A Systemic Analysis of Reefer Logistics in Food Supply Chains

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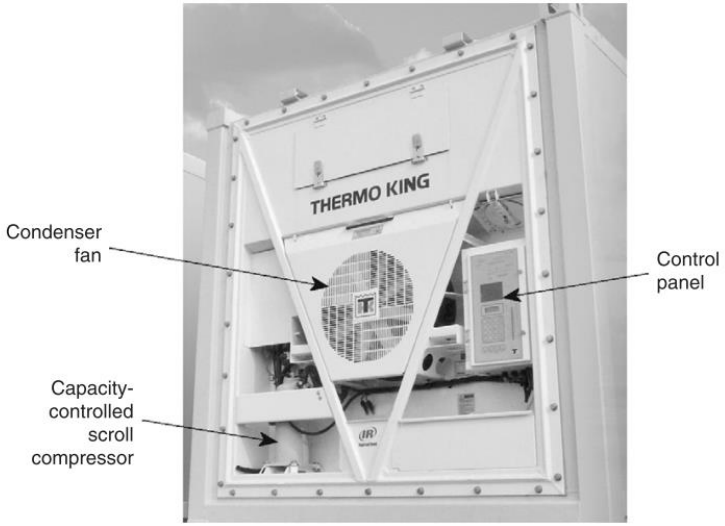
Outline

- Background of research
- Methodology of research: System Analysis
- Results of System Analysis
- Conclusion

What is a reefer container?

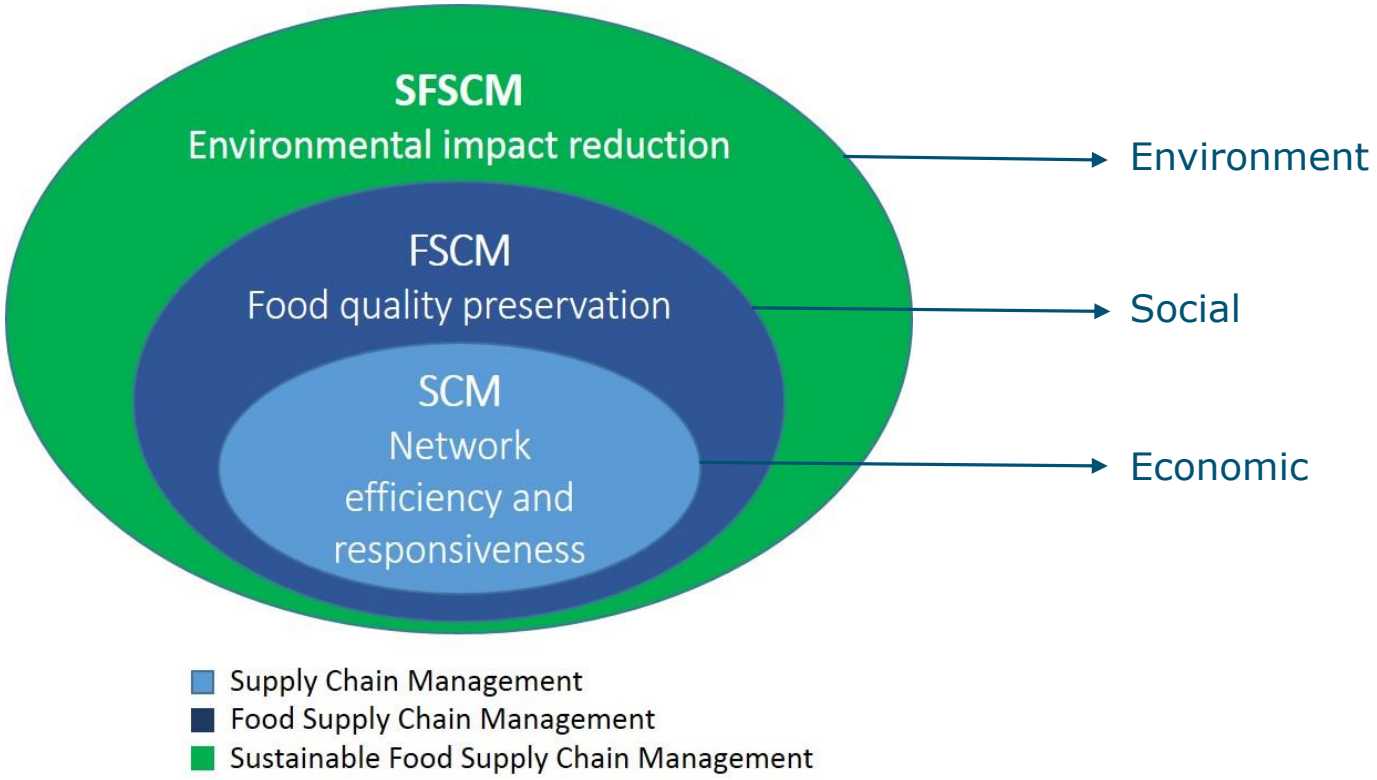
- Reefer container = a standard ISO container that has temperature control and monitoring devices to ensure the safety and quality of the product



Globalization in the food supply chain

- Consumer demand in **year-round availability** of high-quality perishable products
- Products' quality **can be enhanced by cool chain** application
- **Reefer container has an important role in global cool chains** which is characterized by temperature and humidity control and modified atmosphere features
- These features **made intercontinental transport possible** thus offer year-round availability
- Increased containerization; in Rotterdam, over 90% of all temperature-controlled goods is already transported in reefer containers.

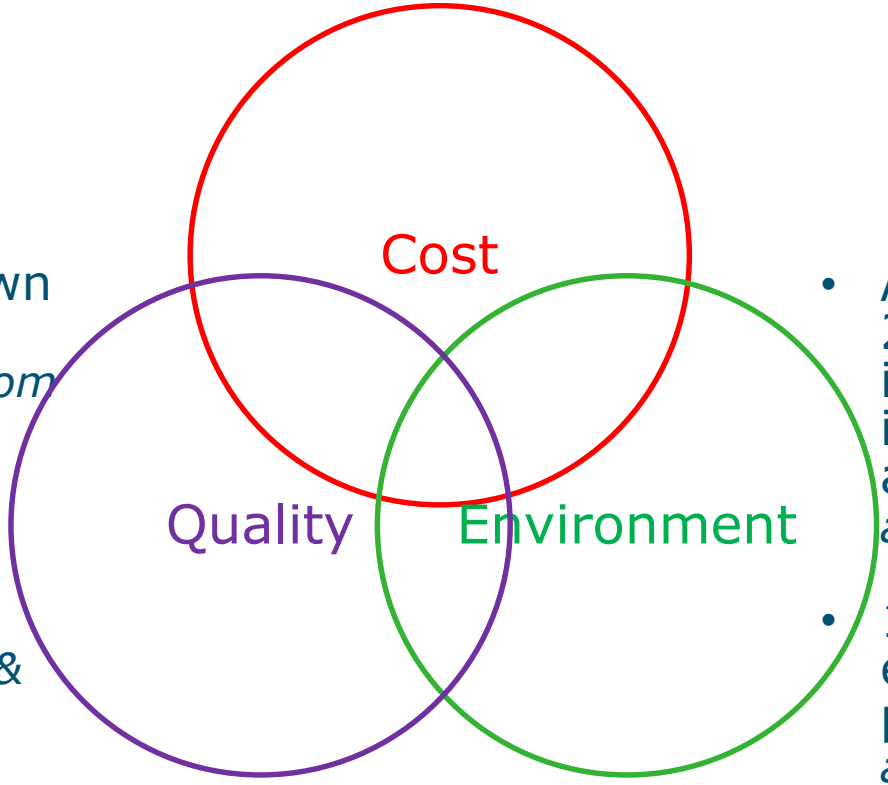
Sustainable food supply chain management



Van der Vorst & Beulens 2002; Luning & Marcelis 2007; Craig & Dale 2008

SFSCM in reefer logistics

- Comparing with dry containers, the investment cost is 6 times more *(Rodrigue 2014)*
- Additional cost for handling/storage in logistics process *(Rodrigue 2014)*



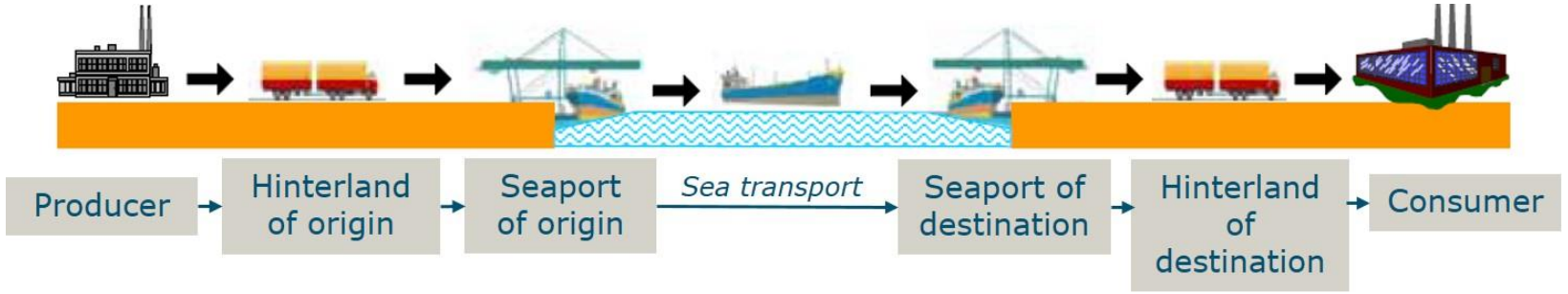
- Electricity shut down to save fuel cost *(Rodrigue & Notteboom 2015)*
- Frequent door opening in direct custom checks / loadings *(Rodrigue & Notteboom 2015)*

- A reefer consumes 20,44 kWh/km during intercontinental import/export activities *(Fitzgerald et al. 2011)*
- 13,8 t/km of CO2 emission was produced *(Fitzgerald et al. 2011)*

Multi-actor setting in container shipping

- Shippers
- Liner shipping companies
- Terminal operators
- (Inland) transport operators

- Port authorities
- Customs



EURECA: Effective Use of Reefer Containers for conditioned products through the Port of Rotterdam

Main research question:

- How to design, align and organize the logistics port processes for fresh produce reefer containers, in such a way that it will lead to new business activities and an efficient, and sustainable port with hinterland connections?

- **Theme 1** Effective use/handling of reefer containers in conditioned supply chains
- **Theme 2** Governance for a transition towards a vital and sustainable reefer flow

Current state of research

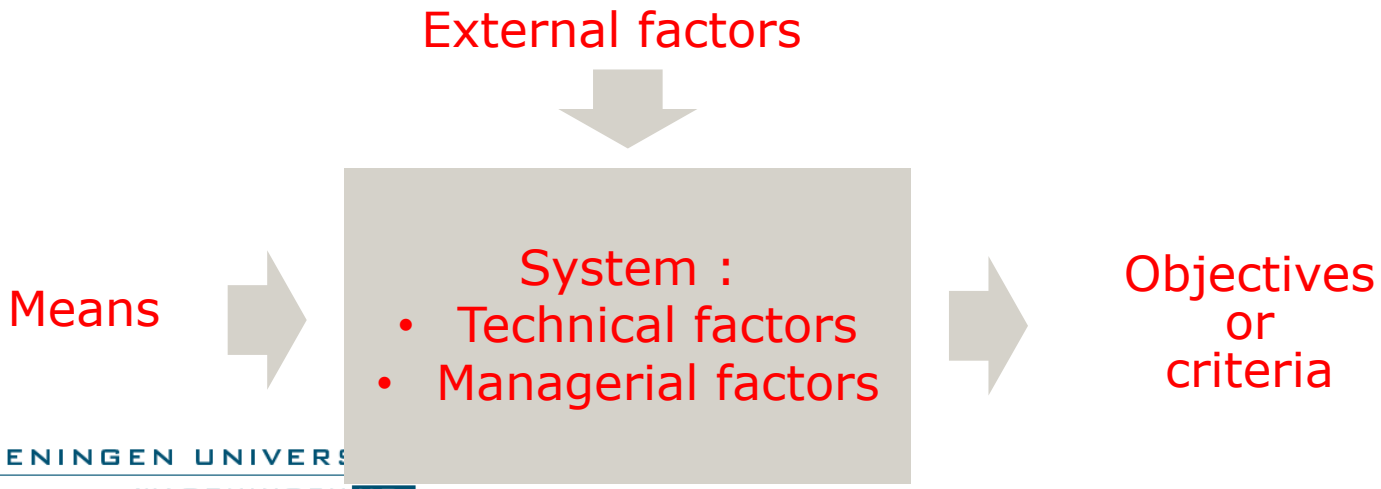
- To get a comprehensive understanding of the actors and challenges in reefer logistics
- To understand the trade-offs between cost, quality and environment in reefer logistics
- To define the problems in reefer logistics (especially in the hinterland transport)

- To conduct a system analysis to address the trade-off between **high quality** (e.g., shelf life and appearance), **transportation cost reduction, and environmental impact reduction** during distribution of chilled products using reefer containers to the Netherlands.

Methodology

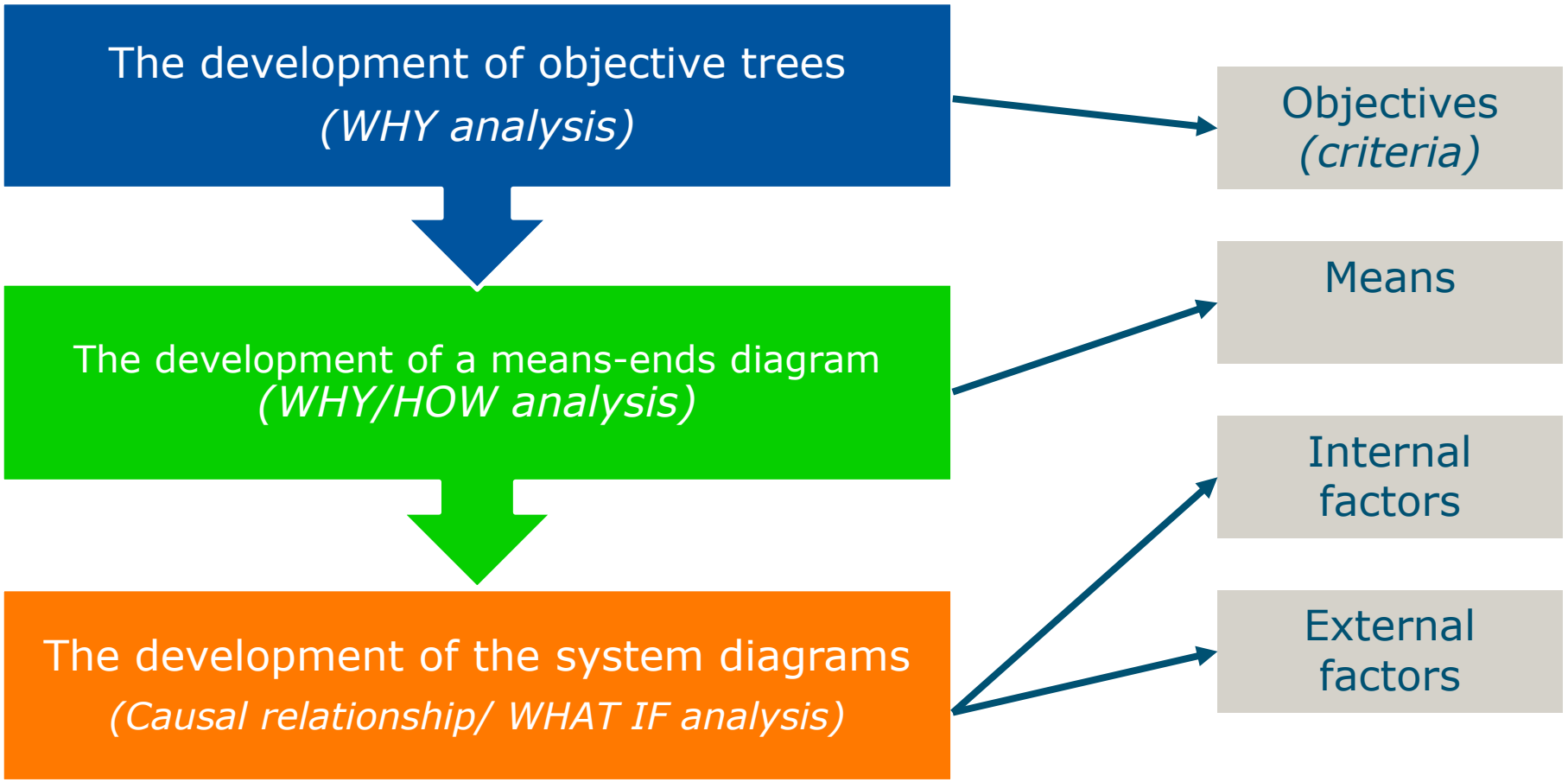
System Analysis

- System analysis is a structured, empirically based, verifiable and reproducible method to analyze a large and complex system (Hermans et al. 2010).
- The output of this analysis is a system description which consists of four major components; the system (internal factors), objectives, means, and external factors.



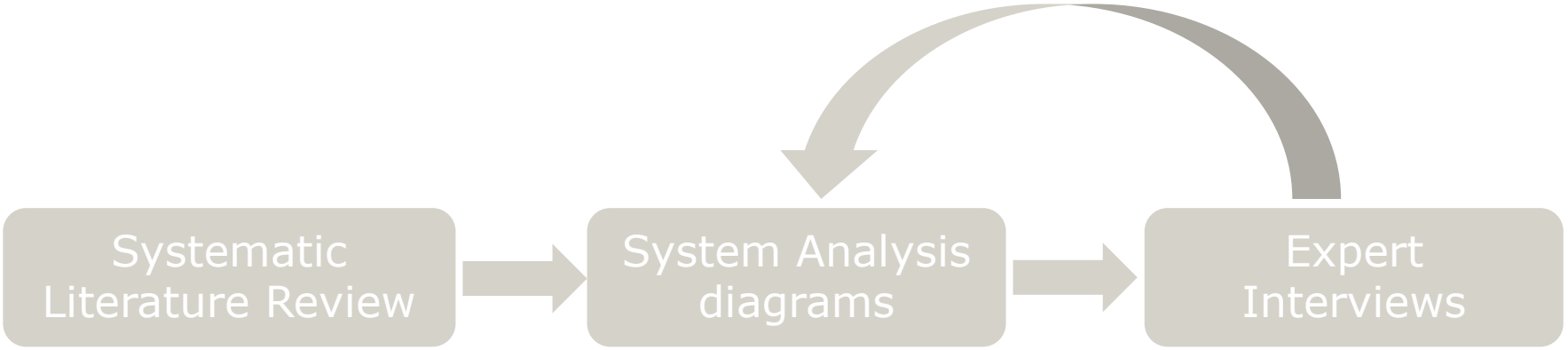
Methodology

System Analysis



Methodology

System Analysis



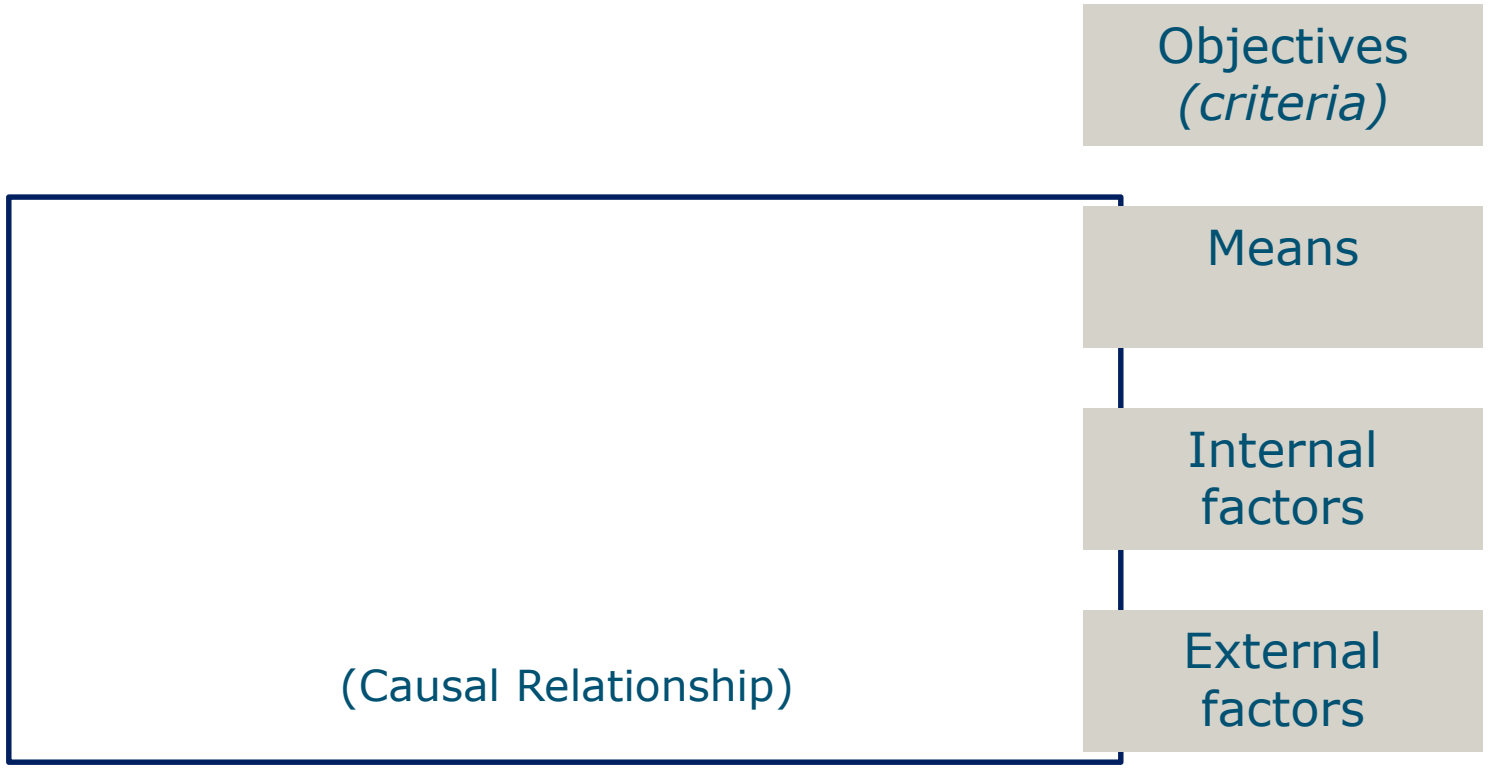
Identification of influential factors from the existing publications

Development of the system diagrams to understand how the system works

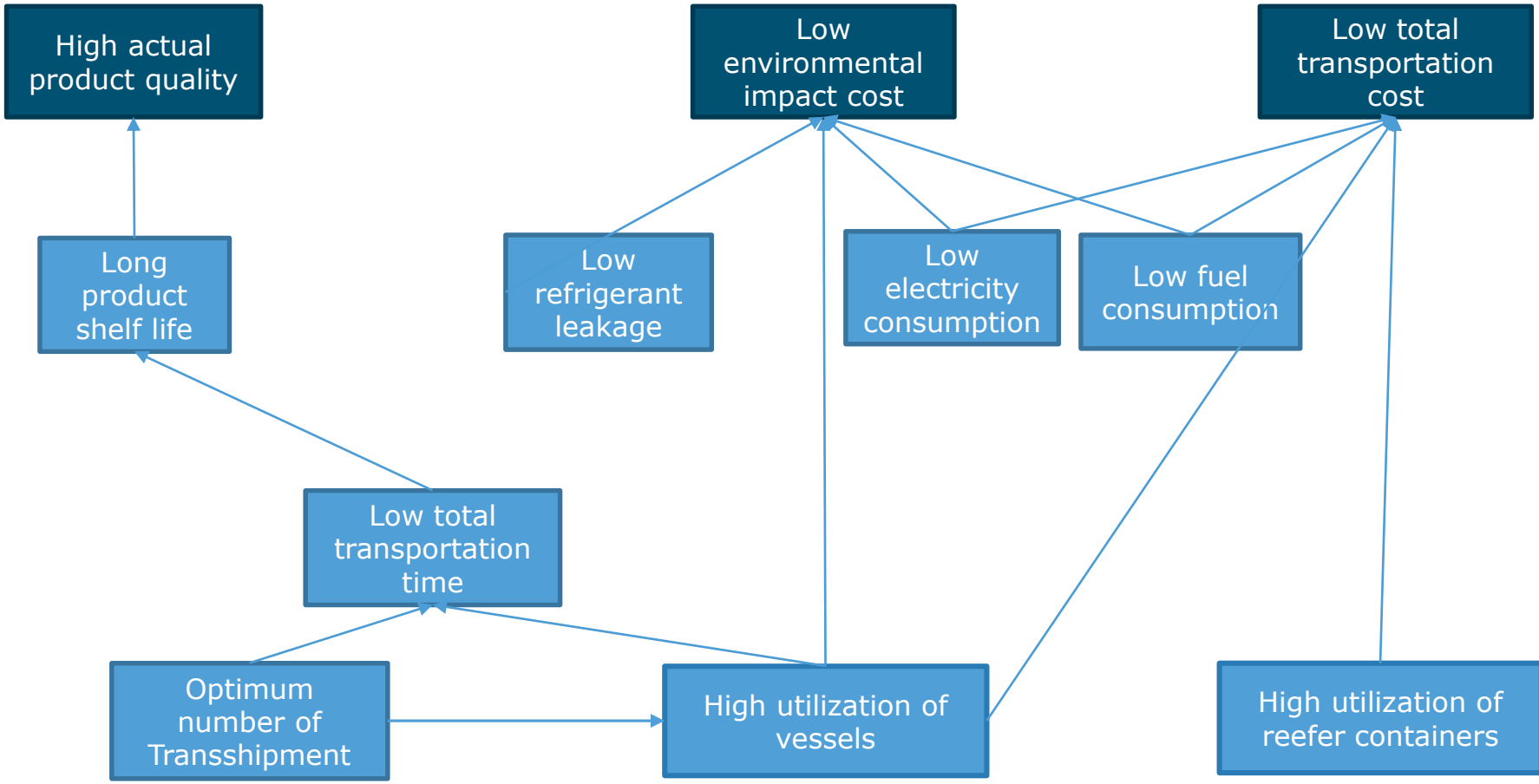
Validation/revising the developed system analysis diagrams

Results

System Analysis



Objective tree for a liner shipping company



Means for a liner shipping company

No.	Means	Definition
1.	Container pre-cleaning	Cleaning procedure of a container before being loaded to avoid any form of shipment contamination. (Rodrigue & Notteboom 2015)
2.	Calibration and maintenance	Calibration: The setting or correcting of a measuring devices by adjusting it to the predetermined standards. Maintenance: Actions necessary for retaining a piece of equipment, or system to the specified operable condition to achieve maximum useful life. (Likar & Jevšnik 2004)
3.	Pre-trip inspection	An inspection done by a liner shipping company on an empty reefer container before it can be released, to ensure the correct functioning of the cooling units, temperature control and recording devices. (Hamburg Süd 2010)
4.	Slow steaming	A container management strategy by reducing shipping speeds to reduce fuel consumptions during shipments. (Lindstad et al. 2011)
5.	Transshipments	The shipment of goods or container to an intermediate destination, then to yet another destination. (Rodrigue & Notteboom 2015)
6.	Triangulation	Container management by matching the drop-off locations and nearby origins of new container journeys. (Van den Berg & De Langen 2015)
7.	Container leasing	Container management by allowing carriers to hire containers at places where they have a shortage and to off-hire containers at points with a surplus. (Braekers et al. 2011)
8.	Container information exchange	Information exchange regarding container arrival schedule, and next journey schedule. (Steadieseifi et al. 2013)
9.	Vessel pooling	Interfirm alliance with a joint sailing schedule combined with a profit pool to generate economies of scale. (Van Der Horst & De Langen 2008)
10.	Vessel size leverage	Investment on replacing small vessels with bigger vessels (in a constant annual demand case). (Lindstad et al. 2012)
11.	Green technologies in reefer container	Shipping technologies that use energy alternative as substitution to fossil fuel, or that reduce emission rate from shipping fuel/machineries. (Eyring et al. 2010)

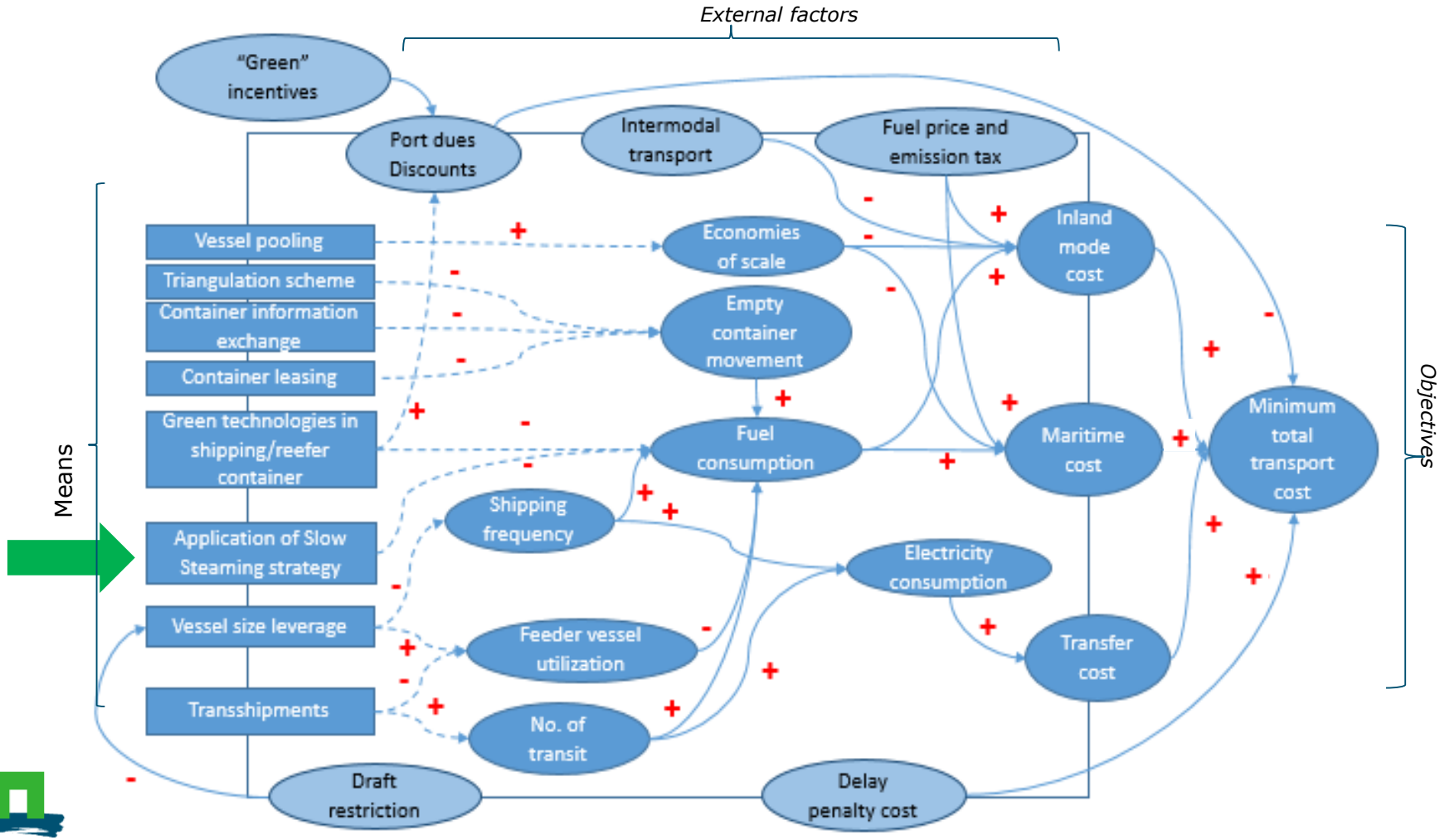
Means-end for a liner shipping company

Actor	Means	High product quality	Min. total transport time	Min. total transport cost	Min. environmental impact
Liner shipping company	Container pre-cleaning	✓			
	Calibration and maintenance	✓		✓	✓
	Pre-trip Inspection (PTI)	✓		✓	✓
	Slow steaming			✓	✓
	Transshipments			✓	
	Triangulation scheme		✓	✓	✓
	Container leasing		✓	✓	✓
	Container information exchange	✓	✓	✓	✓
	Vessel pooling			✓	
	Vessel size leverage			✓	✓
	Green technology in reefer container				✓

Results

System Analysis

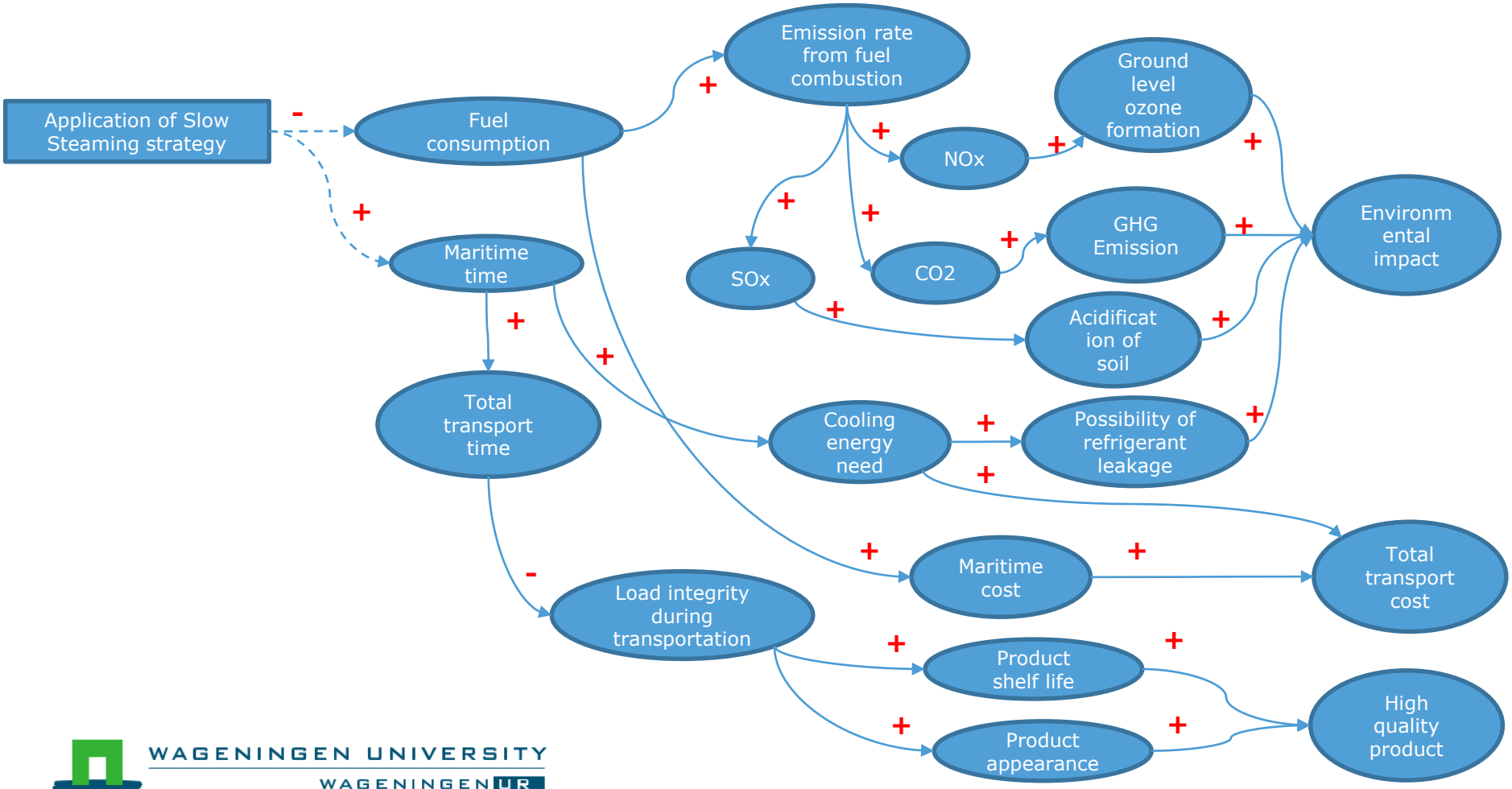
Example of a system diagram : Transportation cost reduction



Results

System Analysis

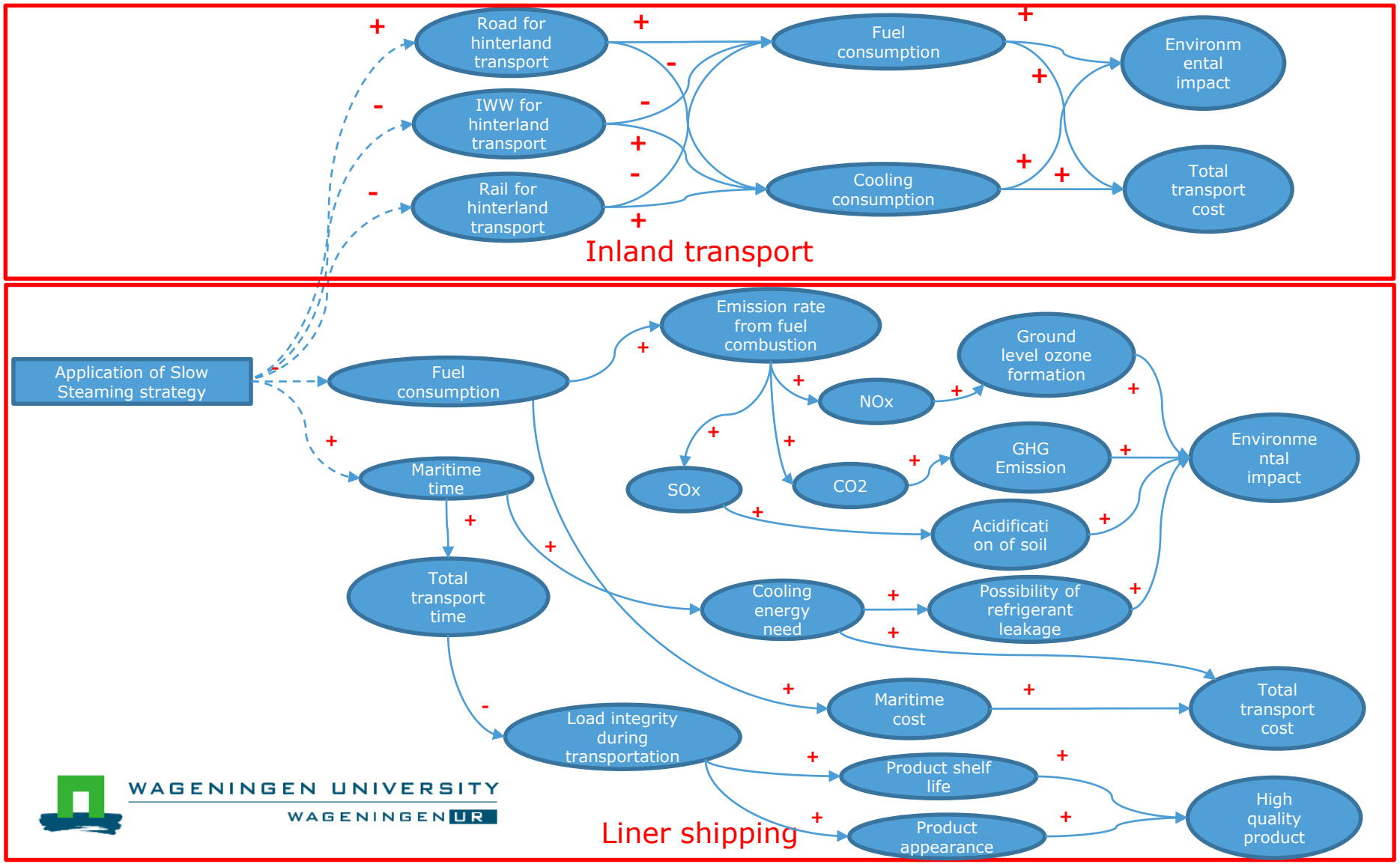
Example of a trade-off identification of a *means:*



Results:

Multi-actor trade-off

System Analysis



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Results: setting propositions/ hypotheses

Trade-off identification of the selected *means:*

No	Means	Objectives			
		High actual quality	Min. total transport time	Min. total transport cost	Min. environmental impact
1.	Slow steaming	-	-	+	-/+
2.	Transshipments	-	-	+	+
3.	Vessel pooling and vessel size leverage	-	-	+	+
4.	Container information exchange	+	+	+	+
5.	Triangulation scheme	NA	+	-	+
6.	Container leasing	NA	+	-	+
7.	Green technology in reefer container or shipping	NA	NA	+	+

Wrap-up

- In defining reefer logistics concepts, we need to consider the trade-off between sustainability, cost efficiency and product quality
- A system analysis approach helps explore/analyze these trade-offs from multi-actor perspective
- Understanding of trade-offs can be a basis for developing propositions (for further empirical/ analytical studies) or decision making tools/models for reefer logistics

Thank you for your attention!

Questions/ Remarks?

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