed of the market oriented and non-regulated approach. That is the honest story that needs to be told. Public governance should govern in a way that society is aware of it. For the good and for the bad.

12 NRC September 6, 2022: Mestuitzondering vanaf 2026 weg.

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On Harry Geerlings

Ik ken Harry al lange tijd. Wij studeerden destijds in Delft en Amsterdam. Daarna hebben wij elkaar decaden niet meer gezien tot een reünie. Dat was weer als vanouds, Gezelligheid en kameradie waren daar weer aanwezig tussen al die, fors grijzer of kaler geworden reünisten. Ook daarna was het weer een tijdje stil totdat ik mij voorgenomen had een proefschrift te schrijven. Dat was een hernieuwing van het contact en al was Harry eerst niet van plan mij te begeleiden, maar wel wilde begeleiden bij een Plan van Aanpak, al na een half jaar bleek dat ik mij schikte in zijn commentaar en opmerkingen. Dus Harry werd mijn promotor. Locus en focus, dat waren de sleutelwoorden in de jaren die volgden en wat een geweldig traject is dat geweest, samen met Bart Kuipers als co-promotor. En nu verliezen wij elkaar niet meer uit het zicht door ons nog over papers en ontwikkelingen te buigen. Harry is niet alleen een uitmuntend wetenschapper, maar ook een ware vriend. Wij vinden elkaar in wetenschappelijke en persoonlijke zaken. Ik hoop dat dat nog lang zo mag doorgaan.

Being sewn into the suit: Transumo A15 container study

Bart Kuipers[1]

Abstract

'Transumo A15 project From Maasvlakte to Hinterland; sustainable transport as a challenge' was an important, multidisciplinary research project, carried out in 2006-2009, with Harry Geerlings as project leader. The goal of Transumo A15 was to facilitate the expected growth of container flows to and from the Maasvlakte area in the port of Rotterdam and the hinterland of the port through a number of policy packages, aimed at limiting the growth of road transport especially by modal shift, making transport operations more sustainable and increasing of the quality of the environment in the Rotterdam port region. This article is devoted to a thematic investigation in the wider research program Transumo A15 on container logistics. The results of the 2009 container study will be assessed. How realistic were the established policy measures as seen from the current perspective, 13 years later? Have the policy measures proposed in Transumo A15 actually been implemented? Has Transumo's A15 policy to reduce road traffic on the A15 been successful? How does this policy relate to current approaches to influencing road container transport?

A package including five policy measures have been developed to achieve the desired modal shift and traffic reduction on the A15: (a) 'Container transferia', reducing container traffic by using container transfer points and extended gates, (b) 'Night distribution'; moving container road transport to the night to reduce congestion during rush hours, (c) 'Sustainable transit', policies to improve deep-sea terminal operations for barge and rail operations, including new IT solutions, (d) 'Transport Prevention', a package targeted on fewer container movements by making more use of foldable containers and 'grey container pools' and (e) 'Sustainability market', the introduction of auctions for road and terminal capacity and for empty containers.

Effects of the suggested Transumo A15 policy measures on container flows by road were smaller and different than expected. An important background is the much lower than expected growth in container flows to and from the port of Rotterdam. In retrospect, 'Sustainable transit' has led to the most significant effects of the policy package.

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1. Introduction: The Transumo A15 project

'Transumo A15 project From Maasvlakte to Hinterland; sustainable transport as a challenge' was an important, multidisciplinary research project, conducted in 2006-2009, with Harry Geerlings as project leader. The aim of Transumo A15 was to facilitate the hinterland activities on the A15 motorway, driven by the expected growth of container flows in the port of Rotterdam from 10 million containers (TEU) in 2006 to 33 million in 2033 (Vonk Noordegraaf & Van Meijeren, 2009).

The result of the construction of a new world-class container infrastructure at the container hub of Maasvlakte 2 in the 2010s was an expected severe congestion on the A15 motorway and deteriorating environmental effects in the Rotterdam region: strong negative effects on emissions, noise and external safety and the overall quality of life. In 2008-2012, Rijkswaterstaat (part of the Dutch Ministry of Infrastructure and Water Management responsible for infrastructure construction and management) conducted an investment program of 1.4 billion euros for the improvement of the A15 motorway. An important reason for the start of the Transumo A15 project is that this investment project would lead to capacity shortages and congestion on the A15 highway shortly after delivery due to the impressive growth of container throughput in the port of Rotterdam. The investment in Maasvlakte 2 and the A15 motorway has not been treated as one integral project by Rijkswaterstaat.

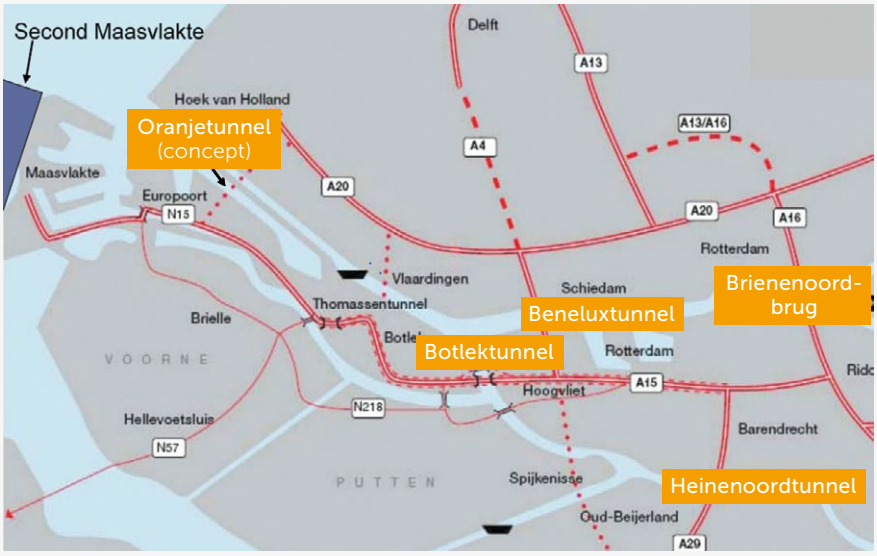
The expected negative effects on congestion and the Rotterdam environment were the reason for the start of the project 'From Maasvlakte to Hinterland: sustainable transport as a challenge' – 'Transumo A15' for short – in 2006, as part of the Transumo research programme. The aim of Transumo A15 was the production of a number of broadly supported innovative and sustainable policy measures aimed at improving both the accessibility and sustainability of the Rotterdam port region.

Highway A15 is literally the arterial road of the Rotterdam port area. It is a road that connects the port from the far western part – the Maasvlakte area with five large deep-sea container terminals – to the 'ring' of highways around the city of Rotterdam (figure 1). An important feature of the A15 motorway is the lack of alternative roads to the Maasvlakte: the A15 is a dead-end road and only offers secondary regional roads (such as N218) as an alternative to road traffic, not suitable for large volumes of road transport. Rail and inland waterway transport are the real alternatives to road traffic on the A15 motorway.

Project Transumo A15 was a large project involving 250 stakeholders, resulting in 25 deliverables. The project has been structured along three policy packages. The first package was called 'Modern Classics' and was devoted to well-known and proven policies aimed at reducing road transport, such as modal shift policies. Due to the limited results of this package on congestion and the environment, a second, more refined package of policy measures has been developed called 'Sustainable, Dynamic and Daring' - in Dutch: 'Duurzaam, Dynamisch en geDurfd', abbreviated as '3D'. This package offered ten powerful measures: (1) investment in a tunnel connection to improve the robustness of the network, (2) innovative concepts for passenger

transport, (3) innovative modal shift policy, (4) target group strips for road traffic, (5) promotion of night-time distribution, (6) sustainable policies to facilitate transit flows, (7) transport prevention; avoiding transport movements, (8) spatial policy aimed at influencing road transport, (9) market-oriented solutions and (10) policies aimed at influencing the organization of freight transport. In addition, more innovative long-term policies were developed in a third policy package, called 'The innovation impulse'. This package was created by outsiders, transition thinkers, and lateral masterminds (which this author was excluded from). The effects of these three policy packages on traffic flows, environmental effects, policy innovation, innovation in inland shipping and container logistics have been presented in six 'thematic studies'.

Figure 1 Highway network Port of Rotterdam, situation 2006.
Dotted lines: planned extensions of the network in 2006 (Kuipers, 2009)



This article is devoted on one of these six thematic studies: the '3D policy package' on container logistics as elaborated in Deliverable D21 (Kuipers, 2009). Deliverable D21 contains a detailed assessment of policies aimed at reducing container traffic on the A15 motorway and suggestions for alternative policies. In this article, we assess the results of the 2009 container study. How realistic were policies identified, as compared to the current perspective 13 years later? Have the policy measures suggested in Transumo A15 actually been implemented? Have the policies of Transumo A15 to reduce road transport on the A15 been successful? How do these policies relate to current approaches to influencing container road transport?

2. Policies aimed at modal shift and better use of container transport between port and hinterland

The rapid growth of deep-sea container volumes at Maasvlakte 2 was the main influence on the growth of road traffic on highway 15. Influencing these flows was therefore a main goal of the Transumo A15 project. In 2006, at the start of the Transumo A15 project, container throughput in the port of Rotterdam amounted to 9.7 million containers (again: TEU). In the strong growth scenario of the Central Planning Bureau (Besseling et al., 2006), Rotterdam container volumes were expected to grow to 33 million containers in 2033, an average annual growth of 4.6 percent. This volume of 33 million containers was seen as the starting point of the Transumo A15 container study. An understandable assumption because in the decade before 2006 (1996-2006) container throughput in the port of Rotterdam increased with an average annual growth of 7.3 percent in a period that has been called 'hyperglobalisation' (ADB et al., 2021) in retrospect, mainly because of the rise of China. However, the amount of container traffic expected on the road infrastructure to and from the hinterland of the port is a fraction of these 33 million containers.

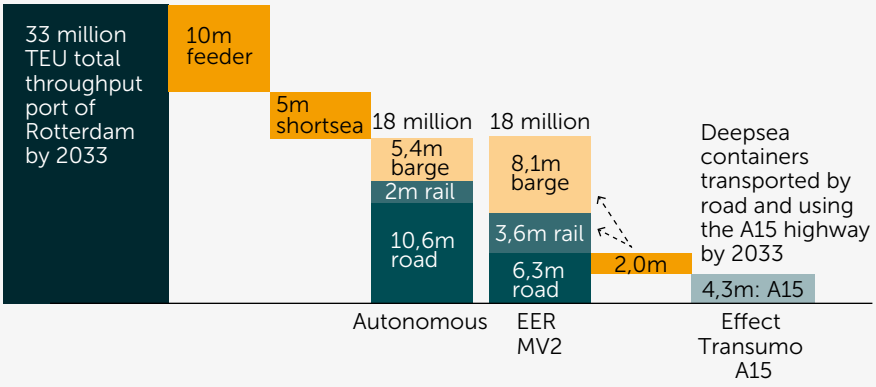
Of the 33 million containers, it was assumed that 10 million would relate to feeder traffic and would not reach the hinterland infrastructure of the port of Rotterdam via inland transport modes. Subsequently, 5 million is related to shortsea flows that are not linked to the container terminals on the Maasvlakte, but to the older Eem-Waalhaven area (near the centre of Rotterdam). This means that in 2033 it is expected that 18 million containers will be transported from the Maasvlakte terminals to the hinterland by inland shipping, rail and road. In an autonomous scenario, based on the modal split ratio in hinterland transport in the port of Rotterdam, 10.6 million will be transported by road, 2.0 million by rail and 5.4 million by inland vessels. The Environmental Impact Report (EEA) for Maasvlakte 2 (Bakker and De Bruin, 2007) contains strong modal split policies regarding terminal operators starting their activities on Maasvlakte 2. The two new terminals to be built on Maasvlakte 2 – APM Terminals and DP World, and later also other Maasvlakte terminals – were contractually bound to realize a modal split in which the share of road transport is shifted from the 2009 percentage of 47.5 percent to 35 percent. Inland shipping and rail transport will receive a contractually agreed share of 45

percent for inland shipping (modal share in 2009 was 39 percent) and 20 percent for rail (with a 2009 modal share of 13.5 percent). The operations of these terminals should therefore enable seamless intermodal operations. This modal split policy results in a modal split whereby in 2033 approximately 6.3 million containers will be transported by road on the A15 (in 2006 4.4 million containers were transported by road on the A15). The modal split contract in the EEA is an important measure to achieve the desired sustainable accessibility of Maasvlakte 2.

The expectation in 2009 was that this modal split contract would largely solve the problems for the container sector, certainly if the planned 'environmental zone' on Maasvlakte 2 was also realized and old trucks with dirty engines (Euro 1-3 without diesel filters) were no longer able to visit the Maasvlakte. The contractually agreed modal split policy in the EEA and the introduction of an environmental zone are important first steps towards the necessary transition from the container system to sustainable accessibility.

In addition, in the Transumo A15 policy packages, another 2 million containers should be shifted to inland shipping and rail, to meet the Transumo A15 goals for congestion and the environment, resulting in a volume of 4.3 million containers that will be transported by road transport on highway 15 in 2033 (Figure 2). This further reduction must be achieved by means of five policy measures from a much broader set of measures from the 3D policy package. These five measures have been selected based on the effect on achieving traffic reduction and on the feasibility of the policy. The selection was carried out in a workshop with six logistics experts and twelve members of the Rotterdam business community (Kuipers, 2009). In addition, the twelve most influential container experts in the Netherlands – referred to as 'container gurus' in the study – were interviewed to assess the assumed effects and to make suggestions for alternative policies.

Figure 2 Container flows port of Rotterdam in 2033: high-growth scenario. Policy package in Transumo A15 results in an additional shift of 2 million TEU from the road to inland shipping and rail (Kuipers, 2009)



Note: EER MV2: Environmental Effect Report Second Maasvlakte (Bakker and De Bruin, 2007)

The policies selected for realizing the desired modal shift and traffic reduction on highway A15 are:

1. 'Container transferia', reducing container traffic by making use of container transfer points and extended gates. This container infrastructure is aimed at bundling containers arriving by road transport in terminals at the edges of the port region (such as in the town Alblasserdam) and transport them by barge to the Maasvlakte, avoiding road transport on highway A15.
2. 'Night distribution'; the shift road transport of containers to the night to ease congestion during peak hours.
3. 'Sustainable transit', policies improving deep-sea terminal operations for inland shipping and rail operations, including new IT-solutions increasing the transparency of deep-sea terminal operations and intermodal operations and an increased use of carrier haulage being better positioned to realize modal shift practices.
4. 'Transport prevention', a package aimed at reduced container movements by making increased use of foldable containers and 'grey container pools'.
5. 'Sustainability market', the introduction of auctions for r.ad and terminal capacity and for empty containers, and measures aimed at increasing emission allowances.

These five policy-measures were expected to decrease the amount of road traffic on highway A15 with a further 2 million containers. This was a reduction of some 30 percent of the 6.3 million containers expected on highway A15 after the legal modal shift requirements resulting in 4.3 million containers in 2033 (figure 2). 'Container transferia' was by far the most powerful policy, reducing flows by 1.2 million. 'Night distribution' would have very limited effects, mainly because of limited opening hours of warehouses in the hinterland. The other three policies would result in modest effects, reducing traffic by some 0.3 million containers each.

The consulted container gurus assessed this result of reducing traffic by 2 million containers towards 2033 as too ambitious. Instead, their estimate was 1.3 million and in addition to 'Container transferia' they expected the same level of reduction from 'Sustainable transit'. These two policies would result in a reduction of container road traffic of 0.6 million containers each. In addition to the five policies identified, investment in IT-infrastructure to facilitate intermodal transport and improve rail and inland shipping performance were seen by the container gurus as the most promising policies.

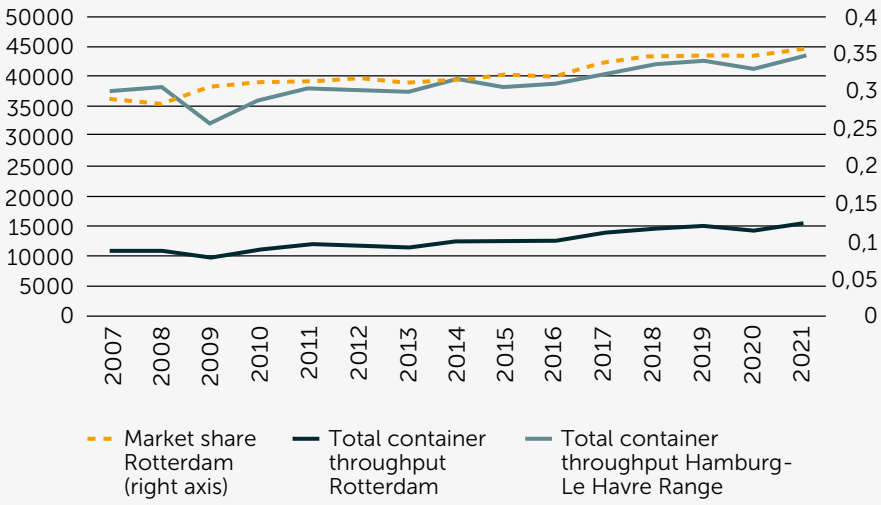
Fast forward to 2022. In the next paragraph, the growth of deep-sea container traffic in the port of Rotterdam since the start of the Transumo A15-project is presented, also the effects of the five policies adapted to container transport are assessed.

3. Container development in the port of Rotterdam: 2006-2021

Lower growth of container throughput as expected

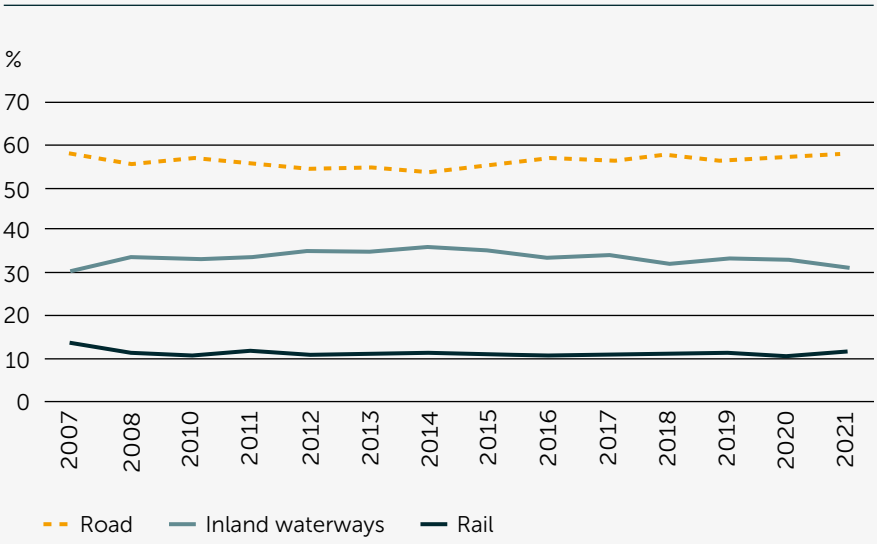
Container throughput in the port of Rotterdam grew in 2007-2021 from 10.8 to 15.3 million containers: an average yearly growth of 2.5 percent, much slower than the 7.3 percent growth of 1996-2006, and also much lower than the expected yearly growth towards 2033 of 4.6 percent. Growth of container throughput in Rotterdam by 2.5 percent outperformed growth in the Hamburg-Le Havre range, in which container volumes handled increased from 37.3 to 43.3 million in 2007-2021: an average yearly growth of only 1.1% (figure 3). The market share of Rotterdam's container throughput in the Hamburg-Le Havre port range rose from 28.9 percent in 2007 to 34.0 percent in 2017 and 35.3 percent in 2021. The additional capacity of the two new terminals on Maasvlakte 2 is clearly visible in growth of Rotterdam market share in 2017 (figure 3), the year in which the new terminals really took off. A much lower growth of containers handled in the port of Rotterdam than expected in the high-growth scenario, despite two new deepsea terminals on Maasvlakte 2 resulting in a growth impulse, means a much lower number transport operations between Maasvlakte and hinterland.

Figure 3 Container throughput in the port of Rotterdam and in the ports of the Hamburg-Le Havre range, TEU * 1.000, market share port of Rotterdam in the Hamburg-Havre Range



Note: Hamburg-Le Havre range: Hamburg, Bremerhaven, Rotterdam, Antwerp, Zeebrugge, Le Havre.

Figure 4 Modal split container transport port of Rotterdam – port hinterland, percentages.



Source: Port of Rotterdam

More transhipment containers compared to hinterland transport

The modal split in the hinterland transport of containers remained stable in 2007-2021: from 57.2 percent in 2002 to 57.7 percent in 2021 (table 4). However, in 2014 the share of road transport was only 53.4 and since 2014 a process of 'reverse modal shift' took place, with the share of road transport increasing. On average, growth of the hinterland modes lagged behind the growth of deep-sea throughput, because the share of feeder transport rose from 25 percent in 2007 to 35 percent in 2021 of total container throughput in Rotterdam. This means that the transhipment function of Rotterdam became more important compared to the gateway function, serving the hinterland by means of inland transport modes. This is a second factor, responsible for less hinterland transport.

Congestion on the deepsea terminals instead on highway A15

The 'reversed modal shift' towards the hinterland of the port of Rotterdam is strongly related to congestion on the deep-sea terminals and not on congestion on highway A15. Important factors related to this congestion are (a) the increased size of deep-sea vessels resulting in larger call sizes, increasing quay occupancy and greater peaks in the need for inland shipping handling capacity, (b) these larger deep-sea container ships also resulted in a growing number

of feeder activities, resulting in less available quay capacity available for barges, (c) unreliability of deep-sea services; more ships arriving out of schedule and (d) increasing dwell times on the deep-sea terminals, resulting in reduced terminal productivity. These are problems demanding more flexibility and shorter lead times towards the hinterland, which resulted in an increased use of road transport.

Investment in the Rotterdam road transport network

Since 2006, a number of important investment projects have been realized on the Rotterdam road network, as shown in figure 1. Highway A4, which connects Delft with highway A20 and the Benelux tunnel, was completed in 2015. The important investment in highway A15 mentioned in the introduction was also completed in 2015. This has led to a realignment of traffic flows on the network (figure 5). When assessing traffic flows, two developments stand out. First, overall traffic flows on the network remained stable, despite heavy investment in warehousing in the region and increasing port traffic. Secondly, there has been growth on the highway A15 segment Elbeweg-Merwedeweg, in the middle of the port region, since 2015 and accelerating in 2020-2021 (figure 5a). This growth might be related to the growth of container transport by road: the 'reversed' modal shift from the Maasvlakte to the hinterland, see figure 4. The share of road freight transport on A15 Elbeweg-Merwedeweg segment in particular shows a strong increase. Further research is needed, but developments are in line with each other.

Congestion related to the deep-sea terminals is probably a strong cause of the growth of container transport by road on the A15. Have policy measures as indicated in the Transumo A15 container study (Deliverable D21) been applied? And if so, what was the effect of these measures?

4. Implementation of Transumo A15 policy recommendations

The results of the important and widely supported Transumo A15 program have not been adopted by policymakers in the Rotterdam region. After the completion of the Transumo A15 project, no implementation plan was proposed, or follow-up measures were initiated. For Transumo project leader Harry Geerlings, this was a major disappointment and an indication of the passive and risk-averse nature of Rotterdam stakeholders: "We let ourselves be sewn into the suit there." (Dutch expression: "Daar hebben we ons in het pak laten naaien.") was a recent conclusion by Harry Geerlings on Transumo A15. It is therefore illustrative that Harry does not refer to Transumo A15 (Geerlings et al, 2018) in two chapters of his hand about sustainability and transition management in the book 'Ports and networks', a book that Harry mainly realized.

In section 2 of this article, the Environmental Impact Report (EEA) Maasvlakte 2 and the legal obligations of fixed modal shift shares to be realized in 2033 on the Maasvlakte were explained. This strict modal split target is not really in the mindset of stakeholders in the container industry in the Port of Rotterdam. And as indicated above, the desired modal split is far from being achieved. Road transport should have a share of 35 percent in the modal split. However, this share had risen to 58 percent by 2021 (Figure 4). This year, environmental organizations successfully went to court to enforce nature compensation measures in connection with the construction of Maasvlakte 2 (NRC, 2022). This could also happen with the modal split targets and therefore parties in the container sector should prepare for this more seriously than is currently the case.

Figure 5a Development of road freight traffic: working day annual average for selected road segments in Zuid-Holland and for the total of selected road segments, 2012-2021

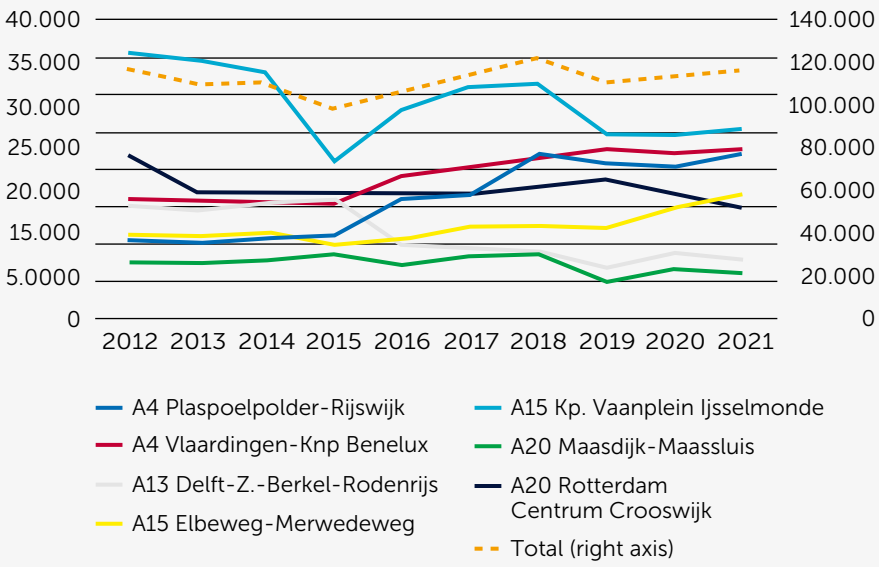


Figure 5b Share road freight traffic, 2012-21, selected road segments

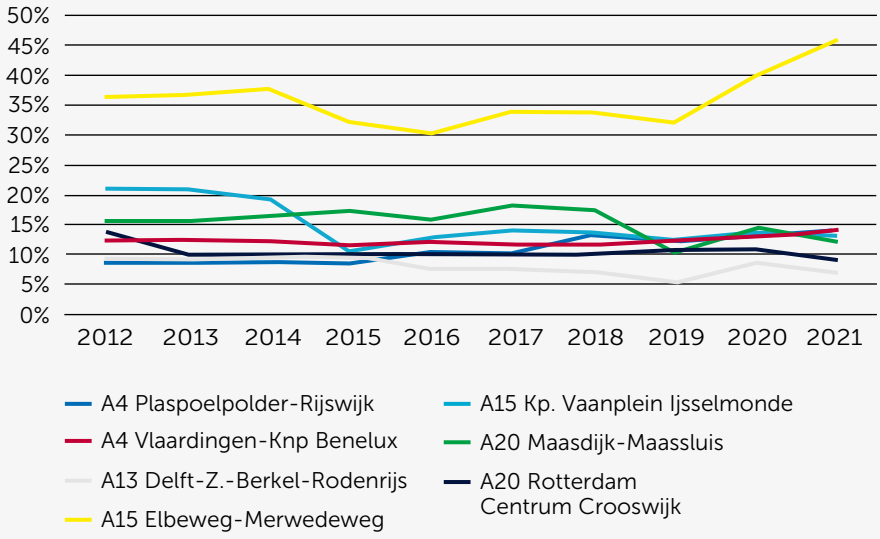


Figure 5c Road segments included on road network Zuid-Holland

Source: Rijkswaterstaat (2022)

What has been implemented of the five policy measures suggested in the Transumo A15 container study?

The first policy measure was the introduction of 'container transferia'. There are currently two container transferia in operation: Groenenboom Containertransferium Ridderkerk and BCTN Terminal Alblasserdam. These two transferia have a capacity of 10 and 140 thousand containers respectively. This total of 150 thousand is well below the level of 1.2 or 0.6 million containers expected in the container study of 2009. Moreover, despite the use of the 'Container transferium' label, both terminals also function as traditional inland terminals, reducing the 'transferium effect'. Conclusion: the concept of container transferia has been adopted, but the effect is much lower than expected; estimated at some 0.1 thousand containers.

'Night distribution' was the second policy measure identified; shifting road transport of containers from rush hours on highway A15 to the night. The expected effects of night distribution were limited due to the limited opening hours of warehouses in the hinterland. At the moment, the effect is indeed still very limited. However, new concepts are currently being developed, such as reefer-hubs where reefer containers can be stored on agrologistics parks in the Rotterdam region. This concept could be further developed through safe parking

spaces for containers on logistics parks. These measures have yet to be implemented. Conclusion: night distribution is still an attractive policy measure for shifting containers outside the rush hours, but the effects are currently negligible.

'Sustainable transit' policy, aimed at improving the operation of deep-sea terminals for inland shipping and rail, can be regarded as a successful strategy. This success is not really related to IT investments. The important IT platform 'NextLogic' is still in a pilot phase, despite a positive assessment of the technological possibilities by the market, but users are hesitant to use the platform. The success of a sustainable transit policy is related to organizational measures that reduced waiting times at the deep-sea terminals for inland shipping, increasing the use of inland shipping. Firstly, cooperation of inland terminals in a number of 'corridor initiatives' – including the West-Brabant Corridor and the Limburg Express – resulted in the collection of containers in one ship at various inland terminals along a corridor in the hinterland. As a result, a fully loaded barge arrived at one of the deep-sea terminals in the port of Rotterdam, instead of a larger number of barges with fewer containers from the individual inland terminals arriving at the deep-sea terminals. In addition, deep-sea terminals introduced fixed time windows and minimum call sizes with guaranteed handling by the deep-sea terminals, albeit at an additional rate. Finally, the concept of the 'Maasvlakte Container Transferium' was initiated, whereby container company ECT made a dedicated container crane available for the handling of inland vessels, a crane planned by inland shipping operators. The domestic transport of containers in the Netherlands increased from 1.1 to 2.7 million containers in 2007-2021, based on data form Statistics Netherland (CBS). Much of the growth of these 1.6 million containers can be attributed to the policy presented above. A conservative estimate is that one-third of these 1.6 million containers, 0.5 million, were transported by inland shipping as a result of these policy measures. This is about the same as the estimated impact of the container gurus, of 0.6 million containers. The Port of Rotterdam Authority has played an important role in this policy by initiating a 'Congestion deliberation for inland container shipping'.

The last two policy measures, 'Transport prevention', a package aimed at reduced container movements by making more use of foldable containers and 'grey container pools', and 'Sustainability market', the introduction of auctions for road and terminal capacity and for empty containers, and measures aimed at increasing emission allowances, were not successful. In 2007-2021 two initiatives were started to develop foldable containers, '4FOLD', the foldable shipping container by company Holland Container Innovations and 'Cargoshell', a foldable fiberglass container from the Rotterdam entrepreneur Rene Giesbers, were promising initiatives but failed to attract large-scale demand.

All in all, the policy measures suggested by the Transumo A15 Container study have led to a number of 0.6 million containers being shifted to inland shipping and not entering the A15 highway. This is much less than assumed in the Container study, where the effects of this policy package were determined between 1.3 and 2.0 million containers. The effects were realized through policy measures aimed at improving the operation of deep-sea terminals and to a lesser extent aimed at removing containers from the port region's road infrastructure by using container transferia. These policy measures were not directly related to the output of the Transumo A15 project.

Conclusion

Transumo A15 was an important research project in 2006-2009 that received a lot of attention both in the port and in the city of Rotterdam. The project has been very successful with regard to participation by Rotterdam stakeholders and with regard to research outcomes. However, the results were ignored by policymakers and were not implemented. This disregard for the hard work that has been done is what the title of this article means: being sewn into the suit (or the Google translation of the Dutch expression: getting screwed into the suit.) In the years after Transumo A15, a number of policies were implemented, but not directly related to the results of the study.

Thirteen years after the end of the project, the policy measures from the Transumo A15 container study are still relevant and play a role in the current discussion about limiting traffic growth on Rotterdam's road infrastructure. Overnight distribution plays a role in ongoing reefer hub initiatives. The Sustainable transit package is still relevant and in projects aimed at limiting congestion at deep-sea terminals, the issues raised in the container research project remain useful. Policy measures aimed at auctioning transport infrastructure and transport prevention do not currently play a role. But a new road transport tax, which will be introduced in a few years, and a peak levy of 15 euros for road transport during the day by deepsea terminal operator RWG are interesting initiatives. These initiatives can increase the efficiency of road transport and even lead to a modal shift, together with the introduction of emissions trading systems.

The current reverse modal shift towards road transport of containers calls for the implementation of new policy measures, as proposed by Transumo A15 in different packages. An assessment of the different policy measures proposed in Transumo A15 will be useful, despite the expected low growth of container flows in the coming years. Since 2006, completely new approaches have been initiated in inland shipping, such as Zero Emission Services: inland vessels powered by batteries in a container, and hydrogen as an energy source. Inland shipping is facing new challenges, such as low water levels. Road transport also uses new energy sources such as batteries and biofuels and perhaps hydrogen. Interesting concepts have also been developed such as 'clean energy hubs'. These latest developments were not foreseen in Transumo A15 and are an indication of the strength of new approaches emerging in the coming years.

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On Harry Geerlings

I can't name one event where I first met Harry, but suddenly we were standing next to each other with a glass of wine in hand at various conferences and social events in the greater Rotterdam area. The fact that we really liked each other led to a very productive collaboration in several research projects. Five projects are particularly important. First of all, of course, the Transumo A15 project, presented in this article. Secondly, a large project called IDVV (Impulse Dynamic Traffic Management Inland Shipping). This project is comparable in level of ambition to Transumo A15 and has resulted in detailed knowledge of the fundamentals of inland shipping. Third, writing the book Ports and Networks, together with Rob Zuidwijk. This was a tour de force from Harry, without his energy the book would not have come about. Fourth, working with Harry in the PhD research of co-editor and driving force of this liber amicorum Jos Vroomans was a real pleasure. Finally, our commitment to Erasmus Smart Port Rotterdam was very important. This first phase of the current Smart Port organization was not seen as a success by everyone in the Rotterdam region, but our collaboration was! In addition, there were a large number of smaller projects in which we collaborated – I certainly wanted to name the work for my place of birth Spijkenisse/Nissewaard!

Finally, together with our partners Patricia and Ellen, we celebrate life during a number of very pleasant dinner events. This is definitely going on! Thank you very much for the very nice collaboration, Harry, and all the best in the coming years, in which we are continue our collaboration as port veterans (together with Jos)!

Culture and Tourism: A sustainable Dilemma?

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Abstract

This paper addresses the culture-tourism nexus from a sustainability perspective. It sketches in a cascade form the methodological roadmap for handling the uneasy relationship between culture and tourism from a data-driven angle, based on a novel decomposition approach.

Keywords

Culture, tourism, sustainability, decomposition.

1. Setting the Scene

The tourist sector is one of the most rapidly growing export industries in the world, with a wide array of environmental, economic, social, transportation and cultural aspects. From a 'happy few' phenomenon, tourism has over the past decades turned into a global mass movement of people seeking to spend their lisure time elsewhere. Even despite a severe dip during corona times, the tourist sector is nowadays rapidly resuming its growth trajectory from a few years back. This means a rise in tourist volumes, a higher frequency of tourist trips in a given year, and an increasing participation rate in international tourism by low-income visitors and visitors from emerging economies. Apart from the externalities involved with global mass travel movements of many people (see Geerlings et al., 2012), there are many environmental implications of large volumes of visitors in destination areas. According to Goodall (1992), tourists are 'consumers of the environment' travelling to producers' locations, namely the tourist destination place, in order to consume a multiplicity of tourist products. The 'environment' has a broad meaning here, and relates to all attractiveness features of the destination, ranging from nature, beaches and scenic sites to local culture, history, and unique landscapes.

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Clearly, the tourism-environment interface has a wide spectrum of possible environmental externalities, such as: pollution of water, air, sites or nature, decay of vulnerable ecosystems, destruction of unique flora and fauna, degradation of landscapes or historical sites and monuments, crowding and congestion effects, and visual downgrading of attractive places (see also Cerisola, 2019).

If the tourism environment is seen as a resource for generating socio-economic benefits to both visitors and locals, preservation of environmental resources is pertinent (Cossossis and Nijkamp, 1995). Consequently, a successful tourism policy should not only look into volumes of visitors and amounts of revenues, but also into the maintenance of environmental quality. According to Savignac (1992), it is an important challenge to seek for a symbiosis between tourism and the environment, since: (i) tourism may promote environmental awareness; (ii) wise tourism policy favours environmental quality; (iii) tourism needs attractive environmental resources. Thus, tourism and environment can be both enemies and friends.

The need for a friendly co-existence between tourism and local environmental interests is undoubtedly apparent in the case of cultural assets in tourist destination areas. Such assets usually need tourists for their economic survival (e.g., Pompei, Taj Mahal, the pyramids of Giza), but a long-term sustainable development is only feasible, if the protection, maintenance, restoration and adjustment of these amenities (e.g., historical sites, cultural ambiance, prominent monuments, social-political and cultural heritage and buildings, urban landscapes) are taken serious in local tourism policy.

In the remainder of this article, we will zoom in on cultural resources as a vital part of any local sustainability policy. The problematic nature of sustainable development in the nexus tourism – culture is clearly articulated in a statement by Fusco Girard and Nijkamp (2009): "Cultural heritage – a broad container concept – has a hate-love relationship with modern tourism. It acts as an attraction force for people from different places of origin, while it stimulates local socio-economic development and reinforces a sense of local identity and pride. On the other hand, vast volumes of tourist flows may be at odds with the ecologically benign development of localities and may negatively affect social cohesion at a local level. Consequently, the issue of local sustainable development is at stake here" (p. 2).

This article seeks to offer new thoughts on the tourism-sustainability dilemma. It addresses the question whether and how local cultural resources may contribute to an attractive environment for visitors and local residents, seen through the lens of local cultural amenities. After a sketch of some methodological issues on the tourism-culture nexus in Section 2, we will provide an outline of a new methodological framework on the importance of local culture for place-based sustainable development, so as to sketch out a roadmap for operational research in this rapidly evolving field.

2. The Culture-Tourism Nexus

Culture is a multi-faceted concept and plays in the tourism sector mainly a role in two forms: the stock of cultural heritage (e.g., museums, castles, cathedrals, historical cityscapes, and landscapes etc.) and flows in the form of performing arts or science (music festivals, cultural entertainment, scientific gatherings, etc.) (Loulanski and Loulanski, 2008). In this context, Nijkamp and Riganti (2008) provide the following conceptual clarification: "The definition of cultural heritage can be quite controversial *per se*. In broad terms, we could define cultural heritage as the record of human achievements and relationships with the world. Therefore, it always has a local dimension, though sometimes it embeds universally shared values. The concept of heritage is not given, but created by a community, by people who attach values to some objects, rites, languages, contexts, lifestyles, historic sites and monumental buildings. Labelling something as heritage represents a value judgement, which distinguishes that particular object from others, adding new meaning to it. Cultural heritage summarises people's identities, and shapes communities' identities, and to this extent contributes to the creation of social capital. Many different cultural heritages can be identified, and this cultural diversity becomes a new form of capital embodied in artefacts both material (monuments, historic sites, cultural landscapes, and so on) and immaterial (languages, traditions, religions, and so on)" (p. 57).

In a recent study by Kourtit and Nijkamp (2019), an extensive overview of the relationship between culture and local development paradigm has been given. The authors present a critical review of the culture-led local development hypothesis, while they address in particular the role of historical cultural heritage as a magnet for attracting visitors and creative class members. In general, the presence of a broad portfolio of historical-cultural resources in a city appears to attract in particular 'creative minds'. The authors demonstrate that usually human creativity and cultural amenities are two mutually complementary assets. The importance of such a *'creative-cultural complex'* in a city is confirmed by their extensive empirical modelling study on urban areas in the Netherlands.

In a subsequent study (Kourtit and Nijkamp, 2022), the authors seek to identify the main cultural drivers that determine urban success. Based on a large sample of global cities, they assess the '*urban cultural value*' of these cities. They find that urban size, average income in a city, the organisation of major events, favourable housing and labour market conditions, and entertainment amenities all contribute to the role of culture as a major facilitator of urban success. The combined influence of tourism and culture on urban performance is however still, an under-investigated item.

It goes without saying that in a balanced local tourist policy the question often arises: 'How much tourism is enough?'. The optimization of the volume of local visitors might conceptually be based on an inverse U-shaped curve, but operationally this is very hard to establish. The cases of Venice, Barcelona, Paris or Amsterdam illustrate that overcrowding is a serious problem, but even though this problem is recognised, it is very hard to develop an effective strategy that in a balanced way would optimise the size of tourist flows, mainly because there

are conflicting interests in a destination city (e.g., among inhabitants, visitors and businesses people). Throsby (2009) in an informative article, has formulated three 'golden rules' for a balanced local strategy on tourism and culture heritage:

i Get the values right (e.g., economic, cultural, social, spiritual, symbolic, etc.)
ii Get the sustainability principles right (e.g., continuity, intergenerational equity, diversity, etc.)
iii Get the analytical methods right (social accounting methods, input-output analysis, social cost-benefit analysis, digital support tools, etc.).

These 'golden rules' may be helpful in assessing the societal significance of cultural resources for the tourism sector. In a study by Riganti and Nijkamp (2008) the authors argue: "The evaluation of cultural assets is a research activity that finds its roots in environmental evaluation. The latter aims to access from an individual or societal perspective the economic meaning of environmental goods (or degradation of such goods). Cultural heritage forms a particular subset of environmental goods with specific characteristics in terms of uniqueness and historical orientation. Nevertheless, various general principles from environmental valuation apply also to cultural goods, as they have similar attributes: scarcity, non-priced nature as a result of externalities, and site specificity" (p. 57). Clearly, tourist attraction and local well-being are often not running parallel.

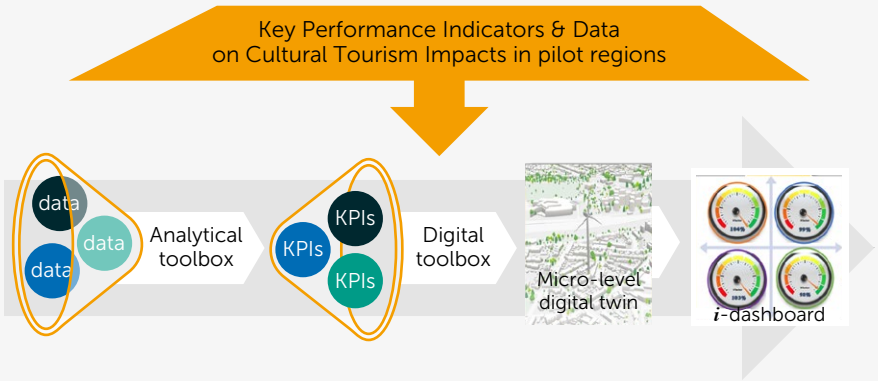
It is noteworthy however, that in most well-being studies the role of culture or cultural amenities is undervalued (see e.g., Font et al., 2018). For example, in well-known happiness or well-being assessments (e.g., based on the Human Development Index, the Happy Planet Index, the Index of Sustainable Economic Welfare, the Gross National Happiness Index, the Better life Index etc.) cultural resources are hardly ever included as determinants of human-centered well-being. To the best of our knowledge, we found only one study – an EUR master study by Putri (2015) – which included cultural resources in a study on 'happy amenities'. Clearly, the triangle culture-tourism-sustainability is hardly ever addressed in quantitative well-being research. There is a clear need for novel contributions in the tourism sciences (see e.g., Coca-Stefaniak and Seisdedos, 2020; Errichiello and Marasco, 2017; Hall and Williams, 2008).

It is thus evident that solid, tailor-made assessment methods are a *sine qua non* for effective decision support in the tourist sector in destination places. Spatial cultural impact evaluation tools, community impact studies at the tourism-culture interface, user-oriented scenario and envisioning experiments and digital support tools (e.g., cultural-tourism dashboards, citizen-oriented interactive digital twins etc.) are badly needed in sustainable tourism research, most likely in tandem with citizen science.

3. Human-Centered Heritage Strategies and Tourism

A recent EU Horizon project, named Be.CULTOUR ('Beyond CULtural TOURism'), has the overarching goal to co-create and test new sustainable human-centered activities in the tourism sector. It seeks to assess the impacts and market potential of sustainable and (circular) cultural tourism at national, regional and local level, based on a CoP (Community of Practice) of 6 pilot areas in Europe and a CoI (Community of Interest) with 16 'mirror' areas in Europe. On the basis of KPIs (Key Performance Indicators) on cultural tourism impacts in the successive pilot regions, a systematic scheme is designed and tested, starting from an extensive database in the pilot regions and using analytical tools and digital support systems (e.g., imagineering, digital twins) to arrive at an interactive i-dashboard as a policy support vehicle (see Figure 1).

Figure 1 A cascade of hierarchical data use and monitoring



Source: Authors' elaboration

This figure comprises the main driving forces for assessing a balanced set of local sustainable and cultural assets development in order to evaluate the relevant KPIs in the tourism-culture nexus, from a local sustainability perspective. This framework provides the 'umbrella' setting for all case studies concerned. It seeks to provide the joint contours for smart data management systems, to be used for tracing sustainable development trajectories at the interface of culture and tourism (using e.g., i-dashboards, digital twins etc.). This approach calls for a co-creation of innovative development strategies including diversity, inclusiveness, and citizen/stakeholder

participation in tourist destinations. In this context, an i-dashboard is an advanced performance-based operational navigation tool for decision-makers, stakeholders and the public at large.

The organisation of the database follows systematic analytical *decomposition* principles, as extensively described in Kourtit (2021). Figure 2 offers a sketch of such a hierarchical data processing methodology based on three geographical levels (micro or eye-level, meso, macro), where the decompositional 'attractor' is XXQ, which stands for the highest quality of urban liveability (see Nijkamp, 2008), seen from the perspective of the tourism destination area, subdivided into geographical micro-, meso- and macro-levels.

Figure 2 Model of spatial sustainable performance of tourism destinations

Source: Authors' elaboration

Figure 2 seeks to integrate the methodological and conceptual approach to smart data management at the interface of tourism and culture, based on evidence-oriented policy initiatives and actionable sustainability programmes. It is also based on a participatory approach to enhancing XXQ, against the background of an innovative cultural tourism amenities policy, in order to exploit the sustainability potential of cultural heritage and valuable ecological landscapes with a view to community well-being. This is clearly a data-driven research effort, employing data composition principles (a 'cascade' paradigm) so as to achieve a high urban performance (XXQ) at the culture-tourism nexus.

The architectural model used to map out the complex interplay of all variables in a tourism-culture-sustainability spectrum is sketched out in Figure 3[3], comprising operational variables based on available databases.

Figure 3 offers an illustrative data-based architecture of sustainability-oriented cultural tourism impacts as a frame of reference for the European tourism studies under consideration. It comprises a *function-specific* database (e.g., regional characteristics, enabling conditions, cultural indicators and sustainability performance indices) and *actor-specific* information (e.g., individual attributes and motivations, social-cultural networks, destination accessibility to visitors, experienced quality of services, or quality-of-life indicators). The structure of Figure 3 integrates the various geographical levels in a tourist destination, based on the '*microcosmic*' principle (see Kourtit et al., 2020; Kourtit et al., 2022). In this respect, the empirical tourism database provides interesting and policy-relevant information (for both policy-makers, city-marketeers, researchers, etc.) on the value systems and judgements of all actors regarding the items or achievement indicators of the pilot regions at hand. In Figure 3 the notion of X-factor refers to the measurable critical factors (or KPIs) that shape the structure and mechanism of the tourism system concerned. The internal X-factors refer to personal or actor-oriented perceptions of tourism areas, while the external X-factors refer to observable or tangible features.

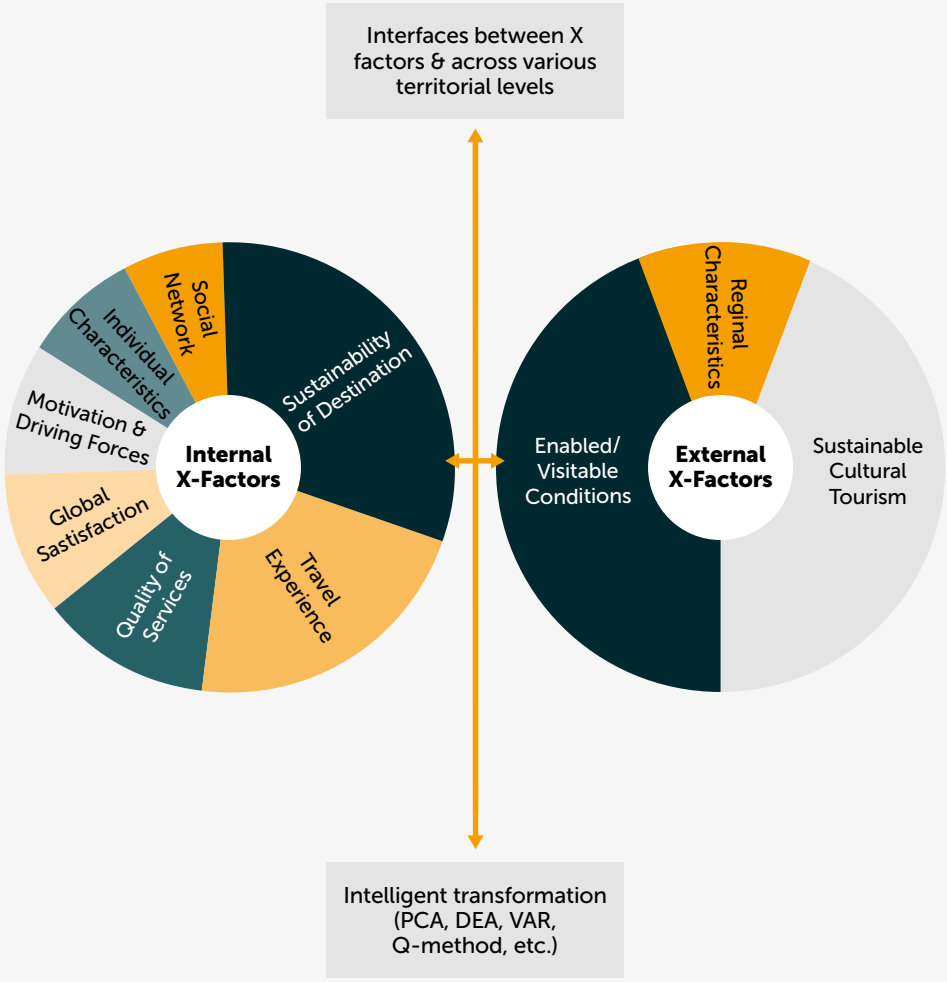
The major strengths and advantages of the comprehensive data system are the provision of:

- a systematic comparison of the X factors (key performance indicators) of the pilot regions/cities in the Be.CULTOUR project;
- development of a multidimensional criteria set for quantitative benchmarking and rank orders of the regions under investigation;
- an empirically verified and testable collection of comparative quantitative data on many important policy aspects of the pilot regions;
- an involvement of different stakeholders in different – local and global – sectors of contemporaneous city life;
- a possibility of a multi-annual or regular updating of the information, so that a unique data set – up-to-date – can be obtained as a basis for urban monitoring.

Finally, the 'umbrella pictures' from Figures 2-3 shape the container for the data warehousing picture for a typical survey data decomposition presentation in Figure 4.

3 For the sake of readability in this book, figure 3 is simplified and restricted to a few levels of analysis.

Figure 3 Multidimensional (endogenous (X) and exogenous (X) explanatory factors) assessment model of sustainable and circular cultural tourism in the six pilot regions. Source: Author's own elaboration. A systemic constellation of the multidimensional determinants and critical factors shaping an intelligent sustainable and circular cultural tourism system.



Source: Authors' elaboration

Figure 4 Architecture of the KPIs in an urban tourism data warehouse system

Source: Authors' elaboration

Figure 4 shows the ingredients of a data warehouse that serves to highlight conflicts and compatibilities between relevant KPIs at the culture-tourism nexus. It is clear that the operationalisation of this approach calls for advanced instrumental tools. Our framework sets out to develop and present the cornerstones and contours of an appropriate methodological and conceptual smart data management framework which supports also a sustainable and regenerative cultural tourism co-governance (community empowerment). Furthermore, it also calls for on strong strategic alignments with planned evidence-based policies and integrated actionable programmes. This in order to improve local sustainable cultural tourism performance value at the interfaces of various spatial scales and time levels, by enhancing participatory place-based decision-making in search of the *X* factor for innovation of cultural tourism facilities and cultural heritage attractions in the pilot regions - in a data-rich urban environment. In conclusion, the proposed framework provides a challenge in building up a transparent space–time information framework so as to obtain and ensure a high quality of knowledge-based information that is necessary for managing and enhancing the potential of cultural heritage and landscapes as drivers of inclusive sustainable economic growth, communities' wellbeing, and resilience and environmental regeneration as well as effective cooperation at cross-border, regional and local level.

4. Conclusion

The present paper sketches out the methodological framework for an operational understanding of culture-tourism dilemmas. It is clearly a challenge to assess and monitor a complex sustainable management and performance of tourism destinations, contributing to a valuable cultural and ecological system and to evaluate whether the different stakeholders involved are still on track. Using new comparable data and results supported by intelligent systems – for instance, the so-called 'i-dashboard' – will help to identify critical patterns and trends, and to monitor and evaluate the identified KPIs across various territorial and time levels. Such a new intelligence approach offers a convincing case for a novel view on a set of qualitative and quantitative assessment instruments to map out the drivers of sustainable tourism. The so-called decomposition evaluation method based on various analytic approaches serves to map out systematically the critical success factors for a sustainable harmony between people and places, including tourists and local culture. This may support improvement of quality, standing and recognition of tourism regions, from the ambitious perspective for all people and places supported by novel technologies (e.g., digital twins, dashboards).

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Personal Epilogue on Harry Geerlings

Harry Geerlings is one of those remarkable scientists who does not like to be at the forefront of public interest or political turbulence. His modesty hides a scholarly and open mind which made him a leading person in sustainability research in the Netherlands, through his intellectual and broadly-based view on the social, economic and technological complexity of a world that seeks to achieve a sustainable future. It has been an extremely great pleasure to join Harry on his PhD trajectory and to see that later on he managed to pave the road for an academic career, sharing his views with many colleagues and students. Meeting Harry was always a great social and academic experience. Thank you, Harry, for so generously – and in cooperation with others – working on the cornerstones for a better world!

Peter Nijkamp

The State of Environment & Policy

Jacko van Ast

Introduction

"How do you save a suicide bomber who has already jumped?". It was a question from *Dennis Meadows*, one of the authors of the Club of Rome, illustrating the urgency of action to save the Earth's ecosystem. Actually, it was already too late. Van Ast & Geerlings (1992) had an answer in their book *Milieukunde en Milieubeleid, een introductie* (further referred to: *Environment & Policy*). This book from the early 1990s, ends with an answer to this little hopeful, rhetorical question: "ensure a soft landing!".

It was the expression of the belief that a rescue was still possible. If we were all to give everything we could, there would still be hope. One of the prerequisites, awareness, was the first step. And that would go quickly with the knowledge we obtained of the end of the 20th century. As a follow-up to the publications of the Club of Rome, humanity would soon realize that it must immediately change its direction of development. The Earth is simply too small to continue striving for unbridled economic growth without considering the consequences. The computer models of *Limits to Growth* (Meadows et al., 1972) were clear enough. And the many international publications that followed left nothing to be desired.

However, concrete action was slow to get underway. In the Netherlands, for example, it took until the second half of the 80's for concrete steps to take place. It was a right wing (VVD)-minister who first dealt with the environmental theme very insistently. In a book about the urgency of the problem: *Guest in own home* (*Gast in eigen huis*), Winsemius (1986) mentioned the problems and shows the policy-solutions. Important steps followed at the end of the 80's after *Zorgen voor Morgen* (Caring for Tomorrow, RIVM, 1988) was published and the four ministries that mattered in this field reacted jointly in the same year with the Dutch National Environmental Policy Plan (*Nationaal Milieubeleidsplan*, 1988). The Ministers of the Environment, the Minister of Water Management, the Minister of Economic Affairs and the Minister of Agriculture jointly signed this important policy document with concrete actions. It fitted very well with the zeitgeist, where *the Brundtland report: Our Common Future* (WCED, 1987) was just published. The Netherlands at the time was in the lead in environmental policy; it was a role model for many countries in the world that became aware of the actual state of the planet.

Environment & Policy also contributed to this awareness leap. In these years it had become a widely used learning method in academic courses. In Van Ast & Geerlings (1992) we were convinced that If so many graduates would also become aware and spread the message, the necessary steps would follow naturally. At the same time, we hadn't actually thought that we still had 30 years to take these measures. It had to be much faster! Predictions showed large areas of dead forest, congested roads on which cars can no longer drive and a sea level rise

that would make most of the Netherlands an uninhabitable country. How did we see these developments at the time, what possibilities for sheltering the suicide bomber had we pinned our hopes on? And what happened in reality?

In the following I will briefly discuss these issues, zooming in on Harry Geerlings' area of interest. I conclude with a tribute to the colleague I have had the opportunity to experience very closely for many years.

Nature and Pollution

"*Das Waldsterben*" was one of the biggest scares of the 1970s. Especially in industrial Europe and North America, the quality of large areas of forest deteriorated alarmingly. Many blame this on acid deposition, ultimately resulting in the disappearance of the forests. At that time, due to the enormous industrial emissions of acid-reactive substances, rain came down, which in extreme cases had the acidity of battery acid. It is undisputed that tree roots can barely withstand this. In reality, forests started to die; first the coniferous forests that can handle the acid poorly, but other vegetation and wetlands as well had a hard time. In Scandinavia lakes became that acid, that life for a large part disappeared. About forests Environment & Policy writes: "almost a third are in a very bad condition in the Netherlands" (Van Ast & Geerlings 1992, p.121). However, although all forests in the Netherlands still suffer from pollution (especially nitrogen deposition), most forests have never completely died.

Were these predictions not greatly exaggerated? What safety net has ensured that these expectations have hardly come true? As far as the dying forests is concerned, experts anonymously point to their strongly reduced vitality. The state of the forests in the Czech Republic and Germany, where the most serious problems occurred, also plays a role. Tree deaths mainly took place in monotonous coniferous forests that were declining sharply due to mineral deficiency, their age, and various diseases. However, by making mature monotonous wood stands more diverse, the resistance of the forest also increased. But the main reason for the reduced damage has been the rapid implementation of strong policies. Sulphur dioxide, the main source of sulphuric acid, was quickly removed from fuels and all major industries were given extensive filter systems to capture acid-forming substances. These enormous efforts had a relatively quick effect. In this way, the problem of sulphur dioxide - and thus the reaction to sulphuric acid - could be tackled effectively.

However, there is still acidification. Because in addition to sulphuric acid, there is also deposition of nitric/nitrous acid, which is caused by nitrogen compounds like NO2, NO3 and NH4). And the fact that the problem with nitrogen has not yet been solved in Europe and specifically the Netherlands, will no longer have escaped anyone's attention. Van Ast & Geerlings (1992) warn for the remarkable increase in pollution from agriculture. It was stated that 90% of all ammonia (NH4) comes from agriculture, where it is precisely this nitrogen compound that causes local damage in nature reserves. Since these observations at the beginning of the 1990s, the farming sector however has grown strongly, especially after the European milk quotas expired. One

could argue that the current nitrogen problem is the result of the conversion of the farming community into an agricultural industrial sector, in which economies of scale are highly valued. The risks of too much emissions from farms were also pointed out in the 1980s, but in contrast to power plants and large industries, anti-emission measures were overtaken by the sectors growth. The consequences can be seen everywhere: decrease of tree vitality, grassing of heath areas, increase in undergrowth in more light-permeable forests and a general decline of lime-loving species and animals.

Due to the multiplicity of stakeholders and the profound impact of business closures on families who have been supplying food to society for generations, the problem in agriculture is persistent. More persistent than the sulphuric acid problem that is mainly caused by a limited number of manageable industrial companies. This is all the more so because financial margins of farming can be left small due to scaling up, but at the same time can generate immense profits (or losses) in absolute numbers. Modern, bank-driven investments are big for the individual farmer, and the debts are correspondingly; often too bulky to solve for the cornered families. Added to this, is the little apparent deterioration of nature. The deep green perennial ryegrass provides a beautifully raked view of the farmland and conceals that it is a poor desert from an ecological point of view. It is this unwitnessed minimal diversity of life forms that contrasts with the overwhelming green grass that grows like weeds! So where is this severe deterioration we are talking about?

Ozone Layer and Climate Change

In addition to "acid rain", the depletion of the ozone layer was acute in the 1970s and 1980s. Here too, the Apocalypse seemed to be really close. Because the ozone molecules in the stratosphere are broken down by a variety of chemicals at 10-50 kilometres from the Earth's surface, significantly more ultraviolet radiation from the sun reaches our planet. CFCs that are added to aerosol cans as a propellant were especially important here. Especially around the South Pole area, the diluted ozone layer results in more cases of skin cancer and damage to many plants and animals that are unable to cope with the strong radiation. Micro-organisms in particular would be the victim, because they often lack protective pigments. This applies, for example, to the algae in the sea, which provide the largest share of Earth's oxygen supply. In "Environment & Policy" the consequences were called disastrous; people would become severely ill and nature would become catastrophically impoverished. Due to the after-effect (the slowness of the chemical reactions), a recovery of the ozone layer could only start after 20 years from the moment the measure would be taken.

Has this worked out in practice? No definitely not. Fortunately, not all the oxygen-producing algae in the ocean have died from the powerful radiation. However, many additional cases of skin cancer have occurred, especially near the "hole in the ozone layer", a dilution up to 50%, next to Australia and New Zealand. But also in other areas the influence was surely measurable but not disastrous. Were these warnings exaggerated? Here too, it has mainly been policy that has provided solutions. The Montreal Protocol (1987) banned most forms of CFCs in products,

and they were in industrial installations also largely dismantled. A significant reduction of ozone-depleting substances was the positive result. Therefore, the continuous increase in depletion of the ozone layer fortunately did not continue at the pace expected in the 80's. The layer stabilised in the end of the 90's and currently even seems to show signs of recovery.

Unfortunately, this was not the case for a less directly harmful group of substances that was expected to have very serious long-term consequences: the greenhouse gases. Just like with the depletion of the ozone layer, it is hard to believe that global climate warming could be caused by human beings. Moreover, an effective climate policy means that many achievements – often associated with energy consumption – had to be given up. This caused even greater resistance. In addition, the developing countries often do not feel responsible for their emissions where the rich countries have been producing pollution for decades. This under the motto: "Develop first, then the savings measures". The result is the most unmanageable environmental problem in human history. Although both corona and energy crises helped, a soft landing for this suicide bomber does not seem immediately available here...

Transport and Technology

In the 90's, the unbridled growth of traffic and transport was yet also already full in the spotlight and urgently needed to be restrained. It *was Ken Gwilliam*, the English professor of traffic and transport, who inspired Harry Geerlings to delve into this subject. In the words of Geerlings (1998: p.VII) "an important stimulus [...] was the increasing awareness of the seriousness of environmental impacts caused by transportation". Due to the enormous pollution and land take of this sector, the disadvantages are growing at an enormous rate, while the traffic itself has come to a standstill. Definitively, these problems have not diminished in recent decades. The question is still where we can find the solutions. Maybe other modes of transport? Also, all alternative modes of transport are fully used in a very short time when they offer a reasonable alternative. The better the transport option becomes, the more it is used. This means that every concrete solution creates new traffic demand. And new problems, especially bearing in mind that employees are aiming for the same travel time everywhere – about half an hour between home and work is ideal. If the journey becomes shorter in time, the distance between the work and home location will be longer.

But a special turn in developments found place in this area too. The corona crisis acted here as a catalyst for solutions that were previously not taken very seriously. Due to the digital revolution, much of the physical traffic can be replaced by digital exchange of data. However, this change is at odds with social and cultural habits and structures. The Covid virus forced us to make this switch. After the impact of the corona crisis has been greatly reduced, the share of working from home is still much higher than before the crisis. To a level that environmentalists at the turn of the century could only dream of. In the words of *Donald Huisingh*, the American sustainability guru who gave Rotterdam environmental science new impetus, every crisis brings new opportunities for improvements. However, a vast reduction in the density of transport flows is still highly desirable, not in the last place because of the Ukraine energy crisis.

In many cases, according to Geerlings (1997), the best option for transport over land is the train. The potential of the MagLev technology in this area had his special attention. This train that lifts from its rails on the basis of magnetic force was expected to eventually break through, making public transport enormously attractive. Unfortunately, although the technology turned out to be superior, it was at the same time too expensive for large scale implementation.

Geerlings was in these days of writing his PhD-thesis also very interested in the expected great future for hydrogen technology, and in particular the fuel cell. Again, this applies to environmentally superior technology. With hydrogen as fuel, transport can take place without pollution. It seems to be too beautiful for the reality. And again, the energy crisis as a result of the war in Ukraine could provide new opportunities here. In any case, hydrogen technology nowadays still remains very promising.

Policy

Great emphasis is placed in Environment & Policy on the prevention of environmental problems, whereby "end of pipe" solutions – with new waste and pollution problems – can be avoided. If we had sufficient knowledge, we would of course decide to choose for implementation of more efficient and cheaper source-oriented solutions. This instead of always trying to limit the environmental consequences at the end of the chain as much as possible – and at great cost. Pollution Prevention Pays! Stop now with the most polluting products and all the pollution that comes out of the production pipe is automatically something of the past. Yet, beyond the ban on CFCs, PCBs, and some carcinogenic pesticides such as DDT, not many truly preventive measures have been taken. As is the case with nuclear energy, the economic benefits of risky or polluting activities are so large that they could not be rigorously stopped. And we still do not want to part with, for example, the many strong and cheap plastic materials that are made from mineral oil, or from all kinds of very effective substances for the protecting of agricultural products from nature.

In the history of environmental policy, Environment & Policy distinguishes seven historical phases. In every period, there are events and publications that lead to an intensification of attention for environmental policy. It is interesting to see how the seventh phase of "confrontation between society and environment" (titled "1987-present") has continued after the last reported in the book. The prediction from the title of this phase has certainly come true, as confrontations are currently going on all over the world over environmental issues such as climate change, deforestation and pollution. The agreements on climate policy, in particular in Rio de Janeiro (1992) and Paris (1995), were important highlights, but the phase does not seem to be replaced by a new phase with a new paradigm - for the time being. It appeared that a long period of backfire started in the beginning of the 20th century. Nevertheless, in the last years we see some elements of revival of environmental awareness with the many initiatives that can be summarised by "the transition towards a sustainable society" or "zero waste society".

At the same time, it is very much the question where the confrontation will lead to. Will it be the populists, the climate change deniers, the liberals or the idealists who will be successful in the end of the day? The answer to this is not yet foreseeable, but developments in the field of war and peace, energy transition, differences between rich and poor and especially the mentality of the voter who seems to pay little attention to the threats that plague the world, are not hopeful. From this perspective, a major crisis should not be inconvenient. It could change the basis of our society in such a way that an emergency landing of our planet could – unexpectantly - still be a possibility....

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The role of Prof.dr. H. Geerlings

At the start of his scientific career in the 1980s, Harry Geerlings was – just like me – driven by concern about the fate of our planet and its inhabitants. With great effort we wrote the texts for Environment & Policy on a massive Olivetti laptop. The expectations were that the book would contribute to better behaviour of environmentally disruptive people. More knowledge and insight into the polluting society will mean that people would repent and take the measures that are absolutely necessary to preserve our planet.

In his research, Harry searched for solutions, especially in the area of traffic and transport. He specialised in the many environmental and congestion problems of our modern society, with the port as a place where this all comes together. The fact that theory and practice are not always easy to reconcile was shown by the many trips and travels we took with Harry's old Volvo. It also turned out to be impossible to be a good environmental professor without using air travel.

Harry Geerlings became a professor with the (Rotterdam) harbour as his specialty. This "port professor", as he called it himself is a fantastic fit for Harry, who considers networking an attractive sport. He has his friends and acquaintances everywhere, and the social ties are always warm for all. Spoiling his friends, both domestic and foreign, is another specialty. Not only with presents, stimulated by his equally sociable Patricia, but above all by his warm personality. Because Harry knows the art of telling a good story, his enthusiasm and knowledge quickly lead to everyone hanging on his every word. In this way you are very soon drawn into Harry Geerlings' social space, characterised by a lot of friendliness. And soon it will be time for a nice snack or drink. It is also always cosy and hospitable in the Geerlings' home. With Harry in the house, all activities are at least twice as fun to experience.

Still, I would be disrespecting Harry if I attributed his wonderful career solely to his social and networking skills. How many weekends and long evenings has Harry worked through, to fulfil all those important obligations? Or to work out opportunities for great new initiatives? Or to give his attention to the PhD students he supervised? His Patricia always sighed deeply when this subject came up, but at the same time she only could be very proud of the man who showed such enthusiasm for work and who was never reluctant to help his colleagues or his friends and family. If retirement can be earned, it's here.

Finally, from the moment you bring up the name of Harry Geerlings to anyone of our faculty, directly a smile appears. A smile that continuously appeared on my face, when I entrusted the above to the computer. It has been a great pleasure to think about all the experiences I had the opportunity to go through with him. Harry, all the best to you as a retiree! Enjoy children and grandchildren intensely. Enjoy your many friends for a long time to come. And enjoy the numerous colleagues from your extensive network. I hope to be able to participate in that from the second and third category for the coming decades!

Jacko van Ast, Rotterdam, November 8, 2022

The greening of hinterland corridors: towards a research agenda

Ron van Duin

Bart Wiegmans

Introduction

According to Rodrigue and Notteboom (2020), the definition of the hinterland is 'a land area over which a port (or a transport terminal) sells its services and interacts with its users. Depending on its nature, the port (terminal) serves as a place of convergence for the traffic coming by roads, railways, inland waterways or by sea/fluvial feeders'. Due to congestion and lack of space in port areas, inland hubs have been constructed along waterways and railways, providing reliable connections with the seaports. Around these inland terminals, logistic zones have emerged, offering additional services such as customs clearance, empty depots for containers, value-added logistics, and attracting regional or global distribution centers (Caris et al., 2014). The added value of the associated flows of goods and logistics has been demonstrated for the economic added value of the Netherlands (Ministery of Infrastructure, 2017). The importance of hinterland connections is shown in Parola et al. (2016) where, besides the port costs, the key drivers for port competitiveness are 'hinterland proximity' and 'hinterland connectivity. Hinterland proximity refers to the geographical proximity of the main hinterland markets served by a seaport and hinterland connectivity refers to the efficiency of inland transport networks.

An important concept within the hinterland connections is the so-called 'corridor' (see e.g., Witte et al. 2012 and Witte et al. 2013). The main components of a corridor are usually a seaport, waterways, road and rail networks in the hinterland, inland ports or bulk ports, and border controls. In a corridor, all modes of transport follow the same spatial orientation and serve the most important agglomerations and economic centres within their route. A distinction can be made between corridors according to their scale, from corridors within and between regions to corridors that stretch and connect entire continents to Europe. In addition, the approach to the corridors varies from coordination and development of the infrastructure to the coordination of spatial trade and economic developments (ITF, 2022). As Wiegmans & Janic (2019) expected, the corridors serve (new) supply chains by attracting more voluminous freight transport demand primarily from road at the continental (European) and from deep-sea shipping at the intercontinental (Asia-Europe) scale. The Silk Road initiative is clearly a proof of this.

The Trans-European Networks in the fields of Transport, energy, and telecommunications (TEN-T) are represented by nine Core Network Corridors, which are identified to streamline and facilitate the coordinated development of the Core Network. The policy of developing TEN-Ts has been an integral part of the European Union's policy since the last decade of the 20th century. In addition, the Trans-European Transport Networks (TEN-T) are related to the European Union's policy toward the development of road and rail infrastructure, inland waterways, maritime routes, airports, and road-rail terminals across Europe. Union guidelines for the development of the trans-European transport network define that the TEN-T includes a comprehensive network covering all European regions, and a core network that relates to routes that connect the most important points of the comprehensive network (EU, 2013). In addition to building the necessary infrastructure and improving the existing one, the objective of the TEN-T policy is to remove bottlenecks and eliminate technical barriers that exist between the transport networks of EU member states, as well as to strengthen the EU's social, economic and territorial cohesion and to contribute to a single European transport area. According to ADB (2008) a corridor is a holistic strategy that improves and enhances investments in transport, energy, and telecommunications in the corridor. A highly efficient transport system means goods and people movement without excessive cost or delay. These corridor improvements promote further economic growth and regional development, thus contributing to poverty reduction.

The TEN-T policy also includes the promotion and adoption of innovative digital technologies and the use of alternative energy sources in transport. According to Panagakos (2016), an extension to the corridor concept is the green corridor which has gained popularity as a policy tool that enhances the overall environmental sustainability of transport by improving the competitiveness of the railway and waterborne modes that exhibit better environmental characteristics than road haulage (Panagakos, 2016).

On a Dutch national scale (Ministery of Infrastructure, 2017), one can observe that the focus of the policy must be on better use, sustainability, and optimization of all modalities, by removing remaining infrastructural bottlenecks on the corridor itself, improving multimodal connections in nodes, digitization, and data management and the application of innovative measures.

To support the development of green corridors a research group Greening Corridors is subsidized by Taskforce for Applied Research SIA to develop a knowledge infrastructure of 5 Applied research Universities together with practice partners, universities, and knowledge institutes. The main objective is to develop and promote sustainable logistics corridors and in the meantime radically reduce the emissions of CO2 and other harmful substances from the logistics sector with new technologies focused on the hinterland connections of North Sea Port, Rotterdam, Amsterdam, and Antwerp. The research will focus it centrally on 3 themes: (1) better usage of capacity; (2) clean, safe, and autonomous modalities; (3) Digitalization in the supply chain.

Figure 1 Research themes with Greening Corridors

The goal is of this paper is to develop a research agenda for the 3 themes mentioned in the Greening Corridors consortium. Within each team the methodology applied is based an expert-meeting with the consortium members of Greening Corridors supported with main findings in the literature review.

Theme 1 - Better capacity usage

Better utilization of available capacity requires to further develop and apply (synchromodal) planning methods to organize the capacity of different operators in the corridors more effectively and efficiently. Current industry business and governance models are a barrier to information and capacity sharing with other stakeholders. Concepts from the sharing economy and the emergence of online platforms offer opportunities to gain more transparency in the available capacity and efficiency of the transport market. Smart planning of maintenance is also possible leading to a higher availability of capacity. The scope of the research focuses on the planning and business models and the way in which the sector that implements these can organize and realize change.

The capacity of road infrastructure is still sufficient. According to Rodrique (2020) the capacity can be defined as the dynamic capacity that relates to superstructure, labor, and technology, which can be improved upon. The intensity and density of utilization are improved with a more efficient superstructure and management. For example, the dynamic capacity of a road system can also be improved with a better synchronization of traffic lights or the introduction of road pricing to avoid peaks in infrastructure usage (Verhoef, 1996). Another issue in road transport is the driver shortage. To tackle both issues it could be interesting to look for synchromodal opportunities with the usage of rail or barge transport. As a research action, it is good to continue work with the Off-Road Runners program where companies are supported in their choices to make use of other modalities (Joint Corridors Off Road, 2022).

Rail freight transport suffers from the fact that some tracks are not well aligned causing (un) foreseen delays. The causes can be different track widths, different voltages at the overhead lines, or different infrastructure costs per country. As an example, it takes 5 days to travel from the Netherlands (Tilburg) to Poland, however, it takes just 10 days to travel from Poland to China. The usage of rail freight still remains low compared to the other modalities (about 9%). A more detailed analysis of the railway planning process is needed to understand the full complexity of the railway issues. The railway capacity during daytime is restricted due to the priority of railway passenger transport. During nighttime capacity seems to be available, however, maintenance and noise restrictions do not allow operational usage of the tracks. In the literature, the most appropriate monitoring technologies are available for each of the main railway track failure modes. Sensor technologies, such as strain gauges, piezoelectric sensors, fiber-optics, geophones, and accelerometers have proven to offer appropriate characteristics and accuracy for the continuous monitoring of a railway track's structural state (Castillo-Mingorance et al., 2020).

The *inland waterway transport sector* has sufficient infrastructure capacity. At the same time, one can observe that waterways are more and more disruptive and disturbed by low and high water levels causing congestion or sometimes a navigation ban for inland vessels. In recent years, also problems have arisen due to outdated waterworks. The main bottlenecks are at the (sea)terminals where there are high waiting times for inland shipping as the terminals do not have the capacity (cranes and quay capacity). Although sophisticated simulation models/games are developed to gain more insight in the barge planning process (Kourounioti, et al., 2018), the current practice still shows extreme long waiting times for the inland vessels. A more detailed analysis of the planning process is needed to understand the full complexity of the barge planning issues. The complexity of port operations severely challenges the mitigation of port delays. Deepsea vessel arrival times to the ports are typically uncertain. Even though vessels must submit their estimated time of arrival (ETA) and estimated time of departure (ETD) in advance, these estimates are usually inaccurate (Nikghadam, et al., 2021). The ETAs are often too optimistic and they are adjusted many times (Veenstra & Harmelink 2021).

The *inland terminals* can play a buffer in the network (dry port/extended gates) for the seaport terminal with transport with fixed connections to the ports or the hinterland via inland shipping and rail. Extended gates can play a role in reducing delays in the port by postponing the receipt of goods until the inland terminal. The extended gate concept aims to reduce this pressure on ports by shifting processes from seaport terminals to inland terminals, also called dryports (Veenstra et al., 2012). In essence, a dry port is able to offer the same service as a seaport. Research has shown that demurrage costs are reduced as a result of using dryports (Fazi & Roodbergen, 2018). Studies addressing the most commonly represented thematic areas, i.e., a network perspective on dry ports or performance impacts, are based on quantitative approaches. Gammelgaard (2004) adds that the actor-approach is highly contextual and argues that it is impossible to make predictions based on external cause-effect relationships of social reality because of people's intentions. Therefore, an understanding of reality requires an investigation of intentions, mainly through qualitative studies' (Gammelgaard 2004, p. 4). Both approaches are needed to arrive at the right advice.

The *shipping company* wants to concentrate empty containers in one place (often in the port), so that many empty containers are shipped back and forth between the port and the hinterland. Another issue is that a terminal often does not know where to put containers in the stack, because they do not know the destination for the hinterland. Quite often there exists a mismatch between ICT systems as a result of which information cannot be shared with each other in the chain.

Shippers often don't realize the influence they could have on the transport chain and the choices they can make as they simply pay for the transport service. Shippers must make good agreements with the shipping company so that hinterland transport can be better arranged and the various links in the chain are better connected. In line with this are the findings of Khakdaman et al. (2020) who identified four market segments among the shippers. The first and largest segment is called high service-level seekers, who have a high willingness to use synchromodal services and delegate modal control, provided LSPs are able to secure high-quality transportation in terms of service time, flexibility and reliability. The cost-sensitive risk-taking shippers make up the second largest segment. They are mainly willing to relinquish modal control in exchange for cheaper transportation services. The third shipper segment is called ancillary service seekers who are to a large extent willing to delegate modal control by shifting towards synchromodal services that provide the value-added services they are looking for in transportation service. The fourth segment contains the risk-averse shippers who are not willing to relinquish modal control and prefer using the transportation services they are currently using. The segments indicate that there are opportunities for a variety of transportation service improvements (Khakdaman, 2020).

The *locations of distribution centers* (logistics service providers) can play a role in the spread of capacity in waterborne, railway, and road transport. It should be noted here that most distribution centers do not have a railway connection. The government could facilitate this process. At the same time the provinces, companies, and the national government could develop a freight flow map of the current and future freight flows. This is important to know where to position new energy hubs as they influence transport flows and vice versa. At this moment 14 terminals in the hinterland are evaluated on their performance in a region. In some regions, there are too many terminals. A future terminal plan (with the identification of high and low volume areas) and/or real-time corridor management are interesting to develop. Less emphasis has been placed on the opportunities lying within *port-hinterland corridor management initiatives* that have been formally or informally developed, addressing not only the strategic but also the tactical and operational levels. These initiatives could bring together corridor members to discuss existing challenges, persistent bottlenecks and major inefficiencies, and jointly plan the implementation of appropriate actions that can successfully address them and improve, in turn, business competitiveness and trade attractiveness (Sdoukopoulos & Boile, 2021).

By 2030, equipment and infrastructure need to use fewer resources, i.e., have a lower footprint, while having lower costs and higher availability (EU, 2022). For companies within service industry, it is difficult to achieve these long-term goals, as they deal with the complexity of equipment/infrastructure and high uptime requirements of its users. They need to achieve low

costs and high equipment/infrastructure availability, but also a low footprint in terms of usage of raw materials, energy and (highly skilled) personnel. This requires performing maintenance just-in-time, and organizing the after-sales service delivery such that parts and service engineers are at the equipment/infrastructure before it fails, without using unsustainable and expensive transportation. The (after-sales) service should be organized such that it has a lower footprint, lower costs, and a higher availability than currently. Innovation such as smart sensors linked to the internet of things (IoT) that signal when a part of the infrastructure needs to be replaced and drones that conduct inspections are feasible solutions for the future. With advanced AI, it also becomes much easier to predict maintenance, reducing the number of disruptions.

Summarizing the following research agenda topics are formulated for better usage of capacity:

- Study night-time operations for all combined transport modes;
- Active studies on searching multimodal transport options for specific companies;
- Possibilities of dry port concepts for inland terminals;
- Detailed analysis of the planning processes in the corridors;
- Improvement of the ICT systems to follow the position of the container;
- Shippers' behavior analysis on key drivers for synchromodal transportation based on the Khakdaman's customer segments;
- Policy issues related to location of (new) warehouses;
- Development of Corridor management/performance monitor;
- Improve footprint, costs, and availability of equipment/infrastructure through the development of smart Operations Control Centers.

Theme 2 - Clean, safe, and autonomous modalities

The assignment from the Climate agreement to achieve a 30% CO_2 reduction through better utilization of capacity is significant. The technical solutions for zero-emission long-distance transport are still under development and very limited available. The more technical research is developing quite extensive. However, the choices for alternative energy carriers, such as hydrogen and batteries, to made by the entrepreneurs and their scaling up to system level are hardly studied. At the same time, the supply chains of the new energy carriers (including maintenance and preconditions for physical safety) have not yet been developed. A second change with a high impact on the transport system is the development of autonomous modalities. This introduction leads to change and shifting of tasks and responsibilities in the chain, but can also lead to the development of a network of intelligent and autonomous hubs that operate 24/7.

Connected and Automated Transport (CAT) is expected to revolutionize transportation and logistics by providing major improvements in the field of road safety, traffic flow, logistical efficiency, comfort, and reduction of emissions. Connected and Automated Transport includes all technologies and applications aimed at the control, routing, and communication of a vehicle with the environment in order to (Madadi & Verduijn, 2022):

- move the vehicle safely, efficiently, and sustainably through traffic move;
- make optimal use of the infrastructure;
- the logistics chain (by streamlining the digital sharing of information).

With respect to the last issue the interface with logistics entities such as distribution centers, terminals and logistics parcs is an important issue to implement CAT. Current operational *Automated Guided Truck* applications are bound to fixed infrastructure and do not offer opportunities to operate in the public domain. The challenge is to connect the automated transport operations to DC areas, terminals and logistics parks and meanwhile bridge the gap with autonomous driving in the public domain (Kusumaker, et al., 2021; Van Duin et al., 2022).

Interest in the concept of *autonomous ships* is rapidly growing in the past few years. Inspired by the recent adaptation of autonomous and automated systems in other transportation methods and the accelerated evolution of technology, one could wonder how and if these technologies can be implemented in the shipping industry. Different to the 5 levels of autonomy in road transport, the International Maritime Organization (IMO) distinguishes four degrees of Autonomy (IMO, 2017):

Degree 1: Ship with automated processes and decision support: Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.

Degree 2: Remotely controlled ship with seafarers on board: The ship is controlled and operated from another location. Seafarers are available on board to take control and operate the shipboard systems and functions.

Degree 3: Remotely controlled ship without seafarers on board: The ship is controlled and operated from another location. There are no seafarers on board.

Degree 4: Fully autonomous ship: The operating system of the ship is able to make decisions and determine actions by itself. (IMO - Autonomous shipping, 2017.

From a study by Kooij (2022) it is found that the factor that has the largest influence on the economic feasibility of unmanned ships, is the nationality of the crew and the flag state. For that reason, it is expected that ships registered in high-wage countries are more likely to transition to unmanned than ships registered in low-wage countries. When looking at the operation of the ship, the number of port calls is the most influential. Making more stops in port costs money, as extra personnel is required to perform services to the ship. This could also have an influence on inland shipping as most vessels arrive at several terminals. Also, the traffic is more intense on the inland waterways than at the open sea. More in-depth research is needed for inland shipping.

Moving freight by rail hasn't changed much over the last several decades. Trains can move freight four times as efficiently as trucks can, and they can move a huge amount of it at once with minimal human supervision. *Autonomous trains* can ride more closely together. Combined with smart rail traffic management, this enables you to increase capacity. The disadvantage of trains is that they are best at long-distance hub-to-hub freight transfers, and usually a truck is needed to get it to its final destination. In addition, autonomous trains are very expensive due to all required information and systems.

From a technical perspective, it is obvious that these autonomous electric-rail vehicles really seem likely to be used in practice. Due to its today railway safety systems for infrastructure usage ((European Rail Traffic Management System (ERTMS)), it is a substantial simplification of an autonomous-driving problem. With some halfway decent sensors to detect obstacles on the track, the road to autonomous trains is open. Like in road and barge they identify four levels of automation:

- **Level 1:** the train operator is in full control. He/she oversees the tracks and decides when to speed up or slow down;
- **Level 2:** the locomotive is controlled remotely but the operator is still in the driver's seat, overseeing the tracks and deciding whether to intervene;
- **Level 3:** the train is controlled remotely;
- **Level 4:** the train's control is fully automated, and its operation is being monitored remotely.

Considering the current conditions of the European railways, only degrees of automation 1 - 2 are used. Fully autonomous trains in the world are used only in urban railways (metro) and airports (inter-terminal traffic), where there is no risk of collision with an obstacle on the line between stations. In most cases, it is also possible in an emergency to take over remote train control from a remote-control room. On conventional national railways, autonomous trains are only in the development phase (e.g., Amtrak in the United States of America), with the exception of Australia, where the autonomous train successfully passed a 100 km track during the tests. However, even in this case, the presence of a driver is still necessary in case an emergency needs to be dealt with (Hranický, et al., 2021). Due to employee shortages, it raises urgency to investigate and experiment with autonomous railway vehicles.

The other important issue theme in this research topic is *sustainable development toward emission-free vehicles, trains, and vessels*. For all modalities, there are many uncertainties about which energy carriers or combination of energy carriers will be used. At the same time, it is important to think about smart and safe locations for bunkering energy. The following sustainable alternative fuels are considered also proved the technology-readiness level (TRL) (Schmidt et al., 2022):

LNG (liquefied natural gas)

The TRL is mature and there is an increasing trend of vessels in service and on order with LNG as a main engine fuel type. There is no need for further RD&I but rather stricter regulations regarding methane slip. For the trucking industry it is a dead end as the European environmental organization Transport & Environment (T&E) studied trucks that run LNG are no better for the climate than diesel trucks.

(e-)Hydrogen

The general TRL still need to further mature. There are several projects ongoing that investigate the use of compressed and liquid hydrogen in both internal combustion engines (ICE) and fuel cells (FC), all applied in trucks, smaller vessels and even trains. Further RD&I in the form of demonstrators is needed to investigate the best fit regarding truck/vessel type and operational profile for this technology. Fuel cell electric vehicles (FCEVs) commonly use hydrogen gas as a power source. FCEVs are more suitable for replacing heavy-duty internal combustion vehicles because this energy vector has a high specific energy density, and fuel cells have good energy efficiency. FCEVs have fast charging times and great autonomy (Pagliaro & Meneguzzo, 2018). The way how hydrogen can be obtained varies a lot. Most promising looks sodium borohydride ($NaBH_4$). For the future it is necessary to experiment and make use of more demonstrators in the coming years which fits best for which type vehicles/vessels/trains. Demonstrators for inland shipping can be seen such as the AbInitio, Antonie and the Neo Orbis. In the railway sector similar demonstrators can be found. This year ProRail successfully tested a hydrogen train. On the route between Groningen and Leeuwarden, a sprinter and express train service run several times, demonstrating that this innovative train can be accommodated within the service. Hydrogen trains can serve as alternatives for the diesel trains that run on 1,000 km of the 7,000 km of track without overhead wires. With green hydrogen, that kind of train is not only more sustainable than diesel, it's also significantly more quiet (Slump. 2022).

(e-)Methanol

Methanol is considered one of the most promising sustainable alternative fuels in the short term. Compared to fossil fuels, renewable methanol as a fuel for elan 'electrofuel' reduces carbon emissions by 65 to 95% depending on the feedstock and conversion process. That's one of the highest potential reductions of any fuel currently being developed to displace gasoline, diesel, coal and methane. Renewable methanol can be made from many plentiful sources. The necessary carbon molecules to make synthesis gas for methanol production can be obtained from CO_2 from industrial process streams, or even captured from the air. Other sources include municipal solid waste (MSW), agricultural waste, forestry residues and renewable hydrogen (Klein, 2020). The general TRL of onboard storage and propulsion is maturing and there is an increasing trend of a wide range of vessel types in service and on order with methanol (Schmidt et al., 2022).

(e-)Ammonia

The TRL of ammonia is still quite low and is the least advanced sustainable alternative fuel. There are no vessels active yet. There are vessels are designed in such way that once the fuel is available, the vessels can be retrofitted relatively easy.

Electrification/batteries

Electric powertrain systems include the main components that generate and deliver power to the road surface for fully electric, hybrid electric and plug-in hybrid electric vehicle applications. Battery Electric Vehicles (BEVs) that contain an electric powertrain has higher energy efficiency than internal combustion engines since they have less heat loss (Lee et al., 2018). They also have power reversibility associated with a charge-discharge efficiency of the Li-Ion batteries, which reduce the overall energy consumption by recovering braking energy. However,

intensive use and long distances require high energy storage, which increases battery mass, reduces available cargo volume in the vehicle, and boosts costs and energy consumption. It is already proven that for short distances.

In road transport heavy trucks like the Euro-trailer do operate in (large) retail transport operations with range of 150 kilometers without charging. At same time the smaller transporting companies, almost 40 per cent of these companies are not even planning to switch to electric vehicles. The main reason is that companies are worried about the high purchase costs and the limited radius (SCM, 2022).

Same developments can be found in the shipping industry where the smaller ferries opt for fully electric due to the possibility to recharge partially. Illustrative example to mention is the 'Alphenaar' who travels with a 2-container battery swap from Alphen a/d Rijn (Heineken) to port of Moerdijk (distance 65 km). Each container battery consists of 45 battery modules that generate a total of 2 MWh. One battery is used during the journey towards Moerdijk, a journey that takes about six hours. The second container is used for the return trip. Recently, a large investment has been announced to increase the number of battery packs and ZES vessels. Like the road sector the barge sector with a 6,000 vessels mainly operated by private captains is struggling with the questions how to invest in which sustainable engine as the future is uncertain about what the best energy carrier will be, how is the supply of the energy carrier guaranteed, what are the logistical consequences and safety procedures of the new technology, and how can I make such a high investment. This implies that for both modalities further research is needed how to upscale and integrate the technologies from policy making perspective as well as from an entrepreneur perspective.

Summarizing the following research agenda topics are formulated for clean, safe, and autonomous modalities:

- The challenge is to connect/integrate the automated transport operations to logistics environment and meanwhile bridging the gap with autonomous driving in the public domain.
- Demonstrators and pilot testing seem to be the best way to obtain insights. To scale-up from a research perspective digital twins could be the solution to use the individual vehicle behavior/consumption to integrate these in large multi-agent simulation models.
- At policy level the government needs to develop robust roadmaps to provide clarity what the potential futures could look like in terms financing, locations, safety procedures, and integration in the public domain.

Theme 3 - Digitilization in the supply chain

New technology, such as 5G, Blockchain, and Physical Internet (PI), makes it easier to share data in chains. With advanced data processing, such as data science and machine learning, complex issues can be solved. The investigation of the SPRONG group, focuses on the effective use of new technology in practice. A precondition for achieving sustainable corridors is that all companies (including SMEs) that form part of the corridor can apply the new solutions. The research focuses on the success factors for the adoption of digitization by SMEs, such as insight into application possibilities, business cases and human capital needs.

As Behdani et al. (2020) stated efficiency improvements are often attributed to the increasing use of information in freight transport chains (e.g., Blockchain). According to them research should focus into the role, effects and impacts of the increasing use of information and the related business cases.

The introduction of Industry 4.0, the Internet of Things (IoT), and other related digital innovations makes it possible to collect and aggregate large amounts of data from different sources. Data science and advanced analytics have a direct relevance for logistics; in recent literature different tools and techniques to make data driven supply chain management decisions have been proposed (Govindan et al., 2018). Heilig et al. (2017) define digitalization as a sociotechnical process, in which digital tools in a broader social and institutional context are implemented. Digital transformation is described as a broader process of transformation of, among others, strategy, governance and leadership and possibly the business model of the company. The same holds for digitalization on the hinterland connections where Behdani et al. (2020) also state that efficiency improvements are often attributed to the increasing use of information in freight transport chains (e.g., Blockchain). According to them research should focus into the role, effects and impacts of the increasing use of information and the related business cases.

From the 100 top logistics companies 20% is seriously involved in digitalization and only 5% uses it to its full potential. Numerous SMEs in the logistic sector are lagging behind in the field of digitalization and data driven logistics. Mostly they are not well informed about how it can improve their business model (Moonen, 2021). Furthermore, relevant knowledge is often conceptual and risky, and it uses a lot of companies' resources to implement. For this reason, companies can better be offered plug and play solutions, which are less risky and costly to implement (Dahlander, et al., 2016).

In the market of synchromodal transport new initiatives become available to provide standard digitalization solutions (see for example NextLogic and Ishare are good examples in the Netherlands). In Germany a new type of solution is provided by the utilization of a data hub, which for the first time connects all players in combined transport in terms of data technology. The shareholders are the combined transport operators Hupac and Kombiverkehr, the transport companies Hoyer and Paneuropa, the railway undertaking Lokomotion as well as Kombiterminal Ludwigshafen. The company DXI emerged from the research project "Digitalization of intermodal supply chains - KV4.0", which created a cross-system data platform for combined

transport. In the long run data in these systems can be analyzed with data analytics techniques to provide more artificial intelligence.

Summarizing the research topics:

- Integration of information systems to make the corridor operations more efficient by the use of preferable standardized solutions from managerial, organizational, juridical, and logistical perspectives.
- Application of data analytics (selection of some nice pilot projects).

This chapter has proposed a future research agenda for the sustainable development of the freight corridors for the next five years. As the corridors can be seen as the connecting lifelines of our ports and our cities (respectively distribution centres), the research topics in the agenda are quite important for the development and wellbeing of our future generation.

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Personal note

Beste Harry,

In 2007 hebben wij elkaar op de 11th WCTR in Berkeley leren kennen. We kwamen er al snel achter dat duurzaamheid in ons werk centraal staat en ook in de prive-sfeer delen wij vele interesses. Toen wij in 2008 een gezamenlijke afstudeerder Mels van de Voet begeleidden, hebben we gemerkt dat onze samenwerking wel eens tot mooi onderzoek zou kunnen leiden. 12 Journal papers, 9 conference papers, een boekbijdrage en als kroon op ons werk een succesvolle promotie van Bob Castelein. De samenwerking houdt gelukkig nog niet op en hoop dat we samen nog twee promovendi naar de eindstreep gaan brengen in Greening Corridors. Verder hoop ik dat je nog lang mag genieten van je oude dag en wens je een mooie tijd samen met Patricia. Carpe Diem, maar dat hoef ik jou eigenlijk niet te zeggen.

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Bart

Rotterdam, the Rhine and Germany[1]

Hein Klemann

Introduction

It is often claimed that the Dutch economy is dependent on the German. 'When Germany sneezes, the Netherlands catches a cold' is a wisdom that can regularly be heard in the press.[2] Few realize that the economic ties between the two are now weaker than they have been since the 1880s (Klemann, 2006; Möller, 1991). In 2021, imports from Germany amounted to 11% of GDP; exports to 16%. Even the value of trade with the entire European Union (imports and exports combined) at 78% of GDP in 2021 was incomparable with the rough estimate of 114% for German trade in 1908![3] The high level of Dutch-German trade from the 19th century onwards can be explained by the fact that a large part of the Netherlands and the German Ruhr area formed one economic region. This is no longer the case because the Ruhr area as an industrial core area is in decline. As a result, Rhine shipping has lost ground. Since 1990, Rhine barging from Rotterdam to the Ruhr area has fallen by a quarter in tonnage (CBS, 1970).

Looking at macroeconomic figures, it seems as if the Dutch economy became dependent on the German economy from the late 19th century onwards. However, it is questionable whether national figures are the right instrument to measure this. In the 1930s, when world trade was decimated, the US Congress, the parliament of a country with relatively little trade, needed insight into economic developments. To this end, Simon Kuznets at the National Bureau of Economic Research developed the national accounts, a system that provides insights into the national economy and how to manipulate it (Kuznets, 1934). In these accounts, the sum of value added in each industry and the sum of incomes within the national economy is calculated and the difference must be explained by international transactions. The national context is paramount. The accounts are a toolbox in economic policy. The question whether they can be used for scientifically analyzing is rarely asked.

1 This article is partly based on: Klemann and Schenk, 'Competition in the Rhine delta'; Klemann and Wubs, 'River dependence: Creating a Transnational Rhine Economy, 1850-2000.'; Klemann and Schenk, 'The Rhine in the long 19th century: creating the Lower Rhine region'.

2 See for instance: Peter de Waard, 'Nederlandse groei overtreft die van alle buren: Duitsland niest, maar Nederland is nog lang niet verkouden,' *De Volkskrant*, 14 augustus 2019 of Jan Kleinnijenhuis en Christoph Schmidt, 'Wat doet Nederland economisch toch verkeerd?' *Trouw*, 14/12/12 of Pieter van den Akker, 'Als Duitsland niest, zijn wij verkouden.' https://www.bnr.nl/nieuws/beurs/10263903/als-duitsland-niest-zijn-wij-verkouden (6/8/2013).

3 In 1908 the sum of the import and export with Prussia, Hamburg and Bremen (the two German port cities only became members of the German Zollverein in 1888 and still had their own column in in Dutch trade statistics) was ƒ 2.022 million. It is a fact that these trade statistics are not very reliable, but that the recalculated GDP was only ƒ 1.778 million makes clear that trade with this neighbouring country was enormous. CBS, *Jaarcijfers voor het Koninkrijk der Nederlanden 1909 (; CBS, 200 jaar statistiek in tijdreeksen*, 78.

German research shows that until the war of 1914, there was no defined German economy distinct from surrounding economies. The economic contacts between German regions were no more intensive than those with neighboring non-German regions (Wolf, 2009). Due to free trade and monetary stability, guaranteed by the gold standard, political boundaries were hardly relevant economically. Further, as early as the 1980s, Sidney Pollard pointed out that the industrial revolution had not taken place in England or Germany, but in Lancashire or the Ruhr. Therefore, economic development should be analyzed at regional, not national level (Ranton, 2005). Nina Glick-Schiller and Andreas Wimmer also point out that in empirical social sciences the national unit is almost automatically taken as the unit of analysis. They point to the collection of data at the national level as a cause, which creates series that give the impression that social, cultural, or economic developments are national phenomena (Glick-Schiller & Wimmer, 2002). However, everything points to the fact that the Ruhr area integrated with Rotterdam and its port and economic life in and around that port city with that in the Ruhr into one economic region in the 19th century (Krugman, 1995). Such a region can only be understood by looking at development at a level other than a national one. Theoretically, the ideas of economists such as Michael Porter and Paul Krugman, who both explain regional clustering of economic activity by pointing to externalities, may be helpful (Krugman, 1991; 1995; 1996; 2004; Fujita et al., 1999; Marginean, 2006; Delgado, 2010; Porter, 1998). Based on Krugman's work, a number of economists concluded that '…large-scale regions are more significant economic units than nation-states.' (Martin & Sunley 1996, p. 264). The problem with analyzing a regional economy is that all sources and statistics are national. In the Rhine region, this became apparent at a time when politics barely interfered with the economy, which formed its own geographical borders. They had little to do with the borders of the nation states.

An enormous mining area developed along the Ruhr, a tributary of the Rhine, around which the industrial heart of Europe formed from the 1840s. The Rhine was transformed into a superior waterway for the supply and transport of the output of this industrial area. As Rotterdam became the seaport for the supply and removal of bulk goods, a transnational region was created. Because the Netherlands is smaller than Germany, this largely determined the economy in the Netherlands. The region also determined the economy of the German Ruhr area, but within Germany that was an important but limited region. It therefore seemed as if the Netherlands became dependent on Germany. In fact, that dependence was mutual. From 1914, when political measures gave the national borders economic significance, it caused problems that Rotterdam and its port were part of a transnational region, but the bulk transport of the Ruhr area could not do without that port. It was not until the last half century, when the center of gravity of German industry shifted elsewhere, that the region was broken up. This can be seen in the national figures in less intensive trade contacts.

The Rhine and Rotterdam until 1914

Industry developed rapidly from the mid-19th century in the western German territories acquired by the Kingdom of Prussia at the Congress of Vienna in 1815. Coal mining boomed along the Ruhr and after the introduction of coke iron in 1849, so did the iron and steel production. In 1877 the mine owners of the Ruhr region agreed that coal production had reached such a level that exports were necessary to keep internal prices profitable and not to spoil their own market by oversupply. To this end they founded the *Westfälischer Kohlenausfuhrverein*. A year later, this Verein decided that Antwerp should become their export port. The reason that Rotterdam was hardly mentioned was that this port city had no rail connection with the hinterland (Rive 1861; 1878; Heubach, 1898; Klemann & Schenk, 2013). Steam power and railroads sparked a transportation revolution in the 19th century. Due to their need for coal, iron and steel, investments in railways propelled industrialization and also determined industry in the Ruhr area. At the same time, the railways connected the new industrial centers with resource-producing areas, markets, and ports (Fremdling, 1975). Inland transport became possible on a hitherto unprecedented scale. As a result, the train became dominant in the period 1840-1870 and inland shipping, which was confronted with serious competition for the first time, lost a good part of its position (Ville, 1990; Tutein Nolthenius, 1896). The growing rail network was able to solve the transport problems of the developing industry in the German countries, including in the Ruhr area (Strauch, 2007; Fremdling, 1991). In 1870 most transport took place by train in the Rhine basin, including the Ruhr area. Since important railways went to Antwerp and the German ports, but not to Rotterdam, that port lost its position to these competitors (Klemann & Koppenol, 2013).

By prohibiting others from using their railroads, railroad owners created monopolistic transportation markets. After all, on a route that already has a railway, another company will rarely build a second one. Waterways, and certainly rivers, were state property and in principle freely available. However, the Rhine was an international waterway, which traditionally led to protectionism. After the collapse of Napoleon's empire, the banks of the Rhine were again divided into a number of states. Because it was feared that tolls and other obstacles would be reintroduced as a result, cooperation seemed necessary. To this end, the Congress of Vienna established an international commission, the Central Commission for the Navigation of the Rhine (CCNR). It was given the task of organizing that voyage without discrimination according to flag or cargo. It also had to supervise the toll collection, which should not exceed the costs of maintaining the towpaths. Today, this Commission considers it its task to maintain free navigation on the Rhine and its tributaries, to supervise the maintenance of the river channel and to enforce uniform regulations throughout the river.

Because the industrial areas along the Rhine and Ruhr needed cheap transport and train traffic had to result in monopoly prices, Prussia took steps to improve Rhine navigation. From the middle of the 19th century, when this country became dominant within Germany, and therefore within the CCNR, that organization became Berlin's instrument to enforce normalization of the river, also outside the Prussian part of it. Standardization refers to the adaptation of the fairway to certain standards, established in the CCNR in order to make the river suitable for large-scale steam tug towing of four to six huge iron barges. The Rhine had to be straightened, deepened

and narrowed to that end and to be cleared of obstacles such as rapids, sandbanks, islands and gravel beds. Berlin feared that without modern Rhine transport, its main industrial area would become dependent on monopolistic railways. As a result, the Rhine was turned into a dead, narrow, straight and deep channel. The fact that the Netherlands cooperated in this was related to the change in its position.

Prussia's power grew and it protected the interests of its western regions, the Rhineland and Westphalia, also because Prussia's new dominant position was partly based on industry there. Hence, Berlin put pressure on the other Rhine states to liberalize navigation and normalize the river. While Prussia developed in the 1860s into the core around which the new German Empire was forming, after the Belgian secession of 1830, the Netherlands fell from a proud kingdom with ambitions to a small, fearful state between large neighbors. Moreover, with the construction of the railway Cologne-Antwerp in 1844, The Hague lost its monopoly on transit to the German hinterland (Brugmans, 1969). The emergence of the port of Antwerp, strongly supported by the Belgian state, has prompted the Netherlands to take steps to remain competitive as a transit country. Everything indicated that rail transport would be the transport of the future and Belgium developed into a railway country faster than the Netherlands. Although the railways accounted for a growing part of transport, between 1835 and 1913 the Rhine navigation also grew. Only in the years 1845-1850, shortly after the construction of the Antwerp-Cologne railway, did this speed stagnate (Kunz, 1975; Beening, 1994; Nusteling, 1974). That is why the Dutch government gave the Rhine navigation an impulse in 1851 by liberalizing it. Transit taxes were abolished, increasing the competitiveness of the Rhine and the Dutch ports and Rhine navigation again acquired a share in the growth of total trade. In 1844, the river and the Dutch ports had nevertheless gained a permanent competitor with the first Cologne-Antwerp railway.

In the mid-19th century, rail transport was efficient and cheap, while inland shipping seemed doomed (Tutein Nolthenius, 1896). Antwerp's success in the first years after the opening of its railway, according to the Düsseldorf Chamber of Commerce, was not only due to the fact that train traffic was faster, but above all that it was cheaper. In 1844, for English iron, an important import product from Germany, the difference was as much as 67 percent. For other important import products as cotton, wine or coffee the difference in transport costs also amounted to tens of percent in favor of the railway and Antwerp (Clapp, 1911; Smits et al., 2000). The freight rate for Rhine transport per tonne/km was lower, but apart from the fact that the distance to Antwerp was shorter, the extra transhipment (necessary because inland waterway seldom could reach the final destination) made the train cheaper. Transport from an inland port to the final destination was also expensive because railways charged high rates for it and sometimes even refused this transport. An additional disadvantage of Rhine transport was its dependence on the weather. The river was often barely navigable for months in winter due to ice conditions.

Rhine navigation was tackled under Prussian pressure. Until 1868, The Hague hoped that deepening the waterway could be done by narrowing it with summer dikes and groynes, as this would cause a stronger current. This was much cheaper than dredging. However, it did not work for the clayey soil in the Lower Rhine. After 1860, the scale of the Rhine navigation did increase slightly as hunting horses were replaced by tugs, but it was not until the mid-1880s, when the normalization of the river started to bear fruit, that an exponential growth in the scale

of transport began. Downstream this took several more decades, which depended on the amount of cargo. Due to the close links between coal mines and railways, it took until after 1900 before coal was also transported over the Rhine. The growth of Rhine transport was only possible through larger barges (Klemann, in press).

Although for a long time the Netherlands considered normalization too expensive and doubted whether the problems associated with it were technically solvable, in the end it did more for it than any other country and spent the most money on it. The results also strongly favored the Netherlands, i.e., the port of Rotterdam. From 1880, the canalization process, including the construction of the *Nieuwe Waterweg*, the improved connection between Rotterdam and the sea, was virtually completed and the scale of Rhine navigation increased by leaps and bounds (Clapp, 1911). In the mid-19th century, the railways were favored by economies of scale and although freight rates per tonne/km were higher, rail transport was generally cheaper. In order to be able to compete with rail, Rhine navigation had to realize a large price advantage per tonne/km. This became possible when the Rhine became navigable for large iron barges pulled by steam tugs of hundreds of horsepower. The CCNR promoted and supervised the adaptation of the infrastructure, but the Prussian pressure was always felt. Berlin did not want its main industrial area to become dependent on expensive, monopolistic rail traffic and therefore made a strong case for the Rhine.

As a result of normalization, the costs of navigation on the Rhine fell by 75 percent between 1890 and 1914. In that period, the costs of Dutch rail freight increased slightly, while those of German rail freight decreased slightly (Klemann & Schenk, 2013). Transport from Rotterdam to the German Rhine-Ruhr area became cheap, which was especially beneficial for bulk transport. That was exactly what the Ruhr needed, as improvements in metallurgy, the continued growth of mining and the influx of workers increased the demand for iron ore, pit wood and grains, while more and more coal from the Ruhr went to overseas markets. In this way, Rotterdam became a port where a limited number of bulk goods were transhipped on an unprecedented scale. Just before the First World War, almost 25 percent of all German imports, measured by weight, and more than 20 percent of all German exports crossed the German border at Emmerich in a Rhine barge (Klemann & Schenk 2013). The quantities soon became such that there was no alternative for the port of Rotterdam. Not only was every other form of transport more expensive, no railway could handle such quantities of bulk goods. This symbiosis was artificially broken during both world wars, but remained de facto intact until the collapse of the German industrial area in the late 20th century.

Economic interconnectedness before the First World War

In the late 19th century, the Rhine became essential for the largest industrial area of Europe and Rotterdam became a port that mainly worked for the German industry. Under pressure from German customers, the transshipment of bulk goods was mechanized and not only got a larger scale and became more efficient, but also became cheaper. Rotterdam and the Dutch Rhine area were integrated into an economic region with the Ruhr area at its core. The American social scientist Carl Strikwerda points to the tension in the years before the First World War between the great degree of international economic freedom that allowed companies to develop into multinationals for all kinds of reasons, while nationalism became manifest in politics (Strikwerda, 1993a). In this period, German companies relocated parts of their activities to the Netherlands, France or Luxembourg or entered joint ventures with companies in those countries. They did this because some activities were only possible abroad – port activity in the Netherlands, iron ore mining in Luxembourg or parts of France – but also to circumvent German social legislation costs or to economize otherwise. For these reasons, Ruhr industrialists set up transport companies in the Netherlands. Due to the lower wage costs, but also the lower prices for iron and steel – the German and Belgian cartels kept prices high on their own market – the construction of Rhine barges became a Dutch specialism. The Rhine fleet of the Ruhr industry often sailed under the Dutch flag for economic reasons, but also because such ships were financed by Dutch ship mortgage banks.

Not only German companies, also French companies internationalized the region by investing in German, Belgian or Dutch mines, as these were unable to extract much coal in their own country. Transport costs in this area were so low and free trade was so developed that there were already indications of the type of internationalization that became visible after the 1970s. Especially the Dutch economy was already showing a degree of openness that elsewhere was only achieved in the late 20th century, often only in the 21st century. Within the Rhine region, for each step in the production process calculations were increasingly made where it could be performed most efficiently and, apart from the rising nationalism, there was little to hinder the dispersion of production. The establishment of German companies in the Netherlands was not hindered by anything. Such companies set up subsidiaries to take care of their transit, but also founded Dutch companies to raise capital at low interest rates (De Roos & Wieringa, 1953). These companies, often Dutch PLC. Companies (NV), would now be called letterbox companies, free-standing companies for investments in Germany. Such a free-standing company raised money by placing shares or bonds on the Dutch capital market. The money obtained was invested abroad. Although the head office remained in the Netherlands, only when more money was needed the sprang to life (Gales, 1994). A German company could also use such a subsidiary as a springboard for activities in countries where German infiltration was viewed with suspicion.

The chemical group *Kohlensäure Werke C.G. Rommenhölle* in Oberlahnstein am Rhein had eighteen German and one Dutch establishments in 1899. This Rotterdam branch was listed on the stock exchange and had a Dutch NV form. The company was intended to tap the Dutch capital market, but also managed the company *Carbonique Moderne* and thus was used as a springboard for activities on the French market, where German investments did not always go well (Gales, 1994). Also, Dutch traders such as *Wm. H. Muller and Co*. a commodities trader from Düsseldorf who had settled in Rotterdam in the 1870s and had grown up there, participated in this process (Schenk, 2015). After a few years, the Rotterdam branch became its main location because the ore trade was concentrated in the port. It became a Dutch company, a step that paid off in the early 20th century when France started to ban German firms. In 1909, the French parliament forbade the Thyssen to exploit French ore fields, but as a Dutch company, *Müller en Co*. continued to participate in ore mining in French Algeria (Strikwerda, 1993a).

In the Netherlands, German companies often involved concerns from the Ruhr area. A German industrial company that wanted to control its supply lines developed into a multinational almost naturally due to the transnational character of the Ruhr-Rhine region. This is how the German steel and coal group Thyssen ended up here. From the early 20th century, Thyssen's Dutch investments were aimed at becoming independent of ore traders and fluctuating freight rates. Furthermore, it wanted to arrange supplies at low Dutch costs and for this purpose, in addition to its own ore mines – at that time it was wrongly believed that global iron ore stocks were running out – it also had its own Rhine fleet and North Sea port. In 1910, Thyssen therefore founded the *Vulcaan Handels- & Transportmaatschappij NV* in Rotterdam, a shipping company of mainly Rhine, but also some seagoing ships, under the Dutch flag. In 1911, Thyssen founded its own ore transhipment installations in Rotterdam to further increase its independence. In 1912 the Vulcaan Coal Company was added, with which Thyssens mines, which were outside the Rhine-Westphalia coal cartel, wanted to organize their export via Rotterdam. Finally, in 1912 Vulcaan bought land for a seaport in Vlaardingen and started to construct the Vulcaanhaven in 1914. In July 1918, when the politically well-informed Thyssen must have understood that Germany was going to lose the war, the group even decided to add the Bank for Trade and Shipping to its investments. Formally, that bank was founded by Vulcaan, Thyssen's Dutch subsidiary. The group had plans to significantly expand its Rotterdam activities after the war and wanted to invest in the port, in its Dutch Rhine fleet and in a new Dutch shipping company for seagoing ships. The bank had to finance all this. For the time being, it was only a financial instrument for Thyssen in a country with a healthy financial structure, a strong currency and sufficient space on the capital market to enable the intended investments.

Strikwerda believes that in the years before 1914 '*captains of heavy industry and political leaders were moving in opposite directions, one toward interdependence and the other toward war.*' (Strikwerda, 1993a, p. 1125). Unilever, Shell, and all kinds of American giants are said to have their origins in these years before the Great War. The international interdependence of industry shows that the nationalism that led to war in 1914 should not be sought with industry, he believes. Motivated by nationalism, the press in various countries protested against business and its international interdependence. In Paris, in particular, there was the idea that German businesses with their French investments were not only pursuing economic interests,

but also serving German politics. For example, a Parisian newspaper believed that Krupp bought up competitors in France through a Belgian firm in order to erode French resilience. When Thyssen bought French ore fields for purely business reasons in 1912, this led to French legislation prohibiting such purchases. It was a step towards unbundling of intertwined economies. Ultimately, the war would undermine economic integration (Strikwerda, 1993a).

In the years before 1914, globalization was just as characteristic as nationalism. The business community became international, but partly in reaction, nationalist sentiments dominated politics. The increasing economic interdependence between its own economy and that of potential enemies, but also between the Dutch and the German economy, was internationally viewed with suspicion. In response to the construction by Thyssen of its own port in Vlaardingen just before the outbreak of the First World War, *The Times* wrote about a German Coup and the newspaper made it appear that a German war fleet was already in the North Sea. The Netherlands developed into a German puppet state, according to the British newspaper.[4] For Thyssen, these investments were economically motivated (Strikwerda, 1993b). His Rhine fleet also sailed under the Dutch flag because it was cheaper (Euwe, 2012). In addition to Thyssen, its competitor Krupp also had its own shipping company and forwarding department in Rotterdam (Schenk, 2015). The need to transport Spanish iron ore via Rotterdam had already prompted this company in 1877 to set up the Kruppsche Spedition und Rhederei Comptoir in Rotterdam (Schenk, 2013).

The First World War and its Aftermath

During the Great War of 1914-1918, economies were pushed back to a great extent within national borders. As a result, the transnational region of which the Dutch Port, but also the economically highest developed part of Germany formed part, crumbled. Nevertheless, new forms of integration emerged during the war. Tax reasons arose for depositing funds in the Netherlands. Before 1914 this was not a big deal. The fact that direct taxes in Germany were not levied by the Reich but by the federal states forced the Empire to largely finance the war through loans and money creation. Tax increases required constitutional upheaval, which was unfeasible in the midst of a war. As a result, Berlin quickly fell into debt, especially with the Reichsbank, increasing the banknote circulation (Clavin, 2000). In Berlin, it was hoped that it could make the enemy pay for the debts. Similar ideas lived in Paris. There, the way in which France had been squeezed after the war of 1870-71 was not yet forgotten. Moreover, the war was largely fought on French soil. That is why George Clemenceau would let slip during the peace negotiations: *Le Boche paiera!* – the Kraut should pay! The Netherlands and Germany were already closely intertwined financially. The world war and the post-war German financial chaos had a major influence on this.

4 'Particuliere havens.' NRCrt., 25 Juli 1914, avondblad; 'German Coup. "Private" Harbour In Holland. Dutch Misgivings.' The Times, Friday, July 24, 1914; 'Germany In Holland. The Granting of a Harbour Concession. Minister's Promise Recalled.' The Times, Saturday, Jul 25, 1914.

During the First World War, the economic interdependence between the Netherlands and Germany even increased in certain respects. When German business was no longer welcome in the global financial center of London, Amsterdam developed into the financial center for German trade, a position it managed to maintain well into the interwar period. In 1918 no panic broke out among the bankers in Amsterdam, unlike in Switzerland. Nevertheless, these bankers understood that their funds outstanding in Germany could not be withdrawn immediately. That is why consultations were held with the banker Franz Ubrig, who acted as the representative of the German banks, about extending the credits. From a German perspective, the Netherlands seemed safe. Unlike anywhere else, here the pre-war period of economic openness known as the first wave of globalization was hardly accompanied by political nationalism. The country seemed ideal for hiding activities that the German government wanted to tax or transferring activities that were banned in Germany under the Peace Treaty. Moreover, the country was one of the few willing to invest in Germany. The question is to what extent advances were made on these developments in the latter part of the war.

Correspondence between August Thyssen, the leader of the most international German iron and steel groups, and Matthias Stinnes, leader of a Ruhr concern with some 3.000 factories, shows that as late as 1917 these captains of industry thought that Germany should continue the war until it was certain that the French ore fields could be annexed. Their pre-war experience with French nationalism forced them to believe that if Germany got out of the war without more raw materials, there would be no business to do (Rash & Feldman, 2003). They didn't want war, they wanted to do business. Nationalism made that impossible and that would not get any better after the war. The Netherlands was the exception. During the war, several German banks already made plans to establish a branch here after the war, and the Thyssen group decided to do so before the end of the war, in July 1918 (Euwe, 2012). Apart from two foreign banks already established in the Netherlands before the war, Thyssen's bank was the first foreign financial institution in Amsterdam. Shortly after the armistice, in December, followed the International Exchange Bank, an institution of German bankers who during the occupation of these areas, had been active in Belgium and France. Many more would follow during German inflation. This was partly due to capital flight to the stable Netherlands, as is visible in the gold and foreign exchange inflow. While the gold and foreign exchange stock at the Nederlandsche Bank – the Dutch Central Bank – averaged NLG 176 million in 1913-14, it suddenly rose to NLG 720 million in 1918-1919. The gold and foreign exchange holdings of other banks or trading firms are unknown, but it seems likely that this also increased by leaps and bounds (De Roos & Wieringa, 1953). Because the assets of all German banks in London had been seized as hostile property, those banks settled permanently in Amsterdam. The de facto Dutch banking secrecy, the stable interest policy, the political situation and the geographical position near the port where a large part of the German trade that had to be financed through the banks in Amsterdam took place, also played a role. Between 1918 and 1926, 67 foreign financial institutions settled in the Dutch capital, mostly German, but also Austrian, Liechtenstein, French, Swedish, American and Polish. For the first time since the Napoleonic era, Amsterdam became an important financial center again (Euwe, 2009). Almost all German banks in Amsterdam were branches of German banks or linked to German industrial concerns. Such concerns move the capital needed for international transactions to Amsterdam. It was safe there, not subject to inflation and there was a favorable fiscal climate. Initially, these banks

were only intended for German customers who wanted to secure funds here or arrange their international transactions. These financial institutions bought Dutch shares or treasury bills in exchange for the capital stored here. From 1921 they started working more dynamically. As Dutch NVs, they raised pounds or dollars and invested them in Germany at an interest rate of up to 12%. To finance this, they attracted Dutch deposits by offering unprecedented interest rates of 6 or 7%. Dutch banks could not compete with that (Euwe, 2012).

Conclusion

After the end of the war it proved impossible to restore economic contacts without further ado. The pushing back of economies within national borders, a process that began in 1914 and continued well after World War II, was economically one of the most devastating effects of a period of militarism and nationalism. The 1914 war caused the state to interfere in all aspects of economic life and actively tried to replace trade that could be cut off in times of war with domestic production. As a result, normal contacts were only partially restored. Many countries aspired to a degree of autarky, if only for products deemed essential. There was some liberalization again in the second half of the 1920s, but from 1929 the economic and financial crisis took its toll and the 19th century laissez faire received the death blow. The nation-state perceived dependence on a potentially hostile foreign country as a problem. Although before the war, it proved economically advantageous that for example, the shortage of coal in Northeast Germany was replenished from England, while the coal surpluses from the Ruhr went to the Netherlands and France, fear of another war prevented such relations from being restored. Even the strongly trade-oriented Netherlands had sensed its vulnerability during the war and, with government support, provided import-replacing production of coal, iron, steel, fertilizer and food. However, the economies of small, highly developed countries could not be detached from its environment without serious damage. The increasing protectionism that characterized the interwar period threatened their economic base.

The policy of economic isolationism began with the 1914-1918 war, but did not end there. From 1925, when Berlin was given a free hand in the field of trade under the Treaty of Versailles, it introduced high import duties. She wasn't alone. In fact, until the 1930s, the Netherlands and Great Britain were the exceptions. During the depression, these countries also became protectionist. In 1925, Berlin's new trade policy spoiled the relationship with the Netherlands, which was just recovering, and certainly not only in economic terms. Some years later, during the Nazi period, the German pursuit of economic autarky was pushed to unprecedented heights. Because of that extreme regime, but also because the economies still needed each other, but the contacts were far from smooth due to all kinds of monetary and trade policy regulations, the political relations also became sharp. It was not until long after the war that these were able to normalize within new international partnerships. Despite the major economic and political problems and the various crises that occurred from 1914 to well after the middle of the century, economic contacts with Germany remained exceptionally strong. This was apparent from, among other things, the fact that transit through Rotterdam increased in the late 1930s. The full recovery of the Ruhr region required this, showing that the

transnational region was by no means undone. The fact that the Dutch economy experienced a brief but sharp recovery during the German occupation, as the German market opened, also points to this (Klemann, 2002). It was only with the decline of the Ruhr from the 1970s and 1980s that exceptional close economic ties with Germany came to an end. From the 1880s, Rotterdam, its port and its Rhine navigation – and with it a large part of the Dutch economy – depended on the Ruhr area. That area was also dependent on the Rhine navigation and the port of Rotterdam. This created a strong interdependence that lasted until the 1980s or 1990s. From those years on, no statistically significant relationship can be discovered between the growth figures in the Netherlands and Germany anymore. With the exception of the time around the world wars, such a connection had characterized economic relations from the late nineteenth century. The cause of the loss of this link should not be sought in the German reunification of 1990. Even if we only look at the interrelationship with North Rhine-Westphalia, the closest German state, there is no longer a connection. The intensive contacts that determined the relationship between the Netherlands and Germany from the late nineteenth century to the 1990s and that largely steered political relations are subject to strong erosion due to the decline of the Ruhr area.

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Personal note

Beste Harry,

Verschillende malen hebben we geprobeerd tot samenwerking te komen. Dat dit niet is gelukt, betreur ik. Het heeft aan mijn gevoelens van vriendschap niet gelegen. Waar het wel aan heeft gelegen zullen we hier maar in het midden laten.

Het ga je goed!

Sustainable Global Supply Chains: From voluntary to regulated responsibility

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Rob Zuidwijk[2]

Abstract

Over the years, many parties have progressively attempted to get a grip on sustainability performance in their international supply chains. To signal this to their stakeholders, businesses have developed responsible supply chains by accounting for their sustainability efforts and performance voluntarily through certification and labelling products. More recently, because of severe incidents, regulators have stepped in and introduced, or are planning to introduce, mandatory due diligence schemes to which businesses must comply. In this paper, we aim to analyze this development, with particular attention to the effectiveness of voluntary and mandatory regimes in establishing responsible supply chain practices that aim at sustainability performance.

1. Introduction and problem formulation

The development of globalization in the last few decades has brought the world as a whole more wealth. Also, partially because of this global integration, poverty has fallen considerably between 1990 and 2015[3]. At the same time, however, poverty has not been eradicated (Sustainable Development Goal nr 1), and the growth in wealth and income is not spread evenly around the world. Especially in the last two decades of the 20th century, income inequality has increased significantly[4].

It is not surprising therefore, that there will be differences in working practices in global supply chains in different parts of the world. Costs advantages resulting from globalized production are based to a considerable extent on using cheaper and more abundant labour in Asian, South American and African countries.

1 Rotterdam School of Management and Centre for Urban, Port and Transport Economics (UPT).
2 Rotterdam School of Management.
3 https://www.compassion.com/poverty/global-poverty-rate.htm.
4 World Economic Forum, World Inequality Report 2022.

Lower income countries often exhibit low or restricted regulatory systems, lower payments for social support related to labour, and relatively less attention for the supervision of working practices. This makes manufacturing in these countries cheap, but also, more and more, risky from a corporate social responsibility perspective.

The idea that businesses should also act to the benefit of society is not new. In the 19th century, large industrialists such as Carnegie and Rockefeller, perhaps to compensate for their rather inconsiderate business approach, also donated significant amounts of money to social causes. In the 1940s, businesses, instead of their wealthy owners, started to take up this role as well. The real starting point for the business strategy now termed Corporate Social Responsibility (CSR) is perhaps the book 'Social Responsibilities of the Business Man', by Howard Bowen in 1953[5].

CSR went through some stages over time and is often very much focussed on the footprint of a company in its home country. However, for globally operating companies, the socially beneficial role of the company very logically extends to the global supply chain.

It is difficult to pinpoint when and where this realization started to gain a foothold in companies. What is clear, is that NGOs such as Greenpeace with analyses such as the Green Guide to Electronics (launched in the mid 1990s), and incidents such as the poisonous led paint in Barbie dolls at Mattel in 2007, the suicide scandal at Foxconn producing iPhones in 2010 and later, and the collapse of Rana Plaza in Bangladesh in 2013 have accelerated the attention in global businesses for their responsibilities in the global supply chain. This attention was and is being directed to sourcing of materials, responsible manufacturing, working conditions, fair pay for farmer, miners and workers, environmental footprint, and so on.

Much of that global supply chain responsibility was taken up voluntarily at first. Businesses developed certification schemes, such as UTZ of the Rainforest Alliance, the Better Cotton Initiative, or Worldwide Accredited Responsible Production (WRAP). Much of these schemes refer to mining and agricultural products at large but also specific products such as apparel.

For consumer product manufacturing, the European Union introduced the CE label as early as the 1970s, although it gained more traction from the late 1980s onwards. This is a label that signifies that products attain the EU common market standard on safety, health, and environmental regulation. This is an EU regulatory mechanism that puts a minimum safety standard in the market. Obtaining a CE marking requires formal testing of the product by a certified party. CE markings apply if the product falls under one of the 21 product directives that require CE marking as one of the measures. These include hazardous substances, toys, medical devices, low voltage equipment, and medical personal protective equipment[6].

5 See https://accp.org/resources/csr-resources/accp-insights-blog/corporate-social-responsibility-brief-history/.
6 See https://cemarking.net/eu-ce-marking-directives/.

Note, however, that these two approaches do not cover all stages of the supply chain. The CE marking only looks at the physical product, not at how it is produced. The voluntary certification schemes look at very specific products and markets and have restrictions in what they address. Marbach (2022), for instance, finds that the global sugarcane industry has at least five separate certification schemes (Bonsucro, Fairtrade, SCDD program, KRAV and the EU Organic label), and none of these cover the entire supply chain, all relevant parties, or the full extent of supply chain sustainability goals.

Companies who are trying to fulfil their global responsibility promise signal this by joining ecosystems such as B Corp[7]. At the same time, there are also many companies that do not have such a strategic view on corporate social responsibility, and as a result, are not effective (Rangan et al., 2015).

It may not be a surprise, therefore, that there is more governmental regulation being proposed. Partly these are extensions under the CE marking approach of the EU common market, and partly these are regulatory efforts to further curtail specific greenhouse gasses, such as fluorinated gasses, as part of the EU 'fit for 55' package. Finally, however, there is also new regulation being developed in the EU that will formalize responsibility practices in global suppy chains: the Corporate Sustainability Due Diligence Directive[8].

The main research question of this paper is as follows: Can formal regulation of responsible practices in the supply chain be effective and if yes, to what extent can such an effective approach be inferred from our understanding of voluntary schemes, existing regulations, and enforcement practices?

In this paper we consider sustainability to mean not only benign to the environment and society but also fit for the future. We thus employ a rather broad conception of sustainability. In addition, we specifically refer to responsible supply chains, when these supply chains are thought to have some system of accountability in place, that allows them to show or prove that they are, to some degree, sustainable, or at least trying to be transparent in how sustainable their operations really are.

In the remainder of this chapter, we will present our current insights in this matter. We start with an overview of regulatory developments, focusing especially on regulation relevant for manufactured products. We will discuss in some detail the current state of affairs of the EU Corporate Sustainable Due Diligence directive and the development of its implementation approach. We will elaborate specifically on enforcement practices when we discuss this regulation. We will then introduce some insights from the responsible supply chain literature and mechanisms, such as blockchain, that have been introduced as potential solutions. We will finish this chapter by summarizing our arguments and the formulation of a pathway towards more responsible supply chains.

7 https://www.bcorporation.net/en-us/.
8 https://ec.europa.eu/info/publications/proposal-directive-corporate-sustainable-due-diligence-and-annex_en.

2. Voluntary and regulatory developments

We will describe some developments over time, starting with the CE Marking Directive of the EU, and voluntary, or perhaps better, unregulated, initiatives. We also discuss in some detail incidents that have resulted in interesting developments across the world in terms of sustainable working practices. In some cases, these initiatives aimed at making practices more sustainable, but we will also see that in other cases, the aim was specifically to increase the level of responsibility, by introducing some measure of accountability. At the end of this section, we will introduce the EU proposal for Corporate Sustainability Due Diligence (COM (2022) 71 Final).

Early regulatory developments

The 1993 EU CE Marking Directive[9] was an attempt to harmonize a number of earlier independent product safety regulation into one framework. The earliest regulation was on low voltage equipment (stemming from 1973), and other examples included gas burning ovens, children's' toys, and weighing equipment. Most of these individual regulations stem from the 1980s and early 1990s.

The CE Marking Directive formalizes and harmonizes the rules for formal verification and certification of product quality, while keeping all the individual regulations in place. This is a reflection of the fact that different DGs of the EU can still introduce their own product regulation, but all of these regulations will follow the same pattern and demand the same level of product testing. The Directive also directs the responsibility to enforce correction of infringements to the Member State where the infringement was identified.

The CE Marking approach is based on technical testing of the product based on physical tests, and reviews of design and manufacturing approaches. Formal proof, through certificates, is offered after approval. This testing is done on the basis of the formulation of so-called consistent requirements.

The verification of the CE marking happens when goods are brought into the European market. This means that in many cases, the verification has to be made at the border: in seaports, in airports, at the outside road borders of the European Union. In the Netherlands, this results in an interplay between the competent authority at the border, which is Dutch Customs, and the competent authority for the product regulation, which can be, among others, the National Food and Product Authority (NVWA), the Inspection Agency for the Environment and Transport (IL&T), or the Inspection of Health and Youth (IGJ). These organizations have contracted the border intervention to Dutch Customs. This arrangement has advantages and disadvantages. Advantages include that there is essentially one agency at the border, and that border crossing is facilitating by this single agency. The disadvantages are related to the interaction between the two agencies, on risk criteria, budget for inspection resources, target percentages for inspection levels, and policy attention for new product flows.

9 COUNCIL DIRECTIVE 93/68/EEC.

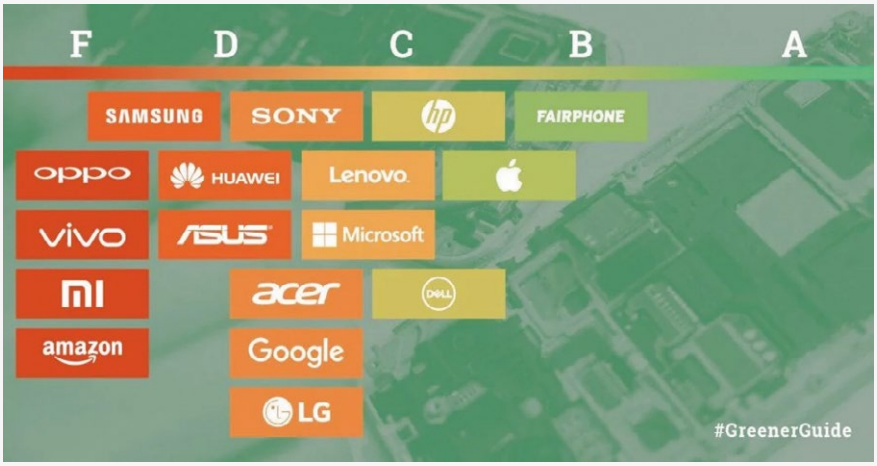
All these issues require dialogue between agencies, and the success of these dialogues is strongly determined by current issues, political developments, and management attention in both agencies[10].

While this ensures the EU allows safe products into the common market, this formal quality marking does not look at all at the supply chain in which the products are manufactured. Therefore, the CE marking mechanism is not effective to control for responsible working practices.

Voluntary arrangements in business

We have already observed that for certain products and trades, businesses have developed their own mechanisms to signal quality of product, but especially responsible operations. Not only business have developed their own measurement and reporting mechanisms, so have NGOs. In fact, a current development is that companies move away from independent toward proprietary programs. While a lot of these mechanisms exist for agricultural goods, textiles and fashion manufacturing, much fewer exist for the manufacturing of consumer and business

Figure 1 Guide to Greener Electronics



Source: Greenpeace (2017) Guide to Greener Electronics (https://www.greenpeace.org/usa/reports/greener-electronics-2017/).

10 Private communication Dutch Customs secretary for inter-inspection agency Management Board meeting.

products, such as electronics. Greenpeace observed this in the 1990s when it started to publish its Guide to Greener Electronics. The latest edition of this Guide stems from 2017 and contains a dashboard that is reproduced on the previous page.

This Guide looked initially at the use of hazardous materials in the manufacturing of electronic devices, and at energy use of the devices. Over de period 2006-2012, when the Guide was regularly published, Greenpeace observed significant improvements in these areas[11]. In the renewed version of the Guide, published in 2017, they also included the use of recycled materials. As a result, Fairphone, which is a smartphone designed for reuse and recyclability, comes out high in the ranking.

The report makes some interesting observations about the environmentally friendly nature of the electronics manufacturers' supply chains: in 2017, the 17 companies that were reviewed are not very transparent about their supply chain structures; 70%-80% of the carbon footprint occurs in the manufacturing stage; some manufacturers that also produce components for other companies, such as Samsung, hold back developments in terms of renewable energy usage; planned obsolescence is still a business strategy[12].

The manufacturing of electric cars, as well as its main component, the battery, has in recent years sparked a new look at the mining and processing of rare earth metals. The problem with these metals is two-fold: some of the metals are very scarce, and they are found in a few locations in the world, such as China, Angola, Democratic Republic of Congo, Chili and Canada. China, realizing the geopolitical power of the access to rare earth materials has taken several initiatives over de years to be able to execute control over its supply. The latest such effort is the institution of a new state-owned company, called the China Rare Earth Group, to control up to 30%-40% of the supply of rare earth metals worldwide[13].

Lopez Riveira (2022) has reviewed the responsible practices reporting of 9 of the major OEMs in car manufacturing in the EU (in total 10 brands since Geely and Volvo report separately even though they are part of the same group). He employs the OECD guidance for responsible supply chains of minerals in conflict areas (OECD 2016). He found that none of the companies have a good handle yet on identifying upstream suppliers. This is relevant, because large manufacturers usually do not do business with mining operators directly, but with refining and trading companies that are intermediaries in these supply chains. Where these companies often have some responsible practices in place, it also shields the actual mines from direct visibility on their working circumstances. He also found that the companies all have risk plans, as well as action plans, but do very little to monitor these risks and actions in practice.

11 https://www.greenpeace.org/usa/reports/greener-electronics-2017/#executive-summary.
12 Ibid.
13 https://www.mining-technology.com/analysis/china-rare-earths-dominance-mining/.

Another observation from this research is that companies focus strongly on the conflict metals (Tungsten, Tin, Tantalum and Gold – 3TG) and much less on other metals. Cobalt is one metal that receives more and more attention, and some companies have proceeded to prioritize 3TG and Cobalt in their corporate sustainability approaches, which means they identify the mining companies they do business with or develop rules for sustainable practices. While all companies acknowledge risks of unsafe working circumstances or child labour, for instance, they do not provide very clear risk assessments, or prioritizations. All companies participate in the Responsible Mining Initiative (RMI), that seems to focus on identifying and certifying reliable first tier suppliers such as refiners and smelters. At the same time, none of the companies provide any remedial measures of damage to local environments, social conditions or working practices at all. These specific results are echoed in more general terms in Villena & Gioia (2020), who observe that large multinational companies all face challenges in implementing their sustainability policies into their supply chains, especially across multiple tiers.

Incidents

Finally, a potential driver for change is an incident such as the factory collapse in Rana Plaza in Bangladesh in 2013[14]. This accident resulted in the death of 1.123 people and injured another 2.500 people. The building housed 5 separate garment factories. In the meantime, the Bangladesh government has introduced some obligations and liabilities for employers, but labour inspection and enforcement mechanisms are still poor. Major global businesses, that rely on the garment manufacturing capacity in Bangladesh set up the Bangladesh Fire and Safety Accord[15], to improve security of buildings and factories. This agreement was signed by 27 fashion companies in the Netherlands and more than 200 companies in total. Dutch parties also launched the campaign Clean Clothes (Schone Kleren, in Dutch)[16] and 55 clothing companies signed the covenant Sustainable Clothes and Textiles. After the first review of the progress by the Dutch Social Economics Council[17], there was concern about the real commitment of companies, the effectiveness of the monitoring and reporting mechanism, the transparency on publishing supplier and manufacturer lists. In addition, the transition plans to a liveable wage of most companies were considered vague. In 2021, a new version of the Bangladesh accord was underwritten by less than half of the previous signatories.[18] Apparently, the urgency of these kinds of initiatives fades when years progress.

14 See for more information https://www.ilo.org/global/topics/geip/WCMS_614394/lang--en/index.htm.
15 https://bangladeshaccord.org/.
16 https://www.schonekleren.nl/wat-is-er-mis/.
17 https://behindmycloset.com/2017/12/31/afspraken-textielsector-de-arbeider-merkt-er-nog-maar-weinig-van/
18 https://www.trouw.nl/economie/veel-minder-kledingbedrijven-ondertekenen-vernieuwd-bangladesh-akkoord~b3be046b/#:~:text=Aanleiding%20voor%20het%20akkoord%20was,arbeidsomstandigheden%20van%20fabrieksarbeiders%20worden%20verbeterd.

After this review of existing mechanisms and attempts to 'clean up' global supply chains, it is perhaps not surprising that several parties, including NGOs and lawmakers in the European Parliament, called for more formal regulation to force companies to adhere to responsible practices in their supply chains. Dutch Member of the European Parliament, Mrs. Lara Wolters, spearheaded a resolution in the European Parliament in March 2021, in which the Commission was asked to draft regulation. This regulation was presented by the Commission in February 2022. This resolution (A9-0018/2021; 2020/2129(INL)) specifically states that voluntary measures are not sufficient, and that a proposal for binding regulation for responsible working practices in international supply chains is called for. The resolution also states, in less strong words, however, that the applicability of the due diligence regulation should be a condition for access to the common market. For severe violations, complete prohibition to import is called for (2020/2129(INL), point 10).

Case: Illegal logging and EU Kader Partnership Agreement

The European Union has engaged with several timber exporting countries into a Voluntary Partnership Agreement (VPA) to prevent illegal logging and illicit exports[19]. The exporting country agrees to implement a timber legality assurance system that will help identify compliant exports through certification. Such exports will have automatic access to the EU market. Non-certified imports from exporting countries with VPA countries are denied entry. Imports from other countries require cumbersome due diligence checks by importing entities. First countries that have established such bilateral agreements with EU include Indonesia and Ghana. The system is challenged by timber product obtained through illicit logging that may leak into the legality assurance system due to lack of transparency, and corruption. These are challenges not uncommon to mandatory or voluntary certification programmes. Another set of challenges arises when illicit imports are not properly scrutinized or penalized. Importers need to be able to demonstrate that their imports are sourced sustainably. EU product safety agencies have confiscated illegal imports but in some other cases, the authorities have not penalized non-compliance[20]. In short, the bilateral agreements between EU and exporting countries is an interesting development and may expand to other products as well, such as palm oil. On the other hand, the agreements and associated legal trade are vulnerable to infiltration by illicit parties and require supervising authorities to enforce regulations.

EU Corporate Sustainability Due Diligence regulation (Com(2022) 71 Final)

The proposal for regulation was published on 23 February 2022. It starts with a discussion on the context of this regulation and proceeds to state that performing due diligence is not new for many businesses. Sustainability is also not new. Extending sustainability to responsible agriculture, mining and manufacturing is perhaps new at the EU level, but fully in line with the philosophy and policy priorities of the European Union.

19 https://ec.europa.eu/environment/forests/flegt.htm.
20 https://www.trouw.nl/duurzaamheid-economie/rechter-dwing-importeurs-tot-stoppen-met-fout-hout~b3bed011/

A second point is that the regulation states that voluntary mechanisms are apparently not enough to ensure responsible practices in global supply chains. Many individual Member States have picked up the slack and developed regulation for all kinds of violations of responsible practices. For the single market of the EU this is an undesirable situation and generates another important reason for the Commission to act.

The Commission already has an instrument for the type of corporate responsibility reporting in this regulation: the so-called Non-Financial Reporting Directive (NFRD), which is being amended into the Corporate Sustainability Reporting Directive. This amendment extends the scope of the NFRD into the area of sustainability and extends the number of companies that are going to have to comply with these reporting standards. There are also links with the existing, or proposed, regulations on Sustainable Finance Disclosure Regulation and the Taxonomy Regulation that aims to combat greenwashing. In addition, existing regulations on combatting human trafficking, and unsafe operations in mines (applicable only to 3TG), deforestation and responsible batteries are relevant.

In terms of proportionality, the regulation does limit the scope to larger companies. While it does apply to companies both in the EU, and outside, it limits its working to companies with more than 500 employees and € 150 mln turnover, or a lower limit for companies in so-called high-risk sectors, such as fashion and agriculture: 250 employees and € 40 mln turnover.

The due diligence obligations are[21]:

- corporate policies need to consider human rights and environmental due diligence;
- companies have to provide assessments of their actions in the supply chain;
- companies need to develop and take measures to mitigate potential adverse impacts;
- companies need to take action to end or minimise actual adverse impacts;
- companies need to maintain an appropriate complaints procedure;
- companies have to periodically monitor and assess their operations and measures;
- companies not subject to formal reporting requirements need to publicly report on their due diligence efforts on their websites.

Enforcement is envisaged through administrative measures, through the investigative powers of individual Member States.

The formal approval procedure is running (October 2022) and requires approval of the European Parliament and the Council. There is no precise timeline for these steps and the entry into force[22]. In the meantime, Germany has approved a Supply Chain Due Diligence Act in the course of 2021, which will enter into force in 2023. France already had such regulation since 2017.

21 https://www.whitecase.com/insight-alert/european-commission-issues-major-proposal-due-diligence-obligations-protect-human.

22 https://www.klgates.com/Ethical-Supply-Chain-The-European-Commissions-Proposal-for-a-Directive-on-Corporate-Sustainability-Due-Diligence-8-2-2022.

Both these Member States set much higher limits on company size for the application their due diligence legislation. In other parts of the world, similar regulation has also been introduced in recent years[23].

We observe that the intention to also include prohibitions for importing of goods that result from adverse human rights practices was not included. For this goal, the European Commission chose to follow a different approach. Based on statements from Commission President Ursula von der Leyen in September 2021, a Commission Communication was drafted and published on 23 February 2022 (COM(2022) 66 Final) that is called: "on decent work worldwide for a global just transition and a sustainable recovery".

This Communication is of a very different nature than the proposal for the Due Diligence directive. It focuses on a much broader approach to fight child labour and other forms of forced labour, including consumer-oriented policies, providing sustainable finance, and developing views and evidence on 'decent work'. One supply chain related measure is the active promotion of socially responsible public procurement. This amounts to about 14% of EUs GDP (or € 2 trillion). Several directives in this area have been developed, and the practical Buying Social guide (2021/C 237/01) has been updated.

The Communication does, however, also contain a reference to the explicit proposals of Von der Leyen to ban products made by forced labour from the Single Market. This ban is being developed, and will be based on a 'risk based enforcement framework' (COM(2021) 66 final, pg. 14). The intention seems to be to develop a new legislative instrument for this purpose that will complement the due diligence and transparency regulation. This requirement of avoiding forced labour will also be made part of the new EU Regulation on the Generalised Scheme of Preferences for 2024-2034 (ibid, pg. 15). Violations by partner countries can lead to withdrawal of trade preferences.

The European Parliament agreed on a resolution to call for such a ban on 9 June 2022. As a result, the European Commission came up with a proposal for a Regulation on prohibiting products made with forced labour on the Union market (COM(2022) 453 final). Note that a Regulation is stronger instrument than a Directive: Regulation becomes binding for all Member States, while a Directive needs to be translated into national law first. The regulation proposes restrictions on both products manufactured in the EU, and products imported into the EU.

The structure of the regulation is as follows: it contains an outright ban on import or export of products made with forced labour (regulation, art 3). It then requires Competent Authorities to follow a risk-based approach in assessing the likelihood of violation of the ban (art 4.1). This assessment is based on information on parties involved or the product provided by the parties that want to import or export the product (art 10). In addition, other parties can also report breaches of the ban. To support assessment, a database will be built up on forced labour risks (art 11). The regulation prescribes the designation of one or more Competent Authorities to

23 See https://iuslaboris.com/insights/supply-chain-due-diligence-laws/.

carry out the obligations under this Regulation (art 12). There is a specific task attributed to Customs Authorities: If a product is found in violation of the ban, then Customs Authorities are held to enforce the restriction to export or import these goods (art 15-4). This means that Customs Authorities' actions are made subsidiary to this Regulation. For this purpose, the Regulation also contains provisions to communicate banning decisions to Customs Authorities (art 16).

The conclusion from the analysis of this Regulation is that there is a responsibility for a Competent Authority to figure out if there is a reasonable risk of forced labour attributable to a product, and if this is decided, Customs Authorities will be asked to effectively execute the ban at the border, or when goods are brought into free circulation. The assessment of the reasonable risk is based on a 'substantiated concern' and a subsequent investigation into the product and economic operators. This investigation may include investigations in third countries. Upon a decision to ban a product, not only products underway, but all products already on the market will have to be removed and disposed of by the economic operators concerned.

While the principle is clear, at the same time, this raises questions about the effectiveness of this investigations, especially within the suggested timeframe in the Regulation (a matter of weeks, or at least a 'reasonable period of time' (COM(2021) 453 final, art. 6). We will explore in the next section to what extent business parties themselves can establish the level of responsibility in their supply chains.

3. Responsible Supply Chains

Responsible supply chains have put in place a mechanism that measures, reports and accounts for sustainability performance throughout the supply chain toward stakeholders. In this strict sense, responsible supply chains need not be sustainable, as sustainability performance accounted for need not be at an acceptable level. Although many supply chain actors will only start to account for their performance when such performance has reached an acceptable level, there are notable exceptions. For instance, chocolate brand Tony's Chocolonely grew its brand with explicit statements that their supply chain is not slave-free while apparently putting in considerable efforts to change that situation.[24] Its growing consumer base appreciated that this brand addressed an important issue the whole chocolate industry had been struggling with.

It seems obvious that principles used by responsible supply chains to measure, report and account for sustainability performance allow for the validation of sustainability claims made. We shall argue that this is not necessarily the case.

24 https://tonyschocolonely.com/uk/en/why-we-still-wont-say-were-100-slave-free.

Case: Tony's Chocolonely

Chocolate brand Tony's Chocolonely acknowledged it could not deliver slave-free chocolate bars, while making efforts to move in the right direction.[25] The brand recognized that creating a slave-free chocolate bar would be impossible while relying on the mass commodity trade in cocoa involving a handful of global traders. It engaged in the challenge of scaling its direct trade. The brand has gained a significant market share in the Netherlands and keeps growing internationally. To create transparency in its own supply chain, it has developed 'beantracker' technology to track and trace product throughout its supply chain. It pays a living income reference price to farmers. It also established a dedicated product line with its producer Callebaut to avoid mixing of its own sourced produce with other product. Despite these measures, the brand remains to acknowledge that its own supply chain need not be slave-free, although there is no direct evidence of such human rights violations associated with its sourced cocoa.

Relevance of validation of sustainability claims

A growing number of customers and investors consider sustainability performance as an indispensable contribution to the products and services they purchase. For instance, consumers are progressively willing to pay more for sustainable products.[26] In response to customer and investor needs and preferences, producers of these products and services progressively aim to comply to sustainability requirements. An important challenge is the validity of sustainability claims made by producers: How can customers and investors convince themselves that the products and services are processed sustainably throughput their lifecycles? This may also partially explain the gap between good intentions of customers and actual purchases of sustainable products.

Note that sustainability claims usually are not inherent to the product itself; a product test does not unveil whether a product is produced under proper social and environmental conditions.[27]

We shall argue that complexity in global supply chains challenges the validation of sustainability claims, whether those claims are based on voluntary or enforced programs. Evidently, there are other complicating factors. For instance, the key performance indicators of sustainability performance are quite often ambiguous or even disputed. The volume of carbon emissions produced by a production process may seem accountable in a straightforward fashion but the allocation of these emissions to products remains ambiguous (GHG Protocol, 2011).

25 https://tonyschocolonely.com/us/en/our-mission.
26 https://www.nielsen.com/wp-content/uploads/sites/3/2019/04/Global20Sustainability20Report_October202015.pdf.
27 There are notable exceptions: In some cases, conflict minerals and origin of agricultural produce can be detected using spectroscopy; see for instance (Hark et al., 2012; Zhao and Nakano, 2018).

Acceptable child work in the production of agricultural produce in developing countries has been and remains a topic of heated debate, although progress has been made in disambiguation of child work versus child labour by means of a cross-cultural discourse on appropriate standards.[28]

Even in the case when there is a common and unambiguous understanding of sustainability performance, supply chain complexity inhibits the validation of sustainability claims. This is already a problem for voluntary programs, where companies experience difficulties to account for their sustainability efforts. The advance of legislation that mandates sustainability performance creates compliance risks for organizations that need to live up to standards, while authorities will be facing enforcement issues. We claim that supply chain complexity by nature distorts transparency and thereby deteriorates the level of control that can be exercised. Both the focal firm that aims to account for sustainability along its supply chain and the authority that holds the focal firm accountable are challenged by this. We now elaborate on supply chain complexity.

Supply Chain Complexity: Branching, Bonding, Blending and Blurring

Supply chain complexity predominantly considers structural complexity, which can be expressed by the complexity of the network of suppliers branching out across multiple tiers; we will refer to this as branching. Another well-known source of complexity exists in the supplier-buyer dyadic relationships (Gereffi et al., 2005), which we will refer to as *bonding*. These relationships may be transactional in nature but can also be more strategic. To transfer sustainability efforts to multiple tiers of suppliers, engagement with the suppliers beyond transactional level is required. However, strategic relationships are more involved and require additional effort to uphold mutual expectations (Huang et al., 2020). But there are other sources of complexity that impact transparency and accountability. For instance, some supply chain processes are performed by a crowd of parties that acts in an informal economy. Examples are small traders of agricultural produce that drive around on motorcycles with a few bags of produce on the back, immigrants that work on (smallholder) farms without proper registration, street dwellers that collect recyclable materials, and so on (Sinha et al., 2020). We refer to this type of complexity as *blurring*. Finally, when product is mixed with other product while being processed, the identity of the product and its source is no longer traceable in the final product (Gasper and Billing, 2018); we refer to this type of complexity as blending. The management of complexities in the supply chain as described above may require consideration of the supply chain as a complex adaptive system (Choi et al., 2001), which goes beyond the scope of this chapter.

28 https://www.ilo.org/ipec/facts/lang--en/index.htm.

Supply chain complexity impedes transparency and accountability

How exactly do the supply chain complexities described as above inhibit supply chain transparency and thereby the possibility to account for sustainability claims in a valid way? Supply chain transparency comes down to the ability to account for sustainability performance and associated improvement efforts. There are many reasons why supply chain transparency is problematic (Gardner et al., 2019), some of which originate from supply chain complexities. We will discuss this along the four types of supply chain complexities introduced above. First, the structural complexity of the supply network, which refers to the number of suppliers and the number of tiers across which they are arranged, inhibits transparency simply by the number of business relationships that need to be maintained. For complex products, this is obvious as the number of product components and materials will be large. But this may hold true for agricultural produce as well, in case the number of suppliers that produce similar product is very large, which holds true in the case of smallholder farmers. Moreover, when suppliers are organized in multiple tiers, intermediate suppliers may have an interest in shielding off their own supplier base, which adds to the complexity of the supply chain due to its network structure.

But second, even complexities of a single buyer-supplier relationship may result in lack of transparency. A supplier may experience full transparency as a vulnerability toward the buyer while negotiating the delivery of goods and services. Especially when there is room for performance improvement, there is a need to build trust that this will not be used against the supplier. A proper supplier engagement program may help but this requires time and efforts (Foerst et al., 2015).

Third, supply chain processes that are performed in the context of an informal economy tend to be elusive. Supply chain actors may not have the capability, power, or intention to formally account for their activities. Such activities are by definition not transparent and unfortunately, are most often associated with poor working conditions and environmental risks.

Fourth, supply chain transparency may be hindered by the fact that the final product cannot be traced back to its origins in a straightforward fashion. An important cause of this is the mixing of sourced materials and products in the production of a next stage product. Especially in continuous production, the sourced materials and products are blended in such a way that they cannot be separated afterwards. Instead of trying to identify individual products or product batches, alternative methods can be used to account for sustainability performance while acknowledging blending. This is the challenge of supply chain custody, to be explained below.

Chain of Custody in the Supply Chain

The notion of ‘chain of custody’ originates from forensics and aims at the uncompromised retrieval and storage of evidence from a crime scene. To report and account for sustainability performance, evidence needs to be acquired throughout the supply chain. As discussed, supply chain complexities challenge the ability to uphold transparency in the supply chains. Some of these challenges can be overcome by introducing a wider set of possibilities to ascertain that products have been produced in a sustainable fashion.

The aim of chain of custody in the supply chain is to allow for enforcement of sustainability performance in global supply chains.

There are several types of chain of custody. The first one is called *identity preserving* and corresponds most with the idea that product needs to be traced back to its origin. This is feasible for high-valued gems and agricultural product batches, for example. Idea is that the product receives an identifier at the sourcing location and is tracked along its consecutive stages downstream the supply chain. This type of chain of custody can only be enforced when the identity of the product is preserved along the supply chain.

In case it is too cumbersome or impossible to preserve the identity of individual products or product batches, there is another type of custody, called *segregation*, that can be used when products with similar sustainability performance levels, to be attested by means of certification, are kept separate from other product. If products are mixed that are all certified, the product mix can still be considered certified. Of course, such certification should acknowledge that certification is performed under segregation, not identity preserving.

It is not always viable to segregate certified product. For instance, a factory sources locally and needs to accept certified and non-certified produce to achieve sufficient economies of scale. In such a case, a type of chain of custody called *mass balance* can be applied. The percentage of final product that can be associated with certified content depends on the mass proportion of sourced certified produce. For instance, if 50 ton of produce is sourced of which 30 ton is certified, and 20 ton of final product is produced, then 60% of that final product contains certified content under mass balance.

Under mass balance, it is not evident that all final products have the same actual certified content; the reported content is an average. Another type of chain of custody, called *book & claim*, moves away from the physical supply chain. The sourced certified produce generates certificates in proportion to its volume, and these certificates can be bought by the producer of the final product. In our previous example, where 50 ton of produce was sourced of which 30 ton was certified, with a yield of 20 ton of final product, then 12 ton of final product could be certified under book & claim.

The actual implementation and enforcement of these chain of custody types in real supply chains comes with a lot of challenges. A current ISO standard (ISO 22095:2020) aims to help manage this by providing consistent terminology and general guidance.[29]

29 https://www.iso.org/standard/72532.html

Case: Better Cotton Initiative (BCI)
The Better Cotton Initiative has introduced a set of standards and a certification program for organic cotton.[30] Its standards are a bit more lenient compared to more stringent organic standards but is certainly better than conventional cotton. It deployed supply chain custody model 'Mass Balance' to account for the organic content of products with BCI label.[31] Cotton factories needed to scale and keep production going and therefore accepted a mix of certified and non-certified produce. Although consumers accept the 'Mass Balance' model for cotton product, there was an unintended consequence of allowing mixed content. Non-certified content may not be organic, but it may also lack other sustainability features. It turned out that some produce sourced under the BCI label originated from sites where Uygur labour was used. Given the international concerns around mistreatment of Uygur labourers in China, this discredited the BCI brand as a sustainability brand. The Better Cotton Initiative at some point considered disposing the mass balance chain of custody model.[32]

Information Technologies: Blockchain is not the silver bullet

Information technologies have been advocated to support and enhance supply chain transparency. Examples are the introduction of product identifiers, such as barcodes and RFID tags, with the supporting technology backbones. Idea is that these product identifiers relate to a host of data that help log sustainability performance associated with the production and handling of the product. Such data needs to be acquired in a reliable manner and needs to be immutable. Blockchain technologies allow data providers to remain in control of their data. This enables the sharing of data among data providers and data users without a 'neutral' third party that needs to be trustworthy.[33] In this manner, blockchain allows the tracking and tracing of products throughout the supply chain.

However, such use of Blockchain technologies is challenged in case the identity of the product cannot be preserved. Many providers of such technology solutions focus on supply chains that admit identity preservation. This excludes a lot of important supply chains in the agricultural and processing industries, for example.

Interestingly enough, Blockchain technologies also shape digital currencies by keeping track of those tokens, avoiding double spending and leakage. In this manner, Blockchain technologies can be used to support the book & claim type of chain of custody.

30 https://bettercotton.org/.
31 https://bettercotton.org/what-we-do/connecting-supply-demand-chain-of-custody/.
32 https://www.ecotextile.com/2020120127067/materials-production-news/bci-admits-mass-balance-system-could-go.html.
33 For a nice introduction, see: https://www.ibm.com/topics/what-is-blockchain.

This does not make Blockchain the silver bullet for chain of custody implementation. For instance, the acquisition of data in a reliable way remains a challenge, and the scoping of a Blockchain system as well. It is not possible to have all transactions and documents in one and the same Blockchain system, due to the complexity of the corresponding supply chains.

Case: Responsible Minerals Initiative Electronics Industry
The electronics industry has been confronted with sourcing raw materials that help finance conflicts and are associated with modern slavery. The industry joined forces in the Responsible Minerals Initiative to counter this[34]. It sought to support due diligence by focusing on the smelter/refinery stage in the supply chain with relatively few actors, which facilitates auditing responsible mineral procurement. Compliant smelters and refiners are publicly listed. The so-called Responsible Assurance Process aims to comply with various due diligence regulations in the US and the EU. The initiative has welcomed progressive EU legislation on supply chain due diligence and regulations against the import of conflict minerals. This example illustrates the joint efforts of electronics producers to scrutinize modern slavery in the sourcing of minerals, initiating a voluntary program while being under scrutiny with consumers and investors, and anticipating progressive due diligence legislation.

4. Discussion and Conclusions

In this paper, we analyzed an important development in sustainable global supply chains from mostly voluntary arrangements towards more and more mandatory regulation. We provided a brief overview of the consequences of the global nature of supply chains for sustainable practices, and some of the arrangements that companies, and in some cases, NGOs, have developed over time to make businesses more responsible. We also reported the state of play of some of the main EU-regulation on sustainable supply chain due diligence that aims to provide a unifying framework for the EU common market.

We then looked into what is currently known about responsible practices in supply chains. This insight should help us assess if the regulatory efforts at the EU level have some chance of success in the years to come.

We find, however, that the very nature of global supply chains, with their complex structures, many different parties involved, interconnected processes, and footprints in many countries and often remote places in the world, often prohibits transparency, which is the starting point for any responsible supply chain arrangement. And only on the basis of sound responsible practices can the level of sustainability in global supply chains eventually be improved.

34 https://www.responsiblemineralsinitiative.org/.

The consequence of this insight is that there are supply chains who really try to be responsible, but then turn out to still allow a certain level of child labour or unsafe working practices in their supply chains. Certain current certification practices, such as mass balance accounting, explicitly enable these types of situations. And finally, we also see that relatively new IT solutions, such as block chain technology may not be the final answer either.

The current state of knowledge on sustainable practices in global supply chains indicates that we have significant concerns that mandatory regulation on sustainable practices in global supply chains may prove to be ineffective. While additional regulatory initiatives focusing on transparency may help, another avenue will probably have to look at ways to make global supply chains less complex. Redesigning global supply chains could therefore very well be the – intended or unintended – consequence of this due diligence regulation.

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Salutation to Harry Geerlings

Beste Harry, we hebben elkaar in de vroege dagen van Smartport ontmoet als 'havenhoogleraren'. Dat was een beetje een geuzennaam, omdat we door de havengemeenschap als theoretici, en door de academische gemeenschap als praktijkmensen werden gezien. Jij hebt je altijd hard gemaakt voor een duurzame haven, en schuwde niet om daarbij tegen gevoelige schenen te schoppen. Het ging allemaal niet snel genoeg. De tijd heeft je gelijk gegeven denk ik, de roep om een transitie wordt met de dag luider. De haven moet nu aan de slag met een energietransitie en een digitale transitie en had zich veel kopzorgen kunnen besparen door eerder en uitvoeriger in te zetten op beide. Het doet me altijd deugd je uit te nodigen om je visie te delen met nieuwe generaties studenten en dat blijf je misschien nog wel even doen! Ik wens je alle goeds.

Groet, Rob

Harry en ik zijn samen begonnen bij het Universitair ProfileringsThema (UPT) Verkeer en Vervoer van de Erasmus Universiteit Rotterdam, in 1993/1994. Harry bezette daar de enige UHD positie, en ik had een van de UD posities aangeboden gekregen. Er waren nog een paar UDs (Marcel Ludema, Vivienne Boels, Peter Pol) en een AIO: Erwin van der Laan. We hadden niet direct veel met elkaar te maken, want Harry deed iets met milieu, en ik zat in de scheepvaart. Die twee takken van sport hebben nog steeds niet veel met elkaar. Maar we deelden een kamer, en dat schept een band. We hebben die band nog jarenlang gevierd met af en toe een biertje in de kroeg. Na een jaar of vijf was het UPT aan zijn eind, en toen gingen we ieder ons weegs: Harry naar de Faculteit Sociale Wetenschappen, en ik via een intermezzo bij ETECA BV naar de Rotterdam School of Management.

Maar er blijven onverwachte parallellen: Harry heeft zijn proefschrift opgedragen aan zijn vader die vlak voor zijn verdediging was overleden. Mij overkwam datzelfde, en ook ik heb mijn proefschrift aan mijn vader opgedragen.

Jarenlang kwam ik Harry af en toe tegen op de Erasmus Universiteit, ook toen ik andere functies had bij TNO en Dinalog. Ik ben nooit ver van de universiteit verwijderd geweest en Harry al helemaal niet. Ik was vereerd om, bijvoorbeeld, in de promotiecommissie van Bob Castelein plaats te nemen, die zijn onderzoek mede op een door Dinalog en NWO gefinancierd project heeft gebaseerd. In mijn TKI Dinalog tijd hebben we ook van Harry's expertise op het vlak van waterstof kunnen profiteren (na nogal wat strubbelingen over een afgewezen voorstel door een internationaal review panel van NWO). Waterstof is bijna een geloof aan het worden in bepaalde kringen, en de studie die Harry en zijn collega Bert van Grieken hebben gedaan heeft in ieder geval mij geholpen om het allemaal een beetje concreet te kunnen maken. Harry heeft mij, in mijn functie als boegbeeld van de Route Transport en Logistiek in de Nationale Wetenschapsagenda ook nog geholpen met de review van een aantal voorstellen in de zogenaamde kleine projectenronde. Ik denk ook nog met veel plezier terug aan een seminar dat Harry gaf over zijn proefschriftonderzoek. Ik was toen vooral onder de indruk van de onderwijskwaliteiten van Harry: hoe hij sprak, hoe hij, wat hij zei, een zekere waardigheid en gewicht wist te geven, waardoor wat hij zei bleef hangen. Het feit dat ik me dat seminar nog steeds herinner, meer dan twintig jaar na dato, bewijst denk ik mijn gelijk.

Harry, ik wens je alle goeds. Een pensioen in het academische bedrijf betekent meestal niet dat je meteen ophoudt met werken. Ik hoop dat je de leuke dingen behoudt, en de minder leuke dingen heel snel kunt afbouwen.

Albert Veenstra

A View through a Window of Technological Opportunity: Going Underground with Freight

J.G.S.N. Visser

Abstract

In 2001, Visser and Geerlings explored the opportunities for underground freight transport. They used the concept of a 'Window of Technological Opportunity' (WTO). Now, twenty-one years later, this paper discusses whether the window of opportunity for underground freight transportation has improved. The conclusion is that circumstances have improved since 2001. The level of automation in logistics increased dramatically, mostly within container ports and logistics centers. China made big advances in making underground freight transport ready to implement. In the meanwhile, Elon Musks' Hyperloop has shifted focus towards freight transport. Despite the many research projects, underground freight transport is not part of long-term policy visions in many countries. Not even a basic idea of a long-term implementation strategy has been developed. Therefore, the conclusion of Visser and Geerlings in 2001 that underground freight transport, despite the many advantages, is a long-term development, is still valid nowadays.

A new window of opportunity for underground freight?

Back in the 1990s, the national government in the Netherlands got interested in underground transport of freight. Due to congestion problems around Schiphol Airport, ideas for an underground freight transport network around the airport were developed. This was called an Underground Logistics System (ULS). A series of feasibility studies for other applications within the Netherlands followed, including tests within a real test center in Delft. The results of studies at that time looked promising and showed a way to make freight transport sustainable (Heidemij Advies, 1995). In 2001, Visser and Geerlings explored the opportunities for underground freight transport. They used the concept of a 'Window of Technological Opportunity' (WTO), described by Geerlings (1997), as an ex ante evaluation tool to describe the first drawings of a public policy on underground freight transport. WTO is helpful in defining public policies for so-called 'mega-technological' innovations.

Visser and Geerlings (2001) concluded that underground freight transport could have certain potentials but also had great uncertainties about the costs and benefits, while the short-term problem-solving capacity was rather limited. Their conclusion was that it remained a long-term development. A long-term process that could only be realized when there was more clarity about the existing uncertainties (financial, technological, enviro-technological, and organizational). Application on a large scale could only be expected to happen in the long-term, and a carefully designed long-range strategy was necessary for its implementation. Visser and Geerlings warned that it was certainly necessary that a clear vision remained in place with respect to the magnitude of the underlying social problem and the resolving capacity of the solution. There was the danger that a shift might occur to the long-term (technological fix), or that the machine became unstoppable, even after unsatisfactory and disappointing results.

What Visser and Geerlings couldn't foresee was that after 2001 in the Netherlands underground freight transport lost momentum and for a long time it became very silent in this area. But the situation has currently changed. Since 2019, developers of hyperloop systems have shown interest in moving freight in large pipes. Hyperloop was originally proposed in 2012 by Elon Musk as a superfast land transportation system for passengers. The British Virgin Hyperloop (Wakefield, 2022) and the Dutch Hardt (Dabrowska et al., 2021) have recently moved their research activities towards fast freight transportation rather than to fast transportation of passengers.

In this paper, I would like to discuss whether the window of opportunity for underground freight transportation has improved these recent years. Are the conclusions of Visser and Geerlings still valid or is there a new reality from which freight transport can benefit?

What is underground freight transport?

Underground freight transport can occur in the form of capsule pipeline transport when it concerns smaller objects (less than 1m diameter) and for larger objects in the form of individual vehicles or trains through tunnels. Underground freight transport combines the advantages of taking freight traffic movements underground, thus reducing the use of space and applying electrical (or linear induction) propulsion, with the economic advantages of unimpeded automated transport over a dedicated infrastructure that is separated from passenger traffic.

The first built pipeline transport systems were pneumatic dispatch systems (USDOT and Volpe, 1994) for moving telegrams and messages from telegraph centers to other offices as part of the telegraph system. The first system, a pneumatic system, came in operation in 1853 and connected the offices of Electric and International Telegraph Co. with the London Stock Exchange. By 1909, London had 40 miles of tubes, and 17 British cities also had this type of service. Such systems became operational in the rest of Europe as well as the rest of the world: Berlin (1865), Paris (1867), Vienna, Prague, Munich, Hamburg, Rio de Janeiro, Dublin, Rome, Naples, Milan and Marseille, and in the USA: New York City, Boston, Philadelphia, St. Louis and

Chicago (Standage, 1998). Also, larger capsules were used. From 1859, the London Pneumatic Dispatch used wheeled PCPs (pneumatic capsule pipelines), weighing up to 3 tons in a tube (76×85cm) on a 61cm gauge track on different lines.

At the beginning of the twentieth century, another type of freight transport system was developed. In Chicago, an underground rail transport system for waste and coal was operational from the beginning of the century until 1959 (see Moffat, 1982). In London, an underground transport system called Mail Rail, came into operation in 1927 and was used for almost 80 years for the transport of mail between post offices within Central London (see Bliss, 2000). Mail Rail stopped to operate in 2006. It is now part of the Postal Museum in London, where you can visit the tunnels as part of an exclusive walking tour.

In the 1960s, renewed interest in larger diameter pneumatic capsule pipelines led to the development of wheeled PCPs. In 1971 at Stocksbridge, Georgia and 1973 at Houston, two prototypes were constructed, the first with a pipeline diameter of 0.91m and the second with a diameter of 0.45m. Both systems became known as 'Tubexpress'. Also, in the UK and Russia, wheeled PCP systems were developed. Several Russian 'Transprogress' systems were built and commercially used between 1971 and 1983. Japan has successfully used PCPs of one meter diameter in permanent installations (for transporting limestone to a cement plant), as well as in temporary construction projects (for transporting earth and construction materials in large tunneling and highway projects).

In the 1970s and 1980s, ideas were developed in Europe, Japan and the USA for high-speed transport systems for passengers and freight (Das & Das, 1992). Eventually, these systems were never built.

In the 1990s, a strong interest for underground freight transport grew in the Netherlands, Japan, the USA and the UK. In Japan, the L-net Tokyo project focused on a metro-like system for mail-transport underground within Tokyo. In the USA, a capsule transport system called Subtrans was developed (see Vandersteel, 1992) for the use of transporting mail and parcels between distribution centers of UPS, TNT and EMS and Newark Airport near New York. In the UK, a feasibility study was conducted on underground connections between post offices in Central London used by Mail Rail, to be used for the distribution of freight and mail with Metrofreight, a new automated transport system (see Clarke & Wright, 1993). In the Netherlands, between 1994 and 2001 different research programs researched the technical and financial feasibility of Underground Logistics Systems (ULS) in urban areas, but also the use of ULS at airports, seaports and industrial areas (Rietveld et al., 1999). The driving factor was a proposed ULS at Schiphol airport to connect the flower auction at Aalsmeer and a new freight rail terminal at Hoofddorp to the airport. In Germany, the Ruhr-University Bochum (see Stein & Schoesser, 2000) conducted research on CargoCap. The feasibility of a long-distance freight pipeline system was investigated by the Texas Transportation Institute's Rail Research Center (Roop and Bierling, 2000).

What happened since 2001?

In the Netherlands, the research stopped after the minister of Transport and Waterworks decided that there was not enough private participation in the Schiphol ULS-project to continue projects (Wiegmans, 2010). Other countries started to investigate types of underground freight transport. In the year of 2013, Mole Solutions developed a freight pipeline demonstrator, located at the Alconbury Weald Enterprise Park, near Cambridge, UK (Silverthorne and Zhou, 2016). CUIRE from the University of Texas in Arlington investigated the feasibility of freight capsule systems between cities, at airports and for long distance freight traffic. This multi-year research program showed that there are options for the future. Cargo Sous Terrain (CST) in Switzerland and the JTC Underground Inter-Estate Goods Move system in Singapore focus on actually building an underground freight system, both in areas in which no or difficult transport solutions can be found above ground.

China has investigated freight capsule pipelines since 2003, for instance for moving containers to and from the ports of Shanghai (Fan, You and Huang, 2016) and for collecting waste in Shanghai (Yu and Fan, 2010). Recently underground freight transportation, in China also referred to as Underground Logistics System (ULS), has been formally included in the Regulatory Plan for the Sub-centers of Beijing (2016–2035) and the Planning of the Yangtze River Demonstration District of Wuhan (Guo et al, 2021). JD-Logistics, part of the Chinese ecommerce company JD.com, developed ideas for underground distribution of goods in cities. In November 2018, JD-Logistics showed a scale model of an underground freight transport system at ISUFT 2018 in Beijing, China. The research in China focuses on two types, namely dedicated logistics networks or extending the subway network in cities with extra tunnels and terminals for freight transport. In Xiong'an a 15 kilometre long network is created dedicated to freight. This tunnel network will be used by unmanned trucks. This will be the first ULS operational in China (see https://www.chinanews.com.cn/cj/shipin/cns/2021/03-22/news883716.shtml).

Despite all these initiatives, no underground freight transport system has yet been built and in operation, although China could be the first. However, the circumstances have changed. For instance, the level of indoors transport automation in logistics centers has risen fast and is nowadays at a very high level in most countries around the world. Also, more and more container ports have been partly or fully automated since 2001 and autonomous ships (AAWA, 2016), trains and trucks are being developed.

The thinking of transportation within logistics has also changed, as for instance concepts such a synchromodality. A concept based on the optimal, flexible and sustainable allocation of cargo to different modes and routes in a multimodal network. Another interesting concept is considering logistics as a Physical Internet (Montreuil, 2012). The European Technology Platform (ETP) Alice, Alliance for Logistics Innovation through Collaboration in Europe developed a roadmap in 2020 and positions the interconnected multimodal freight transport as an integral part of an overarching concept called the Physical Internet. The basic idea is that the whole freight transport system operates as one physical internet. Clients order goods without having to organize the logistic supply chain themselves. Physical internet is the

concept of an open global logistics system founded on physical, digital, and operational interconnectivity, through encapsulation, interfaces and protocols. The Physical Internet is intended to replace current logistical models. Automated delivery, including in urban logistics is considered as one of the key elements Although this is a concept and a not real life application, it structures the way of thinking about logistics and fits automated freight transport, including underground as part of an interconnected multimodal transport network for freight.

Conclusions

Underground freight transport systems can lead to a socially attractive transport system, as well as to a considerable improvement of the performance of goods transportation. Research into these systems supports these expectations (see f.i. Braet, 2011).

Is UFT yet ready to be implemented? The technology is no longer critical for the development of underground freight transport systems anymore, since the required technology is already available. More critical is the right market implementation. Compared to the situation twenty years ago, the field of logistics is changing in favor of UFT due to consolidation within the transport market, new logistics management concepts focusing on multimodal consolidated supply chains and new ideas such as the Physical Internet.

Conditions must be right, like sufficient volumes of goods to transport and also favorable conditions. With a growing global population and increasing urbanization worldwide, space has become sparse and the need to use the underground becomes evident. More and more facilities are planned underground in cities like Hong Kong, Singapore and major Chinese cities. Nowadays there is also a strong focus on the environment and sustainability, while at the same time the demand for just in time delivery at homes is rising.

We are dealing with a development path of prolonged efforts on the part of the government and or the private sector. Despite the many research projects, underground freight transport is not part of the long-term policy visions in most countries. Not even a basic idea of a long-term implementation strategy has been developed (see for instance Visser, 2005).

Therefore, research is still necessary to increase our knowledge of underground freight transport, and thereby reduce the existing uncertainties. The key questions that have been addressed in earlier studies, are still valid: What supply chain markets are applicable? What is the nature and size of the economic, social and environmental benefits? What is the optimum specification for an underground freight transport system? What is the optimum blend of proven technologies? What is the optimum development path? How should the development be funded? Which legal and governance issues must be addressed? Private funding is becoming an option since private investors are getting more interested in funding infrastructure as the cases of Cargo Sous Terrain in Switzerland and Hyperloop in the USA show. Due to the public character of the UFT, the government, however, will have a responsibility with respect to decision making, developing proper 3D planning of activities underground to make long

alignments of tunnels possible and may even be in charge of the construction and operation of the infrastructure. Even if the UFT infrastructure will be developed by a limited number of parties and will be exploited on their "own" property (it is then private, and not public), the role of the government is required. The importance of a proper regulatory framework to manage property rights and the governing of underground use and developments are essential, even when it concerns private properties. An efficient use of the underground also requires an integrated planning approach, for the surface and subsurface combined, for the longer term perspective but also for the shorter term (Visser, 2018).

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Personal note

Beste Harry,

We kennen elkaar vanaf het begin van de jaren negentig. Het klikte meteen. Je scoorde behoorlijk punten toen je vertelde over je boeking van U2 in je studententijd. We zagen elkaar niet vaak, maar de zeldzame keren dat we elkaar zagen, was het een genoegen om bij te praten en te discussiëren over ons vakgebied en de ontwikkelingen daarin. Bijzonder was dat we elkaar vaker in het buitenland zagen dan in Nederland. Ik zou graag die traditie willen voortzetten maar dat zit er waarschijnlijk niet meer in. Temeer om een excuus te vinden om in Nederland een ontmoetingspunt te vinden.

Ik hoop dat ik je de komende periode in goede gezondheid met enige regelmaat weer zie en dat we nog lang met enthousiasme bij kunnen praten over de boeiende zaken des levens!

Met groet,
Johan

Reducing greenhouse gas (GHG) emissions at ports: the need for new governance approaches

Michele Acciaro

Abstract

Ports are major economic clusters and occupy a central position in global supply chain networks. Notwithstanding the significant economic benefits that can be associated with ports, their geographic characteristics, proximity to industrial and urban conglomerates, and role in transport networks also make them a site of significant negative environmental impacts. The impact of ports on the environment and how to reduce this impact without compromising the economic benefits of port activities have raised considerable scientific and policy interest. In addition, more and more attention has been paid to the carbon footprint of ports over the past decade. While direct port activities, such as cargo operations, may be limited in terms of carbon emissions compared to other industries, emissions from the entire port cluster can be significant. In addition, given the centrality of ports to global transport chains, and in particular to the production, distribution, and use of fuels, there has been growing interest in the role that ports, and with them port management companies (PMCs), can play in accelerating the development of a low-carbon economy. This paper provides some reflections on the strategic significance of this development in Europe and shows how the current green focus is the result of a decades-long process intertwined with and shaped by economic and historical events. The paper concludes by asking whether port governance systems, which evolved with the primary goal of promoting economic efficiency, need to be revised in light of the increasing significance of environmental and societal challenges, and especially as a result of the climate crisis.

Key words

Port management, sustainability, greenhouse gas (GHG) emissions, energy transition.

1. Introduction

Ports play a central role in global transport chains and are often located near major industrial clusters and cities. Despite their significant positive economic contributions, ports are associated with sizeable negative environmental impacts. Environmental impacts at ports include water pollution from industrial effluents and ship operations, air pollution from industrial and transport activities, soil and land degradation, the damage to local fauna and flora, e.g., from light or noise or habitat destruction, and coastal erosion among other aspects (e.g., Tubielewicz, 1995; Vandermeulen, 1996; Hossain et al, 2021, Braathen, 2011). Furthermore, the climate crisis is impacting ports directly, as a result of the greater exposure to climate impacts on port infrastructure and activities (Becker et al. 2013), and because of the role of ports in reducing greenhouse gas (GHG) emissions from transport (e.g., Alamoush et al. 2022).

Transport is responsible for 25% of total GHG emissions in the European Union (EU), which aims to reduce them by 90% by 2050 as part of its commitments towards carbon neutrality. Shipping emissions are about 4% of European total[1], or about 138 million tonnes of CO_2 in 2018, of which only a small portion is generated when ships are at port. Most port emissions are generated by ships at berth (Merk, 2014), while emissions from port direct activities are marginal on any account. These emissions, however, become substantial if the emissions of port industrial activities and hinterland transport are considered. For example, CO_2 emissions in the Port of Rotterdam's industrial cluster excluding hinterland transport were 26.3 million tonnes in 2018, according to the Port Authority, although they fell by 15% in 2020 and account for only about 16.5% of total emissions in the Netherlands. According to EU MRV[2] data, emissions from shipping were about 13.7 million tonnes in 2018 in Rotterdam, to which about 0.65 million tonnes need to be added for port operations, and about 2.2 million tonnes for hinterland transport. This brings the total footprint of the port of Rotterdam, the largest in Europe, to over 42 million tonnes, which is a quarter of the total emissions of the Netherlands (which do not include emissions from shipping).

These emissions are not directly under the control of port management companies (PMCs), as they often do not operate any commercial activities in the port. In recent years, however, much attention has been focused on the role that PMCs can play not only in reducing pollution and the carbon footprint of port activities, but also as facilitators and coordinators of technological change, particularly in relation to the energy transition. Ports are increasingly seen as industrial clusters with a special connection to port cities. It is not surprising that PMCs are expected to intervene in reducing emissions from cluster activities and shipping and to support the greening of cities, or even to take on the role of environmental stewards for costal and urban areas in the proximity of the port.

1 2020 Annual Report from the European Commission on CO2 Emissions from Maritime Transport.
2 Regulation (EU) 2015/757 on monitoring, reporting on the monitoring and verification of carbon dioxide emissions from maritime transport, known as MRV Regulation, came into force in 2015 and requires ships above 5,000 GT calling on the ports of the European Economic Area EEA (EU, Iceland and Norway) to report their CO2 emissions from 2018 onwards.

PMCs have been entrusted with the responsibility for environmental management in ports for decades. They have responded to increasing pressure from customers, local stakeholders, and port shareholders to improve the port's environmental performance. Some PMCs have also developed a social responsibility strategy to improve their sustainability profile (Acciaro, 2015) or even gain a competitive advantage (Stein & Acciaro, 2020). As policy efforts to curb emissions from transport increasingly see ports as playing an important role in the fuel and technology transition, PMCs find themselves caught between promoting economic growth and acting as a driver for emissions reduction at sea, within the port industrial cluster and in the hinterland.

This role of PMCs raises the question of whether the deregulation-oriented models of port management that have been developed in recent decades with the aim of promoting efficiency and supporting throughput growth (Zhang et al. 2019) are suitable for dealing with the complexity associated with reducing emissions at the level of port clusters and beyond. While more and more PMCs have indeed become cluster managers (e.g., Baccelli et al. 2008), it is legitimate to examine how this role of PMCs has emerged.

To this end, it is expedient to review how the policy discourse has led to PMCs playing an increasingly active role in promoting more sustainable port development models that account for the reduction of environmental impacts and, in particular, greenhouse gases associated with the port cluster. The remainder of this text will focus primarily on Europe, but similar considerations can be made for other regions.

2. Managing port environmental impacts (1970-1995)

PMCs have been concerned with negative environmental impacts in ports for many years. Environmental concerns related to port activities came to the fore strongly in the 1970s primarily as a result of oil pollution from ships at port (e.g., Jones, 1981; Hoyle & Hilling, 1984), and became an integral part of port development and transport policy in the 1990s (Couper, 1992; Smith, 1995). In his article on environmental management, Couper (1992) argues that part of the interest of port managers to port environmental issues is related to the legal implications of neglecting environmental issues in ports especially in Western Europe.

Already in 1985, in response to increasing international and political awareness, member States in the European Community (EC), had agreed to Directive 85/337[3], that advocated, among other things, that all major industrial sites, including ports, should carry out environmental audits. These were the years when environmental issues increasingly appeared in the media and, as a result, were incorporated into legislation. In 1987, the report of the World Commission on Environment and Development: *Our Common Future*, known as the "Brundtland Report", had already set out the challenges related to environmental protection and advanced the concept of sustainable development to limit the negative impact of economic activities. In 1989, the Exxon Valdez oil spill pushed new regulation in the US (the Oil Pollution Act of 1990) and provided an increasing stimulus to environmental activism (Birkland & Lawrence, 2002).

In 1992, the European Commission adopted its White Paper on the future development of the common transport policy, that included a recommendation for transport to adopt a sustainable mobility concept centred on intermodality, with the aim of reducing congestion and pollution associated with transport activities (Commission of the European Communities, 1992). The Common transport policy was translating the focus placed in the Maastricht's Treaty on environmental compatibility as a basic principle in policy making also in transport. By appealing to sustainable mobility, although vaguely defined, the White Paper made a first attempt to reconcile economic growth with environmental protection.

In this document defining the Common Transport Policy, ports are not as prominently featured as in later efforts, and although there is a section on maritime transport, the focus is primarily on efficiency and preservation of the European maritime fleet. However, the document outlines some well-known issues that are also relevant to ports, such as land degradation, modal shift, and GHG emissions reduction. Already, technologies and research and development are seen as powerful allies in reconciling the sometimes-conflicting goals of transport policy, including environmental protection, sustainability, efficiency and safety, territorial cohesion, and growth. In 1992 the Strategic Analysis in Science and Technology Unit (SAST) of the Directorate-General for Science, Research and Development of the Commission of the European Communities also commissioned a series of reports focusing on the connection between transport and the environment.

The Commission recognized that the impact of transport on the environment was increasing, both as a result of growing trade and of the instrumental role of transport in leisure activities. The aim of these reports was to examine the many interactions between technology, transport and the environment in order to set priorities for research and development in transport technologies and to identify how technological change affects policy options in the areas of transport and the environment, but also energy and spatial planning (Gwilliam and Geerlings, 1992). The research reiterated the importance of transport in terms of environmental impacts, specifically distinguishing among global impacts, local impacts, quality of life aspects and resource utilization, and argued in favour of policy well-beyond technology and innovation, as

3 Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment.

"*it is improbable that a technological breakthrough will take place on the short term*." (Gwilliam and Geerlings, 1994, pg. 307).

This work did not have a specific focus on ports, but it was already becoming clear that port authorities had a role to play in reducing transport environmental impacts (e.g., Goss, 1990a; 1990b; Tubielewicz, 1995). In the mid-1990s, the European Seaport Organization (ESPO) started ranking the top ten environmental priorities for port managers. In 1996, these were (in order of priority) (ESPO, 2022):

- Port development (waterside),
- Water quality,
- Dredging disposal,
- Dredging operations,
- Dust,
- Port development (landside),
- Contaminated land,
- Habitat loss/ degradation,
- Traffic volume,
- Industrial effluent.

This list highlights port managers' concerns at the time about expanding the seaside of port capacity and shows a limited focus on the hinterland. Hinterland connectivity will become a priority for ports in the following decade.

3. Port development and the environment (the 1995-2000)

In the second half of the 1990s, port managers, especially in Europe, increasingly sought solutions to prevent environmental problems from delaying port development. In transport, particular attention was paid to technological developments and the role of government in facilitating the path to more sustainable transport technologies. Green and Wegener (1997) argued that more sustainable transport is only possible through fundamental change in the technology, design, operation, and financing of transport systems. It is quite interesting that this article does not consider air pollution from seagoing ships as relevant, even though the authors acknowledge that maritime transport growth requires two critical exhaustible resources, oil and land.

Planning and network development naturally became one of the most relevant aspects on which to focus, given the more sizable impact of passenger transport. The European POSSUM project developed scenarios for volume growth and environmental impacts, particularly CO2 and NOx emissions, within the limits set by policy makers: 25% reduction in CO2 emissions between 1995 and 2020, 80% reduction in NOx emissions, and no degradation of protected areas with a small increase in net infrastructure area. Equally important were in these scenarios

also cost efficiency, full infrastructure cost coverage and reduction of public subsidies to all form of transport to zero (Banister et al. 2000).

Also, for freight, network planning and optimization emerged as a solution to mitigate the negative effects of transport (e.g., Janic, Reggiani, and Nijkamp, 1999). Intermodality with its promise of modal shift, was the subject of renewed interest, although the environmental benefits of moving cargo from trucks to rail and inland waterways were marginal if discussed at all (e.g., Southworth & Peterson, 2000; Campisi & Gastaldi, 1996). Intermodality and new freight transport technologies appeared to offer a solution to improve efficiency and transport services limiting the expansion of transport networks. The lack of coordination both at a policy level, as well as between firms and public authorities, was identified as a source of inefficiency in transport systems.

This view was embraced at the European level, for example with the Communication from the Commission titled "Intermodality and Intermodal freight transport in the European Union, published in 1997 (EC, 1997). That document also referred to the environmental benefits of intermodality, namely: "As different transport modes have different impacts on the environment, for example in terms of their emissions, energy efficiency, noise and land-take, promoting the development of more environmentally friendly transport modes in the transport market is a major way of improving the transport system's environmental performance as a whole." (EC, 1997, paragraph 106). The strategy paper called for cooperation between transport operators, users, relevant supply industries, member states and regional and local authorities.

4. Intermodality, cooperation and sustainability (2000-2005)

Intermodality is just one example of a development that benefits from cooperation between businesses and public authorities, but other cases include sustainability, digitalization, and the uptake of new transport technologies. Janic & Reggiani (2001) argue that the common European transport policy has favoured the development of more integrated and sustainable transport by promoting cooperation and coordination between private and public actors. The role of collaboration in promoting the development of sustainable technologies for transport had already been pointed out in Geerlings (1996).

Through the 1990's it had become clear that harmonization was not enough to reach the goals set up in the European transport policy and that more coordination was required, especially in terms of environmental policy and land-use (Geerlings & Stead, 2002). In the early 2000s, numerous European policy documents began to address these issues. In 2001, the new European Transport White Paper "European Transport Policy for 2010: time to decide" was published (EC, 2001a), following the 1999 European Spatial Development Perspective (EC, 1999) and the 2001 European Sustainable Development Strategy (EC, 2001b).

In these documents the policy maker laid out some of the principles that will determine European transport policy in the following decades. The White Paper built on long-term policies agreed upon in the 1990s such as the constitution of the trans-European transport networks (TEN-T), which were established in 1996[4] and the Kyoto Protocol, that was agreed in 1997, but that would enter into force in 2005 The policy document also included ports as fundamental links in the European transport networks and explicitly recognized their role in improving transport efficiency and transport environmental performance. In this document the concept of motorways of the sea took shape as part of the TEN-T and a renewed interest in digital solutions and maritime safety. Ports were primarily seen as intermodal nodes, instrumental in the creation of an integrated safe and efficient European transport system (Casaca & Marlow, 2007). The document also outlined plans for the creation of the European Maritime Safety Agency (EMSA) and a body to protect the common European border from criminal activity and illegal immigration, that will become the subject of much discussion in Europe again a decade later.

The main priorities for the policy document were the improvement of efficiency and network coordination in view of the recently agreed expansion of the European Union, resolving infrastructure bottlenecks, and improving the resilience of the maritime transport sector to accidents. The International Maritime Organization was discussing the phase out of single-hull tankers by 2015 and there was concern of poor-quality ships arriving in European Ports. The system will be tested in November 2002, with the MV Prestige oil disaster, which resulted in the agreement at the International Maritime Organization to phase out single hull tankers by 2010, while very old ship would need to be phased out by 2005. Another striking feature of the White Paper is that the word "terrorism" was not mentioned once, even though clear concerns about the security of the European transport system were expressed. This will change after September 11.

Efforts to improve policy coordination did not bear immediate fruit. In the mid-2000s, opposition to some of the infrastructural developments in various European countries coalesced in the form of more structured lobbying efforts and protests on the ground (Van Der Heijden, 2006) at times resulting in port workers' mobilization and opposition to regulation (Turnbull, 2006; van Assche & Deschouwer, 2007). For example, the European Commission's efforts to develop a directive on port services in 2003 (Pallis & Vaggelas, 2005) and again in 2006 (Verhoeven, 2009) also failed due to clear resistance from port stakeholders.

The implications that the port packages would have had on the environmental performance on ports are hard to assess. On one side the Commission acknowledged that ports bear specific responsibility for maritime as well as onshore safety and environmental protection. But on the other side, it also recognized the need for port development to be coordinated and competition among European ports to be ensured. The approach focused on maintaining the

4 Decision No 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network.

port-level playing field by harmonizing, among other issues, port financing. This raised the challenge to combine maritime safety and environmental protection requirements and, where necessary, public service obligations with a regulatory structure that was compatible with competitive structures and financial autonomy.

5. Sustainable ports and innovation (2005-2013)

The two decades preceding 2010 were characterized by incredible technological development in European ports. In 1993, the ECT Delta terminal was the first terminal to be automated, followed by the Pasir Panjag terminal in Singapore in 1997. In the next ten years, 17 terminals from Busan to Hamburg will introduce automated technologies (ITF, 2021). This can be seen as a way for strategic port sectors to overcome the disruption to port operations resulting from labour disputes and increase efficiency of operations (Acciaro & Serra, 2014). However, this innovation had only incidentally improved the environmental profile of port activities.

Notwithstanding the importance of innovation in the port sector, little attention had been paid until 2010 to its potential in reconciling the need of ports to accommodate growing traffic and managing port environmental impacts. In an impactful study, Wiegmans and Geerlings (2010) used data collected for the Dutch Ministry of Transport, Public Works, and Water Management to examine how innovations in the port improve the port's sustainability profile. They examined a selection of 78 innovative concepts and new technologies applied in port operations and organization, from loading technologies to hinterland transport management concepts, and alternative energy sources. The authors conclude that these efforts are only partially successful in improving the sustainability profile of ports but reiterate that larger gains are possible. They also point to the fact that sustainability gains are only marginal when the main driver for innovation is efficiency.

Although innovation is often cited as a solution to environmental issues in shipping and ports, there were few scientific studies on this topic in the maritime transport sectors at least until the early 2000 (Arduino et al. 2013). One aspect that emerged from a series of studies published in the first half of the 2010s is that very often innovation processes in ports were not aligned with the overall port management company business strategy and in general environmental issues were not leading innovation processes (Acciaro et al. 2014). Moreover, these studies demonstrated the importance of cooperation and collaborative approaches (Vanelslander et al. 2019) and suggested a leading role for port authorities as orchestrators in the innovation ecosystem (de Martino et al. 2013). At the same time, empirical research suggested that most port innovation, albeit in collaboration with the public sector, was driven by private companies (Acciaro et al. 2018; Carlan et al. 2017).

Increasing attention has also been paid to governance and organizational issues, particularly in relation to the management of hinterland traffic (Hou & Geerlings, 2016). The authors argued that the biggest challenge for the transition to a sustainable transport system is not the development of new technologies, but the development of new governance arrangements. Geerlings & Kuipers (2013) proposed transition management to find a balance between economic development (e.g., because of improved transport accessibility) and sustainability. Current transport policy is mainly formulated through the complex interaction of a variety of stakeholders, at times with conflicting objectives, and that relied on optimistic assumptions about the impact of technology. They also noted that the emergence of more complex environmental priorities, including the climate crisis, requires new approaches. Through a case study in the port of Rotterdam, they note that a sustainable transport policy requires a clear national focus and strong local implementation. But they also point to the need for a governance approach that links different spatial levels, involves civil society organizations, businesses, and citizens, and maintains relations at the European level.

6. Port emissions as an environmental priority (2013-2019)

After all, the Commission's regulatory efforts in the early 2010s aimed at responding to the port sector's demands for greater regulatory clarity and thus responsibility in relation to environmental issues[5] and port development and recognized the role of port authorities in preparing development master plans, consulting with stakeholders and municipal authorities and ensuring conflict resolution (Verhoeven, 2009), and responding to the increasingly urgent demand for sustainable transport. A variety of projects investigated the environmental impacts of ports, e.g., Green Efforts (Geerlings et al. 2014) and Supergreen (Psaraftis and Panagakos, 2012). The calculation of the carbon footprint of port activities, for example, showed that ports, ships and their hinterland, were substantial contributors to GHG emissions (e.g., De Meyer et al. 2008, Geerlings et al. 2014).

As of 2010, air quality became a top priority for port managers. In ESPO's top ten environmental priorities for 2009 and 2013, air quality was ranked second and first, respectively, and energy consumption was mentioned. Air quality and energy consumption will be the top environmental priorities for ports in the next ten years, to be replaced by climate change in 2022. To overcome the trade-off between growth in port traffic, especially containerized cargo, the focus was on emission measurement and new technologies. Around 2010, many studies appeared that looked at estimating emissions at ports (e.g., Tzannatos, 2010; Geerlings & Van Duin, 2011; Villalba & Gemechu, 2011; Song, 2014; Tichavska & Tovar, 2015).

5 See e.g., biodiversity protection with the publication of the Natura 2000 document, (the European Commission, Directorate-General for Environment, Sundseth, K., (2008), Natura 2000: protecting Europe's biodiversity, Wegefelt, S.(editor), Mézard, N.(translator), European Commission.

The global financial crisis affected trust in corporations and institutions (Roth, 2009) and contributed to social unrest and pronounced anti-capitalist sentiment. The Occupy Wall Street movement of 2011, whose origins can be traced back to environmentalists in Canada, was also a response to frustration, particularly among younger generations, about corporate culture, financial fraud, and greenwashing (Rowe and Carrol, 201; Menees. 2014; de Freitas Netto et al. 2020). Although social unrest in ports is not a new phenomenon, the protests of the 2010s have helped to highlight the need for systematic approaches to managing these conflicts (e.g., Parola & Maugeri, 2013).

In the 2010s, the idea that port operators need to pursue different objectives and thus acquire and maintain their licence to operate and licence to grow prevailed. The role of stakeholders in port management had been recognized long before (e.g., de Langen, 2006), especially in case of expansion projects (e.g., Dooms et al. 2013), but the use of appropriate communication skills to enhance environmental and community relations management, outside the commercial sphere were still an underestimated success factor (Verhoeven, 2009).

The 2011 White Paper[6] on Transport and the Single Market Act II[7] emphasized the need for well-connected port infrastructure, efficient and reliable port services, and transparent port financing. The primary goal was fostering economic growth, in the aftermath of the 2008 financial crisis that forced ports to rethink their growth projections (e.g., de Monie, et al, 2010). The White Paper also outlined a set of goals in relation to the environmental performance of the European transport sector, among which carbon emission reduction by 2050 of about 60%. Intermodality, better connectivity and improvements of information exchanges are all featured prominently in the 2011 White Paper. In the case of ports there is particular focus on taxation and on port services.

This focus resulted in 2013 in the third proposal for a framework on market access to port services and financial transparency of ports[8]. The proposal was accompanied by a Communication highlighting the role of ports as engines for growth[9]. In these documents the environment features more prominently, and one of the actions proposed in the Communication, specifically addresses the need to raise the environmental profile of ports, primarily by fostering differentiated charges in the spirit of social marginal cost pricing (Haralambides & Acciaro, 2015). As the 2013 proposal, although much watered down compared to previous efforts, did not find political favour in the European Parliament, some of the ideas developed in 2013 were further integrated into the Commission's policies over the following decade.

6 White paper 2011, Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system, COM/2011/0144 final.

7 Communication From the Commission to the European Parliament, The Council, The European Economic and Social Committee and The Committee of The Regions Single Market Act II Together for New Growth, (Com/2012/0573 Final).

8 Proposal for a Regulation of the European Parliament and of the Council establishing a framework on market access to port services and financial transparency of ports COM (2013) 296 final.

9 Communication from the Commission. Ports: an engine for growth COM (2013) 295 final.

The 2013 Communication also clearly assigned an important role for ports within the TEN-T corridors. In 2013, a new Regulation[10] had given new impetus to the TEN-T concept, and ports featured prominently as key intermodal nodes. The document also highlighted again the importance of sustainable mobility, even if the concept of sustainability was always coupled with efficiency. But it can be argued that a clear focus on carbon emissions emerges from the document. Specifically, article 32 is dedicated to sustainable freight transport services and advocates the sustainable use of transport infrastructure, including efficient energy management, and "*stimulate resource and carbon efficiency, in particular in the fields of vehicle traction, driving/steaming, systems and operations planning*" (article 32, paragraph (d)).

7. Orchestrating GHG emission reductions (2019-the future)

In the second half of the 2010s, interest in the environmental performance of ports increased. A recent literature review (Alzahrani et al. 2021) reports that the literature focusing on decarbonization of ports and port operations has been growing exponentially in the last decade to over 150 publications in 2020. The authors conclude that the literature can be grouped around six topics, namely: carbon reduction, use of renewable energy resources, cost-performance optimization, deployment of smart control technologies, the regulatory landscape for greening seaports, and implementing green port practices guidelines. While most papers focus on carbon emission reductions, only about 10 papers have a primary focus on policy and governance.

In autumn 2018, the Fridays for Future protest movement began to gain momentum. As Greta Thunberg became the most prominent figure of the movement, the climate crisis became a central issue in the European elections in May 2019, building on the impetus of the 2015 Successful Paris Agreement. In December 2019, the newly appointed Commission presented the European Green Deal[11], which outlines a European growth strategy that promises to address climate and environmental challenges.

10 Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU.

11 Communication From the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions the European Green Deal (Com/2019/640 Final).

The Green Deal also includes specific provisions on maritime emissions and the role of ports in restricting access to the most polluting ships.

In 2020 the European Commission presented its strategy for sustainable and smart mobility[12]. The strategy sets out various short-, medium- and long-term goals, which will have important implications for the transport and port sectors. The strategy entails a substantial decarbonization of the sector, the replacement of fossil fuel ships and vehicles, with low-carbon ones, the development of a low-carbon infrastructure, the development of zero-carbon ports, ambitious modal-shift targets to decarbonise freight transport and policies related to carbon pricing across all transport modes. These sustainability goals are coupled with a vision for smart and resilient transport, leveraging on the use of automation and innovative transport concepts and technologies, considering criteria that will strengthen the single market, a fair and just mobility and transport safety and security.

Still dealing with the COVID-19 Pandemic, on July 14, 2021, the European Commission adopted a set of legislative proposals to secure the European Green Deal - the "Fit for 55" package[13]. This sets out how Europe will reduce its net GHG emissions by at least 55% from 1990 levels by 2030. This is essential if Europe is to become the world's first climate-neutral continent by 2050. Among the various proposals included in the package several will have implications for the port sector.

The Commission will strengthen the demand for renewable and low-carbon fuels for deep-sea shipping by setting a cap on the GHG content of energy consumed by ships entering European ports and promoting zero-emission technologies at berths (where ships remain in port) using a technology-neutral approach. This will be coupled with the extension of the EU Emissions Trading Scheme (ETS) to maritime transport, limiting maritime emissions as part of the overall ETS cap and creating a carbon price signal to encourage GHG emissions reductions in a flexible and cost-effective manner and generate revenue to combat climate change and promote innovation.

On the energy supply side, the Commission is supporting the development of alternative fuels infrastructure by replacing the Alternative Fuels Infrastructure Directive with a regulation[14] that will include mandatory targets for onshore power supply (OPS) in maritime and inland ports. In addition, the Commission will support increasing the supply of renewable energy in the EU through the revision of the Renewable Energy Directive (RED), which raises the current EU target of at least 32% renewables in the overall energy mix to at least 40% by 2030, with a focus

12 Communication From the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Sustainable and Smart Mobility Strategy – Putting European Transport on Track for the Future, Com/2020/789 Final.

13 Communication From the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'fit for 55': Delivering the Eu's 2030 Climate Target on the Way to Climate Neutrality Com/2021/550 Final.

14 Proposal for a Regulation of the European Parliament and of the Council on the Deployment of Alternative Fuels Infrastructure, and Repealing Directive 2014/94/eu of the European Parliament and of the Council, Com/2021/559 Final.

on sectors where progress has been slower, such as transport. This also requires the revision of the existing Energy Taxation Directive (ETD), which aims to bring the taxation of energy products in line with the EU's climate objectives and to abolish outdated exemptions such as those for intra-EU maritime transport.

This package of measures reflects the Commission's objective to reduce GHG emissions by addressing the various barriers to decarbonization of the sector (technological barriers, economic barriers, etc.). The Commission is pursuing two complementary approaches: first, improving energy efficiency (i.e., using less fuel) and second, increasing the use of renewable and low-carbon fuels (i.e., using cleaner fuels). The goal is to simultaneously strengthen fuel demand, distribution, and supply. With port-specific efforts to mitigate climate change already in full swing, ports are playing an increasingly important role as hubs for energy and as hubs for the blue and circular economy. The ESPO *Trends in Port Governance 2022* Report[15] notes that energy is increasingly part of the port business. Ports are key entry points for energy commodities, sites for energy production, and act as enablers for the energy transition.

While ports are accountable for a relatively minor share of GHG emissions, given their centrality in global transport chains and their role at the centre of large industrial and urban clusters, they can play a major role in fostering the uptake of cleaner technologies and low-carbon energy sources. In addition, ports already for decades have been supporting the development of logistics concepts at sea and on land by acting as interfaces between ocean transport, short-sea shipping, and hinterland transport (road, rail, barge, and pipeline) to reduce pollution and GHG emissions.

8. Concluding remarks

The climate crisis and the ecological crisis have featured prominently in the agenda of ports around the World. In Europe, since the launch of the European Commission's Green Deal strategy in 2019, pressure on the transport and port sectors has been increasing, as a low-carbon transition for transport is critical for the achievement of the European decarbonization objectives and ports are instrumental to such transition. While the environmental ambitions of the Green Deal strategy are unprecedented, the strategies set out to achieve them are not. In this brief historical overview of port environmental policy since the 1990s, I have shown how environmental concerns have increased over time and how, in parallel, PMCs have gradually been recognized as important drivers of change due to ports' central position in global transport and energy networks and in national economic and industrial clusters.

15 ESPO: Trends in EU Ports' Governance 2022, https://www.espo.be/publications/trends-in-eu-ports-governance.

The European Green Deal, recognising the urgency of addressing the climate crisis, places much responsibility directly and indirectly on PMCs, potentially pushing the limits of governance and economic models developed with the primary objective of promoting growth and efficiency. To achieve the important intentions of the Green Deal, it is legitimate to ask whether more needs to be done to enable PMCs to fulfil their additional functions in the future. As the transition to sustainability requires new organizational approaches, the focus should also be on governance and not only on technological solutions.

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Personal remarks

Putting together these reflections was an opportunity to re-read some of Harry Geerlings' papers that I had read for my doctoral dissertation and before. His ideas on how to approach the challenges of today's port and transport systems are relevant today more than ever. His focus on sustainability, innovation, and organization at a time when environmental concerns were often considered secondary, his early recognition of the need to address GHG emissions from port activities, and of the need to develop governance models to facilitate the transition to sustainability in ports and transport are testament of the timeliness and significance of his academic contributions.

The Ultra Large Container Vessel: a blessing or a curse

Rommert Dekker[1,2]

Abstract

In this contribution we investigate the increase of container ship sizes over time. We discuss the consequences of the resulting Ultra Large Container Vessels for shipping lines and terminals. Shipping lines have invested in these ships for economic and competitive reasons. The larger ships also reduced the CO2 footprint per container transported. Partly because of these big ships there were quite some mergers of shipping lines in the last decade. On the downside, terminals had to invest in larger cranes and more handling and storage capacity. Yet also these investments were also used as a competitive action against smaller terminals. We finally argue that a further increase in ship size is not foreseeable in the near future.

1. Introduction

Container ship sizes have increased over the years, together with the increase in containers transported worldwide. Ships went from 3000 TEU in 1980 to 8000 TEU in 2000 and 15000 TEU in 2007. Yet In 2015 there was another increase in size initiated by the introduction of the Maersk EEE class. Suddenly it meant that ports had to make substantial investments to serve these large ships. A report issued by the International Transport Forum (ITF) of the OECD presented all the problems ports faced by these ships. They stated that cost savings from bigger container ships are decreasing, that the overall transport costs due to larger ships could be substantial, that supply chain risks related to mega-container ships were rising, that public policies need to better take account of this and act accordingly and that a further increase of maximum container ship size would raise transport costs. So, a discussion started on the pros and cons of these ultra large container ships.

In this paper we will investigate why ships get larger, whether this trend is likely to continue and what the consequences are / have been for ports, both for terminals as well as the hinterland transport. We will consider both the viewpoint of the shipping line, as well as the terminal and port authorities. We will also draw some analogies with aircrafts, as the Airbus 380 is a nice example of an ultra large aircraft.

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2 The own research referred to in this document was carried out by Judith Mulder, Rafiazka Hilman and Nemanja Milovanovic.

2. The Ultra Large Container Vessel (ULCV)

2.1 Developments in time

Containerized trade has grown over the years. It can be measured in Twenty Foot Equivalent (TEU) measures, a standard small container size. Global trade went from 51 mln TEU in 1997 to 135 mln TEU in 2008, 182 mln TEU in 2016 and to 211 mln TEU in 2021. Cumulative average growth rates however, were first quite high, 8.3% between 1997-2001 and 10.8% between 2001 and 2007. Later on it declined to 3.9% between 2011 and 2016 and some 3% thereafter. This decline seems large, but absolutely the growth is still substantial. To meet the increased demands, container ships have increased in size. The following table gives an overview of these developments with an emphasis on recent increases.

Table 1 Largest container ships in time

Year	Vessel name	Length (m)	Beam (m)	Draught (m)	Max TEU	Gross Tonnage (Tonnes)	Operator
2022	Ever Alot	399.9	61.5	17	24,004	236,228	Evergreen
2021	Ever Ace	399.9	61.5	17	23,992	235,579	Evergreen Taiwan
2020	HMM Algeciras	399.9	61.0	16.525	23,964	228,283	HMM (South Korea)
2019	MSC Gülsun	399.9	61.5	16.5	23,756	232,618	MSC (Switzerland)
2018	Cosco Shipping Universe	400.0	58.6	16	21,237	215,563	Cosco (China)
2017	Madrid Maersk	399.0	58.6	16.5	20,568	214,286	Maersk (Denmark)
2006	Emma Maersk	397	56	16.02	14770	170,794	Maersk (Denmark)
1997	Sovereign Maersk	346	42.8	14.5	8160	91,560	Maersk (Denmark)
1977	Resolution Bay	248.6	32.3		2961	43,995	

Source: Wikipedia

The table shows that there was a substantial growth from 1977 to 2017, but thereafter ships did not get that much bigger. Their length stabilized at 400 m, as vessels longer than that size need permission from the Suez Canal Authority to transit the canal. From 2017, the draught remained at some 16.5 m, their beam increased with one bay (about 2.9 m) and a better internal organization created a further 15% growth since. Are these signs that a ceiling has been reached, or is a further jump in size likely to occur? A McKinsey (2017) report stated, "*On balance, we do not view 20,000 TEUs as the natural end point for container ships—50,000-TEU ones are not unthinkable in the next half-century*". Before we continue, we will make a sidestep.

The development in size of container ships can be compared to the developments in other ship types, like bulk carriers and crude oil tankers. These ship types have also seen growths in size, but they reached a peak some time ago. The largest crude oil tanker was the Seawise Giant of 564,763 tonnes deadweight which had a length of 458 m, a beam of 68.6 m and a draught of 24 m. It could sail at a speed of 16.5 knots (30.6 km/h). It was built in 1979 and scrapped in 2010, so it was way larger than the largest container ship. Oil tankers saw a large increase in size after the Yim Kippur war in 1973 as the Suez Canal got blocked. Oil fields found in the North Sea later on, reduced the need for very large tankers. Presently the largest crude oil tanker is much smaller. It is the Euronav Oceania, which is 380m long, has a draught of 24,5 m and a summer DWT of 441,585 tonnes. This does indicate that there are disadvantages for a very large ship, and that later in time, the largest ship is smaller in size.

For bulk carriers the largest ship was built in 2010 and it is still in service. It is the Vale Rio de Janeiro, measuring 362 m in length, with a beam of 65 m, 30.4 m draught and having a 402,347 DWT. This large draught causes that she can carry metal ore only slowly at a speed of 15.4 knots (28.5 km/h) to few ports in Brazil, Europe and Asia only. Evidently, there has been no need to increase the size of metal ore carriers further. Comparing container ships with oil tankers and bulk carriers indicates that much larger container ships can be built, but it also shows that many other factors play a role on whether these ultra large ships remain useful. Hence, we need to assess the pros and cons of ultra large ships in detail.

2.2 Economics of ship sizes

A ship's size has everything to do with economies of scale. The cost of operating a ship consist of daily fixed costs (capital cost of building), daily operating costs (maintaining the ship, crew costs) and daily fuel costs. All these can be converted to costs per TEU carried. Economies of scale dictate that the larger a ship is, the lower the total shipping cost per TEU and often also lower CO2 emissions per TEU carried. A larger ship, however, also implies that port costs go up. First, it will take longer to load and unload a larger ship as its call size will go up as well, while its capital or time charter costs are higher, hence leading to diseconomies of scale.

A nice model to determine the optimal ship size was presented by Cullinane and Khanna (1999, 2000). They established with econometric techniques relations between ship sizes and the costs elements given earlier. Using data up to 1996 they established that from an overall perspective, the optimal ship size was about some 8000 TEU. Although their data is no longer valid, and hence their outcomes are no longer appropriate, their methodology and basic insights still stands. The main insight is that there is a balance between daily costs at sea and daily costs in a port. These daily costs need to be multiplied with the time at sea and time in port (ships are assumed to have little or no idle time) to determine an optimum size. Hence bigger ships are more effective for long routes, like Asia-Europe than for shorter routes, like Asia – US. If a bigger ship saves 10% on costs per TEU/mile but port costs go up with 20%, then the bigger ship is only effective for very long stretches.

Capital costs for building a ship depend very much on whether shipyards have a filled order book, furthermore on the steel prices and finally on the interest rate on capital. The latter two depend very much on the state of the world economy. There may be some economies in scale in ship building costs, but the last two components may dominate. Bunker fuel cost is an important element in total ship operating costs. Estimated fuel costs for a round trip from Shanghai to NW Europe are several million euros. Increasing a ship's size could lead to fuel savings and thus be beneficial for the environment. This was also advocated in the launch of Maersk's EEE ship types (like the Maersk Madrid). We will look at this in more detail.

Increasing the size of a ship size can be in three dimensions, length, beam, and draught. Consider an increase in size accomplished by increasing each dimension with a factor α (>1), resulting in a total size increase of $\alpha 3$. Yet the cross section of the ship increases with a factor $\alpha 2$. This cross section is one of the main drivers of fuel use. Hence an increase in the total ship size of a factor β (= $\alpha 3$, implying α = third root of beta) results in an increase of the cross section of a factor $\beta 2/3$. Hence the fuel use per TEU then decreases with a factor β-1/3. If the ship's size increase is only realized by increasing beam or draught, then a size increase does not give any decrease in fuel use per TEU. Such a decrease has then to be achieved in other ways.

It is difficult to obtain data on ship fuel consumption, as there is no reported industry standard, and one has to rely on what shipping lines publish. Moreover, the fuel use is very dependent on the nominal or standard speed a ship is designed for. One can compensate for this using the well-known relation between speed and fuel use. Finally, engine technology has advanced over the years, also leading to a reduced fuel use. Some preliminary own calculations, those by the OECD and Hilman (2018) indicate that a further ship size increase of say 24,000 TEU with 10% to 26,500 TEU does not decrease fuel costs with an equal percentage. Fuel costs have increased recently by restrictions introduced on the sulfur content of fuel. Moreover, regulations will require a reduction in CO2 emissions in the near future, by which ships must switch to more expensive fuels like hydrogen, ammonia, or methanol.

3. Cost-effective deployment of ULCVs

3.1 Demand increases stimulate bigger ships

Technically, a larger ship can lead to lower costs per TEU slot. Yet this cost reduction will only be achieved if a container is occupying the slot. The yearly carrying capacity between two ports is the product of the ship capacity and the sailing frequency. This relation holds for all scheduled transport modes. The sailing frequency depends very much on the desired frequency by customers. Already for some time shipping lines have chosen to go for weekly sailings. This allows easier planning for manufacturing companies, who worldwide use a work week system with a weekend break. Cumulating a week's production output and sending that to a port in time avoids extra waiting at the port. A round trip however, between Asia and NW Europe may take some 12 weeks. Hence to offer a weekly shipping frequency 12 similar sized ships are needed. This was enabled by the formation of shipping alliances, in which shipping lines join forces to offer such a frequency on each route. Might alliances no longer be allowed by competition authorities then shipping lines will have problems to maintain this weekly frequency and they may have to cut routes. Having more smaller ships provides more flexibility in this respect.

So, if the demand remains the same, introducing larger ships only makes sense if there are more containers to be transported. Transport of many products has been containerized and in recent times products needing refrigeration moved to reefer transportation. Yet, their share in total volume is limited. In recent years trade growth has slowed down. Moreover, in 2022 we see a reduction of China's growth and concerns about supply chain risks have stimulated reshoring production to closer to Europe. So, container demand growth is less and less a driver for bigger ships.

3.2 Liner shipping networks

The number of containers transported between two ports very much depends on the type of network a shipping line operates. Several types of networks can be distinguished (see e.g., Mulder and Dekker (2017), viz. point-to-point, hub-and-spoke, round tours (also called milk runs). All these types can be observed in practice. Network planning is typically a tactical decision process that shipping lines do. The longer a route the more cost-effective a larger ship is. Hence on the longer routes between Asia and Europe, as well as Asia - US west routes, one typically sees the largest ship employed between the largest ports. Ports with less cargo volume then employ feeders to these major ports. For example, a feeder line may connect Hull with Rotterdam, while Rotterdam then connects to the rest of the world. Contrary the airline networks, main shipping routes have multiple stops. The difference between a shipping line and a passenger airline, is that transfers for passenger lines are cheaper (for the airline) while container transfers are more costly since they need cranes. Moreover, for airlines demand is much more elastic than for shipping lines. This allows airlines to have many more direct connections than multi-stop routes.

3.3 The ULCV as competitive instrument

3.3.1 Game theoretical research

To get more insight into this matter Milanovic and Dekker (2018, 2019) conducted some experiments with network planning and the effect of bigger ships on competition. For simplicity they considered one origin port and two destinations. A so-called Stackelberg competition is set-up between two shipping lines of which one has access to an ULCV, while the other does not. There is a fixed demand between the origin and each of the two destination ports, with one of them being bigger than the other one. Each shipping line can allocate capacity to each destination port and set a price. The shipping line with the big ship is the leader and can set capacities and prices first, the second shipping line responses to this. The shipping line with the big ship has a lower cost per TEU per nautical mile than the other one. The results depend on the price sensitivity of the customer, which can be a winner take all, or a more continuous market share function.

This is a kind of game theoretic network planning, a quite unexplored scientific area. Network design is already a very complex optimization problem, and making it a game even more, as all possible networks for leader and follower need to be considered, and there are very many. Milovanovic developed some optimization programs and did several experiments. The results depend on whether one ship can fully meet the demand in a port or not.

It is very unlikely that demand is exactly equal to the capacity of a ship. We will here consider the case where the total demand is more that the size of the biggest ship but less than the sum of the capacity of the big and the smaller ship. If that is the case the leader will set such a price that the competitor is pushed out of the main market. The follower then concentrates on the smaller market. If the leader uses a feeder for the secondary market, he is more expensive than the follower, as transshipment and using a feeder is much more costly than the advantage of the bigger ship. Does the leader make a round tour, then his costs again go up as his route is longer for the same demand. In case the capacity of the big ship can also serve all demand in the smaller port, then the follower will go to a third port.

Concluding: having access to a bigger ship allows a shipping line to push competitors with smaller ships out to secondary markets. The competition can however concentrate on these smaller markets, which may be less profitable though, but they can still offer a competitive product for these markets and are not pushed out of the game totally. Investing into bigger ships can be done by shipping lines which have access to enough capital, and this means that smaller shipping lines either focus on niche markets or will merge or be taken over by the big ones.

3.3.2 Empirical research

We also did some empirical research on shipping networks. Hilman (2018) took Maersk Line as example and compared its network in 2010 with that in 2018. The number of Asia-Europe routes decreased from 9 to 8, while the employed ships had a 104% increase in capacity. Less ports were visited, but the effect was small: from 27 to 24 ports. Some people envisaged that ULCVs would lead to shuttle connections between major ports and to be specific, a direct

service between Singapore and Rotterdam, where both would serve as mega hub. Research by Mulder and Dekker (2016) shows however, that transshipment and land transport costs are that high that it is more economic for ships to have multiple port calls. In the case mentioned, it would be more economic for a ship from Singapore to call both to Rotterdam and Hamburg than to serve Hamburg from Rotterdam with either a feeder or train transport.

We saw an increase in bigger ships initiated by the introduction of the EEE type of ships by Maersk Line in 2017. Later, many more shipping lines followed this trend, which is clear from the list of largest container ships. Yet some shipping lines were taken over or merged in the last decade: APL/NOL by CMA CGM, OOCL by Cosco, Hamburg Süd by Maersk Line and NileDutch by Hapag-Lloyd. Hanjin shipping went bankrupt in 2017 and the Japanese "K"Line, MOL and NYK merged into the "ONE" line. The mergers were mainly caused by a downturn in container shipping around 2017, but the necessary investments in bigger ships played a big role.

3.3.3 Analogies with the Airbus 380

The Airbus 380 was introduced in 2010, it was Airbus answer to Boeings 747. Airbus always had smaller airplanes, like the Airbus 340 and 330, with max 300 passengers, while the Boeing 747 could carry over 400 passengers. Airbus decided to make a bigger plane which would lower cost per available seat mile drastically. The Airbus 380 could easily carry 525 passengers, depending on the configuration used. It envisaged that the main airports would be slot constrained, that the hub-and-spoke system would dominate and that all passengers would benefit from very large planes.

Upon entry of the plane several airlines bought it. Many people were impressed by this biggest passenger plane. Apart from some European airlines Lufthansa, British Airways, and Air France buying the plane, Asian companies, like Malaysia airlines, Singapore Airlines, and China Southern followed, while the main buyer was the Middle East airline Emirates, followed by Etihad and Qatar Airways. Especially Emirates built its network out with its hub in Dubai and connecting both the US, EU with Asia, Africa, and Australia. By offering low fares it attracted very many international passengers. However, it was the only airline operating the plane successfully. No US airline bought the plane. Although airline demand increased, the hub-and-spoke system did not dominate and many passengers still preferred frequency and direct connections over one-stops connections. Anno 2022 one sees airlines abandoning the Airbus 380 in favor of smaller but more economic planes with which a higher frequency can be offered.

4. Effect of the ULCV on container terminals

It will be clear that ULCVs bring benefits to shipping lines, and these will force terminals to do investments to be able to handle these large ships. Many terminals have long berths to accommodate ships of various length and are thus able to share shore cranes and storage capacity on different berth positions. Accordingly, a longer ship does not have that many consequences and from Table 1 we see that ships reached already the largest length of 400 m in 2007. An increase of draught or beam of a ship has much more effect.

Increasing the draught is an issue for many ports and it may require repeated dredging, which is very costly. The port of Hamburg for example, is connected through an 80 km long part of the Elbe to the sea and the natural depth of the Elbe is not enough to handle fully loaded ULCVs. In 2016 the 19,000 TEU CSCL Indian Ocean stranded halfway the Elbe as a sign of the Elbe's bottleneck. Hamburg's terminals can serve ULCVs but not as first port of call. ULCVs on a round tour from Asia typically first unload in Antwerp or Rotterdam before visiting Hamburg and on their return trip, their load is finished in these ports as well.

The biggest ships became broader in 2018 and this meant that many Ship to Shore (STS) cranes in terminals were not long enough to handle all bays of a ship. This implied that a ship must be turned for reaching the outer bays, a time consuming and hence costly operation. To avoid this, terminals had or still must invest in larger cranes (see for example Soderberg (2017)). For example, ECT Container Terminals in Rotterdam bought 5 new cranes with a longer beam in 2016 as part of their ULCV upgrade program. This was partly done out of competition reasons, as terminals hoped to get more traffic from shipping lines when being able to handle very large ships. Terminals (partly) owned by a shipping line were in a more favorable position as a joint decision between shipping line and terminal could be made on the investment in bigger ships and cranes. Smaller ports, however, were set at a disadvantage. This comes forward in the OECD report, which was very much initiated by smaller ports like the port of Gothenburg.

A bigger ship could lead to more terminal throughput, but not necessarily. A critical aspect in this respect is whether the call size, i.e., the average number of containers to unload or load during a ship call at the terminal, will be higher. It seems logical that the call size increases with bigger ships, as these are more effective at sea that in a port. Keeping call sizes the same while increasing a ship's size would mean that a ship has to visit more ports. A higher throughput directly requires more capacity needed for storage as well as landside handling activity. The stacking yard needs to be expanded which sometimes may be expensive. Anyhow, there does not seem much difference between handling bigger ships with a larger call size and accommodating the general worldwide increase in container transport. A higher throughput and a larger call size may lead to congestion problems. One should realize that an increase of a ship size from 18,000 to 20,000 TEU is only an increase of 10%, yet from queueing theory it appears that even such a moderate increase in throughput could lead to drastically more queueing. Even without an increase in total throughput, the increase of call size does impact higher traffic directly after the ship call, which may be difficult to accommodate. Investments in landside capacity are expensive but can often be done as add-on investments (additional to

present equipment, instead of replacing it), but they are less expensive than replacing STS cranes by new ones.

5. Effect on hinterland transport.

A bigger ship will likely increase the call size a terminal has to handle. Apart from necessary increases in landside handling capacity it also means that the peaks in truck, train or barge arrivals are likely to increase with more congestion as a result. Congestion is already a big issue for many terminals, and it has many causes. Truck arrivals are not spread over a day, with peaks in the morning and afternoon. Container trains are limited in size in Europe and often compete for capacity with passenger trains on the network, trains may have to visit multiple terminals. Barges may also visit multiple terminals, which may propagate delays. Anyhow, congestion in the hinterland existed already before the ULCVs, but their arrival and increase in total throughput has increased these problems.

6. Conclusions

There has been a lot of criticism about shipping lines ordering larger ships to accommodate more demand and to push smaller container lines out of competition. Terminals had to invest in bigger cranes and more handling capacity and not all were able to do so. Those terminals with a high throughput and lying on the main routes (like the ones in Rotterdam, Antwerp, and Hamburg) could recapture the necessary investments, but smaller terminals had a big problem. Now (2022) the ULCV seems standard on the Asia – Europe trade, yet not for all connections. They reduced transport costs and CO2 emissions per container. Recent years have seen a marginal increase in size, mainly caused by a better internal organization. A major jump in size as the McKinsey (2017) report suggests, is not in the order books. The reason is that it does not lead to much lower costs, it reduces flexibility very much and there is a lot of uncertainty about what kind of future fuels will be used.

The problems sketched in the OECD report did happen in some ports, while other ports are capable of handling ULCVs, though not the biggest ones (the ones with a beam of 61.5 m). Several terminals envisaged the upcoming of ULCVs and used them to improve their competitive position. As such one may wonder whether the problems envisaged by the OECD were not just part of standard competition issues.

7. Acknowledgement

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Personal word to Harry

From around 2013 to about 2017 Harry Geerlings (ESS), Rob Zuidwijk (RSM), Frank Smeele (ESL) and me (ESE) were the so-called port professors, subsidized by the Port of Rotterdam Authorities to further port research and education. Together with Hein Klemann (ESHCC) we formed a nice interdisciplinary team. This was a logical and broadening step after having a single port professor (former port directors) for a long time. We discussed various research related to the port, we held seminars on our port research and interacted with many people from the Port Authorities. Harry could develop his favorite interest, viz. sustainable mobility. His school however was not rich at that time and could not match the funds provided by RSM and ESE on port research. Harry tried to foster cooperation with China, especially the SISI organization in Shanghai. He even spent there some time, but it was less academic than he expected. It was a pity that the port professor construction finished somewhere in 2017 and the Port of Rotterdam Authorities started to develop the SmartPort organization, which finances port research directly. Although much more research was conducted in that way, it also very much reduced the internal Erasmus cooperation. Science organization depends very much on financial incentives. I very much remember Harry's enthusiasm and drive for sustainability and I was infected by it. On one hand It is a pity that he is retiring, because we need more of that spirit. Harry, continue doing good work now and in the future.

Navigation – Risk and Sustainability

Jens Froese

Abstract

One single navigational casualty can easily wipe off the positive results of many years of efforts to improve sustainability in sea transport. Thus, parallel to improve operations from the ecological aspect, reducing risks of navigation is a must. There are mature methods available to conduct a quantitative risk assessment such as IWRAP[1], resulting in collision and grounding probabilities. There is, however, the difficulty to determine the so-called causation factor having a significant impact on the results. Globally collecting relevant empirical data to allow a statical determination could make risk analysis results less questionable and provide a sound basis for safe management of navigation.

Keywords

Causation probability, maritime safety, risk analysis

1. Introduction

Sea transport results in the lowest energy consumption per tonne carried from all transport modes and hence ranks high on the list of sustainable mobility. However, being a leader does not necessarily mean that there is no more room for improvement and shipping works hard to further reduce the carbon footprint, mainly by rising energy efficiency and by introducing alternative fuels. Improving the sustainability of sea transport is an arduous business requiring many small steps to achieve significant progress. These efforts can become in vain very sudden by casualties, such as collisions and groundings, resulting in large pollution of crude oil, oil products or chemicals. Thus, parallel to improve operations from the ecological aspect, reducing casualty risks is a must.

1 IALA, Recommendation O-134 on IALA Risk Management Tool for Ports and Restricted Waterways, Edition 2, May 2009.

2. Quantitative Assessment of Navigational Risk

To ensure safe vessel traffic, navigational risks must be known. One can only manage what can be measured.

Methods to assess navigational risk meanwhile escaped the nursery. There are *qualitative* methods identifying possible hazards and mitigation options jointly with a rough estimation of consequences and *quantitative* methods to more accurately calculate risks based on specified risk scenarios (risk models).

The definition of risk is

Risk = probability x consequences
[annual frequency x average costs]

It is cumbersome but achievable to capture consequence costs, especially when insurance providers support.

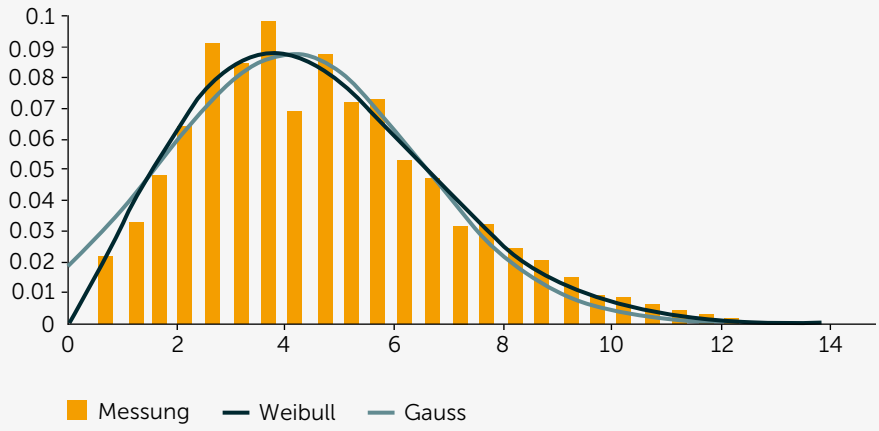
The International Maritime Organization (IMO) published "Guidelines for formal Safety Assessment (FSA)[2], a structured and systematic methodology to be used as a framework to support in the evaluation of new regulations for maritime safety and protection of the marine environment or in comparing between existing and projected regulations. For quantitative risk assessment IMO recommends applying the IALA Risk Management Tool for Ports and Restricted Waterways, the IWRAP Mk2 tool[3] which allows to quantify the frequencies of collisions and groundings in any traffic area. As explained in the introduction, the probability of collisions and groundings is only one fraction of risk. In case of continuous risk assessment conducted to monitor the safety of a sea area or waterway it is sufficient to only once calculate the risk and then to restrict to probabilities for consecutive assessments as long as nature and composition of traffic does not significantly change.

The IWRAP-label "IALA Risk Management Tool…." is misleading as the tool allows only to determine collision and grounding frequencies but not consequence costs, which needs to become assessed separately based on input from IWRAP-results. This shall not deteriorate the enormous benefits of the tool. Whoever sat weeks to investigate collision and grounding frequencies manually, will certainly appreciate this extremely helpful tool, very efficiently to be used.

2 IMO, Revised Guidelines for Formal Safety Assessment (FSA). MSC-MEPC.2/Circ.12/Rev.2, 9 April 2018.
3 IMO, Degree of Risk Evaluations. SN.1/Circ.296 7 December 2010.

IWRAP is a probabilistic approach on the basis of geometric (spacial) distribution of traffic and navigational obstacles. The IWARP theory is described in a working document of the Technical University of Denmark (Friis-Hansen, 2007) [4]. The traffic distribution can become captured by AIS-counts of ships. To allow for mathematical processing a statistical distribution is selected which best fits the histogram-data of traffic (see fig. 1). Frequently a normal distribution can be applied, however it depends on how the distribution matches the histogram-data and on the scenario to become investigated.

Figure 1 Traffic histogram and statistical distributions



3. Probability of Collisions

Risk models and formulae depend on the scenario describing encountering, overtaking, crossing or lane merging traffic, collisions between vessels and fixed obstacles or groundings. To elucidate the approach encountering traffic is used as an example below. Figure 2 shows the Fujii-model for encountering traffic and figure 3 the associated formula to calculate the collision frequency (Fujii, 1971; Macduff, 1974).

Figure 2 Fujii-Macduff-Model for encountering traffic

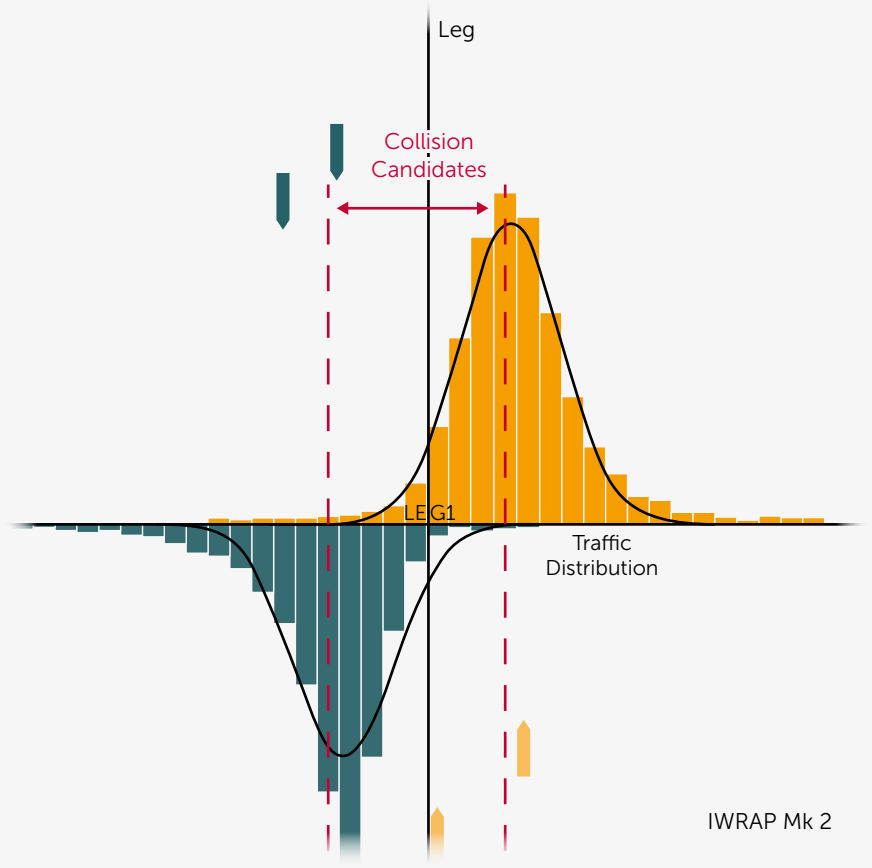
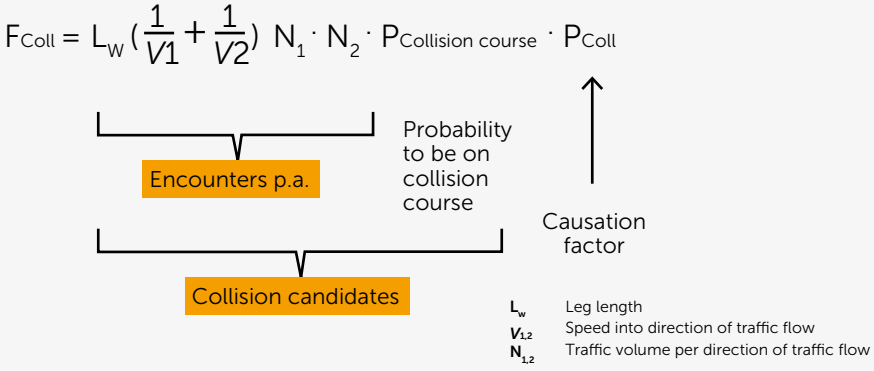


Figure 3 Collision frequency of encountering traffic (Fujii-Macduff)



The elements of the formula are the encounters per time span, usually 1 year, and the probability to be on collision course, calculated on the basis of the AIS-counts providing the traffic distribution. The result shows the collision candidates, however, not all ships having the opportunity to collide, will do so. In the vast majority of cases on one or both ships an evasive action will be taken. Thus, the causation probability or causation factor is added to achieve the fraction of the collision candidates eventually colliding.

4. Causation Factor

The causation factor mirrors all possible human and technical collision causes, from human failure to steering failure. Recommended values can be found in literature (Rasmussen, et al., 2012):

$$P_{human} = 2 \cdot 10^{-4}$$
$$P_{steering} = 6.3 \cdot 10^{-5}$$
$$P_{propulsion} = 1.5 \cdot 10^{-4}$$

IWRAP also provides default values for the causation probability. It seems, however, problematic to generalize the default factor. The conditions governing e.g. the human causation factor may be found in insufficient training, negligence, fatique, attitude, illness or insobriety. It also depends on the bridge team management and organization of ships. It can be assumed that human failures on cruise vessels occur more seldom than on container feeder vessels with minimum manning and always running behind terminal arrival schedules. It can also be assumed that there is an dependence between weather conditions and human failure rates when e.g. in dense fog an otherwise compentent and engaged navigator lacks experience in radar-based collision avoidance.

The most reliable way to determine the causation factor is from empirical data. Also an analystical approach appears possible. There are suitable methods available, such as

Fault tree analysis
Failure mode and effect analysis
Bayesian believe network.

An analytical approach requires to consider all possible causes and conditions to individually estimate the particular likelyhood of occurrence. As long as there are no statistical data available, this is extremely difficult and experience shows that usually the cumulated probability is considerably too high.

There is a better availability of empircal data from some of the technical failures, such as loss of propulsion or steering than from failure of navigational equipment such as e.g. RADAR.

It is obvious that the difficulty to determine the causation factor is the weakness of the quantitative assessment of navigational risk. The only way to improve the accuracy of the causation probability is to collect suitable empirical data to allow for statistical analysis.

5. Causation Factor Database

The causation probability depends on a wide variety of conditions. To reliably base causation factors on representive statistical data, traffic and incident data covering all relevant navigational conditions must be collected over some years. This is only possible by global cooperation. It is required to depict e.g.

- Waterway/sea area
  - Geometry (routes, exclusion zones, traffic separation schemes, regulations)
  - Underwater morpholoy
  - Current
  - Aids to navigation
- Traffic
  - Ship types
  - Ship dimensions
  - Ship speeds
  - Cargoes carried
  - Traffic distribution per ship class
- Environmental conditions
  - Wind
  - Seastate
  - Visibility
  - Ice
- Incidents
  - Types
  - Consequences

The format and content of the databank and the methods to retrieve results must follow an agreed standard.

Figure 4 Conditions contributing to the causation probability

By collecting appropriate data from all parts of the world such a databank would soon become sufficiently mature to deliver reliable causation factors on demand based on an equally standardized retrieval format describing the relevant conditions of the area. The capability and the reliability of causation factors will continously improve over time.

There are already some marine traffic databases providing at least a fraction of the a.m. information, which could contribute. In Europe this is the European Marine Casualty Information Platform (ECIMP), operated by the European Maritime Safety Agency (EMSA) in Lisbon. Amended by a consequences database to easily retrieve damage costs of injuries/fatalities, material and environment by collisions and groundings a very powerful "Navigational Risk Database" could become generated making risk assessment easy and results reliable and comparable.

6. Conclusion

Quantitative risk assessment provides the basis for planning, executing and managing safe navigation. IWRAP provides both, a consistent methodology and an easy-to-apply tool, however, the quality of results depends on the quality of inputs. Most of required inputs can be well assessed but the determination of the causation factor presents the weak spot of the method which could be overcome by establishing a global "Navigational Risk Database".

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Personal note

To Prof. Harry Geerlings

Dear Harry,

The moment of your retirement has come, certainly producing rather mixed feelings. There is an opportunity of enjoying less burden and more freedom but well knowing your absolute engagement into your work as a professor, in science as well as for your students, I can imagine that you might miss your work. However, I am convinced that your knowledge and experience will also be asked for in future. Your expertise in sustainable mobility and ports is of increasing significance.

I really enjoy looking back to our joint research projects, always benefitting from your ability to excellently contribute to results but also your ability to create a comfortable team spirit.

My sincere thanks to you, it always was a great pleasure to work with you. I hope that you will provide your vast knowledge to the scientific community for many more years.

Stay healthy and take care!

All the best
Jens

Green investments in non-European seaports: a comparison of major seaports

Mats Pauwels and Thierry Vanelslander

1. Background and scope

Due to the increasing importance of sustainable operations and the reduction of harmful emissions into the atmosphere, there is more and more research and attention for green shipping technologies in the maritime sector. Not only ships have to become greener, but also seaports. The attention to environmental issues within a seaport is mainly felt at the level of ship and cargo handling, industrial activities in the ports, port planning and expansion initiatives and the accessibility of the hinterland (Lam and Notteboom, 2014). Shipping companies and other stakeholders within the port are being forced to invest in new green technologies. This is largely due to the policies of the European Union and the International Maritime Organization (IMO), they impose international environmental limits for their member states to reduce greenhouse gas emissions (Stevens et al., 2015).

The demands of shippers also play a role in the greening of ports. If no new measures are taken, in the short term this could affect people's health and quality of life. In the long term, this will have an impact on the environment (Laffineur 2012). As a result, it is crucial for shipping organisations to minimise harmful emissions. It is for this reason that an increasing number of ports are focusing on sustainability and green investments and initiatives. Thus, not only European ports are concerned with sustainability, ports from North America, Oceania and Asia are also increasingly focusing on sustainability.

This chapter focuses on green investments in non-European seaports. It aims to find out to what extent non-European seaports differ from each other in terms of green investments. Ports from America, Asia and Oceania are addressed. Specifically, it examines whether a pattern can be observed regarding green investments, the economic profitability with or without government support, what the future will bring regarding green investments in seaports and what the best practices are.

2. Approach

As a first step, on the basis of the World Ports Sustainability Program (WPSP), best practices are selected that are relevant for this research. WPSP is an initiative set up by the International Association of Ports and Harbors (IAPH) (World Ports Sustainability Program 2022). Building on the 17 Sustainable Development Goals (SDG), the aim of the program is to improve and coordinate future port sustainability efforts and promote international cooperation between supply chain partners. The program is also supported by several leading global organizations such as the American Association of Port Authorities (AAPA), the European Sea Ports Organization (ESPO), the International Association of Cities and Ports (AIVP) and the World Association for Waterborne Transport Infrastructure (PIANC).

The WPSP implements the 17 SDG on the basis of five themes. Two of these themes are relevant to the chapter, namely 'climate and energy' and 'resilient infrastructure' (World Ports Sustainability Program 2022). The theme 'climate and energy' focuses on implementing the Paris climate target, which aims to keep global warming below 2°C. The theme of resilient infrastructure aims to provide sustainable port and port-related infrastructure in order to be in harmony with the local communities, nature and heritage.

When selecting the best practices, a number of characteristics are taken into account, so that they can still be somewhat standardized.

- Different regions

Green projects and investments from different regions worldwide will be looked at. In order to get a better global picture of green investments outside Europe, different continents will be discussed, namely: America, Asia and Oceania.

- Ports with different backgrounds

When we talk about ports, we often immediately think of container ports. However, there are many other types of ports. Dry bulk, liquid bulk and breakbulk are examples of different types of ports. Greening is of course about much more than just container ports, which is why other types of ports must also be taken into account.

- Major seaports

This chapter focuses on large seaports. That is why these types of ports are also being investigated. There will certainly also be good green investments/projects in small ports. These are also taken into account in the number of best practices/cases, but these projects are not discussed in more detail for this study.

- Climate and energy projects and sustainable infrastructure projects

Two types of green investments/projects are being investigated. Because both projects involve completely different investments, they are listed and examined separately before being included in this study. Both types of projects aim at sustainability. Where 'climate and energy' projects mainly focus on decarbonisation, 'sustainable' infrastructure' projects focus on resilient infrastructure to withstand changing climate and weather conditions. As a second step, stakeholders involved in each of the respective projects from step 1 were interviewed for the authors of this chapter to see what could be considered a best practice. Both local academics, whose research field is sustainability and green investments in ports, port authorities and port-related organisations were therefore interviewed. This interview series shows that zero emissions, tidal energy generation, new sustainable infrastructure at terminals and 'green port program' are best practices. The interviews led to the selection of cases, starting from the WPSP database, as shown in Table 1.

Table 1 Cases selected for in-depth analysis

Land	Naam haven/organisatie	Achtergrond	Grootte	Type inverstering/project
Klimaat en energie				
Verenigde Staten	Port of Long Beach	Container	Groot	C-Port Zero Emissions Demonstration Project
Overkopelend (VS, Canada)	Port of Seattle, Port of Tacoma, Northwest Seaport Alliance, and Vancouver Fraser Port Authority	Multipurpose	Groot	2020 Northwest Ports Clean Air Strategy
China	Port of Guangahou	Container	Groot	Onshore Power Supply
China	Port of Guangahou	Container	Groot	Guangzhou Container Terminal - Electric Prime Movers
Australië	Glastone Ports Corporation	Droge bulk	Groot	Tidal Energy Demonstration
Duurzame/veerkrachtige infrastructuur				
Canada	Port of Vancouver	Multipurpose	Groot	International Collaboration on vessel emissions reduction
Singapore	MPA Singapore	Container	Groot	Singapore's Next generation Tuas Port Project
China	China Merchants Port Group (Shenzhen)	Containers	Groot	Innovation Prospers Sustainability
Australië	Port of Brisbane	Multipurpose + cruise	Middel-groot	Brisbane International Cruise terminal

Source: own composition

Third, Interviews were also conducted with five experts[1] for answering all four research questions, and also for verifying the author's findings on the selected best practice cases. Academics with the research field of sustainability and green investments in ports, as well as CEOs of port authorities and port-related organizations were involved.

3. Results

Now, we come to the results of applying the above steps. The four research questions mentioned above (section 1) are here consecutively dealt with.

3.1 Success factors

For the first research question, we look into which trend or pattern can be observed within green investments in large seaports. First, we look at which investments are successful, and which are not. It is immediately noticeable that the majority of the respondents cite that there is no 'one size fits all'. Having a strong business case is very important. Furthermore, the success or failure of an investment also depends on the necessary partnerships. Furthermore, little is known about investments that fail. Entering the market is a major problem and therefore certain investments or projects fail. Many private companies are willing to invest in green technologies but only when the technology is ready.

Subsequently, it is examined whether there is a noticeable difference in green investments or projects in seaports with different backgrounds. Firstly, it can be concluded that there are not necessarily more investments in a container port, as many people think. The same goes for the cruise sector. It is pointed out that types of investments can differ per type of port because of the social pressure these ports feel.

Another pattern that stands out is that green investments and initiatives not only come from the government but also from the private sector. In the United States, for example, environmental and green technology standards are imposed by the government. Private actors use the Southern California model. This model is a self-regulatory model, which means that ports can decide for themselves to what extent they implement green technologies. We also find this pattern in Australia. On the one hand, the government imposes strict environmental standards. On the other hand, the ports are in very close contact with the surrounding society, and they work together with society to come up with new green initiatives.

1 Antonis Mihail (technical director of World Ports Sustainability Program (WPSP)); Cassia Galvao. assistant professor at Texas A&M University in Galveston; Zengqi Xiao, professor at Nanyang Technological University Singapore; Mike Gallacher, CEO of Ports Australia; Tom O'Brien, Executive Director of the Center for International Trade and Transportation (CITT) at California State University, Long Beach (CSULB).

Furthermore, there are a few other patterns or trends that can be observed. Not only large ports come up with great initiatives and investments, small ports also do an excellent job. It should also be noted that there is also a geographical pattern. Green innovations have started in Europe, but more and more green initiatives are now popping up worldwide. A final pattern that stands out is the awareness of ports and all its actors that not everything revolves around profit, but that the environmental and social aspect is becoming increasingly important.

3.2 Government support

The second research question is about finding out whether green investments are profitable with or without government support. All respondents agree that government support is a very important factor in green investments and projects in a seaport. Nevertheless, the various respondents have differing views on how government support can be used in seaports. Cited is a case of government aid in Sweden, where all profits from ports go to the state. In return, ports can call on the state if they need money for green investments or projects. It is also pointed out that the reverse is also possible: ports may keep all profits, but should not count on government support. Overall, government support is very important for ports, but a good risk assessment must first be carried out. This assessment should determine the economic viability of a project and whether or not it is a good idea to invest in the project. Next to supporting, the government can of course also sanction in case a port does not comply with certain objectives.

In addition to government support, external (private) investors are also called upon to make investments economically profitable. Public Private Partnership (PPP) is becoming increasingly important. In Australia, the government often does not intervene and projects are only supported by private investors. This is at odds with the vision in Europe, where the government often finances infrastructure projects. It is indicated that energy companies are often large private partners of ports. They also invest the necessary capital in so-called pilot projects that test the new fuel infrastructures.

3.3 Future

The third research question is about finding out what the future holds for green investments in seaports. Firstly, it can be concluded that in the future all ports will become so-called ‘green ports’. Both the ports and the community around the ports want as little pollution as possible. In North America, the focus was first on the large seaports, but gradually the smaller ports will also become ‘green ports’. Ports in Asia and Australia will also strive for the status of ‘green ports’.

Subsequently, it was investigated whether the focus will be on one type of investment in the future. Every port is different and therefore requires a different approach or investment. However, the experts make several points. For instance, there should be a holistic approach. In Singapore, for example, the focus is on the whole and there are widespread investments/ projects such as biofuel, renewable energy, electricity and the improvement of operational efficiency across Singapore.

Finally, decarbonisation will be the investment of the future. Four of the five interviewed experts point out that ports should focus on bunkering carbon-free fuels. Hydrogen and ammonia are seen as the alternative fuels of the future. Nuclear fusion itself will be discussed in the very distant future.

3.4 Best practices

For the final research question, we look into the best practices as identified in Table 1, so covering North America, Asia and Oceania.

3.4.1 Port of Long Beach (US): C-Port Zero Emissions Demonstration Project

C-Port Zero Emissions Demonstration Project is a collaboration between the Port of Long Beach, SSA Marine and Long Beach Container Terminal to reduce emissions. The project was started in 2018. In concrete terms, it concerns a demonstration project where five cargo handling vehicles that produce no emissions are demonstrated. What makes this demonstration so unique is that it features three never-before-tested battery-electric top handlers and a direct comparison between a hydrogen fuel cell off-road vehicle and a battery-electric all-terrain vehicle. This demonstration is in line with the Clean Air Action Program, which aims to reduce all emissions by 2050.

All zero emission units have been deployed from February 2020 (Port of Long Beach 2022). Also, all charging stations are UL certified and commissioned. Furthermore, by the end of 2020, the base emissions test had been completed.

The C-PORT demonstration project will ensure that emissions in the port will be reduced annually by 347 tons of CO2, 0.69 tons of NOX, 0.159 tons of ROG (Reactive Organic Gas) and 0.0212 tons of PM10 diesel (Port of Long Beach 2020). The California Air Resources Board has awarded a $5.3 million grant for this project. In addition, 2.5 million dollars will be raised from matching funds. This results in a total investment of 7.8 million dollars.

Confronting this case with the trends mentioned above, the following can be concluded. With regard to trends or patterns, it is observed that the scale of the investment and the type of cargo handled is reflected in this investment. Scale means that large ports often take precedence over smaller ports. The Port of Long Beach is one of the largest ports in the US. This investment is also aimed at handling equipment for containers, which ensures that this investment is focused on one type of cargo. Moreover, government support is also very important in this project. No less than 68% of the investment is financed with public money.

3.4.2 Port of Vancouver (Canada): International Collaboration on Vessel Emissions Reduction

Like many other ports worldwide, the Port of Vancouver provides financial incentives to ships using green technologies. Notably, however, ports often operate in isolation in terms of

incentives and infrastructure, making it challenging for customers to make maximum use of these important opportunities to reduce environmental and other impacts, as well as costs. The implementation of incentive programs is also often inefficient for the ports. Vancouver Fraser Port Authority (VFPA) believes that by working together, these capabilities can bring about greater changes than if left to operate in isolation. VFPA leads an international partnership to reduce shipping emissions through incentive programs for ships and environmental infrastructure. This cooperation has three objectives: (1) to maximize the number of calls of cleaner and more sustainable ships, (2) to increase the number of these ships in the world fleet and (3) to improve the experience of users who are involved in a system of incentives and environmental protection.

With regard to trends and patterns, it can be concluded that indeed not only investments/initiatives occur in container ports per se. The Port of Vancouver is a multipurpose port. The priority of the port itself is also a trend that is returning here. The Port of Vancouver itself is coming up with the initiative to give green ships an incentive and is therefore making it their priority. With regard to government aid, little is known about this case. Since VFPA is a public/government service, it can be argued that the government intervenes in this case and (co-) finances the incentive programs (Transport Canada, 2022).

3.4.3 Port of Seattle, Port of Tacoma, Northwest Seaport Alliance, and Vancouver Fraser Port Authority (VS and Canada): 2020 Northwest Ports Clean Air Strategy

The Northwest Ports Clean Air Strategy (NWPCAS) is an innovative collaboration between the above four ports to reduce and ultimately eliminate air and climate emissions from their seaport operations in the Georgia Strait-Puget Sound airspace. In 2020, the involved ports decided to renew the strategy. Their new mission statement is as follows: "phase out emissions from seaport-related activities by 2050, support cleaner air for our local communities and fulfil our shared responsibility to help limit global temperature rise to 1.5°C" (Northwest Ports Clean Air Strategy 2020). Concretely, these ports want to eliminate port-related diesel emissions that contribute to public health risks and environmental health inequalities in the vicinity of the port communities, and they want to modernize infrastructure and develop new technologies with a view to the transition to a zero-emission maritime industry.

In addition to the above matters, a distinction can be made between different actors in a port and what their role is in realizing this project (Northwest Ports Clean Air Strategy, 2022). First, there are the ocean-going vessels. For these seagoing vessels, the efficiency must be continuously increased, and the emissions of existing ships must be reduced. By 2030, every major cruise and container terminal should have shore power installations. Cargo handling equipment (CHE) also plays its part. By 2020, 80% of the CHE must meet Tier 4i emission standards. By 2050, all CHE, trucks, port vessels and the rail sector must be emission-free. Regarding rail, there should also be a 20% increase by 2020, compared to the base year 2013, of train engines that have been modernized. Finally, the port administration also plays its role. By 2030, 100% of light passenger vehicles must be emission-free or use renewable fuels.

By 2050, GHG emissions from buildings and lighting must be zero and the Port Authority's entire fleet, including all vehicles, equipment and vessels, must be zero-emissions.

With regard to trends or patterns, it can again be concluded that there are not necessarily only green investments/initiatives in container ports. The four ports mentioned above give a nice mix of port backgrounds. The 'no one size fits all' principle also applies here. The various players in the port have to contribute to the emission targets in a different way. In this case, too, little is known about the financing of the project. Since ports in the US and Canada are often landlord ports, it can be assumed that the government will play a role in financing these projects.

3.4.4 Port of Guangzhou (China)

Onshore Power Supply

In April 2017, the container terminal in the Nansha Port district of Guangzhou Port introduced the Onshore Power Supply System (Guangzhou Port Group 2022). By using the shore power system, ships can switch off their auxiliary engines, which can greatly reduce the emission of carbon dioxide and the emission of air pollutants (NOx, SOX, PM). Other benefits include noise reduction and better working conditions on board. Two sets of frequency conversion power supply systems of 1500kVA are used to downgrade 10kV power supply to 480V. A high voltage approach is used. Compared with the traditional low voltage approach, it has the advantages of stable power supply system, simple cable connection operation and low power loss. This shore power supply can be found at two terminals and can be used by ships simultaneously.

By 2020, 50% of the terminals in the port of Guangzhou were equipped with shore power. With a reduction of 1,500 tons of CO2 and 600 tons of fuel per year, the port is already well on its way to become emission-free.

Guangzhou Container Terminal – Electric Prime Movers

Prime Movers are essential equipment in a container terminal. However, carbon emissions caused by diesel prime movers (dPM) are high. In the container terminal of Guangzhou (GCT), dPMs account for 19% of the total CO2 emissions caused by equipment. In 2020, a total of 10 818 tons of CO2 was produced by these dPMs. GCT has started a project to replace all 40 existing dPMs with electric ones in the next 5 years. In December 2020, the first series of 10 electric prime movers (ePM) was operational.

Evaluation

A recurring trend also in the Guangzhou cases is the fact that investments depend on the type of cargo. The port of Guangzhou is a container port, which means that shore power and certainly the investment in electric prime movers is focused on the handling of containers. In these cases, too, little is said about government support. The owner of the port of Guangzhou is the state-owned Guangzhou Port Group Co. Ltd. It can therefore be assumed that the Chinese government will provide the port of Guangzhou with the necessary support in financing the project.

3.4.5 Port of Shenzhen (China): Innovation Prospers Sustainability

On the basis of two sustainable infrastructure projects, namely the Mawan Smart Port and the Co-ordinated Port project, the port of Shenzhen wants to accelerate the development of the 'Trade – Finance Eco System'. Mawan Smart Port project applies 5G communication, Internet of Things, big data, artificial intelligence and other new generation information technology in port services and operations. Concrete examples are the emergence of smart cities around the port, automation and remote control, unmanned vehicles based on 5G and unmanned inspection in the air and on the ground with drones based on 5G.

The Co-ordinated Port project builds on the Mawan Smart Port project and focuses on the digital optimization of infrastructure and uses innovative and cost-efficient applications to solve important infrastructural and service challenges such as the handling of increasingly larger ships, process and document flows and address digital innovation and adaptation in response to the Covid-19 crisis in ports. Furthermore, this project also has socio-economic benefits such as promoting the rapid economic integration and development of the Greater Bay Area (GBA), promoting the port economic zone and manufacturing industry, and helping all participants in cross-border trade work more efficiently and reduce costs.

Both projects together provide (1) 30% improvement in overall efficiency, (2) 30% more efficiency in customs formalities, (3) 50% less construction costs through terminal automation, (4) 50% reduction in security risks, (5) a 90% reduction in carbon emissions, (6) an 80% reduction in yard personnel and (7) social and economic benefits of over 10 billion Yuan.

In this case, one clear trend can be observed, namely automation. Everything in this case is aimed at automating actions and processes in the port. As with previous cases, little can be found about the financing of this project. The port of Shenzhen is owned by the state-owned China Merchants Port Group. Since the port is in the hands of the government, it can again be assumed here that the government will make the necessary financial resources available. This case also has decarbonisation in mind. Note that instead of decarbonisation, automation is the main goal of this investment.

3.4.6 MPA Singapore (Singapore): Singapore's Next generation Tuas Port Project

Tuas Port is a new port under development in Singapore. When fully developed by 2040, this port will be the largest container port in the world, capable of handling up to 65 million TEU annually (MPA Singapore 2022). From planning to implementation, this port will be a sustainable and resilient port. The port provides a single consolidated location for Singapore's container operations, significantly reducing inter-terminal transportation operations and greenhouse gas emissions. Furthermore, the construction of this new port applies the reuse of materials, which saves more than 2 billion USD. To protect marine habitats and sensitive commercial water intakes, environmental impact assessments were conducted to establish strict environmental quality objectives to be met during land reclamation operations. A $6 million program was also implemented to relocate degraded corals. In addition, $100 million has been invested in

supporting green initiatives in the Port of Singapore over the past 5 years. In addition to the physical port, Tuas Port will also be a digital and automated port. Finally, work will mainly be done with automated and electrified port equipment, which will improve the environment and productivity.

As far as trends or patterns are concerned, there is not really one pattern to be found. Rather, it is an overarching whole. This new port focuses on all aspects ranging from sustainable/resilient infrastructure adapted to the type of cargo it handles, priorities that are also placed on the local fauna and flora, to automation of the entire port. Again, little can be found about the financiers of this project. What is known is that MPA is the developer of the project, with a top-down approach. This means that the investments are driven by the government. There are also partnerships between ports, external investors and the government itself. Taking all this into account, it can be deduced that this port is most likely financed on the basis of PPP. Finally, the Tuas Port Project can be seen as the port of the future. For example, the port is not only focusing on sustainability and decarbonisation, but is also fully committed to automation.

3.4.7 Gladstone Ports Corporation (Australia): Tidal Energy Demonstration

Tidal Energy Demonstration is a climate and energy project of Gladstone Ports Corporation. With the installation of a tidal turbine at Barney Point Terminal in Gladstone, it aims to generate renewable energy. During the demonstration, it will be investigated how predictable tidal flows in the port of Gladstone can be used. Furthermore, electricity production and possible interactions with marine fauna are monitored and maintenance and growth requirements are evaluated. What is very important in this project is the aim to minimize the environmental impact through a proactive marine fauna management plan. This plan included the design and remote operational control of the turbine using multiple cameras and impact detection sensors.

With regard to trends/patterns, it can be concluded that mainly the social pressure of the local society is reflected here. The ports in Australia experience continuous pressure from the local community. Virtually no information is provided about financing for this project either. Since the Port of Brisbane is in the hands of the government, one would think that there is some form of government intervention after all. However, this is often not the case in Australian ports. Infrastructure investments, such as the installation of a tidal turbine, are almost always financed with private capital. As far as the future is concerned, it can be concluded that this project is also aimed at decarbonisation.

3.4.8 Port of Brisbane (Australia): Brisbane International Cruise terminal (BICT)

The Port of Brisbane has built a new sustainable cruise terminal to also receive the largest cruise ships (World Ports Sustainability Program, 2022b). What makes this new terminal so sustainable is that all kinds of sustainable factors have been taken into account in the design. The orientation, natural lighting and shading maximizes natural light and improves the user experience, while reducing artificial energy sources and pollution. It also uses future energy, such as photovoltaic panels and battery storage, and integrates solar energy into the basic design. This solar energy produces 1,300MWh of electricity annually and reduces the energy

requirement of the building. In addition, 300,000 m^3 of dredging material was used for the construction and no use is made of so-called capital dredging. Finally, investments are being made in charging stations for electric vehicles.

Furthermore, this investment also has a positive impact on society around the port (Port of Brisbane, 2020). For example, there is close cooperation between the cruise lines, national and local governments and other important stakeholders. Local residents are also involved in the project. They will be kept informed of the progress, information meetings have been organized for them and there is cooperation between the port and the local residents' association.

In this case, one clear pattern immediately stands out, namely social pressure. The Port of Brisbane is making this investment to increase its competitiveness on the one hand, but on the other it takes great account of the social pressures of the local community. A good dialogue and partnership with the local community was established throughout the project. Moreover, this investment was fully financed with private capital. There was no government intervention. Only the local government, together with the port of Brisbane, invested a "small" additional contribution for better roads to the terminal. With regard to the future, it can be concluded that this investment will contribute to the realization of the 'green port' status and decarbonisation.

4. Conclusion

This chapter provided an understanding of green investments/initiatives in non-European seaports. Several trends or patterns of green investment were identified. A first major trend that can be observed is that there is no 'one size fits all'. This means that each type of investment must be adapted to the specific reality of the port. Moreover, it is often thought that there are more investments/initiatives in container and cruise ports. However, this is not true. These ports are more often in the media, which makes it seem that way. In addition, it can be established that the type of green investments/initiatives mainly depends on the type of cargo handled by the port. Other factors such as geographical location, port priorities, social pressures and the scale of the investment also play a role. Note, however, that green investments do not only come from the government, the private sector also attaches increasing importance to sustainability. Furthermore, something can be said about the size and capacity of a port. Not only large ports come up with great initiatives and investments, small ones too.

With regard to government support, it can be concluded that this is an important factor in green investments and projects in seaports. Government support often comes in the form of subsidies for infrastructure. Note that the government can also act in the form of a sanction. However, what is necessary for government money well spent is the investment in good risk assessments to determine the economic profitability of an investment or project. In addition to government support, external (private) investors are also called upon to make investments economically profitable. Public private partnership (PPP) is now used in almost every port.

With regard to green investments and projects for the future, it can be concluded that almost all ports will/want to obtain the status of 'green port'. The trend starts in Europe but will gradually move to the rest of the world.

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Salutation to Prof. Harry Geerlings

I have gotten to know Harry early in my academic career, first through reading his publications, later on by listening to some of his presentations at events where we both were, and then still later by working with him in projects, theses and publications. From the first moment on, Harry has always been that very knowledgeable but also always very amicable person. He showed great insight into how the port and shipping sector was working, and could eloquently transfer his message, both in written and in spoken. Harry was a good friend of my former supervisor and colleague Eddy Van de Voorde, who meanwhile also has retired. It's always a pity if such 'eminence grises' have to disappear from the formal academic stage, purely due to retirement age, but at the same time of course, luckily, they are not disappearing from the planet, so we can keep in touch with them. Harry, I hope we may meet up often still, be it at conferences or other events. I wish you all the best in your post-university life, and hope you may enjoy any activity you plan to roll out! Have a good sailing!

Thierry Vanelslander

Weathering the COVID-19 pandemic towards the 'new normal': potential longer-term impacts on port and shipping governance, performance, and infrastructure geopolitics

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1. Introduction

The year 2020 will go down in history as the year of COVID-19. With the World Health Organization's declaration of an *International Pandemic* on 11th March 2020, its social and economic consequences have spread globally as quickly as the virus itself and, in no small measure, the decease has ushered in a *new normal* which has yet to be fathomed. Concepts such as *teleworking for business* and the *e-campus* for education, particularly in the way these are facilitated by the simplicity of platforms such as Zoom, Teams, etc., are probably here to stay – at least to some extent and in some form. The effects of this on business travel, education and e-commerce are likely to be profound (Suau-Sanchez et al., 2020: Conway et al., 2020; Pokhrel & Chhetri, 2021; Mohdhar & Shaalan, 2021).

Of course, with the outbreak of the pandemic, both global production and international trade initially declined. Naturally, this had to do with the lockdown in China and the closure of many of its production facilities in January 2020. The corresponding lockdowns in Europe and North America that followed in March 2020, substantially reduced the demand for Chinese imports. The Chinese lockdown, moreover, led to serious disruptions in global supply chains, demonstrating, if any more lessons were needed, the pivotal role of China as the engine of global industrial production. The short-term economic effects of COVID-19 have been most immediately and acutely felt in the contraction of global demand, mainly for merchandize goods, and the curtailing of passenger travel, holidays, and entertainment events. It should be noted, however, that the contraction in overall demand experienced over the course of the whole of 2020 has not been as dramatic as many analysts have predicted and, to the benefit

of the shipping industry, the same was also true for international trade. This reason was because the contraction of demand experienced in some sectors has been compensated for by an increase in demand in others, such as: electronic equipment (e.g., computers and peripherals, video game consoles etc.); mobile phones; exercise equipment; home-improvement and gardening materials and last but by no means least, medical equipment, such as surgical masks, gowns and disinfectants, most of which were manufactured in China. In addition, it should not be forgotten that during the various lockdowns of the first half of the year (H1 2020), inventories were run down, as evidenced by the substantial restocking that took place in the second half of 2020 (H2 2020). This restocking wave, combined with an increased demand for consumer products initiated a global supply chain crisis which lasted through 2021 and the first half of 2022. The peak in demand was partly fed by extensive COVID-related financial support packages implemented by governments in North America and Europe, and the further easing of monetary policies. The resulting excess demand pushed the global logistics system to its limits and became one of the root causes of high inflation.

The primary objective of this chapter is to identify the effects and implications of a major disruptor (the COVID-19 pandemic) on the activities, operations, management structure and performance of the international ports industry. The analysis is undertaken by positioning the immediate impact and potential longer-term implications of this significant disruptor within the wider context of contemporary research in the field of port economics. What follows, therefore, is a critical assessment of some of the key issues and themes in port economics research, attempting at the same time to propose new thought avenues for further port research in a post COVID-19 era. We summarize the main developments by identifying trends and exploring research challenges, gaps and points of (re)orientation. Instead of providing answers, therefore, we provide inputs to ongoing discussions by sketching emerging and eminent issues in the hope that this will provide some guidance for further port studies in the field.

To this end, the rest of this work is organized as follows: In section 2, the short-term impact of the COVID-19 pandemic on the shipping industry is summarized, with a specific focus on liner (container) shipping. This provides the short-term demand-side context for the immediate and potentially longer-term response of the (container) ports sector, as the supplier of cargo handling services to the shipping industry. Section 3 outlines the confounding effects associated with the more stringent environmental regulations that have been placed on the shipping industry immediately prior to, and immediately following, the peak of the COVID-19 pandemic. The immediate short-term effect of the pandemic on (container) ports and the shipping industry's response to it are outlined in section 4. The focus of the work is contained in section 5, where the longer-term implications for the governance of ports is discussed in relation to the industry's geopolitical and commercial context, potential business models for the sector, the standard port governance typologies, the potential emergence of new approaches to, and models of, port governance and the role played by the various 'models' and measures of port performance. Conclusions are drawn in section 6.

2. The short-term impact of COVID-19 on shipping

The COVID-19 crisis has exerted a profound impact on the shipping industry. The two shipping sectors hit the hardest were those most directly concerned with personal mobility and cross-border movements – i.e. ferry services and the cruise industry (Jenelius & Cebecauer, 2020; Urbanyi-Popiolek, 2020; Renaud, 2020). Ferry services and short-sea-shipping (SSS) are of great importance in two respects: a) they provide connectivity to remote territories (e.g., small, inhabited islands) – in other words, they entail *public service obligations* (PSO) and are, therefore, frequently subsidized by the State concerned; and b) they take pressure off a congested road transport system, thus reducing negative environmental externalities (see Raza et al., 2020 for a literature review of this issue). Within the EU more specifically, SSS serves one of the Union's top policy priorities; the *Motorways of the Sea* and their role not only in diverting both passenger and freight traffic from road transport, but also in connecting the transport system of the EU (Trans-European Transport Networks – TEN-T) to that of third countries, notably in Northern Africa and the Middle East (Morales-Fusco et al., 2012; Aperte & Baird, 2013; López-Navarro, 2020).

It thus becomes obvious that the effects of COVID-19 on these two sectors (ferries and SSS) were far-reaching and to an extent are probably irreversible, in view of the high transaction costs associated with modal shift decisions in the case of SSS, and the EU's limited success in relieving the pressure on its road network (Sambracos & Maniati, 2020). Dry bulk and tanker shipping have also faced reduced demand and consequent hardship during the pandemic. However, given China's significant demand for commodities (e.g., iron ore and coal), dry bulk shipping was expected to do quite well in 2021 and into the immediate future (Danish Ship Finance, 2021). In 2020 and 2021, tanker shipping was plagued by chronic overcapacity in an era of disinterest in fossil fuels (SSY, 2021; BRS, 2021). Following two slow years of COVID-19, Russia's invasion of Ukraine, and the market upheaval that has followed, there have been steep increases in freight rates and an increase in average tonne-miles in the first half of 2022.

Realizing handsome profits overall, the one sector which did unexpectedly well in 2020 was liner (container) shipping. The market leader, Maersk Line, reported record profits for Q3 of 2020 and again in Q4. The company reported another record pre-tax profit for Q1 of 2021 that was only just below the value achieved for the whole of 2020 (Baker, 2021). The average operating margin in container shipping increased from 2.6% in Q1 2022 to 55.6% in Q3 2021 and remained at this high level in the first half of 2022 (Alphaliner, 2022). Anecdotal evidence suggests that, at the peak of the market, north American and European shippers may have been paying rates five to ten times more than what they would normally pay, and many of them may have had to wait for weeks, if not months, to secure a slot on a ship, or find a container to bring their orders from Asia (Attinasi et al., 2021). The high profitability in container shipping has accelerated vertical integration strategies of some major container carriers. Maersk Line, CMA CGM or MSC have embarked on a take-over spree in the air freight business, e-commerce and last-mile logistics, digital platforms and forwarding activities (Paridaens and Notteboom, 2022). Examples include the take-over by Maersk of Senator International (air

freight forwarding) and e-commerce firms HUUB (fashion industry), B2C Europe Holding, Visible SCM (US) and Pilot Freight Services; or the take-over by CMA-CGM of Ingram Micro's Commerce & Lifecycle Services (CLS) and the Colis Privé Group in late 2021 to boost its e-commerce expertise. However, not all carriers are walking the path of logistics integration.

Judging from their shipbuilding program, it would appear that the general positive perspective on 2021 and 2022 is a vision shared by container carriers. Compared to just 40 ships ordered in the period January to September 2020 (Chambers, 2021a), as of September 2022, the orderbook for containerships is approaching 900 vessels, representing 72.5 million dwt or a capacity of 7 million TEU (Maritime Executive, 2022). This represents a remarkable level of *gross capital formation*, and a *leading indicator*, from an industry which is rather good at adjusting its supply to demand[1]. In parallel to this trend, container manufacturers in China are struggling to cope with a very high demand for container production, due to a notable worldwide shortage which is driving up freight rates and the cost of transport (Youd, 2021).

Liner shipping had been quick to adjust supply to demand in H2 2020. Contrasting starkly with the current trend towards building new containerships, this was achieved with the 'withdrawal' of shipping capacity (20-30%) from the main trade lanes, something that has come to be known as *blank sailings*. By October 2020, blank sailings overall during the year had reached the impressive number of 515. Port calls were thus cancelled; frequency, connectivity, and quality of service declined; call sizes increased; and the volume of laid-up tonnage rose as well, reaching record levels in H1 2020: by May 2020, laid-up tonnage amounted to 11.6% of the deployed cellular container fleet. To further reduce supply, additional measures were adopted by carriers, such as slower speeds and longer routes, e.g., around the Cape of Good Hope rather than via the Suez Canal. In May 2020, containership transits of the Suez Canal had fallen by 32% year-on-year, to settle at an all-time low of 330 passages (BIMCO, 2020).

These actions, but particularly blank sailings, allowed carriers to sustain freight rates during the first half of 2020, even when demand was down. Starting in the late Summer of 2020, the surge in demand quickly reduced idle capacity to only 2% of the global container fleet tonnage, but this did not prevent a rapid rise in freight rates, and an emerging global supply chain crisis.

Thus, burgeoning demand for liner shipping services soon translated into surging freight rates and carrier profits which have continued to rise at a rapid pace, hitting record levels, as reflected in movements in the value of the Drewry Composite World Container Index (WCI). In the second week of December 2020, for example, a weekly change in the WCI of 23% ($793) was registered, representing $4,244 for a 40ft container. This was 166,6% higher than that of the same period in 2019. On December 31, the WCI reached $4,359, escalating to $5,221 in the first week of 2021 (an increase of 185% year-on-year). In the same week, the annual changes in the individual freight rates used to calculate the composite WCI for 40ft containers rose by 212% on Shanghai-Genoa ($8,380); 282% on Shanghai-Rotterdam ($8,882); 148% on Shanghai-New

1 For research on the formation of carrier expectations and the way they adjust their supply of tonnage, see Fusillo and Haralambides (2020).

York ($6,385); and 134% on Shanghai-Los Angeles ($4,194). Meanwhile, the transatlantic route New York-Rotterdam saw a rate increase of 31% ($690), while Rotterdam-New York decreased by 14% ($2,185). Price inflation continued apace in 2021, with the WCI reaching a peak of $10,377 per FEU in September 2021. The WCI has been declining continuously since that peak, and a year later, in September 2022, was around half of the peak value at $ 5,379 (Drewry, 2022). In view of all the above, shippers and international transport associations started to publicly express their discontent over carrier behaviour during the COVID-19 crisis. Complaints were naturally addressed to the competition authorities responsible for the regulation of international shipping in the world's largest trade lanes, i.e. in the EU, USA (FMC), China, and Australia. The concerns expressed related to capacity management strategies; reduced levels of service; capacity withdrawals (blank sailings), lower schedule reliability; rolled containers; additional surcharges; equipment shortages, etc.

Of course, there would be nothing wrong with the 'capacity management' strategies of carriers[2], were it not for the 'coordinated' manner in which they are implemented, amongst the members of consortia and global shipping alliances (GSAs) that, to a large extent, are exempted from antitrust regulation (Tang & Sun, 2018). Concentration, as well as *vertical integration* along the supply chain have been remarkable in liner shipping[3]. In 1998, 5 alliances and 3 large independent shipping companies (MSC, CMA-CGM and Evergreen) co-existed. Ten years later, in 2008, the EU removed the exemption from competition law (effectively, antitrust immunity) granted to liner shipping conferences. As a direct result of this and amidst the negative impacts of the financial crisis, MSC and CMA-CGM ceased to remain independent, forming a new Alliance in 2009. A few years later, in 2015, Maersk and Evergreen joined their respective alliances (2M and Ocean Alliance). In this way, the process of horizontal integration through alliances evolved to a situation whereby the top 10 shipping companies, grouped in 3 alliances, controlled 91.5% of the global container fleet capacity in early 2021. In 2009, the top 10 shipping companies controlled only 70.8% of the total fleet capacity (based on Alphaliner data). Interestingly, no large independent carrier exists at present. As such, there is a clear *rationale* for questioning both the competitiveness and contestability of the market (Hirata, 2017).

Although regulatory bodies, like the FMC in the U.S., under pressure from shippers, have started to look at the causes of liner shipping profitability in the midst of a pandemic, it is unlikely that anything of substance will emerge from these inquiries. In his 2022 State of the Union address, U.S. President Joe Biden singled-out shipping lines as anti-competitive. Still, this political rhetoric has not been followed by Federal Maritime Commission (FMC). The FMC's fact finding investigation into the effects of COVID-19 on the ocean shipping supply chain (formally known as Fact Finding 29) released in May 2022 found that the high freight rates are not caused by a lack of competition, but due to a combination of unusually strong demand from U.S. consumers, COVID-19, and congestion in the supply chain. There may be some good reasons for the

2 See Cariou & Guillotreau (2021) for a detailed game-theoretic analysis of capacity management strategies in the liner shipping industry.

3 Vertical integration, also known as logistics integration, aims at service differentiation through door-to-door transport and control of the supply chain. For a full coverage of the issue, interested readers can consult Haralambides (2019) and Paridaens and Notteboom (2022).

leniency of the regulators in that shippers' criticisms of global shipping alliances (GSA) have failed to recognize the crucial point that unfettered competition in *declining cost industries* (or industries of 'increasing returns to scale') pushes prices down to marginal costs – which are always below average costs – and competition under such circumstances will then become destructive. This is the main motivation behind the (conditional) exemption of GSAs from antitrust laws, and it is exactly this same reasoning that has allowed the continued operation of price-fixing liner conferences in countries where they can still operate legitimately (mainly in Asia). The only difference between the two systems, alliances and conferences, is that the former primarily seek to achieve profitability through cost control, while the latter do so through price-fixing. Finally, although blank sailings have helped carriers sustain rates, these are not without costs, given that laid-up ships (or their beneficial owners) still have to pay the bank, or the K/G investors who have to absorb the losses.

3. The confounding effects of environmental regulation

The increasing influence of the environmental agenda on maritime business has already been alluded to. During the first few weeks of 2020, when COVID-19 had not yet been recognized as the problem it was to become, the focus of interest in the shipping industry was on the potential effect of the IMO 2020 global sulfur cap regulation, particularly with respect to its impact on the operational costs of ships and, thus, on the competitiveness of the shipping industry (Zis and Cullinane, 2020). Considerable uncertainty existed then, and persists still, as to the efficacy of scrubbers (Endres et al., 2018; Comer et al., 2020; Winnes et al., 2020) and the availability of *very low sulfur fuel oil* (VLSFO), the price of which reached a record level of USD 598/mt in January 2020, as market players stockpiled compliant fuel in anticipation of availability issues and even higher prices. In actuality, VLSFO prices slumped throughout 2020 (partially as the result of the previous stockpiling) and only began to recover to their previous levels by mid-June of 2021. Since then, however, prices have risen to a new high of 1018 USD/MT on June 8th 2022 and, until the time of writing, have since been in decline (Ship & Bunker, 2022).

In terms of reducing CO2 and other greenhouse gas (GHG) emissions from shipping, the IMO has been fiercely criticized for a lack of vision and expedient progress (Shi, 2016), particularly in relation to the imposition of market-based measures (Psaraftis et al., 2021). This has prompted the European Commission, within the context of its *Green Deal* strategy, to include shipping in the European Union's Emissions Trading system (EU ETS), irrespective of any future progress made by the IMO. This decision has caused considerable unrest in shipping industry circles, particularly amongst shipowners, and is perceived as a regional measure that undermines the merits of a multilateral approach to regulation, as advanced by the IMO.

With respect to the IMO's *short-term measures* for the abatement of CO_2 emissions, at the meeting of its Marine Environment Protection Committee in June 2021 (MEPC 76), the IMO

adopted amendments to its MARPOL Annex VI regulations to introduce two new instruments which are planned to come into force in January 2023: the Energy Efficiency Design Index for existing ships (EEXI) and the Carbon Intensity Indicator (CII). The latter effectively measures the energy efficiency of ships in relation to the transport work they undertake in moving freight and/or passengers, and this is then used to operationalize the EEXI, which is a technical instrument that is directly comparable to the widely understood workings of the EEDI, but which is more generally applicable to existing ships, rather than just new ships. In the short-term, it now seems that speed reductions might be the only feasible route to compliance with the new measures. Still, these new instruments have not evolved without considerable discussion and controversy, mostly raised by countries exporting perishable or time-sensitive products. The logic of their argument is that longer transit times (due to slow-steaming) would impact negatively on the value of their exports (e.g., fruit or dairy products), and that the deterioration in product quality might in turn lead to modal shifts favoring air transport. Given the very high speeds of the benchmark year 2008 (24 knots), however, the speed reductions necessary to achieve the goals of all the short-term measures would be minimal and, as such, unlikely to lead to either product deterioration or modal shifts (Zis & Psaraftis, 2021).

4. The short-term impact on ports

The combined effects of the COVID-19 pandemic and the concomitant application of more stringent environmental regulations saw an immediate response from the shipping industry which meant that many major ports with a strong gateway function saw their container throughput plunge in H1 2020. Sea-Intelligence (2020) reported that, for some ports, *blank sailings* implied reductions of anything from 20%, up to even 50%: fewer containership calls in the second quarter of 2020 were mainly visible in the main trade routes, e.g., Far East-Europe. Container volumes had been impacted as well, although large differences could be observed among the larger container ports, as illustrated by their year-on-year change in the first half of 2020 (based on TEU): minus 6.8% for Shanghai; -1.1% in Singapore; -17.1% in LA; -6.9% in Long Beach; -7% in Rotterdam; +0.4% in Antwerp; -9.1% in Valencia; -20.5% for Barcelona; and -29% for Le Havre[4]. Only four major ports saw their volumes increase: Gioia Tauro (+52,5%), Tanger Med (+22%), Port Said- SCCT (+23,5%) and Antwerp (+0,4%)[5]. However, the spectacular revival of demand in H2 2020 translated immediately to increased demand for port services, with many ports reporting record throughput volumes in September, October and November 2020. To a certain extent, the rise in demand related to large-scale restocking, taking place first in North America in Q3 2020, and later in Europe in Q4 2020. As an example of this, the port of Los Angeles registered a historic surge in throughput of nearly 50% in H2 2020, and in the week before Christmas the port handled 94% more throughput than in the same week the year before (Port of Los Angeles, 2021); this was followed by another record period in Q1 2021, where throughput was 122% higher than the previous year (Watkins, 2021).

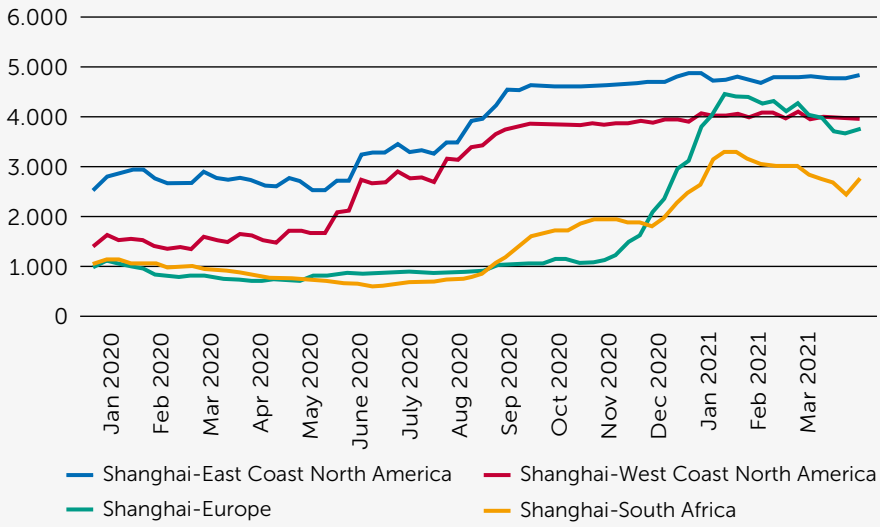
4 Information obtained from the respective port authority websites.
5 *Source:* Based on data collected by the Port Authority of Valencia.

Port and transport networks were caught unprepared for such a fast transition in demand and, as a result, supply chains suffered from shortages in equipment (chassis), truck drivers and dock labour; the latter due to quarantines and constraints on personal mobility due to COVID-19. Congestion and long turnaround times had been the result, with the build-up continuing into 2021. Although at the time of writing, the situation had improved to some extent, as of February 1st 2021 there were a record 40 containerships in anchorage in the San Pedro Bay area awaiting berths at the container terminals of Los Angeles and Long Beach (Miller, 2021). Congestion at these two Californian ports had been so severe that, in order to avoid becoming embroiled in it, ships were known to offload, *impromptu*, containers at Oakland, 600 kilometres to the north (Chambers, 2021b). However, as ships are stowed with a certain ship-rotation in mind, such decisions are a stowage planner's worst nightmare, and they tend to worsen the problem rather than solving it (Chou & Fang, 2021). The supply chain crisis made major retailers revise import cargo routing through U.S. ports, as exemplified by Walmart and Nike (see for a full analysis Cariou and Notteboom, 2022).

An important parameter that can partly explain the 'pressure' on the overall system (and the pursuant hike in container freight rates – see Figure 1) has been the severe shortage of containers referred to earlier. Many circumstances can help explain this. First, the decline in international trade took place only in H1 2020, with a precipitous fall of 12% in April-May. This, however, was reversed equally impressively in H2 2020. The system was unable to adjust quickly to the new level of demand, with containers being left – not to say abandoned – in the 'wrong' places, many of them having been used in H1 2020 to carry medical equipment to Africa and Latin America. In parallel with this, given the very high demand for containers in Asia, and the price Asian shippers would pay for them, carriers were returning empties as soon as possible, without offering western exporters the capacity they required (Yang et al., 2021).

Figure 1 Container freight rates on some major trades (USD)

Note: Following accepted convention, the freight rates shown for Shanghai-ECNA and Shanghai-WCNA are quoted in $ per FEU, while the freight rates shown for Shanghai-Europe and Shanghai-South Africa are quoted in $ per TEU.



An additional pressure on ports has been the increase in average call sizes, the intention of which was to partially compensate for blank sailings and lower frequencies. The COVID-19 pandemic brought record call sizes in major ports around the world. For example, Port of Los Angeles broke the all-time record in June 2020 when 34,263 TEU were handled during a single call. The *diseconomies of scale* in container ports that arise from the use of bigger ships (or bigger call sizes) has been widely recognized; for example, see Martin et al. (2015), Haralambides (2017), Haralambides (2019) and Ge et al. (2021). At the risk of over-simplifying, one could say that *the time to handle a container arriving on a large ship is on average longer than that of handling the same container arriving on a smaller ship.* Even in the case of the largest ships, adding extra ship-to-shore cranes beyond more than, say, five to six, makes little sense both technically and economically. Moreover, in today's container shipping context and given contemporary containership designs, handling efficiency at berth has less to do with the number of cranes working the ship, and more to do with the availability of cranes that are able

to reach row 24 and beyond[6]. Finally, competition with neighboring ports and the requirements associated with *green* port status further exacerbate a terminal manager's call size headaches. Pressing things to address, jointly most of the time, include (among many others): the minimization of gate congestion; the minimization of dwell times (possibly together with the creation of dry-ports in the hinterland and the modernization of customs services); the minimization of rehandles and container movement equipment, aiming at the same time at the minimization of atmospheric emissions; the synchronization of appointment systems with port equipment availability; the allocation of berths such that equipment movements and emissions are minimized and; incentivizing 'dual-transaction' truck movements inside the terminal, etc.

5. Longer-term considerations for the port industry

5.1 Commercial and geopolitical context

The geopolitical and commercial landscape in which ports operate is changing in leaps and bounds: the seaport of today is increasingly becoming a logistics and industrial node, in the centre of complex, intertwining global supply chains. As such, a functional and spatial clustering of activities takes place in the wider domain of a seaport, all aiming, directly or indirectly, at seamless and sustainable transformation and information processes within these global supply chains (Notteboom, 2016).

Although some ports might benefit from shelter policies, designed by regional or national government agencies, seaports generally operate in an efficiency-oriented, competitive and highly dynamic market environment. Neoclassical thinking, founded on the premise that individual freedoms are guaranteed by freedom of the market and of trade, dominated much of the global economic and trade development in the post World War II era. Such thinking is increasingly questioned today, and global clashes in economic thinking (and economic systems) are surfacing, as exemplified by the tensions between China's 'state capitalism' and the free markets of western economies. Economic shocks such as the financial-economic crisis of 2008-2009 and the COVID-19 pandemic, combined with rising international trade disputes (e.g., China-US trade relations), and tensions in existing trading blocs (e.g., Brexit in Europe) add to the observed volatility in international trade and cargo volumes in ports. Despite China's efforts to champion the creation of a *new* global economy based on interconnectedness and mutual trust and understanding (Cullinane et al., 2018; Costa et al., 2020; Haralambides and Merk, 2020), the western world came out of the 2008-2009 economic meltdown more wary of the alleged benefits of consumerism, free trade, free movement of persons, and globalization. The impact of such perceptions on international trade have been only too

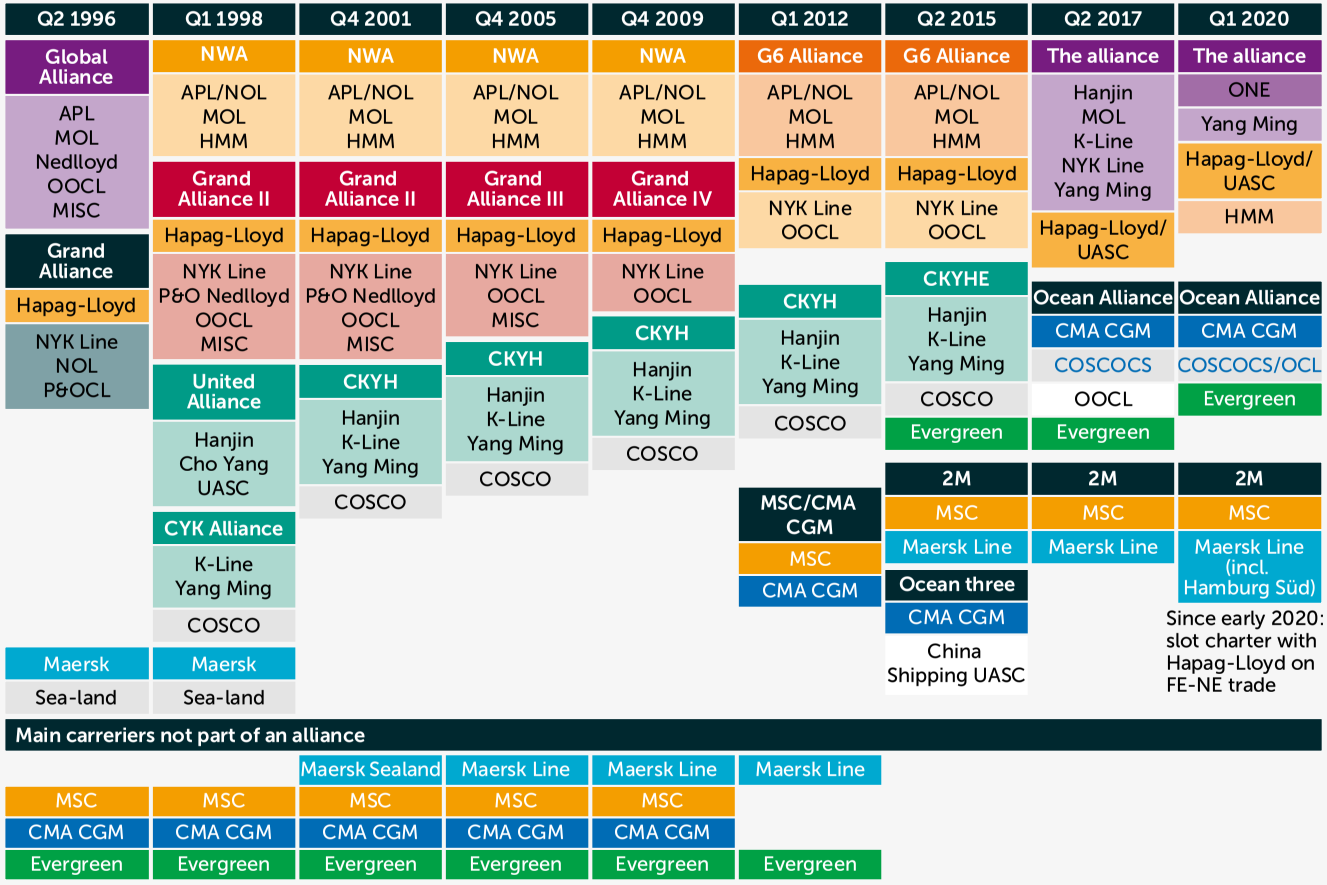
6 For a technical analysis of optimal containership design, see Priftis et al. (2018).

obvious: the GDP Multiplier, a metric often used to link a country's income to its containerized imports, almost halved from 2.2 in the early 2000s to 1.3 today (calculations based on figures by IMF and Boston Consulting Group). Often, the theoretical grounds to tendencies such as the above have manifested themselves as introversion, nationalism, populism and, at times, questioning of the ability of western democracies to solve the *new* societal problems just by simple recourse to the well-acclaimed 'rule of law'.

Corporate strategies in shipping and global logistics are also exerting their influence on the port industry. Examples of such developments include consolidation and concentration in container shipping, as well as in terminals and logistics companies, vertical integration along the supply chain and an increasing role of global shipping alliances (horizontal integration; see Figure 2).

Figure 2 The evolution of global alliances in container shipping aimed at joint vessel capacity Management

Source: adapted from Notteboom et al. (2017)



In other words, to improve their operating margins and offer a better service to their customers, market players in shipping, ports and logistics simultaneously pursue two complementary strategies: cost control through horizontal integration (e.g., shipping alliances) and service differentiation through vertical integration along the supply chain (Notteboom and Winkelmans, 2001a; Haralambides, 2019; Paridaens and Notteboom, 2022). Ports increasingly compete not as individual activities that handle ships, but as crucial nodes, linking competing global supply chains. The port and route selection criteria of shippers and carriers are thus based on the entire network in which the port is just one node.

The increasing importance of integrating ports and terminals in value-driven supply chains has shifted the focus onto horizontal and vertical integration and collaboration among relevant actors, particularly with respect to digital transformation and value capture along the chains. Changes in supply chains are forcing ports and terminals to seek effective integration in these supply chains when delivering value to shippers and third-party logistics service providers (Robinson, 2002; Mangan et al., 2008). Song and Panayides (2008) provided a conceptual contribution to the measurement and quantification of such integration efforts whose success, however, has also been questioned by Magnan and van der Horst (2020), in the case of certain major European ports.

Thus, modern seaports have evolved from pure cargo handling centres to pivotal entities in a comprehensive and complex mesh of intertwining global supply chains. The competitive battle of ports to accommodate global supply chains has led to functional changes in seaports, as well as in the other nodes of the worldwide transport and logistics network. Nodes increasingly seek co-operation and coordination, for example, by bundling their transport flows to/from the hinterland (e.g., the role of the inland port of Duisburg as a bundling hub connected to Belgian, Dutch and German gateway ports), or by using available space efficiently through an attractive supply of possible locations in seaport areas and in dry ports or logistics platforms in the hinterland. Nodal competition is supplemented by nodal co-operation. Based on the type of vertical control of the development process, Wilmsmeier et al. (2011) distinguished between inside-out development, whereby inland terminals seek greater integration with their seaports (often driven by public body intervention) and outside-in development whereby inland terminals are used by seaport actors to expand their hinterland. While Witte et al. (2019) rightly observe that most initiatives have followed an outside-in approach, the growing emancipation of inland ports has given rise to in inside-out developments.

It is not just hard economic factors, however, that guide port development and operations. The growing role of environmental and social considerations shape the behaviour and strategies of port-related actors, with a greater role attributed to setting and achieving sustainability goals and to rolling out initiatives in the field of Corporate Social Responsibility (CSR), stakeholder relations management and Green Supply Chain Management. Companies implement such initiatives due to motivational drivers, such as sales to customers and corporate reputation, regulatory pressures and the growing emancipation of individual citizens and stakeholders.

5.2 Potential implications for port governance

The governance of port management is continuously challenged to adapt to a changing port ecosystem. Not surprisingly, a vast amount of literature has focused on port governance reform, port devolution (but also re-centralization of decision-making powers), port management efficiency, and the effectiveness of port operations.

Both in academic and business circles, various typologies of port governance models have been analysed and applied. The World Bank's *Port Reform Toolkit* presents an early and commonly used typology, distinguishing between four port administration models; i.e. the private service port, the landlord port, the tool port and the service port.

The landlord model is the most common model of port administration, found in more than 80% of ports around the world. The term 'landlord' derives from the simple fact that the PA, among its many other responsibilities, is the 'curator' and the 'authorized manager' of port land and adjacent aquatic surfaces, to be rented out (leased) for economic profit to the private sector. Often, revenues from this activity amount to 50% of total port revenue. As a 'landlord', the PA must optimize the use of its domain[7] by: (1) earmarking port areas for specific uses; (2) awarding concessions and authorizations to a carefully selected 'mix' of companies and (3) adopting an appropriate pricing system.

Advances in academic research and business practices have revealed the limitations of the port management governance model typology. Brooks (2004) claims that it is difficult to use the framework of the Port Reform Toolkit or others (such as in Baird, 2000) to understand the management of port activities. Furthermore, empirical studies have clearly (and correctly) demonstrated that, notwithstanding the long and interesting academic discourses, in practice there is no such thing as "adoption of a specific governance model". Rather, *port management* is subjected to a series of smaller or bigger variations over time. A large body of port economics literature has analysed how the governance model of individual or groups of (national) ports can dramatically change as a result of far-reaching port reform and devolution programs (see the rich body of case studies in the edited volumes of Cullinane and Brooks, 2006 and Brooks et al., 2017, and the literature review on *port governance studies* in Pallis et al., 2011 and Zhang et al., 2018), or stakeholder interests (and related lobbying).

The role of the public sector in ports has attracted particular attention. In many parts of the world, a wide range of privatization, corporatization and commercialization schemes (Haralambides, 2017; Notteboom and Winkelmans, 2001b) have resulted in the entry of global terminal operating and logistics groups, large investment groups and equity fund managers. In a number of cases, this infusion of (private) money has led to greater competition, higher productivity and eventually lower costs which, often, are passed on to importers and exporters, wherever adequate intra- and inter-port competition among stevedores and terminal operators has also been ensured.

7 Defined here as the total area (land and aquatic) under the statutory responsibility of the port authority.

In this new environment, the public sector has been forced to reassess its role in the port industry, in some instances generating a discussion on whether public sector port authorities are indeed needed; a discussion often starting from the full privatization examples of the UK, Australia and New Zealand. To our view, this discussion is pointless and dangerously misleading. Irrespective of how infrastructure is financed, developed and managed, the final owner of the port's infrastructure, both land and aquatic, is the State. In most cases, the State entrusts (i.e. through port devolution) ownership and exploitation rights to the port authority. Moreover, passing on PA regulatory responsibilities, such as those pertaining to *public service obligations*, or the monitoring and control of nautical-technical services, could never be accepted in many developed and developing countries alike. Thus, despite the greater private sector involvement in the port industry, many port assets or services have not been transferred from the public to private sector. Instead, most countries have relied on some form of commercialization or corporatization of public port authorities, in order to deflect demands for much greater private sector involvement and safeguard the prerogatives and collective interests of the public sector.

The privatization of UK ports in the 1980s is a textbook example of a shockwave port devolution. In many cases, however, the evolutionary trajectory of port governance occurred in different and distinct phases covering several decades. For example, the decentralization of port management in China, from the central to the local level, unfolded gradually in three phases between 1979 and 2004, each supported by new regulatory frameworks (Cullinane and Wang, 2006). In recent years, the Chinese port system is undergoing a certain degree of recentralization, supported by large-scale port co-ordination and integration schemes at provincial level (Notteboom and Yang, 2017; Huo et al., 2018; Ma et al., 2021; Li et al., 2022). The new Chinese orientation on port governance is two-pronged: on the one hand, no efforts are spared in creating national champions (e.g., Shanghai or Shenzhen), able to compete at regional and global level, while on the other hand, greater intra-provincial cooperation and coordination among ports is pursued, to ensure that duplication and resource-wasteful competition are avoided (Wan et al., 2020). Those were also the objectives of the 2016 Italian port reform (Prete and Tei, 2020; Parola et al, 2017), but similar objectives could be found today in most countries including the United States and Japan where, in the case of the latter, port development is centrally included in national development plans. Interestingly, port devolution seems to be reversing, with decision-making powers returning to the 'centre'; a trend apparent not solely in ports. It seems to many that concentration and recentralization of all sorts of economic activity might be the answer to the failures of globalization.

Every port is confronted with specific challenges and opportunities in terms of economic and social development priorities, port-city relations, spatial dynamics, environmental pressures, and more. This regional embeddedness implies that ports may go different ways in terms of the tasks, roles and activities they develop and, sometimes, this may require a different management approach. Classifying port management models in neatly labelled packages – assuming one might still have an interest in doing so- is becoming increasingly pointless. Quite a few countries or regions with a strongly centralized port management system have realized that a 'one size fits all' approach to port governance is impracticable as it poses great restrictions in effectively dealing with the regionalism in a seaport system. Ultimately, such rigidity can undermine the necessary dynamism at the local port level.

In actual fact, a large diversity exists even within the same port management governance model. For example, neighbouring ports of a similar scale, applying the same landlord governance model (such as Rotterdam and Antwerp), might in practice show a lot of differences in port management. Such diversity in scale, tasks, organization and skills can render a port much more attractive to customers vis à vis its competitors. Processes of layering at the regional and local level allow actors to add some regional touches to port governance practices, without necessarily disconnecting from the national policy nor breaking out of the existing path. In other words, regional assignment of roles may lead to different management orientations, not necessarily different models.

Ports can learn from specific best practices of other ports, things like formalizing city-port relationships, master-planning, concession agreements or marketing approaches to clients. But the management philosophy of the port, one presumably based on performance and results, should not be much different from that of any other economic activity when it comes to such things as human resources management, informatics, accounting, finance, concession contracts, authorizations, etc. This means that port policy is getting (or should get) more orientated towards the formulation and enforcement of general rules of the (competitive) game, e.g., pricing for cost recovery or harmonization of port statistics, instead of trying to force individual ports into standardized governance models and solutions.

5.3 A stronger area-specific approach to port governance challenges

Typologies of port management governance models typically do not elaborate on the specific roles and regulatory and operational functions the *port authority* adopts, either voluntarily or being obliged to pursue by law. Still, the port economics literature presents us with possible discrete levels of engagement of a port authority (see e.g., the 'passive', 'facilitator' or 'entrepreneur' categorization in Verhoeven, 2010) and a port's specific roles (e.g., landlord, regulator and operator, see Baird, 1995; Baltazar and Brooks, 2001). As we already hinted above, however, and apart from the very few instances where such categorizations have been used as a roadmap to rationalize financial resources of donor agencies, to be spent among competing ports in the developing world (see for instance World Bank,[8] 2019), hierarchies and typologies such as these today attract rather limited interest, mostly among academics.

In the 2000s, port economists started to argue that the port authority should play a more proactive role in facilitating and coordinating stakeholders in logistics networks, and in developing the necessary competencies to succeed in a highly competitive market (see Notteboom and Winkelmans, 2001a; Comtois and Slack, 2003; Van Der Lugt and De Langen, 2007), perhaps even by adopting a more entrepreneurial role (Verhoeven, 2010). Port authorities have also been encouraged to add a functional role as cluster managers (De

8 The publication was prepared by Martin Humphreys, Aiga Stokenberga, Matias Herrera Dappe, Atsushi Iimi, and Olivier Hartmann of the World Bank, based on a 2018 World Bank project entitled "Ports Assessment Eastern and Southern Africa", carried out by MTBS (Maritime Transport Business Solutions) under the academic supervision and consistency control of Hercules Haralambides.

Langen, 2004) and community managers (Chlomoudis et al., 2003), to solve collective choice problems in and around the port domain.

In the past two decades, a number of scholars have provided more insights to the call for a more active facilitator and even entrepreneurial role of port authorities. Studies have been carried out to examine the role of port authorities in specific activity areas such as intermodal transport and hinterland development (Notteboom and Winkelmans, 2001a; De Langen and Chouly 2004; Notteboom and Rodrigue, 2005; Van Der Horst and De Langen, 2008; Van den Berg and De Langen, 2011; Magnan and Van Der Horst, 2020; Wan et al., 2020); land management including terminal concessions/leases (Notteboom, 2006; Notteboom et al., 2012; Ferrari et al., 2015); digital transformation as a key enabler of cargo flow facilitation and supply chain coordination; sustainability (Lam and Notteboom, 2014; Acciaro et al., 2014; Ashrafi et al., 2020), green supply chain management in ports (Notteboom et al., 2020); the green port concept (Pavlic et al., 2014); energy efficiency (Iris and Lam, 2019); energy transition (Hentschel et al., 2018; Wang and Notteboom, 2015); the circular economy (De Langen and Sornn-Friese, 2019; Mańkowska, et al., 2020); and port marketing (Parola et al., 2018). It is clearly observable that, in many cases, port authorities move beyond the pure facilitating role by entering into key investments, particularly in those cases where private investors show reluctance to do so, or when there are possibilities to partner with private or public entities. But this has not been always so. Until recently, at least among the ports of the European Union, the development of port infrastructure was not always demand-driven but rather an 'entitlement' of the port, particularly if the port's 'neighbours' were lucky recipients of public funding themselves. Such 'understandings' had created considerable excess capacity which went hand-in-glove with high levels of management inefficiency (Haralambides, 2017).

The empirical findings presented so far suggest that port authorities can follow very different paths in dealing with current issues in the above areas of port activity. It has also become evident that tangible achievements and progress made by port authorities in a number of these areas, or action fields, remain rather underwhelming. For example, many port authorities are struggling to define their role (or to create one for themselves), to enhance collective actions, and to achieve visible positive results in the field of, say, intermodal hinterland transport (Van Der Horst and De Langen, 2008), including connectivity and the port's relations to inland ports (Magnan and Van der Horst, 2020). Other current challenges include the role of port authorities in the large-scale implementation of cold ironing solutions for deep sea vessels (Arduino et al., 2011; Tseng and Pilcher, 2015; Innes and Monios, 2018; Lorange, 2020) or the largely untapped possibilities for the greening of terminal concession procedures and agreements (Notteboom and Lam, 2018).

As such, a PA-centric approach, advocating an ever-stronger role for port authorities, might not be the right approach. In each 'area of port activity' and for every single initiative ports might be willing to undertake, port authorities and their stakeholders should evaluate whether a) the port authority may have a statutory role to play and b) if so, whether such involvement is likely to lead to a superior outcome, compared to no involvement. In the context of such considerations, the PA needs also to decide on whether its involvement should be restricted to

its statutory domain, or extend beyond the confines of its legal responsibility; what tools or instruments to use (e.g., regulation, penalty or incentive pricing, knowledge development, data sharing, investments, etc.); whether or how to co-ordinate or form partnerships with other actors; and, finally, whether the PA should act as facilitator or entrepreneur. Thus, the role and function of a port authority needs to be contextual: the PA can be an investor/entrepreneur in one area of activity but remain the usual 'onlooker' in another.

An area-specific approach to port authorities' roles and functions provides a lot of room for a further analysis of the strengths and limitations of specific port governance arrangements. The PA's capabilities and regulatory room to manoeuvre and act in one area of activity might be limited. A good example is a PA's inability to make changes to an approved masterplan, aiming to adjust it to changing demand scenarios. In other *areas of activity*, e.g., investments in enhancing port security, or in the maintenance of infrastructure with the latest generation of ships in mind, the role and capabilities of the PA might be much more substantial and decisive. In other words, port governance should be tailored as much as possible to the specific needs and ambitions in each of the activity areas. This would naturally render a generalized and static/rigid approach to port governance less relevant. More research is needed to analyze the effectiveness and efficiency of specific port governance arrangements and routines in each of the activity areas.

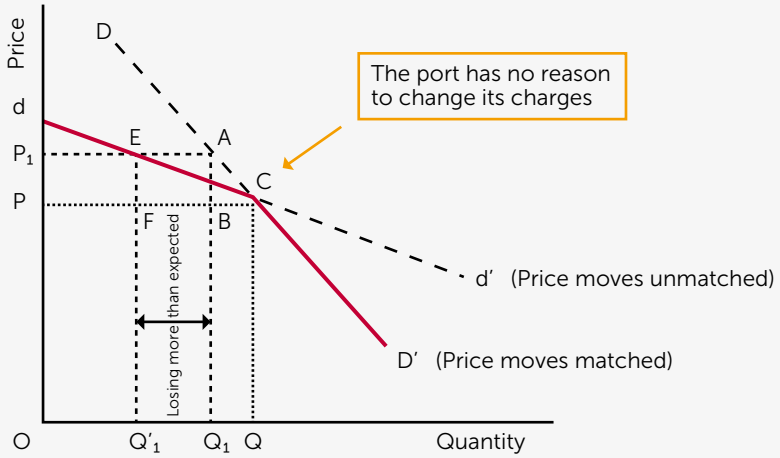
Finally, a successful port authority – in terms of efficiency criteria – must adopt a market-oriented management style, based on clear goals, managerial skills and accountability. However, this does not imply that every decision concerning the involvement and actions of the PA in a specific activity area is taken in the context of a well-prepared long-term strategy or strategic plan. Some actions and initiatives might be the result of *ad hoc* decisions and investments, fuelled by windows of opportunity that arise suddenly at a specific point in time (Jacobs and Notteboom, 2011). Such decisions present critical junctures, shaping the role and function of the PA in the respective area, without excluding any future path disruptions. The increasingly volatile market environment might imply that the governance structure of PAs will have to be tailored towards more flexible *ad hoc* type of decisions, at least in those business activities that do not entail major regional or national interests. Such an approach has the potential to increase port resilience by continuously adapting the port to opportunities arising from a changing economic geography, economic shocks, sustainability needs or major shifts in the corporate world.

5.4 From spatial separation in port governance solutions to regional and global entanglement

Port management models did not 'confront' each other so much in the past, as neighbouring/competing ports typically followed similar port management models and their decisions were fairly, game-theoretically- interdependent. Demand for port services (among competing ports), as an example, has been known to be *kinked* (Haralambides, 2002), i.e. tariffs respond to those of the competitor in two distinct ways: a) they remain unchanged on the way up, but they follow suit on the way down (Figure 3).

Figure 3 The kinked demand for port services

Source: Haralambides (2019)



However, this picture is changing. Despite the many calls and efforts for more inter-regional cooperation and coordination among neighbouring ports, especially in areas of activity where public resources might be thoughtlessly and wastefully expended, in other, more business-like areas of activity, such as marketing or pricing, inter-regional competition is intensifying. This brings ports or port groups with different port governance philosophies into head-on competition (e.g., competition between northern and southern European ports).

Moreover, some (mostly public) port groups, in order to anchor firmly their competitive position, are also walking down the path of *internationalization*. Usually, such policies take the

'innocent' form of an MoU, on things like exchange of best practices or training. Behind them, however, may be hidden more 'sinister' objectives such as tacit collusion, aiming to make the two-port-link the carriers' preferred choice vis à vis competitor ports.[9] This said, PA internationalization can also be rather modest, combining small, targeted, investments with port management support and advice (see e.g., Dooms et al., 2013 on the internationalization strategy of the port of Rotterdam). In other cases, PA internationalization could go hand in hand with a large-scale mobilization of resources and funds, exemplified by the Chinese port investment spree which in some cases has led to the adoption of new or adapted governance models at the local level.[10]

The resulting mix of local and imported port governance approaches might lead to clashes in port management styles[11], but it also has the potential to produce efficient, new hybrid or mixed forms of port governance. The above developments give an impetus to the *level playing field* discussion and they could well water down (national) attempts towards the standardization of port management approaches (see above). At the same time, many countries around the world are confronted with a shift from the management of individual ports to the management of multi-port regions. Port authorities are thus regionally integrated or even merged. This includes 'bottom-up' integrations such as the cross-border merger of Copenhagen and Malmö ports (De Langen and Nijdam, 2009), the founding of the new *North Sea Port* (Belgium/the Netherlands, Notteboom et al., 2018), or the corridor-based gradual integration process of the ports of Le Havre, Rouen and Paris into Haropa (Deiss, 2012); a development which resulted in a formal merger between the port authorities in June 2021 (Maritime Gateway, 2021). Other port authority integration processes have been more top down, like in the case of the creation of the Italian *port system authorities* (Ferretti et al., 2018) and the integration of Chinese port groups at provincial level (Notteboom and Yang, 2017; Huo et al., 2018).

Irrespective of the drivers behind such integrations, the observed port integration processes in China are resulting in a wider spatial reach of corporatized and commercially driven provincial port groups. As a result, Cosco Shipping Ports, along with the integrated provincial port groups, are investing in foreign ports. In addition to full port authority integration schemes, a range of port alliances and co-ordination initiatives are in evidence too. An example is the *Northwest*

9 We are aware of the allegation and of the anecdotal statement. But we are equally aware of the possible legal consequences, were one to be more 'specific' on the objectives of cooperation. The point that is made here however is that regulatory authorities around the world should pay more attention to such 'MoUs', also in their investigations of mergers and acquisitions in shipping.

10 Compared to other global terminal operators, the international expansion strategy of Chinese public port groups such as Cosco Shipping Ports or the Qingdao Port Group, seems to be strongly embedded in the geoeconomic and geopolitical policies of the Chinese government. As we have said above, the Chinese government is actively supporting the creation of champions able to play a role on the international scene. The role of companies in the Belt and Road Initiative has been made very explicit in the 13th Five-Year Plan: The ambition is to enhance co-operations between China and Belt and Road countries, with private and corporatized enterprises taking a leading role. Chinese port actors have seized the windows of opportunity created by the BRI to go international (Notteboom and Yang, 2017; Wang et al., 2021).

11 A notable example was the friction that emerged (and resignations that followed) between the old Greek PA staff and the Chinese management that arrived, as soon as COSCO took over the Port of Piraeus. This said, however, the transfer of ownership and management transformed the port into the number one in the Mediterranean Basin and number 4 in Europe (Pelagidis and Haralambides, 2019).

Seaport Alliance between Seattle and Tacoma in the US (Knatz, 2017). Less far-reaching and targeted co-operation schemes are widespread and typically involve the creation of ad hoc bodies in charge of specific and limited functions, or project-based co-operation initiatives involving a few ports.

5.5 Performance measurement and port governance

The performance of ports and port authorities has grown into an important theme in the literature of *maritime economics* (see the content analysis in Pallis et al., 2011 and Woo et al., 2012). Port performance is often approached from a port competitiveness and competition angle, as ports want to position themselves as competitive nodes, with the ability to adapt effectively to intensified port competition around them. Cargo throughput and vessel traffic (i.e. absolute figures, growth, market share) remain important output measures for port competitiveness and, indirectly, so do the effectiveness of existing port governance structures and port reform programs. Despite some concerns on the appropriateness of comparisons across ports, port throughput figures remain a commonly used and simple basis for market share analysis and port rankings. These indicators are increasingly complemented with KPIs in the area of supply chain performance, maritime and inland connectivity, financial performance, customer satisfaction, sustainability, socio-economic significance, port governance, port resilience, etc. (for example, in a European context, cf. the results of the EC FP7 project PORTOPIA). Many of the newer KPIs are still rather experimental, with concerns expressed on their feasibility, acceptability and relevance, particularly when one wants to engage in comparing ports.

Port performance studies, in their grand majority, have focused on the performance and efficiency of container terminals, most of them these days being run by private companies. The measurement of the performance of a port authority, however, is by far under-researched. Indeed, it could be rather challenging were one to attempt to measure a PA's efficiency in accounting and finance; concessions and authorizations awarded; engineering designs; planned maintenance work; veterinary, health and security controls, etc. The identification and relevance of governance-related performance indicators for a PA might to some extent be influenced by the PA objectives and the beliefs of PA executives. Empirical research has shown that public port authorities resemble regular for-profit companies, but they also habitually enshrine certain beliefs, such as a perceived 'role' in matters of national security, that distinguish them (Van der Lugt et al., 2017).

Moreover, meaningful port performance exercises should explicitly consider the requirements, needs, expectations and perceptions of different stakeholders. Valuable attempts have recently been made in the maritime economics literature to present both qualitative and quantitative approaches to port performance measurement in a multi-stakeholder environment. For example, Ha et al. (2017) modelled the interdependencies among port performance measures, and a combination of weights of interdependent variables. The authors used both qualitative and quantitative evaluations of measures deriving from multiple stakeholders in their quantitative performance measurements.

The interdependencies (or lack thereof) between various port performance measures remain a rather underexplored research area in port studies. For example, the relationships between port throughput and the evolution of the socio-economic indicators of seaports, such as value-added, growth and employment, have not been systematically examined, except for some rather factual exercises (see e.g., Merk, 2013) or local case studies. The examination of the link between port activity levels, in terms of cargo flows, and land management – e.g., concession awards – is another potentially interesting research theme (e.g., the spatial productivity of port areas and related concessions pricing). Many more possible linkages between well-established and more experimental port performance measures can be explored using statistical techniques, decision science, system dynamics modelling or other quantitative and qualitative methods.

Finally, in closing the 'interdependencies' discussion, one should not fail to mention the problem of *multicollinearity* among input variables, such as those used in Data Envelopment Analysis (DEA) and Stochastic Frontier models. In fact, variables like 'number of quay cranes' and 'quay length', or 'terminal surface', are not just collinear but their dependence is almost orthogonal. The problem is usually 'solved' by arbitrarily dropping a collinear variable and, sometimes, the one dropped is the most important; the technical solution prevails over the economic ramifications of a modelling choice, and this is a common pitfall in this type of studies (see Psaraftis, 2017).

Port performance is not only about hard economic values; it is also about the cultivation of the soft values of seaports, sometimes necessary to safeguard their 'license to operate' (Van Hooydonck, 2007). Among others, such values include CSR initiatives, reaching out to stakeholders through a well-balanced and effective stakeholder relations management, or achieving broad sustainability goals (see for example the *World Ports Sustainability Program* which explicitly targets the UN Sustainable Development Goals in a port context). As part of the soft values discussion, PAs across the world are attaching greater importance to the role of *transparency and disclosure*, as tools in stakeholder relations management and image building in port management performance (see for instance Notteboom et al. 2015 on disclosure practices of the port of Rotterdam; the extensive analysis on the levels and standards of transparency in the governance of ports by Brooks et al. 2020; or the growth of sustainability reporting by PAs in Geerts and Dooms, 2017).

Despite the renewed academic interest in transparency and disclosure (a most welcome initiative indeed), in daily port practice the issues may be quite different than the way they are presented in the academic literature. Ports and their decisions, as we have detailed above, are often under the scrutiny and approval of supervisory bodies. The latter usually comprise a representative group of port stakeholders like city, provincial, or regional administrations; labour unions; concessionaires; railways; chambers of commerce and industry; carriers and their agents, etc. These people, in addition to safeguarding and promoting the interests of the port, may have their own personal or corporate 'agenda'. Therefore, indiscriminately disclosing information to stakeholders, particularly on 'sensitive' matters such as cost breakdowns – things that no commercial entity would ever disclose even to its own shareholders – might be counterproductive to the long-term wellbeing of the port. This said, in an increasing number

of ports around the world, the greatest part of the documentation produced by the PA is by law uploaded onto the organization's website. Such documentation among others includes executive decisions, as well as tenders; qualified suppliers; concessions and authorizations; maintenance plans; technical department designs; budgets and much more.

A last point concerning performance measurement relates to the challenge of comparing and benchmarking port and PA performance in a meaningful way. Benchmarking is a continuous process of evaluation of products, services and practices vis à vis those of the strongest competitors, or of the ports recognized as leaders. Such exercises often constitute learning tools for the organization, with respect to the relative positioning of the port, and for assessing ways to further improve performance. However, key difficulties encountered in earlier research include the identification of a peer group of ports for meaningful and valid comparisons,[12] and the potentially poor comparability of indicator values across ports, given the disparity of methodological variations in data collection and processing. PAs often face a dilemma between the desire to do more international benchmarking (or at least compare to relevant peers), and the desire to focus on highly customized and individualized port performance measures which may not always be amenable to inter-port comparisons.

6. Conclusions

The COVID-19 pandemic has clearly had a significant and obvious impact on the economic activity in seaports, with many world ports being confronted with moderate to strong decreases in cargo volumes and vessel calls, and an overall lower activity level in the logistics and industrial clusters in and around ports. The (hopefully temporary) lower economic activity level, combined with broader ongoing structural trends in the world economy (e.g., nearshoring and reshoring, dematerialization of consumption, 3-D printing, energy transition, trade-related conflicts) make port actors, planning authorities and supply chain managers revisit and update port-related development and investment plans. Furthermore, the COVID-19 crisis, coupled at the same time with China's inroads to port infrastructure investments around the world through its Belt and Road Initiative (BRI), brings again to the surface discussions on the socio-economic impact and resilience of ports as 'essential facilities' to national and regional interests.

There can be no doubt, therefore, that the COVID-19 pandemic has reinvigorated the importance of risk management and resilience within a seaport context, characterized by uncertainty and volatility. Port authorities are challenged to further strengthen their organizational resilience, leanness (Marlow and Casaca, 2003) and agility (Paixao and Marlow, 2003). In the post COVID-19 *new normal*, port authorities will be expected to develop capabilities in port resilience planning (Shaw et al., 2017; Vonck and Notteboom, 2016; Verschuur et al., 2020); adaptive port planning (Taneja et al., 2011); and to enhance the adaptive

12 For example, when applying DEA, the 'peers' are those on the frontier. This can lead to a situation where the analyst *de facto* perceives the least bad ports as the best ports. The ambition of a port should not be to become the best performer among its underperforming peers, but to achieve the best performance that it is possible to achieve.

capacity of ports (Notteboom, 2016), so as to cope with economic shocks and trends, and with the challenges imposed by climate change (Ng et al., 2015). At the same time, port authorities might have a role to play in increasing the overall resilience of the port ecosystem, and of the individual companies within it through, for example, financial instruments (e.g., deferring land lease payments), or the deployment of data-driven market analysis tools. While quite a few studies have been published in the past decade on risk management and resilience, there is still plenty of room for the development of novel performance indicators on risk management and resilience in a seaport governance context.

While it is important to acknowledge that many variations and local/regional differences and orientations in port governance arrangements exist, they nevertheless persist in presenting and applying discrete port governance typologies (see e.g., Brooks, 2004). We believe that further work and analysis of port management practises, styles and models (sic) calls for a more continuous and fluid approach to the subject, whereby even subtle temporal and spatial differences and changes are measured and analyzed along a broad spectrum, instead of a set of discrete categories. The growing regional and global entanglement in port governance and management philosophies, orientations and ambitions form a breeding ground for innovative ideas and customized approaches to port governance in an increasingly globalized and connected world. The port research community can contribute to such insights by examining the melting and merging of port governance arrangements, the tensions and opportunities these processes bring, and how internationalizing PAs can adapt and embed themselves in a regional or global theatre.

The role of public entities and of international and domestic corporations in ports, and the desired development path in port governance, are again being revisited. While it is still early days to evaluate whether the current epidemiological crisis and, more importantly, the onslaught of the *new normal*, will create ruptures in port governance trends, it is important to stress that the academia has again a role to play in assisting the business community in continuously assessing trends and challenges and in identifying gaps and points of (re) orientation. Some of the potential future research areas in port governance will include *inter alia*: (a) exploring new revenue/business models for port authorities (b) the development of continuous and more fluid approaches to port management governance models; (c) a stronger area-specific, targeted approach to individual port governance challenges; (d) research on the conditions and ramifications of an increasing regional and global entanglement of ports and consequent governance solutions; and (e) advancing performance measurement in the field of port governance (Notteboom and Haralambides, 2020). At the same time, adopting a more macroscopic perspective, it should be stressed that the immediate economic hardships induced by COVID-19 were not systemic (as was the case with the global financial crisis of 2008) but, rather, the result of an unforeseen external shock. As such, it is to be hoped that the world economy will not only return to pre-COVID-19 levels of activity but will, in all probability, eventually surpass them. Even during the pandemic, economic forecasts were generally positive in this respect, as evidenced by the way China has already started on its route to economic recovery, with a remarkable Q4 2020 growth rate of 6.5%. This brought the country's overall annual growth rate to 2.3%, thus correcting a Q1 2020 contraction of 6.8% (National Bureau of Statistics of China, 2021). However, now that the worst health impacts of the

pandemic are, hopefully, behind us, a bleaker economic picture is unfolding, with estimates of China's growth rate for 2022 and 2023 recently revised downwards to 3.3% and 4.6% respectively (IMF, 2022).

One cause for future (economic) concern is the astronomical amount of money earmarked around the world in the fight against COVID-19, especially for mitigating its effects on employment. Within the EU, the level of spending involved has literally rendered completely invalid the limits on public spending and budget deficits embodied within the EU's *Stability Pact*. On the positive side, however, the financing of the EU's *Recovery Fund* [what has come to be known as the New Generation EU (NGEU)] through the issuance of mutual debt, and the future payback of this debt through direct taxation, represents the first solid step towards the fiscal integration of the EU that might guarantee its long-term survival (Acharya & Steffen, 2017). The lion's share of the recovery fund will go to Europe's weaker economies (Bulgaria, Romania, Greece, Croatia, etc.), as well as to those hit the hardest by the pandemic (Italy and Spain). On the negative side, it must be said, the Commission's attempts to 'condition' the spending of recovery funding on what it considers to be necessary economic reforms and the 'rule of law' have been rather unsuccessful, with certain member states questioning the legitimacy of linking 'life and health' issues with conditions and considerations related to economic performance and political governance (Fuest, 2021).

With the 2020 election of Joe Biden as president of the U.S.A., the world is now seeking a real commitment to reversing the introversion and isolationism which characterized the Trump administration. Although Biden is no great proponent of the free trade ethos, in seeking to distance himself from the political and policy idiosyncrasies of his predecessor, he is likely to try and restore better relations with both China and the EU (the world is already seeing evidence of this) and to re-engage the U.S.A. with a multilateralist approach to trade relations and other international issues (Cullinane, 2020). Such a change in approach has been manifest in the representation of the U.S.A. within the IMO where, remarkably, the U.S.A. is now, volte-face, a stalwart of the environmental agenda, in vociferous pursuit of much more stringent measures to secure the best possible environmental performance from the international shipping industry.

Equally, it must be recognized that throughout Europe and the U.S.A., nationalist, protectionist and populist voices and politicians have started to become louder and louder, and concepts such as: localization; near-shoring; 3-D printing; teleworking and the like, have been finding fertile ground among the populace. Even under the new Biden administration in the U.S.A., for example, there are clear and explicit, yet very ambitious, objectives for the re-shoring of production and associated supply chains; motivated not only by the need (exposed by the COVID-19 pandemic) to reduce the risks associated with supply chain vulnerabilities, but also by the explicit and understandable desire to benefit workers in the U.S.A. If these sensibilities and tendencies are replicated worldwide and if this were to emerge as the new normal (i.e. if a reduction in trading distances becomes a possibility), then the negative impacts on the transportation industries, starting from long-distance business-class travel and progressing then to international shipping, are only too obvious.

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Personal note

By means of this above modest contribution, Kevin, Hercules and Theo convey their warmest wishes to Harry Geerlings -a distinguished port professor of Erasmus University Rotterdam- for a healthy and (still) productive emeritaat, enjoying at the same time blissful and healthy family times with Patricia and his wonderful family.

1. Salutation to Harry Geerlings from the perspective of ABB team members

Back in 2013, we started a program inside ABB called Smart Port, with a vision to make the Port Society "Greener – Safer – More Productive", driven by the investments in the Port of Rotterdam. Around that time was the first time we met Harry at the Erasmus University, since both of us were using the same term "Smart Port". The frequent meetings with Harry gave us a much wider insight in the port communi-ty, the drivers behind decisions and the bigger picture around environmental footprint and governance structure. During the years, several students of Harry performed the Master Thesis at our company. The first thesis gave an insight in the impact of peaks on power consumptions in container terminal, a topic which was well known by the market, but never seen actual impact of it. Following students focused on the energy consumption of reefers, control and governance models how to reduce the environmental impact of the ever-increasing reefer supply chain. The last active project together was in relation to a PhD study on this topic.

We very much enjoyed Harry his enthusiasm and dedication to the Ports Industry. With much pleasure we have been reading your columns, to the point, sharp and analytical! A true example of bridging the gap between university and companies with "hand on" levers to guide businesses in going forward in our vision "Greener – Safer – More Productive".

Best of Luck Harry and we stay in touch!

Patrick Vloemans

2. Salutation to Harry Geerlings from the perspective of ABB team members

Just as the Panama Canal has influenced world trade patterns, stimulating the growth of countries through maritime and port businesses, so has the career and trajectory of Dr. Harry Geerlings, who has dedicated his life to conveying the importance of the Port and Maritime Industry, including automation and environmental footprint.

It was March 2022 when I had the honor of meeting Harry as he and a group of colleagues (Ron and Bob) visited Panama to share their research with the ABB team in Panama.

I will never forget Harry's simplicity, practicality, and eloquence in explaining to an audience of students at King College the importance of ports worldwide, as well as his memorable visit to the Panama Canal, where he was able to operate the Lock Chamber of Cocolí Locks (Panama Canal expansion) from Control Building by himself.

It was a special milestone for someone who represents an extraordinary example of vocation and dedication. I wish you much success in the following stages you undertake.

Felix Fernandez

About the authors

Michele Acciaro is Associate Professor at the Department of Strategy and Innovation at Copenhagen Business School since January 2022. His research interests are sustainability and innovation, with a particular focus on shipping and ports. Until December 2021, he was Associate Professor at the Department of Operations and Technology and Director of the Hapag-Lloyd Center for Shipping and Global Logistics at Kühne Logistics University (KLU) in Hamburg, which he joined in 2013. Prior to his appointment at KLU, Michele held the position of Senior Researcher - Green Shipping in DNV's Research and Innovation Department in Norway. Between 2004 and 2010 he was Deputy Director and Researcher at the Center for Maritime Economics and Logistics (MEL) of Erasmus University Rotterdam. He holds a BSc and a MSc (cum laude) in Statistics and Economics from the University 'La Sapienza' in Rome, a MSc in Economics from Erasmus University Rotterdam (with a focus on Maritime Economics and Logistics, for which he was awarded the NOL/APL Prize for Student Excellence), and a PhD in Logistics from Erasmus University Rotterdam.

Bob Castelein is researcher and project leader in Supply Chain Development at Wageningen Food and Biobased Research. His field is delivering a contribution to the development of more efficient and sustainable food and biobased supply chains through multidisciplinary applied research projects for corporate and public sector clients. Bob received a PhD in sustainable transport policy from Erasmus University Rotterdam, whereby Harry Geerlings was his promotor. He holds master's degrees in International Economics & Business (cum laude) and Modern History & International Relations (cum laude) from the University of Groningen.

Kevin Cullinane is Professor of International Logistics and Transport Economics at the University of Gothenburg. Kevin has been a logistics adviser to the World Bank and transport adviser to the governments of Scotland, Ireland, Hong Kong, Egypt, Chile and the U.K. Prior to joining the University of Gothenburg on a permanent basis, he was appointed to the lifetime position of Honorary Visiting Professor at the University. Kevin has personally won research and consultancy projects to the value of $US 7m, many of which have informed the policies of national and/or regional governments. His experience and expertise has been recognized with an invitation from the Royal Swedish Academy of Sciences to nominate candidates for the Nobel Memorial Prize in Economic Sciences (2020-Present) and his appointment to the Civil and Construction Engineering sub-panel for REF 2014 and the Engineering sub-panel for REF2021; the UK's national research evaluation exercise.

Rommert Dekker is a full professor of Operations Research, Quantitative Logistics, and IT at the Econometric Institute of the Erasmus University Rotterdam. He was one of the four port professors supported by the Port of Rotterdam Authorities. Apart from researching reverse and green logistics, transportation and maintenance optimization, he was involved in many port related projects, like port congestion, scheduling automatic guided vehicles, designing container stacking rules, to liner shipping network design, reliability of shipping schedules, ETA predictors and hinterland related topics like synchromodality. With respect to sustainability, he participated in the development of a CO2 calculator, in multi-criteria decision making to take emissions into account, slow steaming studies to reduce emissions of ships, etc. In almost all cases he based his research on developing and analyzing quantitative methods together with Master and Phd students. Apart from teaching econometricians advance quantitative models, he is involved in the MSc program in Maritime Economics and Logistics, the MSc on Urban, Port and Transport Economics, as well as the Port Minor.

Felix Fernandez is head of projects for ABB ports and accompanied Harry Geerlings during his visit in Panama.

Jens Froese's first career was in sea service when he swopped his comfortable ship master's chair for a wooden seat in universities' lecturing halls to graduate as a survey engineer, specialized in sea survey and hydrography, and later additionally as an industrial engineer, specialized in maritime logistics. He is professor emeritus in maritime logistics from Technical University of Hamburg and in international logistics engineering and management of Jacobs University in Bremen. He used to deliver lectures as a visiting professor at a number of universities from China to Scandinavia. Research in maritime logistics covering the sea transport, the ports and pre- and post-sea transport always was an important issue of his academic career. He conducted a large number of research projects on national, European and global level focusing on special areas of the whole transport chain.

Wim Hafkamp is an environmental economist; After his master's degree in econometrics (1977), he defended his doctoral dissertation on national-regional environmental-economic modeling at the Free University Amsterdam (1983). He worked at the Economics Faculty of the University of Amsterdam (1977-1984), the Institute for Environmental Studies of the Free University (1984-1988), the environmental consulting unit of Deloitte and Touche and KPMG (1988-1995). Appointed professor of environmental and nature conservation studies at Tilburg University (1989-1995) to later become head of the Erasmus Studiecentrum Milieukunde (1994-2000). As a true transdisciplinarian he was active both in the academic world and in the world of consulting and policy advice. For governments, industry as well as environmental NGO's. Dean of what is now the Erasmus School of Social and Behavioral Sciences (2001-2005) and Erasmus University College (2018-2019). In between (2007-2015) scientific director of the Netherlands Institute for City Innovation Studies. Founder and director of Loft10 Green Living (2015) and Groenplaats De Bleuster (2021).

Hercules Haralambides is Professor of Maritime Economics and Logistics (MEL) (since 1992) having taught at 9 universities (and in 7 different countries), most prominent of which being Erasmus University Rotterdam, National University of Singapore, and Singapore Management University. Currently he is Distinguished Chair Professor at Dalian Maritime University (China), Visiting Professor at Erasmus University Rotterdam, and affiliated researcher with the Sorbonne Center for Economics – Sorbonne University. Hercules is the founder of the Erasmus Center for Maritime Economics and Logistics (MEL) (www.maritimeeconomics.com) and also the founding (and current) Editor-in-Chief of the quarterly journal Maritime Economics & Logistics (MEL). In the period 2011-2015 he was President of the Italian port of Brindisi and at the end of that period (2015) he established "Haralambides & Associates": a global maritime think-tank engaged in executive education and strategic policy analysis.

Hein Klemann is professor in economic history and international relations at the Erasmus School of History, Culture and Communications, Erasmus University Rotterdam. As an economic historian specialized in German-Dutch economic relations he analysed the position of the Port of Rotterdam, the relation between the port and the German hinterland especially the Ruhr area and Rhine navigation. On these topics he did some research himself but primarily organised research project: the Project Outport and Hinterland; Rotterdam Business and the Ruhr, 1870-2000. Besides, there is the project on the expansion of the port after World War II, especially the Second Maasvlakte. Since 2008, together with his staff and colleagues of the University of Frankfurt, he is responsible for the organization of an annually Transnational Rhine Conference on the history of this river as a major European waterway.

Karima Kourtit is assistant-professor at the Open University, Heerlen, The Netherlands. Her main scientific research is in the field of creative industries, urban development, cultural heritage, digital technology, and strategic performance management. Her academic profile is characterized by a profound involvement in evidence-based urban and spatial research on smart city policy and data metrics, by a strong commitment to educational support to young researchers and by an active role in many international scientific and managerial activities. Furthermore, she has been an editor of several books and a guest editor for many international journals, and has published a wide array of scientific articles, papers, special issues of journals and edited volumes in the field of geography and the spatial sciences. She is also managing director of *The Regional Science Academy* (TRSA).

Bart Kuipers works as a port economist at Erasmus Center for Urban, Port and Transport economics in Rotterdam. He is trained in economic geography and wrote a dissertation on the port-based chemical industry in the port of Rotterdam, the scenery of his youth. His career is centered around policy advice. First at the Traffic and Transport Advisory Service (AVV) within the Ministry of Transport, Public Works and Water Management, then at Delft University of Technology, research institute TNO and now at Erasmus UPT. He is interested in container logistics, trade and investment patterns, deep-sea and inland ports and inland shipping. He gets particularly enthusiastic when he conducts research into topics that are completely new to him, such as the impact of the investment in a nuclear reactor in the port of Rotterdam; a research project commissioned by SmartPort, carried out in collaboration with Professor Harry Geerlings.

Peter Nijkamp is emeritus Professor in regional and urban economics and in economic geography at the VU University and associated with The Open University of the Netherlands (OU), Heerlen (The Netherlands), and the Alexandru Ioan Cuza University of Iasi, Iasi (Romania). He has published more than 2000 articles and books in the field of regional development, urban growth, transport and the environment. He is a fellow of the Royal Netherlands Academy of Sciences (KNAW). He has served as president of the governing board of the Netherlands Research Council (NWO). In 1996, he was awarded the most prestigious scientific prize in the Netherlands, the Spinoza award. He is vice-president of *The Regional Science Academy* (TRSA) and involved in many international research activities. He was one of the PhD supervisors of Harry Geerlings.

Theo Notteboom is Professor of port and maritime economics. He is Chair Professor 'North Sea Port' at Maritime Institute of Ghent University, and a Professor at Faculty of Business and Economics of University of Antwerp and Antwerp Maritime Academy and. He is vice-president (2022-ongoing) and past President (2010-2014) of International Association of Maritime Economists (IAME). He is co-director of Porteconomics.eu and member of the Risk and Resilience Committee of International Association of Ports and Harbors (IAPH). He is Associate Editor of Maritime Economics & Logistics and a member of the editorial boards of eight other leading academic journals in the field. He is one of the most cited maritime economists in the world. Theo Notteboom has been involved as promoter or co-promoter in more than 100 academic research programs on the port and maritime industry and logistics topics.

Sumet Ongkittikul is research Director for Transportation and Logistics Policy, Thailand Development Research Institute. He holds a PhD in Social Sciences (Transport Studies) from Erasmus University Rotterdam, the Netherlands. His main research interests are in the fields of transport policy, transport regulation, logistics, and road safety. His current research includes railway regulation; mass transit planning and policy, financing transport infrastructure; urban bus regulatory reform; public transport safety; and road safety policy.

Mats Pauwels was a student Maritiem en Logistiek Management at University of Antwerp until 2021. Subsequently, he became Shipping Administrator Key Accounts Volvo at DB Schenker.

Jacko van Ast is an Associate Professor Public Administration/Law, ESSB, at the department of Public Administration and Sociology, Erasmus University Rotterdam (and former colleague at the Erasmus Studiecentrum voor Milieukunde and later the Program Public Administration at the Erasmus University Rotterdam).

Ron van Duin was appointed applied research Professor in Port and City Logistics at Rotterdam University of Applied Sciences in 2016. He is currently conducting practice-oriented research in the field of ports, multimodal transport, ICT and city logistics in the port city of Rotterdam. Since 1994 Ron works at the Delft University of Technology (Faculty of Technology, Policy & Management in the same fields with a stronger research interest in the development of models. Ron supervises many logistics master thesis students (> 250), PhD students (3), author of many scientific articles (>200) and reviewer/editor of various journals.

Thierry Vanelslander (1975) is a professor at the Department of Transport and Regional Economics. He graduated as a doctor in Business and Economics at the University of Antwerp. Until 2013, he was holder of the BNP Paribas Fortis chair on transport, logistics and ports. Until halfway 2009, he was director of the Research Centre on Freight and Passenger Transport at TPR. He is currently course co-ordinator for the course 'Port Economics and Business' at C-MAT, and 'Logistiek en Transport', 'Maritieme en Haveneconomie' and 'Antwerp Rail School' at University of Antwerp. He furthermore is chair of the Special Interest Group A2 and Topic Area A (Transport Modes) Manager of the World Conference on Transport Research Society. He equally is chair of the Freight & Logistics Committee of the European Transport Conference.

Frans van Nispen tot Pannerden [1951] started his career at the Dutch ministry of Finance before returning to academia. He has been involved in the joint PA-program of the EUR and LU from the mid-80s and is co-founder of the IMP-program. Furthermore, he has been affiliated with GMU in Fairfax, Virginia and EUI in San Domenico di Fiesole, Italy. Currently, he serves on the board of the family estate in the Liemers, which has nature-inclusive agriculture in its colors.

Albert Veenstra is a professor of Trade and Logistics at the Department of Technology and Operations Management of the Rotterdam School of Management (RSM) Erasmus University Rotterdam. Albert is active in research in trade and logistics, with a particular focus on e-commerce. he has a background in econometrics and maritime economics. Albert is teaching in the field of global transport and logistics and ocean shipping. he is also scientific director of Dinalog, the Dutch Insititute of Advanced Logistics.

Johan Visser is senior researcher at the Netherlands Institute for Transport Policy Analysis (Kennisinstituut voor Mobiliteitsbeleid) at the Ministry of Infrastructure and Water Management and participates in the Transport and Mobility Research Group of Faculty of Civil Engineering, Delft University of Technology in the Netherlands. His background is civil engineering, and his interests are infrastructure planning with a focus on economic and technical issues, such as freight transport innovation, economic and spatial impacts of new infrastructure, seaport and airport planning and cost-benefit analysis. He is president of the International Society of Underground Freight Transport and other Capsule Pipelines (ISUFT) and director of the Institute for City Logistics.

Patrick Vloemans is managing director of the legal entities of ABB (global technology company) in Panama, Central America, Caribbean, Colombia and Ecuador, with a focus on streamlining business processes and business growth along the portfolio. He is the legal representative and Profit and Loss responsible within a 300 FTE´s organization. He holds a master's degree in electrical and electronics engineering of Delft University of Technology.

Jos Vroomans (1955) studied at the Teachers Training College in Delft and obtained a master's degree in educational and political geography at the Vrije Universiteit of Amsterdam (1983). For over 25 years he worked in marketing and sales departments of PTT Post (TNT Post, Post NL) and SelektMail (Deutsche Post). Starting 2004, he has been teaching Marketing, Marketing Strategy and Sales at the Faculty of Business, Finance and Marketing at The Hague University of Applied Sciences. For the department International Business Studies, he was involved in workshops, teaching an international group of students how to assess business problems and business opportunities. In January 2021 he received his PhD at the Erasmus University of Rotterdam with Harry Geerlings as his promotor. His thesis researched the relationships between ports and their respective cities. For that, a comparison was made between the port/port cities of Antwerp, Rotterdam and Hamburg. Since September 2020 he is retired but is still publishing papers.

Bart Wiegmans obtained his PhD in Economics from the Vrije Universiteit Amsterdam in 'performance conditions for container terminals'. After his PhD he worked as a consultant for BCI Global and for KPMG before returning to the University of Utrecht. Next, he worked as coordinator at the OTB Research Institute and at the TU Delft faculty of Civil Engineering. He wrote over 100 papers and several books and acted as reviewer and guest editor for several high impact transportation and geography journals. His interests are in innovations in intermodal freight transport and ports connected to cost models, performance and efficiencies. In his current role he acts as Policy Advisor Ports and Economics at the Province Noord-Holland and still works occasionally on academic papers.

Rob Zuidwijk is a Professor of Global Supply Chains and Ports at the Department of Technology and Operations Management of the Rotterdam School of Management (RSM), Erasmus University Rotterdam. With two decades of experience in academic research, education and research projects with industry, his focus is on ports in global networks. He is especially interested coordination for sustainable global supply chains; synchromodal freight transport networks; and inter-organizational systems in logistics. His methodological focus is on modelling and the use of quantitative methods to solve real-life problems.

This liber Amicorum is dedicated to prof.dr. Harry Geerlings who, starting February 2023, has attained the status of emeritus professor in the Governance of Sustainable Mobility at the Department of Public Administration and Sociology of the Erasmus University Rotterdam. Colleagues and former colleagues, former PhD-students, academic contacts, and professionals with whom Harry worked closely together during his academic career, pay tribute to him by contributing to this book.

A wide array of topics passes by. Topics that can be traced back to the domains that were covered by Harry: governance, sustainability, logistics, and of course the maritime sector, especially ports.

The response to the inquiry to contribute to this book was heart warming and as such can be seen as an indicator how well Harry Geerlings is appreciated.

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