

TEACHING NOTES



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The teaching materials is developed with co-financing from Topsector Logistiek.

Contents

1	Literature overview: Fresh logistics and modal shift.....	4
2	Research: Accelerating modal shift in fresh corridors.....	5
2.1	Sense of urgency.....	5
2.2	Bottlenecks	5
2.3	Multiple feedback loops	6
2.4	Solutions.....	7
2.5	Collaborative action.....	9
3	Learning objectives	10
4	The educational boardgame: CO ₂ NGESTION	11
4.1	Narrative	11
4.2	Playing field.....	12
4.3	Solutions dashboard	13
4.3.1	Port Solutions.....	13
4.3.2	Fresh corridors solutions.....	14
4.3.3	Building solutions	14
4.4	Transport node cards.....	15
4.4.1	Kwartet and moving up the solutions dashboard	16
4.4.2	Joker transport node	17
4.5	Role of players.....	17
4.5.1	The use of Superpowers	18
4.5.2	Changing roles.....	21
4.6	Congestion cards	21
4.6.1	Spill-over effect scenario's	22
4.7	Actions per player	23
4.7.1	Move to Neighbouring transport node	24
4.7.2	Visit a transport node by flying.....	25
4.7.3	Remove a CO ₂ unit.....	25
4.7.4	Share information.....	26
4.7.5	Develop a corridor solution.....	27
4.7.6	Example combination four actions per turn	27
4.8	Beginning situation	28
4.9	Playing turns	29
4.10	Winning and losing while playing CO ₂ NGESTION	29
4.11	Increase difficulty of the game.....	29
4.11.1	Increasing competition – Making players responsible for one corridor....	29
4.11.2	Increasing the congestion – Adding Congestion Event cards	29
	Appendix 1: Terminology	30
	Appendix 2: Shopping list for a game set	33
	Appendix 3: Congestion Cards (pdf).....	34
	Appendix 4: Transport node Cards (pdf).....	34
	Appendix 5: Role cards (pdf).....	34

Introduction

To achieve the **Paris climate goals**, it is important that sectors commit to making production, transport, and other aspects where greenhouse gases can be reduced more sustainable. The horticultural sector also needs to work hard on this. **Cross-sectoral collaboration** between the horticultural sector and port logistics sector is needed to make fresh logistics more sustainable. Part of the transition to sustainable transport is a **modal shift** from road transport to more sustainable alternatives such as inland shipping and rail. In the past, several initiatives and innovations have been set up to realize this modal shift. Examples are Coolrail, Greenrail and Greenbarge. However, these initiatives do not lead to a **structural, sustainable modal shift**. Erasmus UPT recently completed a study 'Accelerating modal shift in fresh produce logistics; on the road together on reliable and sustainable fresh corridors for SmartPort.

We wanted to translate the findings and research recommendations into an **educational boardgame**, with which would like to convey the importance of **chain collaboration** and integration. The boardgame is called **CO₂NGESTION** referring to the congestion in the fresh corridors and the pollution of CO₂ by transport. It is a collaborative game, which makes this game different from most other games. In the first chapter existing literature related to fresh logistics and modal shifts is highlighted. The second chapter present a list of terminology related to fresh corridors and the modal split. In the third chapter the research about 'accelerating modal shift in fresh corridors' is shortly elaborated. In this chapter the theories and findings from the Erasmus UPT study are presented. In the fourth chapter, the learning objectives and lesson plans of the game are provided. In chapter 5, the game set-up educational boardgame CO₂NGESTION is elaborated.

Materials consist of:

- Teaching notes CO₂NGESTION (PDF format):
 - Summary of Erasmus UPT (Accelerating modal shift in fresh logistics, in dutch: VERSnellen modal shift)
 - Literature overview consisting of references to articles about fresh corridors and the modal split. Available in this document.
 - The research of Erasmus UPT: The research refers to the literature shown in the literature overview and provides actual insights about the challenges regarding the modal split on the fresh corridors. Summary available in this document
 - Explanation on the educational boardgame CO₂NGESTION. Available in this document
- Slidedeck for gaming sessions: short elaboration on the theory and explanation of the educational boardgame (Powerpoint format)
- Printing cards (role cards, transport node cards, congestion cards) (PDF format)
- Printing board (PDF format)
- Printing dashboard (PDF format)

Pawn and units will have to be purchased separately. A good website for this is <https://allesvoormijnspel.nl/>. The shopping list for one game is as follows:

1 Literature overview: Fresh logistics and modal shift

The existing literature regarding fresh logistics and modal shift is divided in four pillars: Negative modal shift, Modal shift potential, Cool chain and Reefer transport and Coordination mechanisms in port logistics chain. The literature can be used as teaching materials for educational courses about fresh logistics and modal shifts. The overview of the literature is presented in table 1. The research of Erasmus UPT has examined the existing literature and provided new actual information regarding the fresh corridors and the modal shift.

Table 1: Literature overview

Topic	Authors	Title
Negative modal shift	Blok, P.M. et al (1990)	Vervoerwijzekeuze in het goederenvervoer. Een inventarisatie van keuzefactoren en potentiële verschuivingen in de modal split.
	Bagchus, R.C. & Kuipers, B. (1993)	European Shortsea Shipping. Proceedings from the First European Research Roundtable.
	Filarski, R. (2004)	The rise and decline of transport systems. Changes in a historical context.
Modal shift potential	Jonkeren, O. (2020)	Modal shift in het goederenvervoer: een overzicht van ontwikkelingen en beleidsinstrumenten.
	TNO (2020)	Succesvolle mobiliteitstransitie met adaptieve reisbegeleiding. Mobiliteitstransitie vraagt om beleidsmatig navigeren naar gewenste maatschappelijke bestemming
Cool chain and reefer transport	Castelein, B. (2020)	Accommodating Cold Logistics Chain in Sea port Clusters: The development of the reefer container market and its implications for logistics and policy.
	De Leeuw van Weenen et al (2019)	Impactschatting risico reverse modal shift containervervoer.
Coordination mechanisms in port logistics chain	De Langen, P.W & Van der Horst (2008)	Coordination in Hinterland Transport Chains: a major challenge for the seaport community.
	Van den Berg, R. (2014)	Handboek naar Intermodaal Vervoer
	Van Tulder, R., et al (2012)	Creating partnering space: Exploring the right fit for sustainable development partnerships

A list of frequently used terminology is included in the appendix of these teaching notes.

2 Research: Accelerating modal shift in fresh corridors

The main objective of the Erasmus UPT study was to provide insight into the bottlenecks that prevent large-scale multimodal fresh corridors from getting off the ground. This is done by discussing past initiatives with corridor parties. These insights give new modal shift initiatives a much greater chance of success. The main research question was:

“Why don’t the initiatives to organize multimodal transport in fresh-fresh corridors lead to a structural modal shift?”

To answer the research question, the researchers first examined the existing literature that shown in table 1. Then they examined whether there is a sense of urgency for a modal shift throughout the supply chain (see 1.2). In the following section 2.2., the bottlenecks in the logistics operations are presented. Then in section 2.3., the feedback loops that are required to allow modal shift are discussed. Once the bottlenecks and feedback loops in the logistics operations are elaborated, the solution opportunities are elaborated in section 2.4. In the last section the required collaborative action including the relevant actors are explained.

2.1 Sense of urgency

There is a **sense of urgency** for modal shift in the fresh chain. The following issues necessitate the supply chain partners to collaborate more intensively, both horizontally as well as vertically:

- Congestion across the supply chain
- Climate adaptation
- Consumers demand for ecofriendly logistics.

2.2 Bottlenecks

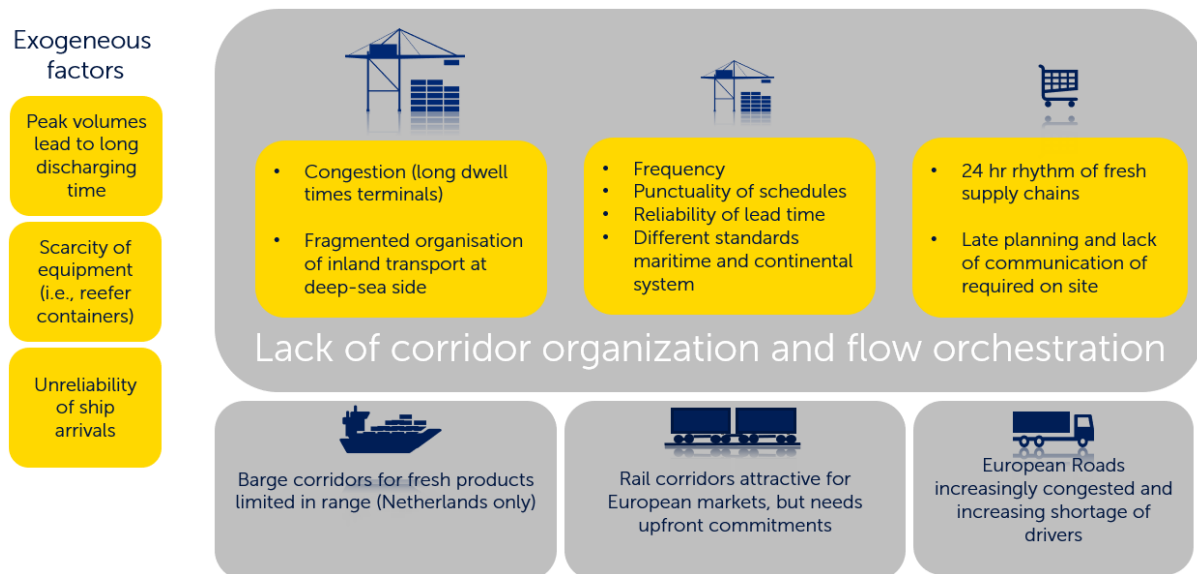
In the logistics operations there are many different bottlenecks. The bottlenecks are shown in figure 1. The bottlenecks are classified in exogenous factors, corridor bottlenecks and modalities. The exogenous factors are as follows:

- Peak volumes lead to long discharging time.
- Scarcity of equipment (e.g., reefer containers)
- Unreliability of ship arrivals

Based on a corridor perspective, the lack of organisation and flow orchestration in the corridors leads to inefficiency. In the port the deep-sea container terminals are congested which causes long dwell times. Besides that, the organisation of inland transport at the deep-sea side is fragmented. In the hinterland there is a lack of frequency of transport flows and the schedules are not punctual. The reliability of lead times is an important factor to improve the scheduling. Additionally, the standards of the maritime and continental systems should align better for improvements in the hinterland. At the end of the corridor, the retailers have late plannings and there is a lack of communication.

The different transport modalities – barge, train, and truck – have their own limitations and face different bottlenecks. The barge corridors for fresh products are limited in range. The rail corridors are existing and are considered attractive but needs upfront commitment from shippers, sometimes one year ahead. The roads for truck transport are increasingly congested and there is an increasing shortage of truck drivers.

Figure 1: Bottlenecks in the logistics operations



2.3 Multiple feedback loops

Figure 2 shows a simplified diagram that depicts three interconnected subsystems between, greenport, mainport, and inland ports. The feedback loops are interrelated and are required to allow modal shift on fresh corridors. On the continental side (**green area**) we see parties that focus on product quality and availability. Calling up orders and delivering them as quickly as possible in the European hinterland imposes such restrictions on hinterland transport that rail and road transport lose out to road transport. Many chain parties currently experience that the necessary feedback loops do not take place, at least not between parties in the chain. This leads to disruptions, mismatch of schedules and a decline in service levels, and ultimately to a lack of confidence in intermodal solutions.

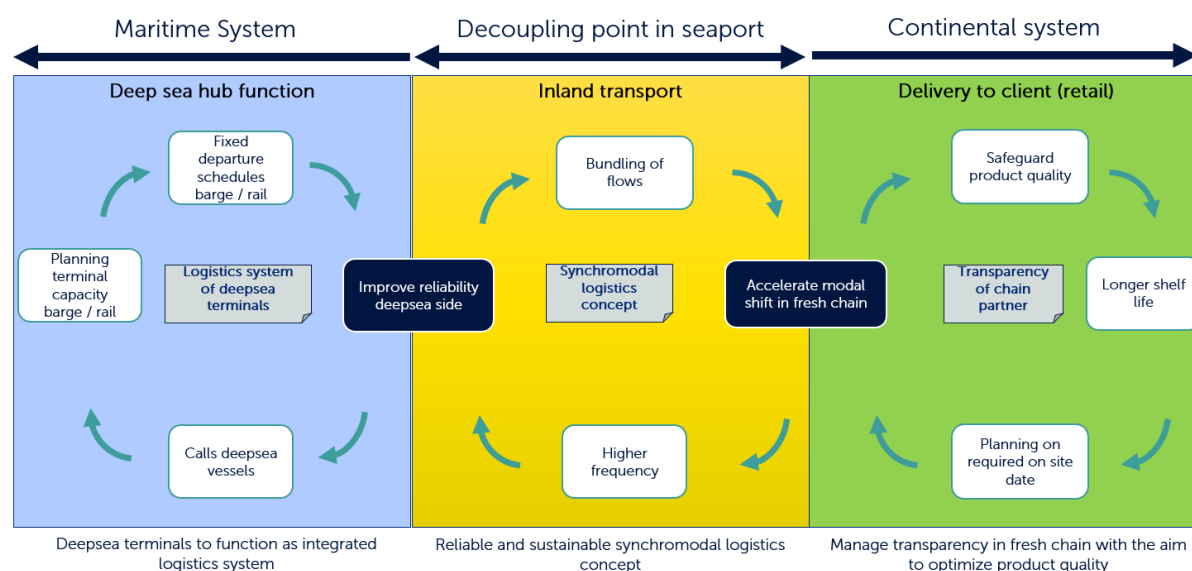
On the seaside (**blue area**) we see major coordination problems to process peak volumes. Shipping companies are dominant in this logistics system. The logistics system revolves around maximizing the turnover rate of container ships and containers, the most expensive assets in the system. All containers go through the same process steps and experience the same bottlenecks, regardless of the value or time sensitivity of the cargo contained in the container. The flows of goods passing through Rotterdam represent a tangle of thousands of supply chains, where goods are directed through the same gateway at the same time. There is no differentiation by load type, which requires different speeds. Due to the erratic arrival patterns of deepsea vessels, departure schedules for trains and inland shipping cannot be guaranteed, with negative consequences for the service levels. Shippers are then hesitant to transfer cargo to rail and inland shipping. On the contrary, reliable departure schedule for rail and inland shipping from deepsea terminals would provide more confidence for shippers, resulting in bundling of flows and a higher frequency.

If we consider the decoupling point in the port (**the yellow**) together with the hinterland logistics, two relevant points can be recognized. Point (1) is located on Maasvlakte 1 and 2 where the deep-sea terminals should function much more as one logistics system, including customs and inspection services. The current configuration of shipping companies calling at multiple terminals, as well as shippers using multiple shipping companies for their supply, results in fragmentation of cargo flows. This means that

opportunities for bundling are not taken advantage of. If the reliability of the arrival of ships is improved, the planning at the terminals can also be improved, which in turn improves that of inland shipping and rail. They in turn can guarantee better reliability towards the receiving party. Improvements at this point (1) are needed to bundle more cargo to the hinterland.

Decoupling point 2 is located at the point where fresh products are placed on the continental system, which mainly runs on 45ft reefer containers and box trailers. This can be a terminal close to the production location. In the port of Rotterdam, the hub is the Coolport cluster with RSC, RST, Lineage Logistics and Waalhaven Group, but C. RO's Brabant port also has important facilities for putting box trailers on the track. In addition, system integration with Venlo and Tilburg is necessary, as well as strategically located hubs in the hinterland (e.g., Nuremberg, Berlin). Freshpark Venlo is a logical hub for both destination (by road and inland shipping) and point of departure (by rail and road) of continental fresh logistics, such as to Milan. Investments made there benefit the quality of service for the entire logistics system. Tilburg is an alternative for freight transport by train to Germany, Poland, and Russia.

Figure 2: Multiple feedback loops



2.4 Solutions

To accelerate the modal shift and solve the bottlenecks, solutions must be implemented at various levels: operational, planning and policy and throughout the entire chain: on the sea and land side of deep-sea terminals, the hubs and on the hinterland connections. These interventions interlock. There are technological innovations at implementation level, but it is also about better coordination, more effective coordination, being able to calculate a business case. The solutions are summarized in table 2.

Solutions in the seaport should focus on managing and planning container handling on the Maasvlakte as a system, in particular internal transport. Fresh loading requires more customization, which could translate into faster container handling, the extension of free time on reefer containers, better cooperation with customs and better and integrated hinterland planning. A good example of this is the virtual crane provided by ECT and used by barge operators to improve the reliability of their sailing schedules.

The modal shift can be accelerated by improving the ‘turntable’ function between the maritime transport system and the continental transport system. Cool Port in Rotterdam is the obvious location for this, but Venlo and Tilburg should also be involved. In Venlo and Tilburg, new transport concepts are being set up based on innovations such as Cargobeamer and Roadraillink. These inland ports lack empty depots for reefer containers. Not only logistics companies, but also shippers ask to be able to collect and return reefer containers in a nearby empty depot.

Table 2: Solutions

	Seaport	Decoupling point	Hinterland connections
Policy	<ul style="list-style-type: none"> Managing Maasvlakte terminals as one system, collaborating on internal transport More attention to customization than to bulk in the port of Rotterdam 	<ul style="list-style-type: none"> Set up more empty depots for reefers further in the hinterland in collaboration with shipping companies. Level playing field for transport modes. Subsidies only for start-up investments in corridor connections Multimodal access to industrial sites 	<ul style="list-style-type: none"> Fresh hubs in the European hinterland Joint approach and promotion of joint corridors The government's role is to keep the market open, based on financial incentives, not complicated subsidies Network strength is in value, not volume Put SDGs central, but with patience
Planning	<ul style="list-style-type: none"> Increase the number of days off (freetime) of reefer containers Virtual crane for inland shipping at deep-sea terminals leads to better planning for sailings Collaboration in quay planning at the deep-sea terminal for inland shipping 	<ul style="list-style-type: none"> Cargo beamer as basis for new transport concept on turntables, for example RSC and Venlo. 	<ul style="list-style-type: none"> Sharing the risk of a semi-open train with a few partners Bundling leads to a better balance in relation to seasonal patterns Train timetable by purchasing train paths Balancing train by using truck and short sea Learning from road transport companies, who know the 24-hour rhythm of retail well
Performance	<ul style="list-style-type: none"> Improving the reliability of approaching container ships on the deep-sea side Point-to-point connections provide higher levels of reliability 	<ul style="list-style-type: none"> Roadraillink (R2L) standard pocket wagon for transporting non-cranable semi-trailers (lorry to rail) Venlo as an ex-NL hub on the Rhine-Alpine corridor 	<ul style="list-style-type: none"> Greater availability of reefer containers (in the hinterland) Extending opening hours of warehouses/ripening houses Tariff for handling inland shipping at the deep-sea terminal Gensets on railcars for reefer containers

In the hinterland, the solutions should focus on a joint approach and promotion of so-called 'joint corridors'. The intention and ambition to 'do the climate a service' must be leading in this. The parties we spoke to want to focus on sustainability and develop logistics concepts. A sound business case is of course necessary, but it must be based on 'shared risk, shared value' principles. By bundling cargo, fixed train paths can be purchased, which can be used to balance seasonal patterns. This can only be calculated on shared value cases. The role of the government is to keep the market open. European road transport seems to be discouraged by the mobility package, but it plays an important role in getting the cargo to its destination on time when there is an 'overflow'. That means daily insight into commitments with retailers. On a structural basis, the overview of cargo flows to destinations in Europe requires the ability to determine fresh hubs in the hinterland.

2.5 Collaborative action

Actors agree that a collaborative action is required both on national as well as on European logistics corridors. The retailers have a leading role, the logistics companies an enabling role and the public authorities a supporting role. The following partnering spaces are shown in figure 3. In A there is a lack of services, often a lack of equipment. In B, there is a lack of (bundling) volumes) and in C, there are individual solution but there is a lack of economies of scale.

Leading role: Retailer

- Set ambition for modal shift
- Determine pace of transport

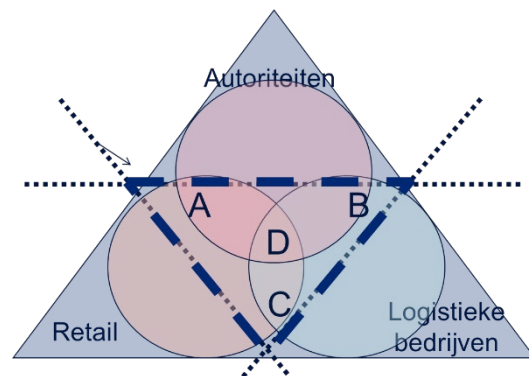
Enabling role: Logistics companies

- Set up service network
- Share infrastructure and equipment
- Make equipment available
- Contingency planning

Supporting role: Public authorities

- Bring people together around the table.
- Support startup phase of initiatives

Figure 3: Roles and partnering spaces



3 Learning objectives

The designing and developing of the educational case study in a boardgame form has the following set of learning objectives:

Collaboration skills

- Conflicting objectives between supply chain partners
- Trade-offs between cooperation versus competition
- Role attribution

Transition management

- Dilemmas of transition pathways
- Environmental effects
- Acceleration effects
- Short-term versus long-term thinking and acting
- Sense of urgency

Logistics management

- Understanding the relationship between hinterland and port development
- Digital solutions and energy transition solutions that contribute to making logistics more sustainable and efficient
- Corridor development in Europe
- Spill-over effects of congestion on the corridors.

4 The educational boardgame: CO₂NGESTION

4.1 Narrative

Jan Michels has been working in a trading company in Rotterdam for fruit and vegetables for decades. At present he is director of the company and widely known in the port logistics industry in Rotterdam. His company is one of the largest trading companies for fresh produce from all over the world. The main trade is Latin America into Europe, mainly bananas, mangos, citrus fruits, and melons. 180,000 of reefer containers from Brazil, Colombia, Ecuador, and Peru arrive in the Netherlands every year, with Rotterdam taking 80% of it.

He understands the market dynamics as no other, because he is in direct contact with the largest retailers in Europe. For years now he'd seen projects come and go. Most of these modal shift projects failed to bring a structural modal shift. Yet, he believes the time is right now. The demand for sustainable transport solutions is imminent, urgent, and irreversible. More than 600,000 truck movements per year are made from the port of Rotterdam into the European corridors, which causes traffic congestion. But apart from that the shortage of truck drivers is becoming an issue. Even trucking companies acknowledge that it doesn't make sense for a long haul to have a driver on the truck. Some of these companies are experimenting with trailer-on-train concepts, others are using the short sea connections as an alternative. None of these concepts can beat the flexibility of road transport. Then there is the push from the retailers themselves. To satisfy consumers their supply chain footprint will have to be smaller. and a modal shift from truck to rail (next to barge and short sea) is a significant part of it.

Recently, Michels organized a stakeholder meeting where 20 people from across the industry, both traders, terminal operators, freight forwarders, trucking companies and rail operators met to pull off a new business initiative, called CO₂NGESTION.

Inga Persson; supply chain manager at RetailChain:

As a retailer we actively marketed the trials on train and barge. We have put labels on our packaging to inform consumers rail transport was used: "the transport footprint for this product is 65% less CO₂ emission than truck". What we are doing is that we want to have a hub in NL, where we have a system to connect trains with fresh produce from Holland with dry products to our stores in Scandinavia. We also look at partners to go the other way around. It is a tremendous work, but we want to do this.

The first priority is to solve the bottlenecks on the European corridors. In some years, there will be scarcity on European transport networks. This cannot be done by players individually but required collaborative and coordinated action. The first movers will have the biggest benefits.

Recently, Inga Persson organized a stakeholder meeting with Jan Michels and other stakeholders from across the industry, both traders, terminal operators, freight forwarders, trucking companies and rail operators to pull off a new business initiative, called FreshXL.

4.2 Playing field

The playing field presents fresh logistics corridors (see figure 4,5 and 6). The port and the four connecting fresh corridors need to become more reliable and greener because of the lack of efficiency and the CO₂ emissions in the supply chain. If the four corridors do not become more sustainable, the supply chain becomes congested and pollutes even more CO₂. Consequently, the climate goals for the transport sector will not be achieved and climate change becomes an even bigger problem. The global warming will cause more extreme weather circumstances such as floods, forest fires and storms. Therefore, the transportation sector will be put under pressure if the goals are not achieved, and new regulations will be introduced to the sector. Less transportation will be made possible and the pollutive transport operators will have to close their business.

Figure 4: Playing Field CO₂NGESTION



All the mapping materials are from google maps

Figure 5: The port and the four fresh corridors

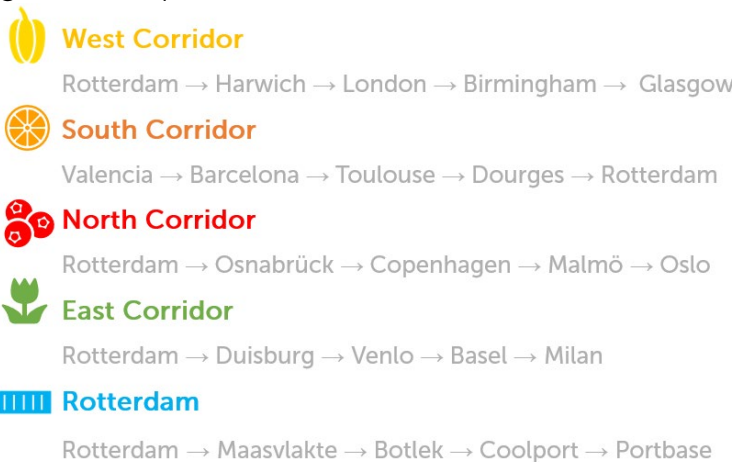


Figure 6: Elaboration Port transport nodes

M	Maasvlakte: The shunting yard and the dedicated barge berth can be built on the Maasvlakte for developing an intermodal transport built.
B	Botlek: The Botlek area represents together with Europort the industrial areas of the Port of Rotterdam. The industries are devoted to producing energy and chemical products. The solutions for the energy transitions needs to be implemented in this area.
P	Portbase: Portbase is located in the city center of Rotterdam. The digital solutions for the Port Community System are developed here.
C	Coolport: The Waalhaven and the Eemhaven are important transport needs for the fresh logistics towards the hinterland. The functionalities for the transport hub should also be applied in this area.

4.3 Solutions dashboard

The solutions dashboard in figure 7 presents the solutions that need to be implemented to make the four corridors and the port itself more sustainable and efficient. The solution dashboard consists of shuttle connections, digitalisation, and the energy transition. The solutions of the dashboard are shortly elaborated in the next paragraphs. First, the solutions in the port are explained and then the solutions in the fresh corridors. In the last paragraph is explained how the solutions are built in the solutions dashboard.

4.3.1 Port Solutions

The solutions that can be implemented in the port are diverse and the players learn about these solutions during the lecture. The following elaboration of the solution provides a definition and/or examples:

- **Shuttle Connection:** A shuttle runs on fixed departure schedules from the terminals and contributes to the modal shift, thereby reducing CO₂. Building shuttle connections in the port consists of a shunting yard on the landside and dedicated barge cranes and berths on the seaside of the deep-sea container terminal.
- **Digitalisation:** Building a Port Community System (PCS) for trading companies and logistics companies in the fresh products
- **Energy transition:** Building production, storage, and transport facilities for the renewable energy.

4.3.2 Fresh corridors solutions

The same holds for the corridor solutions, there is a variety of solutions that contribute to making the corridor more efficient and sustainable. The following elaboration of the solution provides a definition and/or examples:

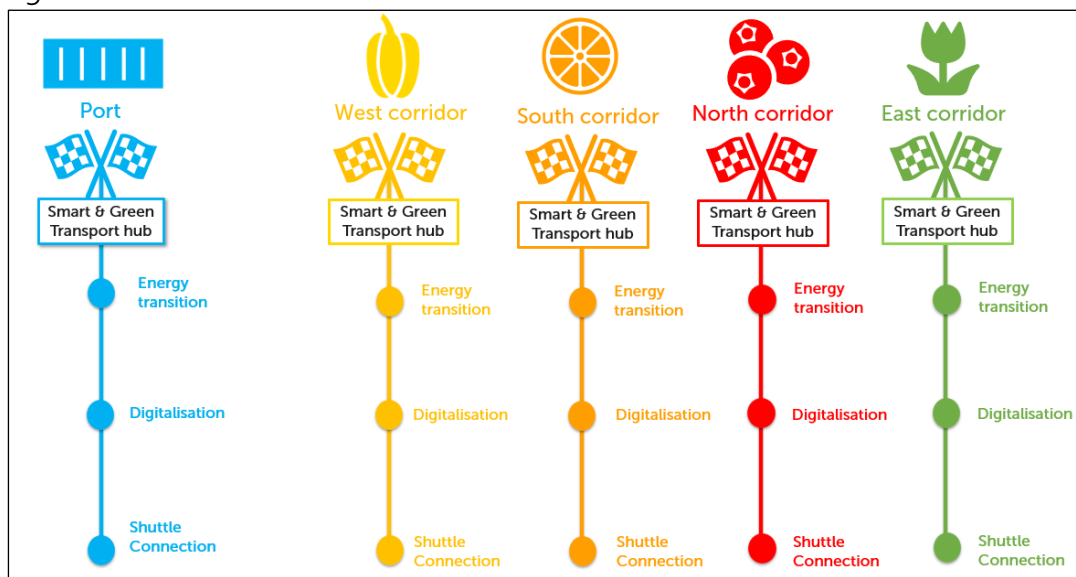
- **Shuttle Connection:** The bundling of the containers on a train or an inland barge leads to a lower CO₂ emission per container.
- **Digitalisation:** Building a platform of dashboards for information services on the corridors connected to the Port of Rotterdam.
- **Energy transition:** Building fuel stations and infrastructure for renewable energy on the corridor.

4.3.3 Building solutions

The fresh corridors become more efficient and sustainable by implementing the solutions. The players build the solutions with transport node cards. These cards are explained in section 4.4. The solutions should be executed in the following order:

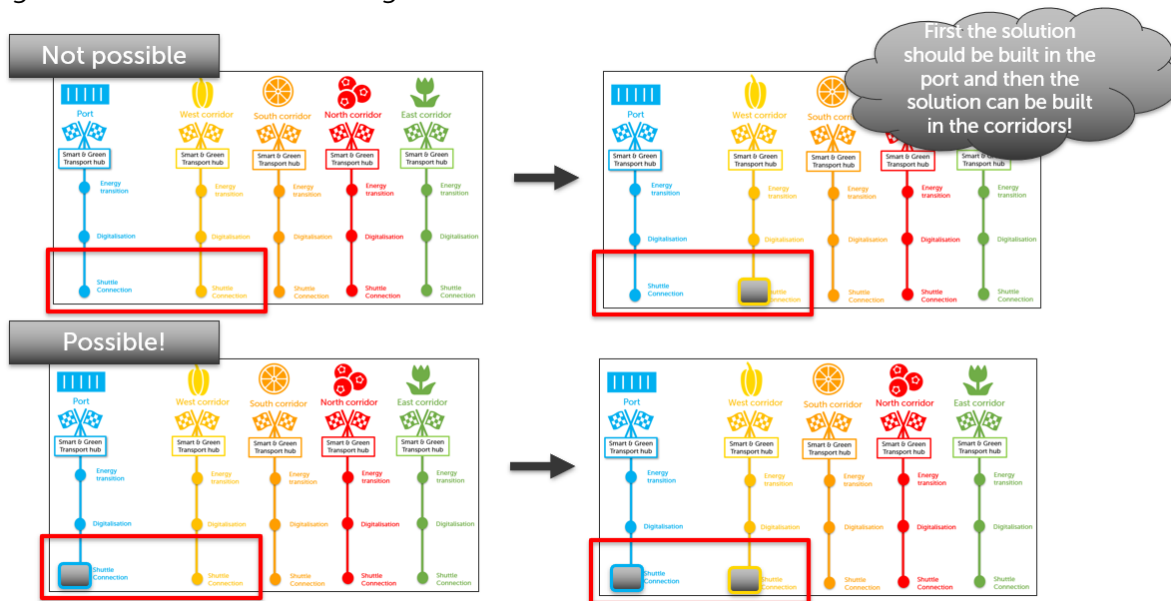
1. Establish the shuttle connection
2. Develop digital software solutions
3. Build the facilities for the energy transition

Figure 7: Solutions Dashboard



Considering that the port is a pivotal point on fresh corridors, first the solutions should be implemented in the port. Once the solution is built in de port, the solutions can be built for the fresh corridors. For example: If the player wants to build a transport hub on the West corridor, first the transport hub should be built in the port (see figure 8).

Figure 8: The order of building solutions on the solutions dashboard



When players are going to build a solution, an extra learning element can be added by requiring players to provide an example for the solution itself. These are written out in the following format (Port example) while playing:

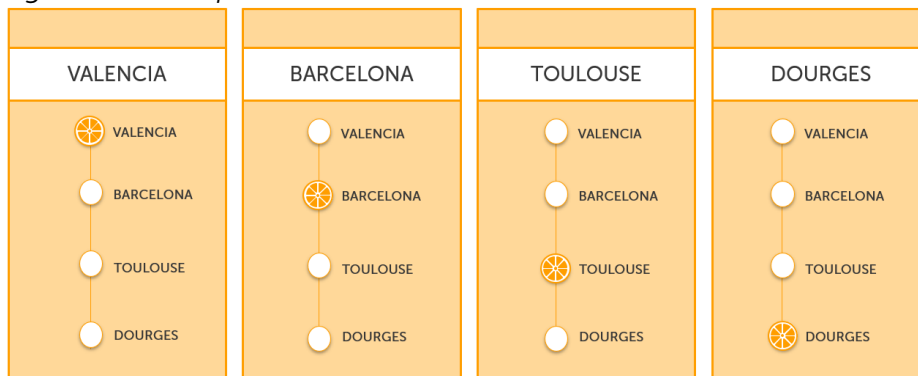
Figure 9: Fill-in form port Solution Dashboard

<p>Port</p> <p>Smart & Green Transport hub</p>	<h3>Filling in the form of solutions!</h3>
<p>Energy transition</p> <p>Digitalisation</p> <p>Shuttle Connection</p>	<p>Solution Energy Transition in the port:</p> <hr/> <p>Solution Digitalisation in the port:</p> <hr/> <p>Solution Shuttle Connection in the port:</p> <hr/>

4.4 Transport node cards

In the game the port and each corridor consist of four transport nodes. The corridors and the corresponding transport nodes are presented in figure 5. The transport node refers to a city on the corridor which is an import transport hub for the fresh products. The whole corridor including the four transport nodes should be brought together to build a solution. This means that every transport node is needed to build a solution. Collect a 'Kwartet' to build a solution (see figure 10). Each transport node card is in the game six times. Each solution needs a 'Kwartet' which is explained in the next section. There are also jokers in the game which are explained in 4.4.2.

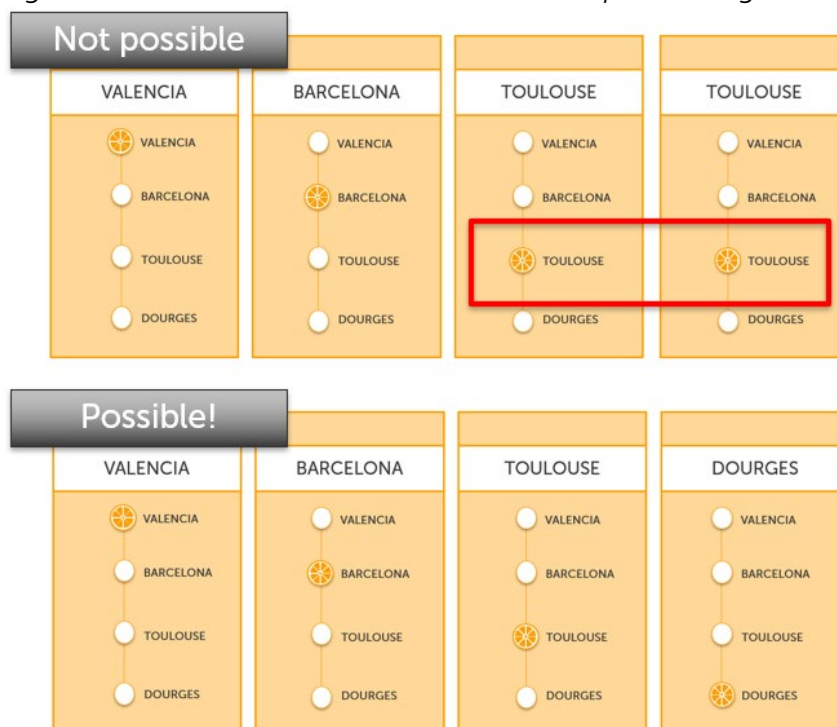
Figure 10: Transport node cards of the South Corridor



4.4.1 Kwartet and moving up the solutions dashboard

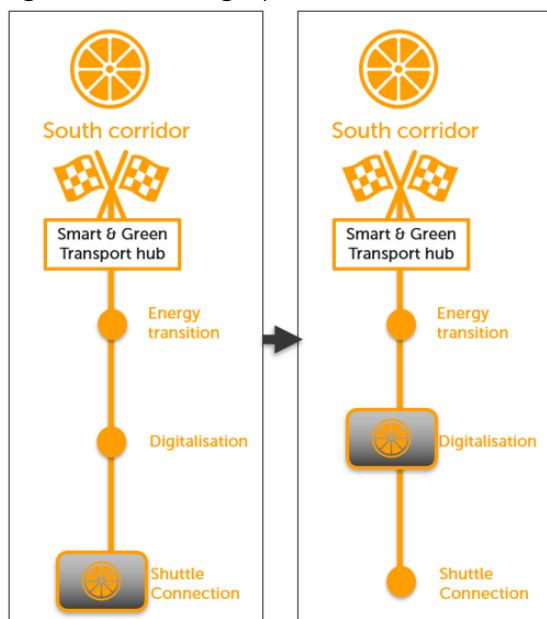
Each transport node card is in the game six times. Each solution needs a 'Kwartet'. The kwartet should consist of the four different transport nodes because the whole corridor is needed for implementing a solution. In figure 11 is illustrated the correct use of a kwartet for implementing a solution.

Figure 11: The correct use of a kwartet for implementing a solution



Once the player has collected a kwartet and is going to build a solution. First, the player has to provide an example of the solution by filling in the form (see figure 9). Then the developer on the solution dashboard can be moved upwards as shown in figure 12. In this figure the south corridor is represented, and the shuttle connection solution is already built. The next move is building a solution for digitalisation in the South corridor. If the player has made a kwartet is made and has provided an example of a digitalisation tool by filling in the form (see figure 9), the developer moves upwards.

Figure 12: Moving upwards on the solution dashboard



4.4.2 Joker transport node

Every corridor has a joker transport node. The player can choose which transport node the joker represents (see figure 13). If the player draws for example the joker for the south corridor and the player only misses *Valencia* for a kwartet, the player can choose that the joker represents *Valencia*. Each joker is represented twice in the game which means that there are eight jokers in the pile of transport nodes.

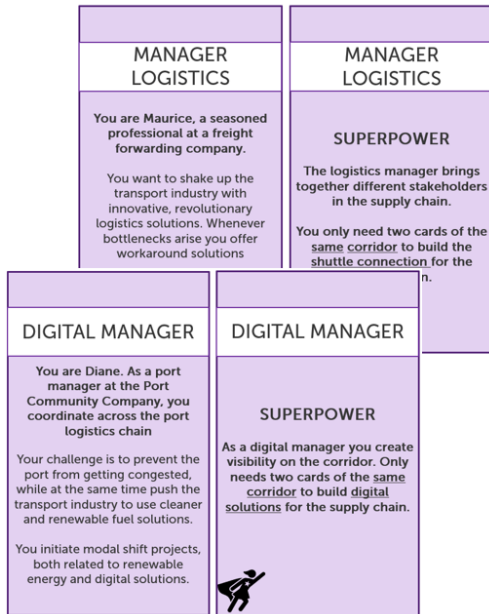
Figure 13: Jokers

 VALENCIA BARCELONA TOULOUSE DOURGES	 HARWICH LONDON BIRMINGHAM GLASGOW	 VENLO DUISBURG BASEL MILAN	 OSNABRUCK COPENHAGEN MALMÖ OSLO
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4.5 Role of players

Each player represents a role in the game and receives a role card in the beginning of the game. Each role has a superpower that he/she can use to improve the transport corridor. The roles and the corresponding description and superpower are presented in table 3 and examples of the role cards are presented in figure 14. In total there are eight different roles with their own superpower. The eight roles represent stakeholders that are important in the port and hinterland fresh corridors for becoming more sustainable and efficient. The stakeholders contribute to the acceleration of implementing solutions, for instance the energy manager has the superpower to accelerate the energy transition in the corridors. The energy manager knows where the energy infrastructure is required in the corridors and therefore has the power to accelerate the transition. In section 4.5.1. The use of superpowers is elaborated and illustrated and in 4.5.2. the *change roles* card is explained.

Figure 14: Role cards



4.5.1 The use of Superpowers

As described in the previous chapter about transport node cards, a full 'kwartet' of transport nodes is necessary for a solution unless the player has a superpower for the solution. If the player has superpower corresponding to a solution, the player only needs two different transport nodes cards instead of one full 'kwartet'. The use of superpowers is illustrated in figure 15. If the player is for example a digital manager, you only need two cards to build the digital solution in any corridor/port.

Figure 15: The use of superpower

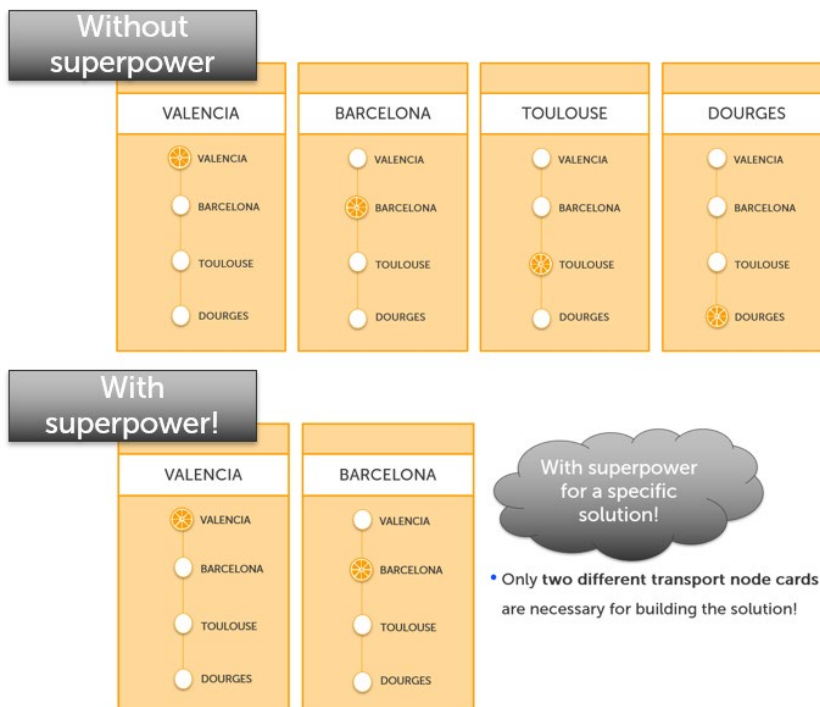


Table 3: Role of players in the playing field

LOGISTICS MANAGER - MAURICE		
The role	Description	Superpower
You are Maurice, a seasoned professional at a freight forwarding company.	You want to shake up the transport industry with innovative, revolutionary logistics solutions. Whenever bottlenecks arise you offer workaround solutions. You understand the business of the retailers but depend on the quality of the operators to deliver to promise.	The logistics manager brings together different stakeholders in the supply chain. You only need two cards of the same corridor to build the shuttle connection for the supply chain.
RETAILER - ROSE		
The role	Description	Superpower
You are Rose, a European retailer who aims to reduce carbon emissions to zero	You are one of the largest and most sustainable retail chains in Europe. Your aim is to make Rotterdam the hub for European fresh products. Your challenge is to meet sustainability targets within the constraints that perishable fresh products require.	As a retailer, you determine the clock speed of the supply chain. By sharing point-of-sales data in the chain, you can exercise your superpower. Only needs two cards of the same corridor to build the digital solutions for the supply chain.
PORT DIGITAL COMPANY - DIANE		
The role	Description	Superpower
You are Diane. As a port manager at the Port Community Company, you coordinate across the port logistics chain	Your challenge is to prevent the port from getting congested, while at the same time push the transport industry to use cleaner and renewable fuel solutions. You initiate modal shift projects, both related to renewable energy and digital solutions.	As a digital manager you create visibility on the corridor. Only needs two cards of the same corridor to build digital solutions for the supply chain.
ENERGY MANAGER - ENZO		
The role	Description	Superpower
You are Enzo and work for an energy company who develops renewable fuels for inland transport.	As a refinery company you have embarked on a journey towards zero emissions. For this purpose, you are not only engaged in R&D of renewable fuels but also work together with port authorities and inland terminal operators to roll out a renewable energy grid across Europe.	As an energy manager, you know exactly where new energy infrastructure is required. Only needs two cards of the same corridor to build the energy transition for the supply chain.

PORT AUTHORITY - PAMELA		
The role	Description	Superpower
You are Pamela, commercial manager at the port authority	You coordinate actions relating to infrastructure that are developed in the port. From transport operators you expect them to set up shuttle services. From terminal operators, you expect to enable fixed departure schedules for barge and rail operators.	As a port authority, you are a neutral party and can bring stakeholders around the table to work together. The energy department of the port authority works on projects to accelerate the energy transition in the port and the connecting corridors. Only needs two cards energy transition solutions.
BARGE OPERATOR - BARNEY		
The role	Description	Superpower
You are Barney, director and owner of a company that maintains shuttle services by barge to inland ports in the network	To run a shuttle service, you want shippers to commit themselves to ship their boxes by barge. You need fixed windows at the deep-sea container terminals in order for your shuttle to depart and arrive on time	Barge operator bundles volumes on the corridor. You only need two cards of the same corridor to build the shuttle connection for the supply chain.
RAIL OPERATOR - RAYMOND		
The role	Description	Superpower
You are Raymond, business manager at a rail operator, You see potential in modal shift	As a rail operator you set up a path between two or multiple transport nodes. Rail infrastructure providers require you to commit for a minimum of one year to a path. This will increase your risk as a rail operator. From shippers you also require them to commit cargo volume	As a rail operator you set up a path between two or multiple transport nodes. You only need two cards of the same corridor to build the shuttle connection for the supply chain.
TERMINAL OPERATOR - TIFFANY		
The role	Description	Superpower
You are a Tiffany, a terminal operator with strongholds in the hinterland.	You have a network of ultra-modern inland terminals in Europe which allows you to offer shippers the advantages of synchromodal transport on all major corridors: east, west, north, and south. Depending on the time sensitivity you combine barge, rail, and road transport solutions.	As a terminal operator you can dedicate crane capacity to barge berths as well as to the rail facilities on the terminal. You only need two cards in the port to build the shuttle connection.

4.5.2 Changing roles

In the transport node pile, there are two *changing roles* card present (see figure 16). If the card is drawn, the player can choose a different stakeholder and therefore a new superpower! The *changing roles* card can be used anytime.

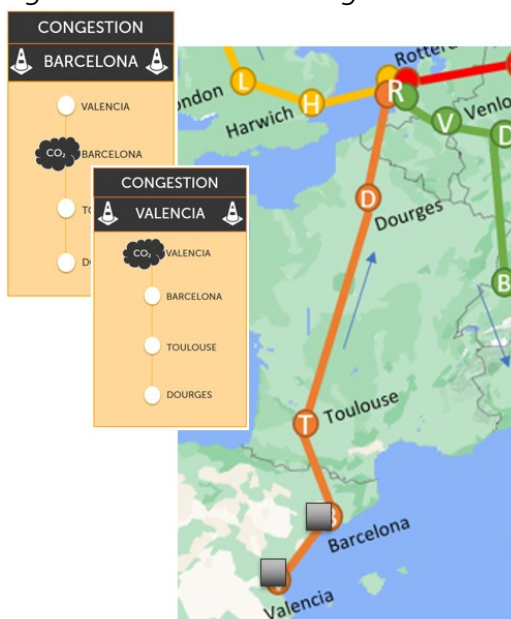
Figure 16: Changing role card



4.6 Congestion cards

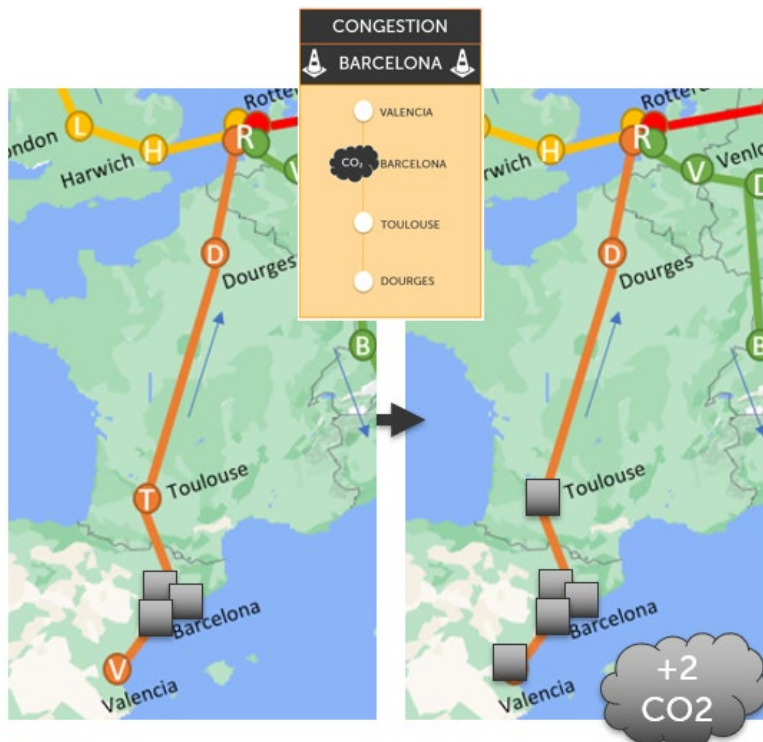
Besides the transport node cards, there is another pile of cards: The *Congestion Cards*. The starting situation of the game is that the port and the corridors are congested. The more congestion on the corridors, the more pollutive and less efficient the corridors are! The congestion is represented by CO₂ units. At the end of every turn two congestion cards should be drawn from the pile. On the transport node that is presented on the congestion card, should be added one CO₂ unit. In figure 17 is shown the situation at the end of a turn. Two congestion cards are drawn – in this case Barcelona and Valencia – and one CO₂ unit is added to the corresponding transport node. The maximum of CO₂ units on a transport node is three. The maximum of CO₂ units on a corridor and in the port is 10. If one corridor or the port is fully congested the game is over. This means that there are no CO₂ units left for the corridor or the port. The maximum of CO₂ units per transport node is three. If a congestion card is drawn from the pile with a transport node that already has three CO₂ units, the congestion spills over to the rest of the corridor. In section 4.6.1 are different scenario's regarding spill-over effects of CO₂ units explained.

Figure 17: The use of congestion cards on transport nodes



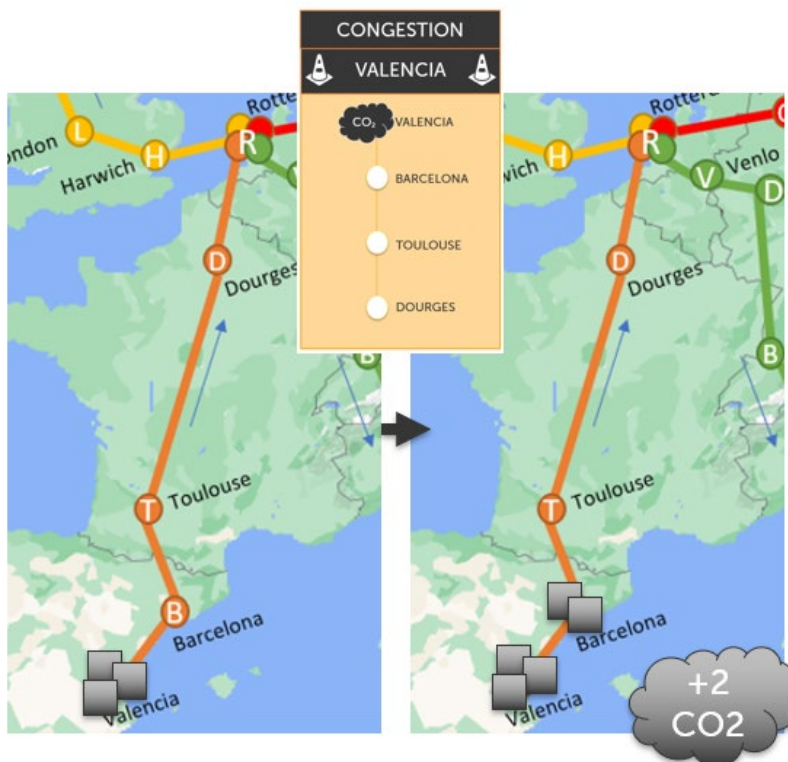
4.6.1 Spill-over effect scenario's

If there are already three congestion points in one transport node and you draw another congestion card, two CO₂ unit are added instead of one! The congestion spills over to the rest of the corridor or the port. In every scenario the congestion does not spill over to another corridor but stays in the corridor. Three examples of spill-over effects are shown in the next three scenarios.



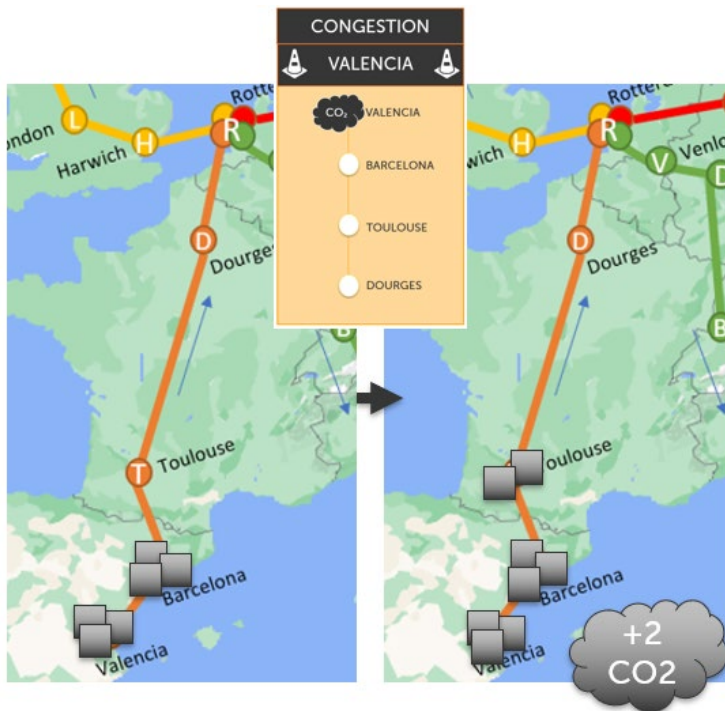
Scenario 1

Transport node in the middle of the corridor to its maximum congested and the corresponding congestion card is drawn from the pile.



Scenario 2

Transport node at the starting or end of the corridor is congested to its maximum and the corresponding congestion card is drawn from the pile. 2 CO₂ units are then added to the adjacent transport node.



Scenario 3

The transport node is fully congested and the adjacent transport node is too. If the corresponding transport node is drawn for from the pile, congestion spills over to the rest of the corridor.

4.7 Actions per player

Each turn the player can execute four actions. There are five different actions in the game and all different combinations are possible. The five different actions are shown in the next figure 18. The five actions are explained in the following paragraphs.

Figure 18: Actions in the game

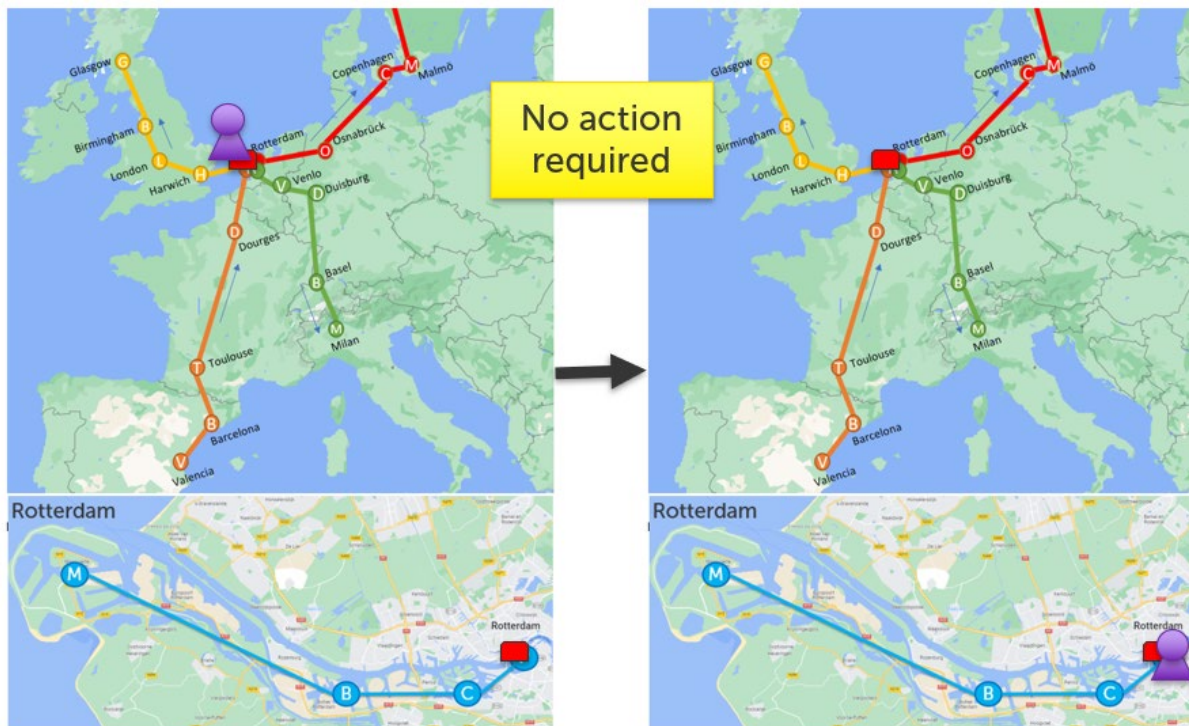
ACTIONS	
1.	MOVE TO NEIGHBOURING TRANSPORT NODE
2.	VISIT A TRANSPORT NODE BY FLYING
3.	REMOVE A CO ₂ UNIT
4.	SHARE INFORMATION
5.	DEVELOP A CORRIDOR SOLUTION

4.7.1 Move to Neighbouring transport node

The player moves to a neighbouring transport node. This 'costs' one action. The player has the possibility to use all four actions to move around the map.



One specific move does not require an action. This move is moving from house to house, which are located in Rotterdam shown in the hinterland map and Portbase shown in the Rotterdam map.



4.7.2 Visit a transport node by flying

The player plays the card of the transport node and moves the pawn to the transport. Afterwards the player places the transport node on the discard pile of transport nodes. Flying is still a pollutive form of travelling and therefore the player must add one CO₂ unit to the departure and arrival transport nodes (two units in total).

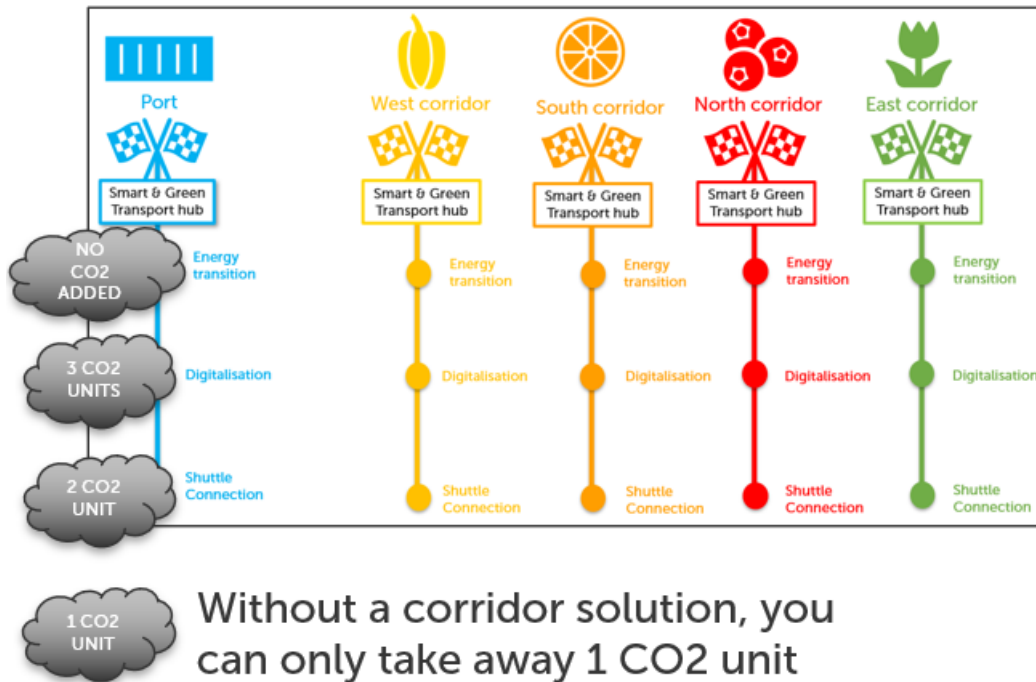


4.7.3 Remove a CO₂ unit

Another action is that the player removes one CO₂ unit and places the stone on the pile next to the board. When the last congestion stone is removed, the corridor is cleared from congestion. If all the solutions are built, no congestion can be added to the corridor. While the developer moves upwards by building solutions on the solution dashboard, more CO₂ units can be removed in one action. This is shown in the dashboard below.



Elimination structure of CO₂ units on corridor solutions dashboard



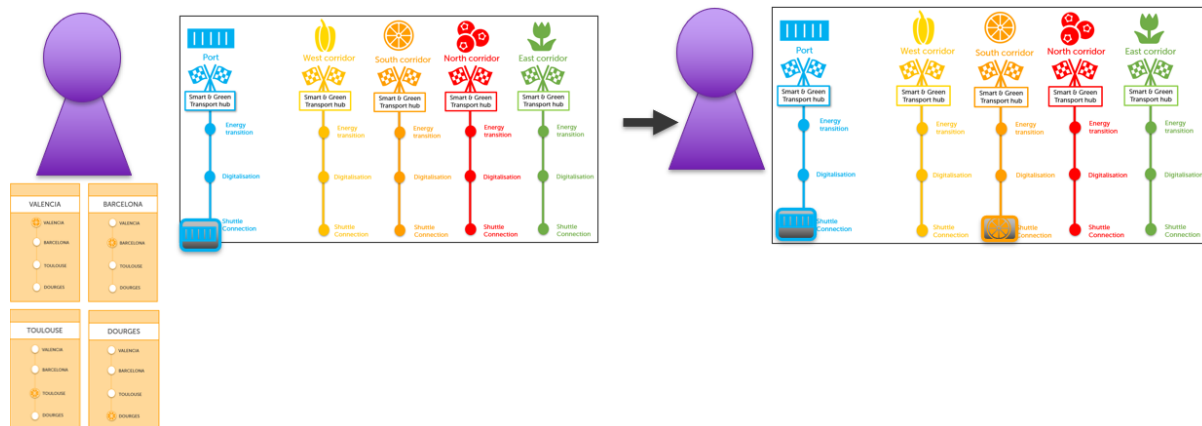
4.7.4 Share information

The player gives the transport node card of his/her choice to another player or receives a transport node card from another player. Both players should agree have to be on the same transport node. If the player has more than 7 cards, the player needs to discard the +7 cards immediately.

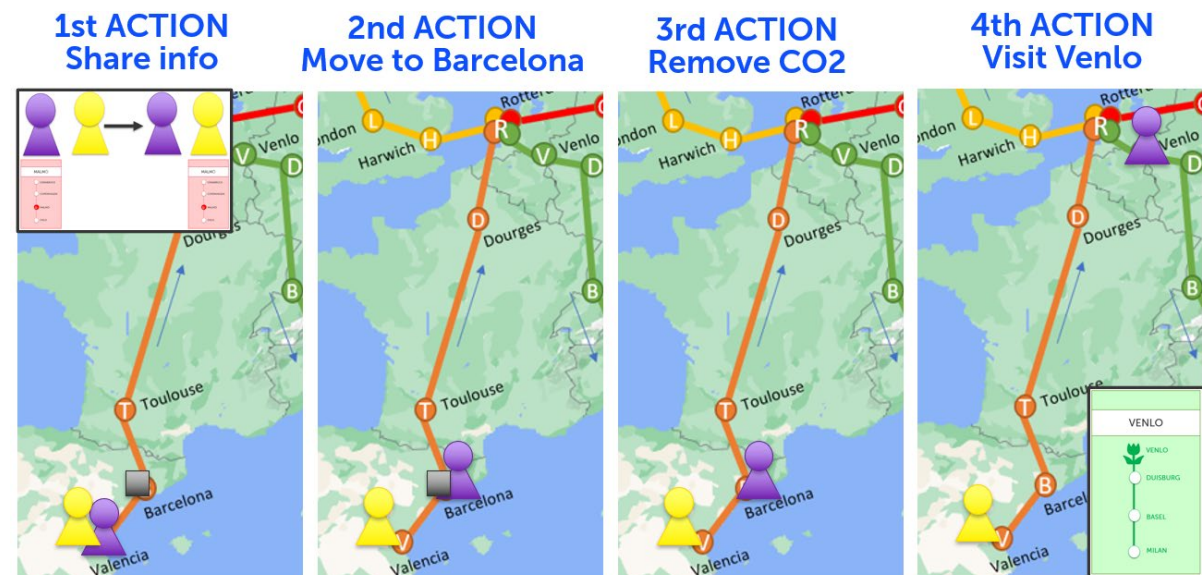


4.7.5 Develop a corridor solution

The player can develop a solution for the corridor or the port. Developing a solution requires a kwartet of a corridor or the port. The player has to be in one of the transport nodes represented in the kwartet. If the player has a superpower and only needs two cards for the corresponding solution, the player needs to be located in one of the transport nodes represented by one of the two cards. Once the player has developed the solution and filled in an example of a solution in the form (see figure 3), the developer can move upwards on the solution dashboard.



4.7.6 Example combination four actions per turn



4.8 Beginning situation

- **Playing field:** In the beginning each transport node has one CO₂ unit. The beginning situation of the playing field is shown in figure 19. The house units are placed on Rotterdam in the hinterland map and in Rotterdam in the port map on the P. This means that these places are the same places and if you move from one house to another this is not an action.
- **Players:** Player receives a role card and four transport node cards. These cards can be shown to the other players.

Figure 19: Beginning situation of the playing field



4.9 Playing turns

Per turn a player needs to take the following steps in this order:

1. Draw two transport node cards
(More than 7 cards in your hand; choose cards to remove from your hand)
2. Play four actions
3. Draw two congestion cards

4.10 Winning and losing while playing CO₂NGESTION

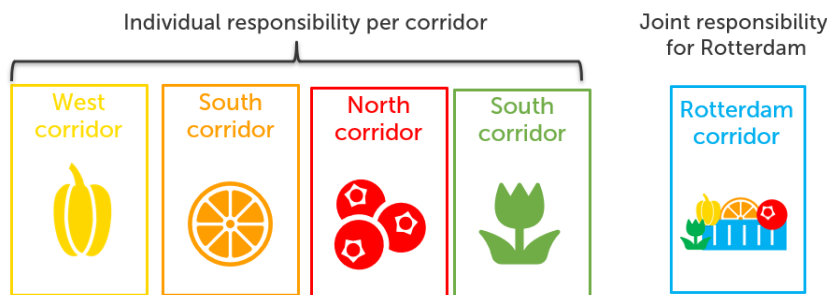
While playing the game, the players can win as a group or lose as a group. The players should work together to build the solutions on the corridors and in the port. If the group is not working together, the group can lose if there are no CO₂ units available anymore for one corridor or the port itself.

4.11 Increase difficulty of the game

The difficulty of the game can be increased by the two following option: adding congestion event cards to the congestion pile and adding competition



4.11.1 Increasing competition – Making players responsible for one corridor

Together you are responsible for the port and each player gets a corridor card and starts on its assigned corridor. The player is responsible to keep the CO₂ units in his/her assigned corridor under his/her control. If one corridor is fully congested, only the responsible player is game over. The other players can keep on playing. If the port is fully congested, everyone has lost the game. For advanced players, CO₂ units can be lowered to 8 units per corridor.



4.11.2 Increasing the congestion – Adding Congestion Event cards

To increase the difficulty level, players can decide to add three or more congestion event cards to the congestion card pile. When a player draws a congestion event card, then the player has to add three CO₂ units to a transport node mentioned on the card.

CONGESTION	CONGESTION	CONGESTION	CONGESTION
FUEL SHORTAGE	FUEL SHORTAGE	LOW WATER LEVELS	LOW WATER LEVELS
	Energy companies are making higher profits due to the increase of energy prices. Therefore, the employees would like to have a salary increase and they organize strikes. This leads to less energy production in the supply chain. Waiting times for transport flows are increasing and this leads to more congestion. Consequently, higher CO ₂ emissions.		Due to the low water levels, some barges are not able to sail the inland waterways anymore. The barges which can still sail the inland waterways cannot load the ships to its full capacity. Consequently, less barge capacity is available, and more barge movements are necessary for achieving the same barge volumes in the network. More inland barge transport flows leads to more CO ₂ emissions.
3 CO ₂ EMISSION UNITS AT DOURGES (SOUTH CORRIDOR)	3 CO ₂ EMISSION UNITS AT MILAN (EAST CORRIDOR)	3 CO ₂ EMISSION UNITS AT MILAN (EAST CORRIDOR)	3 CO ₂ EMISSION UNITS AT MILAN (EAST CORRIDOR)

Appendix 1: Terminology

Term	
Agrologistics	The combination of transport, storage, transshipment and distribution of cargo throughout the agricultural chain, from raw material to finished product.
Box trailer	A closed semi-trailer (13.60 m long) with solid side walls, but which can only be loaded and unloaded from the back. Refrigerated box trailers are equipped with a cooling and/or ventilation system.
Call size	Number of containers that are handled at a container terminal during a ship call
Cargo beamer	A transport system used in intermodal transport to place standard road transport trailers horizontally on a rail chassis. This system ensures a strong reduction in loading and unloading times and thus a better intermodality between road and rail.
Corporate Social Responsibility (CSR)	The way in which companies integrate social, environmental and economic aspects into their business operations and take them into account in policy, purchasing, marketing and investments and in this way give substance to sustainable business practices.
Corridor	A corridor has both a physical and a functional dimension and refers to one or more routes connecting two major transport nodes.
Deepsea	A designation for that part of the logistics system that relates to intercontinental transport by sea. The term can also be used in combination with a container transshipment company or terminal.
Demurrage	The costs that a shipper pays if a container is located at the terminal but cannot be loaded or the container is not collected upon arrival at the port of destination. Usually there are a few days of 'free time' before the shipping company passes on costs to the shipper.
Detention	The costs that a shipper pays if the container is not made available and returned to the shipping company (or to a designated party) and at the designated location within the allotted time.
Dwell time	Lead time of a container at a deep-sea terminal from arrival to departure (gate-out).
Sustainable Development Goals	The Sustainability Goals is a development agenda for 2015-2030 drawn up and set by the United Nations. These are formulated in 17 objectives and are aimed at the sustainable development of society based on 5 core values: people, planet, prosperity, peace and partnership. They are also referred to as the SDGs.
Eco-logistics	Logistics based on the principle of transporting, storage and distribution of cargo in such a way that there is a minimal footprint on the ecosystem. This may relate to transporting as efficiently as possible by optimizing the load factor, using

Term	
	cleaner fuels, choosing a transport mode with low emissions, but also through chain integration.
Free time	Condition set by the container shipping company for making a container available. It therefore concerns the number of days that a container can be used free of charge. As soon as these free days have passed, (rental) costs will be charged.
Fixed window	Fixed departure schedules for barges between deep-sea terminals and inland terminals in the hinterland
Mobility package	The Mobility Package is a package from the European Commission that consists of measures aimed at ensuring a level playing field in European road transport. This package should also ensure that the working conditions of all truck drivers will improve. The measures will be introduced in three steps.
Mental shift	A term often used in conjunction with modal-shift, which refers to the way logistic planning is done. Compared to road transport, the use of rail or inland shipping requires more harmonization, coordination and equalization of logistics processes.
Modal shift	Change of mode of transport, for example from road transport to rail or ship transport.
Modal split	The distribution of transported cargo that is transported to and from the hinterland by mode of transport. Usually, the market share of road, rail and inland waterway transport is compared, but short-sea shipping (coastal shipping) can also be included in this.
Reefer container	A standard loading unit for temperature-sensitive goods, specifically for goods that need to be transported refrigerated.
Reefer plug	A connection to connect refrigerated containers to electricity. This can be on a container terminal, on a ship or on a generator set on a railway wagon.
Shelf life	The number of days a product is on the shelves of a supermarket without loss of quality and associated loss of turnover for the retailer.
Ship-to-shore process	Refers to the loading and unloading of containers between ship and quay using quay cranes
Short sea shipping	The transport of goods over a route that is at least partly seaborne, usually in European coastal waters.
Synchromodal transport	A way of flexible planning of multiple modalities in such a way that the capacity of each of the modalities is used to the maximum and where it is possible to switch between modalities depending on the available planning horizon within which the hinterland transport must be carried out.
Truck platooning	A series of trucks and loading units that automatically drive on the highway in convoy at a short distance from each other
Value added logistics	Creating added value in the logistics chain by offering additional services in addition to physical transport, such as packing,

Term

repacking, labeling, (sub)assembling and/or monitoring products.

Fresh Chain Logistics

The entirety of logistics activities aimed at the transport, storage, transshipment and distribution of refrigerated or frozen cargo, which, due to its sensitivity to temperature, requires extra care to prevent products from spoiling en route.

Note: Terminology is translated from Dutch.

Appendix 2: Shopping list for a game set

CO2 units	Unit	Indicative price	Per gameset
Red	1	€ 0,06	10 + 1 extra
Yellow	1	€ 0,06	10 + 1 extra
Orange	1	€ 0,06	10 + 1 extra
Blue	1	€ 0,06	10 + 1 extra
Green	1	€ 0,06	10 + 1 extra
Pawns	Pawn	Indicative price	Per gameset
Blue	1	€ 0,05	10 + 1 extra
Brown	1	€ 0,05	10 + 1 extra
Yellow	1	€ 0,05	10 + 1 extra
Orange	1	€ 0,05	10 + 1 extra
Green	1	€ 0,05	10 + 1 extra
Purple	1	€ 0,05	10 + 1 extra
Red	1	€ 0,05	10 + 1 extra
Pink	1	€ 0,05	10 + 1 extra
Solution path	Meeple	Indicative price	Per gameset
Blue	1	€ 0,14	1
Red	1	€ 0,14	1
Green	1	€ 0,14	1
Yellow	1	€ 0,14	1
Orange	1	€ 0,14	1
Game box	Box	Indicative price	Per gameset
Box	1	€ 5,70	1
Insert	1	€ 0,95	1
Front cover	1	€ 1,20	1
Playing board A2 (foldable)	1	€ 8,94	1
Plastic bag	Bag	Indicative price	Per gameset
Bag	1	€ 0,17	6
Homebase	Pawn	Indicative price	Per gameset
Wooden house	1	€ 0,10	2

Appendix 3: Congestion Cards (pdf)

Congestion cards is a set of 5 corridors, each containing 4 transport nodes per corridor. For each corridor there are 6 of these congestion cards. This brings the total to 120 congestion cards per game set.

Players may decide to increase the difficulty level by adding congestion event cards to the pile of congestion cards.

Rotterdam	North	South	East	West
Maasvlakte	Osnabruck	Dourges	Venlo Rotterdam	Harwich
Botlek	Copenhagen	Toulouse	Duisburg	London
Coolport	Malmö	Barcelona	Basel Venlo	Birmingham
Portbase	Oslo	Valencia	Milan	Glasgow

Appendix 4: Transport node Cards (pdf)

The staple with transport node cards contains 120 transport node cards, for each of the 5 corridors there are 4 transport node cards. Each of them is represented 6 times in the transport node pile. If jokers are added to the game, per corridor 2 jokers, 10 jokers' cards are added to the game. Another card 'change role' can also be added to the pile, a maximum of 2 change role cards can be added. The total number of cards to the pile adds up to 132 (120+10+2).

Rotterdam	North	South	East	West
Maasvlakte	Osnabruck	Dourges	Venlo Rotterdam	Harwich
Botlek	Copenhagen	Toulouse	Duisburg	London
Coolport	Malmö	Barcelona	Basel Venlo	Birmingham
Portbase	Oslo	Valencia	Milan	Glasgow

Appendix 5: Role cards (pdf)

In total there are eight different roles in the game. Each role card is represented once in the game.

- Retailer
- Logistics manager
- Terminal operator
- Barge Operator
- Rail operator
- Port digital company
- Energy manager
- Port Authority

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Colophon

These study materials are made in July-November 2022 by:

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The study materials have been made possible with an educational voucher of TKI Dinalog
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