



Sheffield
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**Promoting Sustainable Freight Transport in Urban Contexts:
Policy and Decision-Making Approaches**

**Urban Consolidation Centers:
Models and Methods for
Performance Evaluation**

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**International Workshop on Policy
and Decision-Making Approaches
for Sustainable Urban Freight Transport**

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1 Introduction

- Sustainable Urban Logistics: Generalities
- Urban Consolidation Centers

2 Content of the Research

- Research Initiatives
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- Research Topics
- Basic Theories

3 The ProSFet Project

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- Case Study
- Data Analysis Methods

4 Basic Outcome

- Interviews – Quantitative Results
- Interviews – Qualitative Results

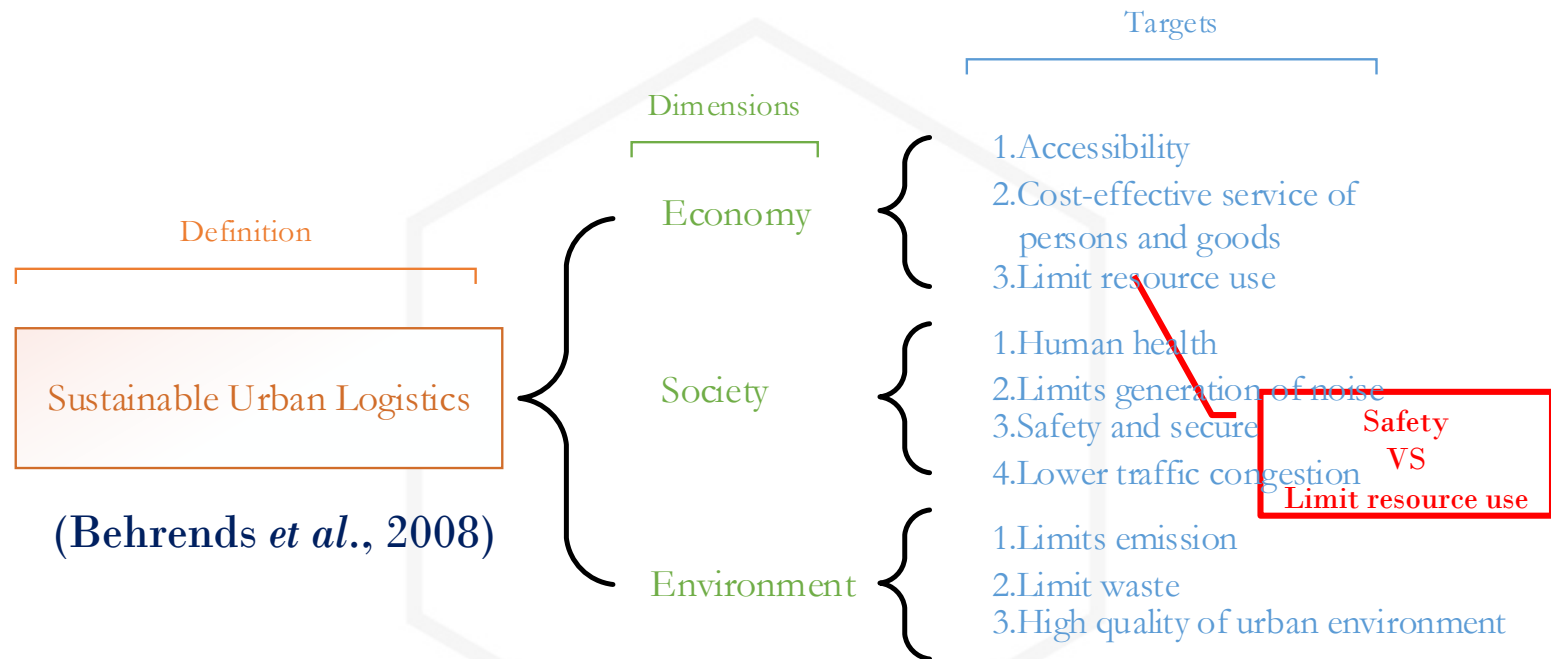
Sustainable Urban Logistics

Sustainable urban logistics (SUL) *is the multi-disciplinary field that aims at understanding and analysing the different **organizations, schemes, stakeholders** and **planning actions** related to the improvement of the different goods transport systems in an urban zone and link them in a synergic way in order to **decrease the main nuisances** related to it”*

Ambrosini and Routhier (2004)

Anderson (2005)

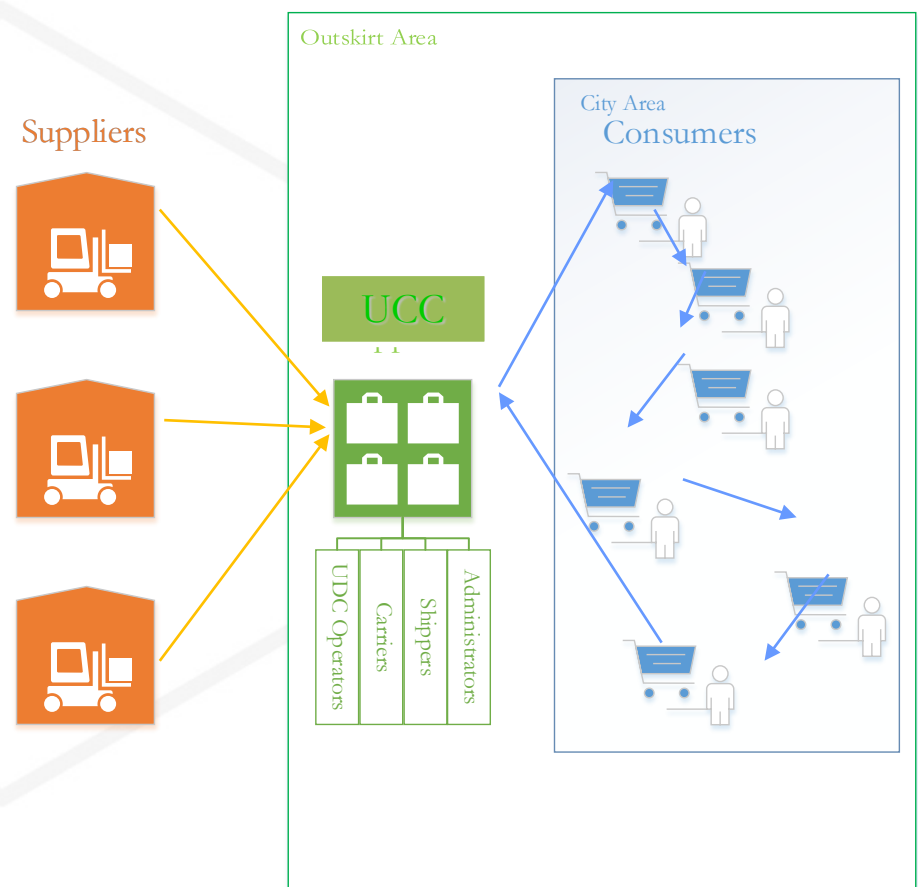
Sustainable Urban Logistics



Many targets are conflicting with each other!

Sustainable Urban Logistics

*An UCC - sometimes referred to as urban distribution centre (UDC) - is a facility involving the transshipment of goods directed to urban areas, aiming to **consolidate deliveries**, and thus provide greater efficiency (and effectiveness) **in the distribution process** by increasing the truckload factor and decreasing the number of trucks used, which help mitigate urban congestion and air pollution' (Tario et al, 2011)*



Sustainable Urban Logistics



Phase 1

Literature
Review

Open Issues

Research Gaps

Research Topics

Phase 2

Preparation of
Data Collection

Field Trip

Phase 3

Data Analysis

Outcome

Open Issues in UCC Literature



ISSUES	REFERENCES
Financial Barriers	(Quak and Tavasszy, 2011; Nordtømme et al., 2015; Vahrenkamp, 2013; Allen et al., 2012; Browne et al., 2005; Marcucci and Danielis, 2008; Verlinde et al., 2012; Gonzalez-Feliu, 2011; Van Duin et al., 2012; Gonzalez-Feliu, 2011).
Conflicts Between the Participants	(Dablanc, 2011; Awasthi et al., 2016; Awasthi et al., 2011; Browne et al., 2005; Nordtømme et al., 2015; Lindholm and Browne, 2013; Holguín-Veras et al., 2014)
Additional Costs due to further handling	(Allen et al., 2012; Browne et al., 2005; Marcucci and Danielis, 2008; Verlinde et al., 2012; Gonzalez-Feliu, 2011)
High Reliance on Support from Public Authorities	(Van Duin et al., 2012; Quak, 2008; Panero et al., 2011)
Insufficient Number of Customers	(Van Duin et al., 2008)
Difficulties in Consolidating Deliveries	(Vahrenkamp, 2013)

Evaluating Real-Word UCCs



Evaluating UCCs' performance according to eight indicators:

1. Fuel Consumption
2. Gas Emission
3. Logistics Time
4. Vehicle Numbers
5. Delivery Efficiency
6. Total Trips
7. Congestion Alleviation
8. Business Volume.

- 27 UCCs were reviewed (through content analysis)
 - 23 UCCs achieved environmental targets
 - 12 UCCs failed due to financial issues
 - 3 UCCs failed due to the conflicts between internal stakeholders
 - 2 UCCs failed because no more consumers were willing to join.

Research Gaps Relate to the Stakeholders

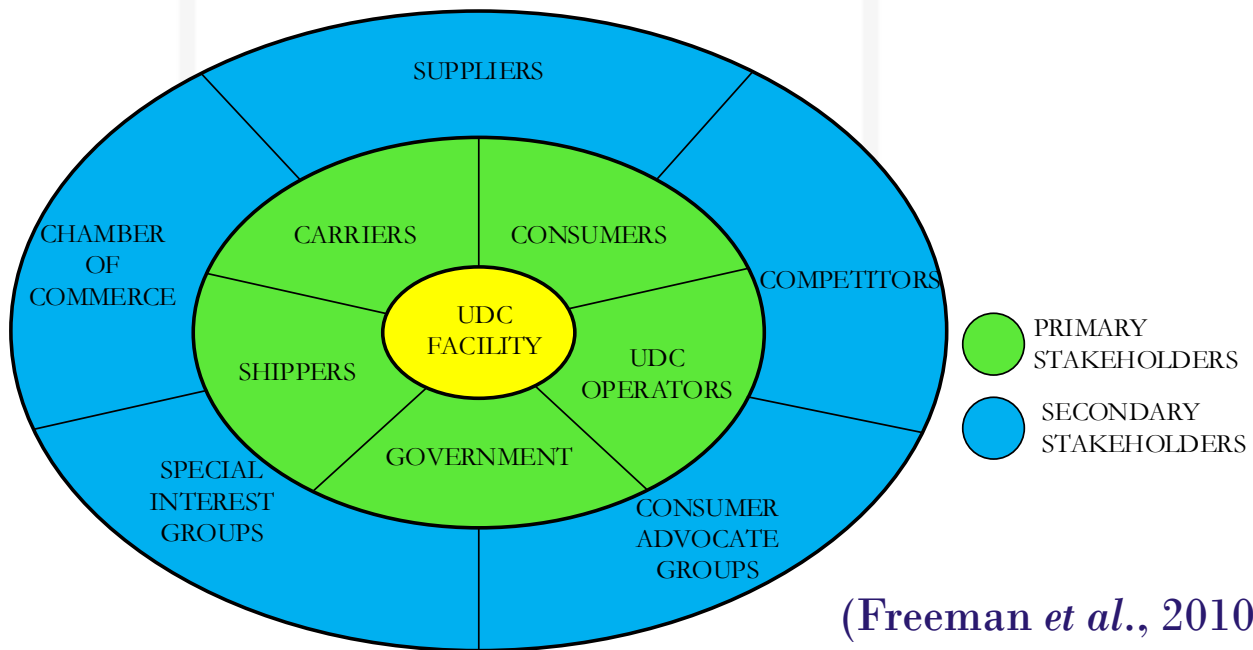
- RG1: Most of the research pays little attention to the impact of **policy and regulation** on the UCC system.
- RG2: Most of the research focuses on the influence of UCCs on the **environmental and social impact** of logistical activities in the urban environment. The **economic sustainability** of the UCC is overlooked.
- RG3: Current academic research fails to deal with real-world issues in UCC operation. This is because of the **omission of market factors**.
- RG4: Few researchers have studied UCC failures due to **internal problems**, such as financial issues and conflicts between stakeholders.

Research Objectives

- **Developing Multi-criteria and Multi-stakeholder decision-making methodologies for:**
 - Highlighting different stakeholders' priorities
 - Evaluating the performance of UCCs and providing a benchmarking tool
- **Two UCC cases from Sweden will be investigated in order to obtain research results:**
 - Stakeholders' opinions on each project and each indicators
 - Conflicts among stakeholders' priorities in different UCCs
 - Solutions to identified conflicts in different UCCs
 - Benefits and detriments of UCC projects

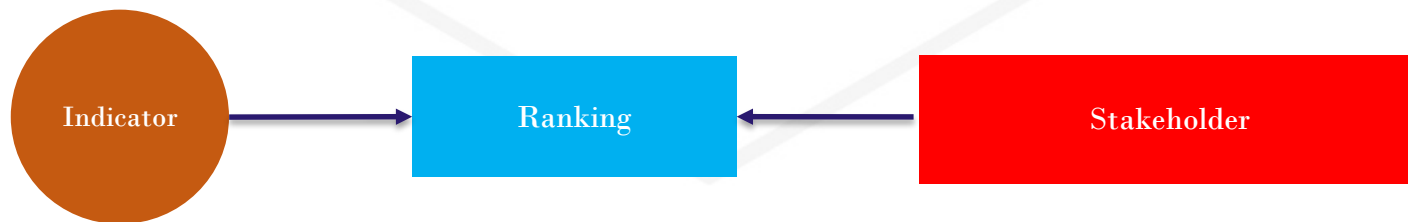
Stakeholders' Theory

- Stakeholders' Theory will be employed in order to map economic actors which influence the performances of UCCs



Multi-Criteria Decision-Making Methods

- The class of Multi-Criteria Decision-Making (MCDM) methods can be used to deal with ranking, rating, screening, and sorting problems.
- All these problems involve **multiple and conflicting criteria**.
- Stakeholders can rate the weight of each criteria (and related indicators)
 - through pairwise comparison matrices by using AHP



Data Collection Preparation

- Initial access to Stakeholders was provided by the EU funded ProSFeT project (Promoting Sustainable Freight Transport in Urban Contexts) led by the University of Sheffield
- Several stakeholders from the Urban Logistics domain are involved, such as:
 - Local authorities
 - Carriers
 - UCC operators
 - Shippers

Academic Institutions



Local Authorities



Software Houses



Data Collection Preparation



Criteria & Indicators Selection

Dimension	Criterion	Indicator
Economy (EY)	Operating Cost	Annual Operating Cost (AOC)
	Pricing Policy	Typical Delivery Price (TDP)
	Infrastructure Usage Efficiency	Infrastructure Surface Usage Rate (ISUR)
	Goods Handling Efficiency	Goods Handled per Full-Time Equivalent Employee (GHEE)
	Delivery Efficiency	Delivery Accuracy Rate (DAR)
	Service Level	Lead Time of Delivery Goods from UCC to its Users (LTDU)
Environment (ET)	Eco-Vehicle Equipment	Percentage of Alternative Vehicles (PAV)
	Rational Vehicle Utilization	Truck Loading Rate (TLR)
	Emission Generation	Travel Miles in Urban Areas (TMUA)
	Delivery Trips	Number of Delivery Trips per Day (NDT)
Society (ST)	Public Support	Public Financial Investment (PFI)
	Workers' salary	Average Staff Salary (ASS)
	Fair Labour	Workers' Overtime Utilisation (WOU)
	Traffic Volume Generation	Total Travel Time in City Centre (TTT)
	Congestion Generation	Time for on-street Parking (TOP)

Data Collection Preparation

Questionnaire Design

Open-ended question: Understanding about the concept of sustainable urban mobility

Close-ended question: 1.1 What is the ownership structure of UCC?

- Private (Solo-owned)
- Private (Joint Venture)
- Private-Public Partnership
- Publicly-owned
- Other (please specify) _____

Pairwise comparison matrix: With respect to Society Dimension Using the scale from 1 to 9 (where 9 is extremely and 1 is equally important), please indicate (Numbers) the relative importance of indicator i (left column) to indicator j (right column).

Indicator i	1	2	3	4	5	6	7	8	9	Indicator j
Public Financial Investment	9	8	7	6	5	4	3	2	1	Average Staff Salary
Public Financial Investment	8	9	8	7	6	5	4	3	2	Workers' Overtime Utilisation
Public Financial Investment	7	8	9	8	7	6	5	4	3	Typical Workers' Commute Time
Public Financial Investment	6	7	8	9	8	7	6	5	4	Total Travel Time in City Centre
Public Financial Investment	5	6	7	8	9	8	7	6	5	Time for On Street Parking
Average Staff Salary	1	2	3	4	5	6	7	8	9	Workers' Overtime Utilisation
Average Staff Salary	2	1	2	3	4	5	6	7	8	Typical Workers' Commute Time
Average Staff Salary	3	2	1	2	3	4	5	6	7	Total Travel Time in City Centre
Average Staff Salary	4	3	2	1	2	3	4	5	6	Time for On Street Parking
Workers' Overtime Utilisation	9	8	7	6	5	4	3	2	1	Typical Workers' Commute Time
Workers' Overtime Utilisation	8	9	8	7	6	5	4	3	2	Total Travel Time in City Centre
Workers' Overtime Utilisation	7	8	9	8	7	6	5	4	3	Time for On Street Parking
Typical Workers' Commute Time	6	7	8	9	8	7	6	5	4	Total Travel Time in City Centre
Typical Workers' Commute Time	5	6	7	8	9	8	7	6	5	Time for On Street Parking
Total Travel Time in City Centre	4	3	2	1	2	3	4	5	6	Time for On Street Parking

Open-Type Question

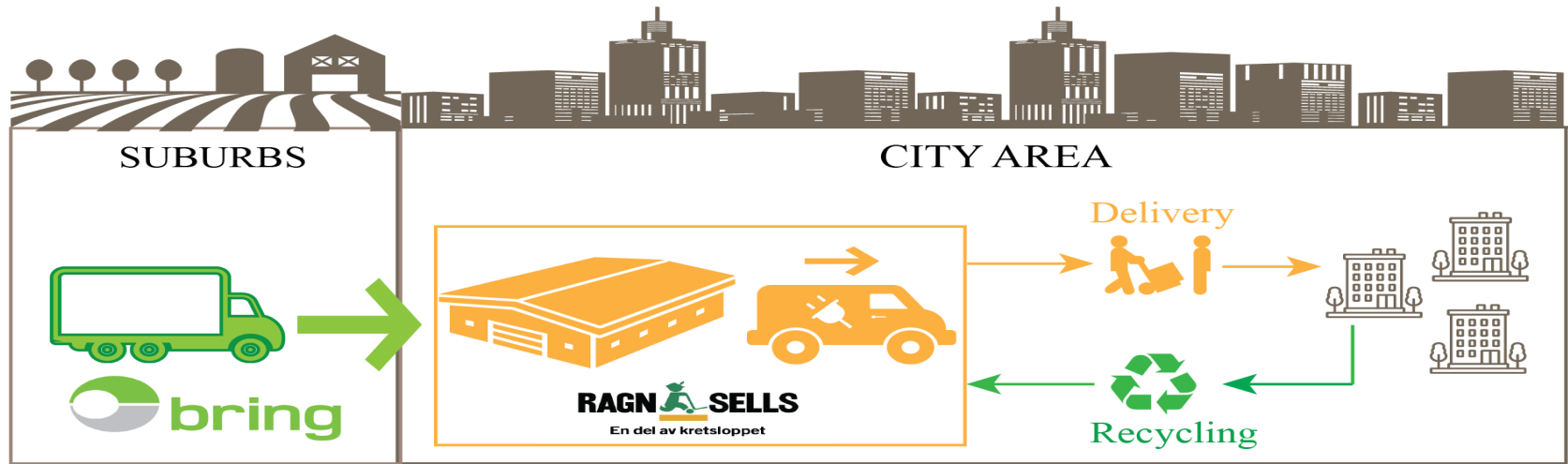
Close-Type Question

Pairwise Comparison Matrix



- The ProSFet project provided a Secondment to Stockholm City Council
 - Two Urban Consolidation Centres were reviewed in one month
 - Seven interviews with different key stakeholders in the two UCC systems
 - A field investigation to the UCC in Stockholm city centre
 - Access to documentation and reports provided by council officers and UCC employees

Case Study 1: UCC in Stockholm City Centre



Ownership

Joint-Venture

Relevant Stakeholders

Stockholm Stad

Shipper

UCC Operator & Carrier

University

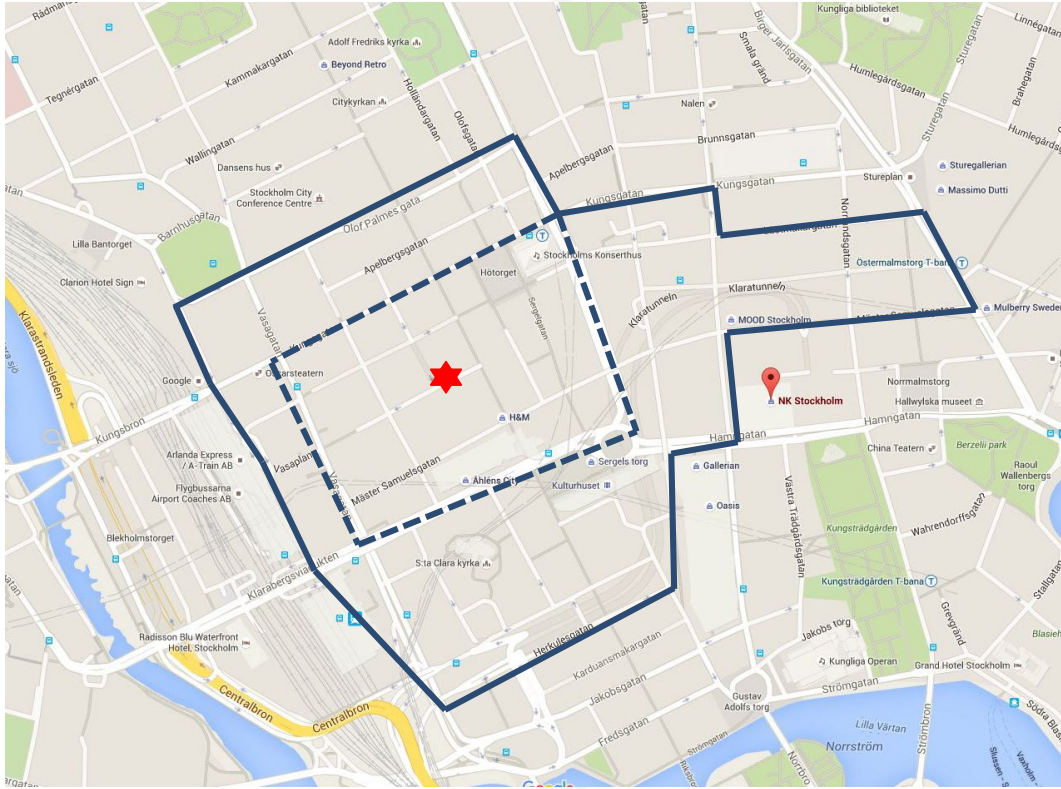
Real Estate Companies

Business Types

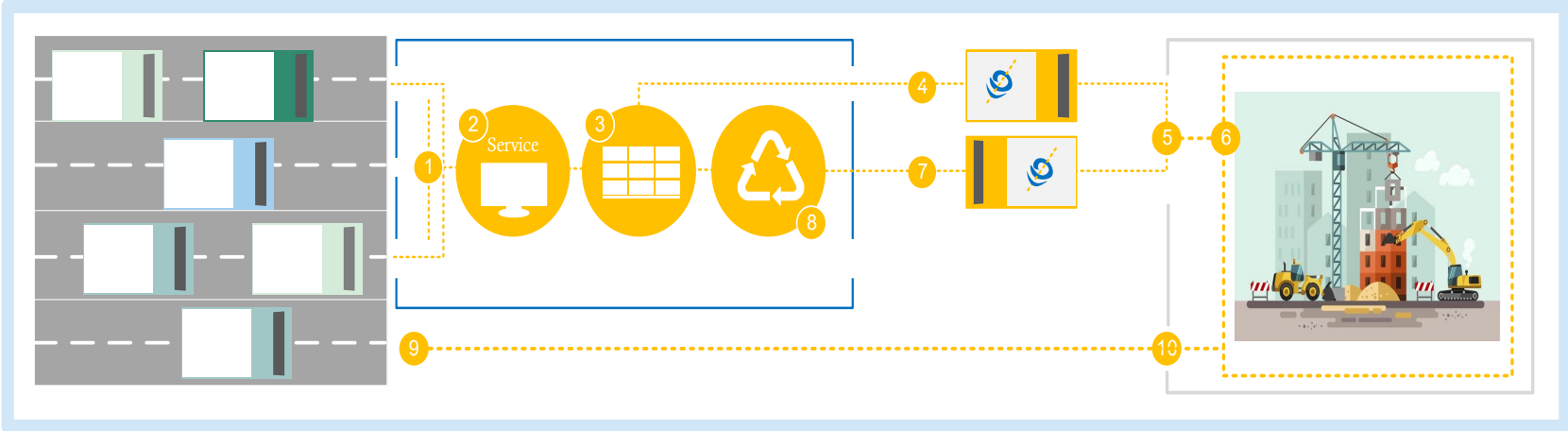
Parcel Delivery

Waste Collection

Case Study 1: UCC in Stockholm City Centre



Case Study 2: UCC in Royal Seaport



Ownership

Publicly-owned

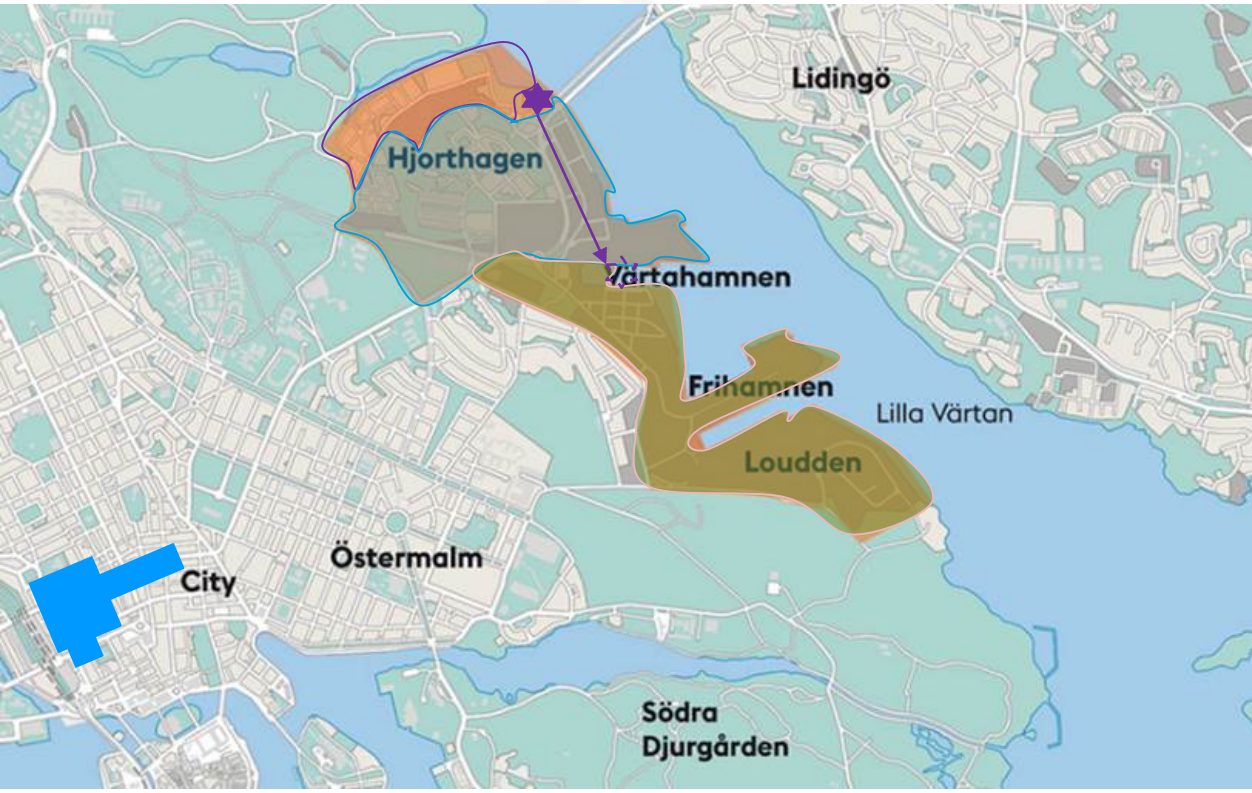
Relevant Stakeholders

- Stockholm Stad
- UCC Manager
- UCC Operator & Carrier
- Facilities and Equipment Provider

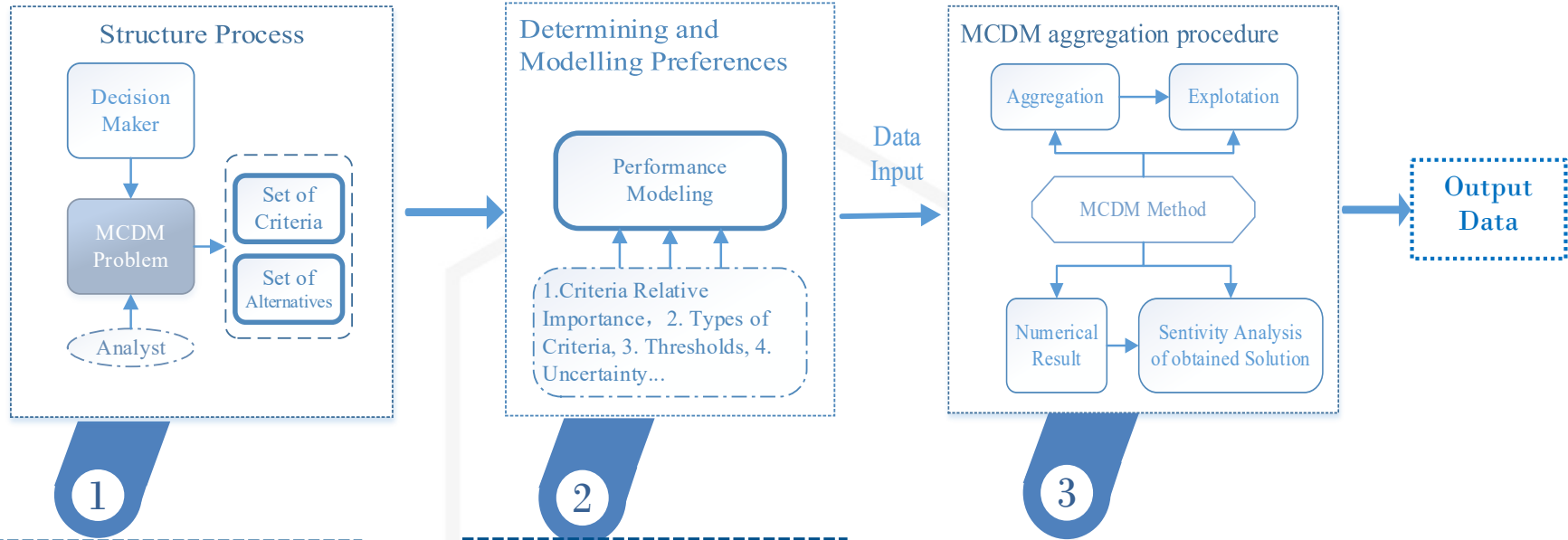
Business Type

- Parcel Delivery
- Waste Collection
- Road Monitor

Case Study 2: UCC in Royal Seaport



MCDM for UCCs Evaluation



Type of Alternatives

- Different UCCs to be evaluated
- Different UCC configurations

Type of Criteria

- Social Indicators
- Environmental Indicators
- Economic Indicators

MCDM Approach

- AHP (Analytic Hierarchy process)

Indicators Normalization



Indicator	Measurement for Indicators performance	Unite of Measurement
Annual Operating Cost (AOC)	$(Cost_{2018}-Cost_{2017})/Cost_{2017}$	±%
Typical Delivery Price (TDP)	$ (UCC \text{ Delivery Price}-Average \text{ Delivery Price in Local Logistics Market}) /$ $Average \text{ Delivery Price in Local Logistics Market}$	%
Infrastructure Surface Usage Rate (ISUR)	Size of UCC Facility/ Numbers of Staffs	M ² per Staff (MPE)
Goods Handled per Full-Time Equivalent Employee (GHEE)	Parcel Handled per Day/ Numbers of Staffs	Numbers per Staff
Delivery Accuracy Rate (DAR)	$(Total \text{ Quantities of Goods}-Quantities \text{ of Damaged Goods})/ Total \text{ Quantities of Goods}$	%
Lead Time of Delivery goods from UCC to its Users (LTDU)	Times of Goods Handling in the UCC.	Time
Percentage of Alternative Vehicles (PAV)	Numbers of Alternative Vehicles/Total Numbers of Vehicles	%
Truck Loading Rate (TLR)	Quantities of Goods Loading/Maximum Capacity of Vehicle	%
Travel Miles in Urban Areas (TMUA)	$(Expected \text{ Travel Miles of Incoming Vehicles}-Travel \text{ Miles of UCC Vehicles})/$ $Expected \text{ Travel Miles of Incoming Vehicles}$	±%
Number of Delivery Trips per day (NDT)	$(Numbers \text{ of Incoming Vehicles}-Numbers \text{ of Delivery Trips from UCC})/Numbers \text{ of Incoming Vehicles}$	%
Public Financial Investment (PFI)	Quantitates of Public Financial Investment/ Total Quantities of Financial Investment	%
Average Staff Salary (ASS)	$ (UCC's \text{ Salary}-Average \text{ Salary in Local Logistics Market}) / Average \text{ Salary in Local Logistics Market}$	±%
Workers' Overtime Utilisation (WOU)	Numbers of Overtime Working Days/Total Numbers of Working Day	%
Total Travel Time in city center (TTT)	Numbers of Vehicles Used per Day × Travel Time in Each Trip/Service Size	Total Travel Time per KM ²
Time for On-street Parking (TOP)	Numbers of Vehicles Used per Day × Times of on-Street Parking/Service Size	Total Parking Time per KM ²

Performance Values for Each Indicator

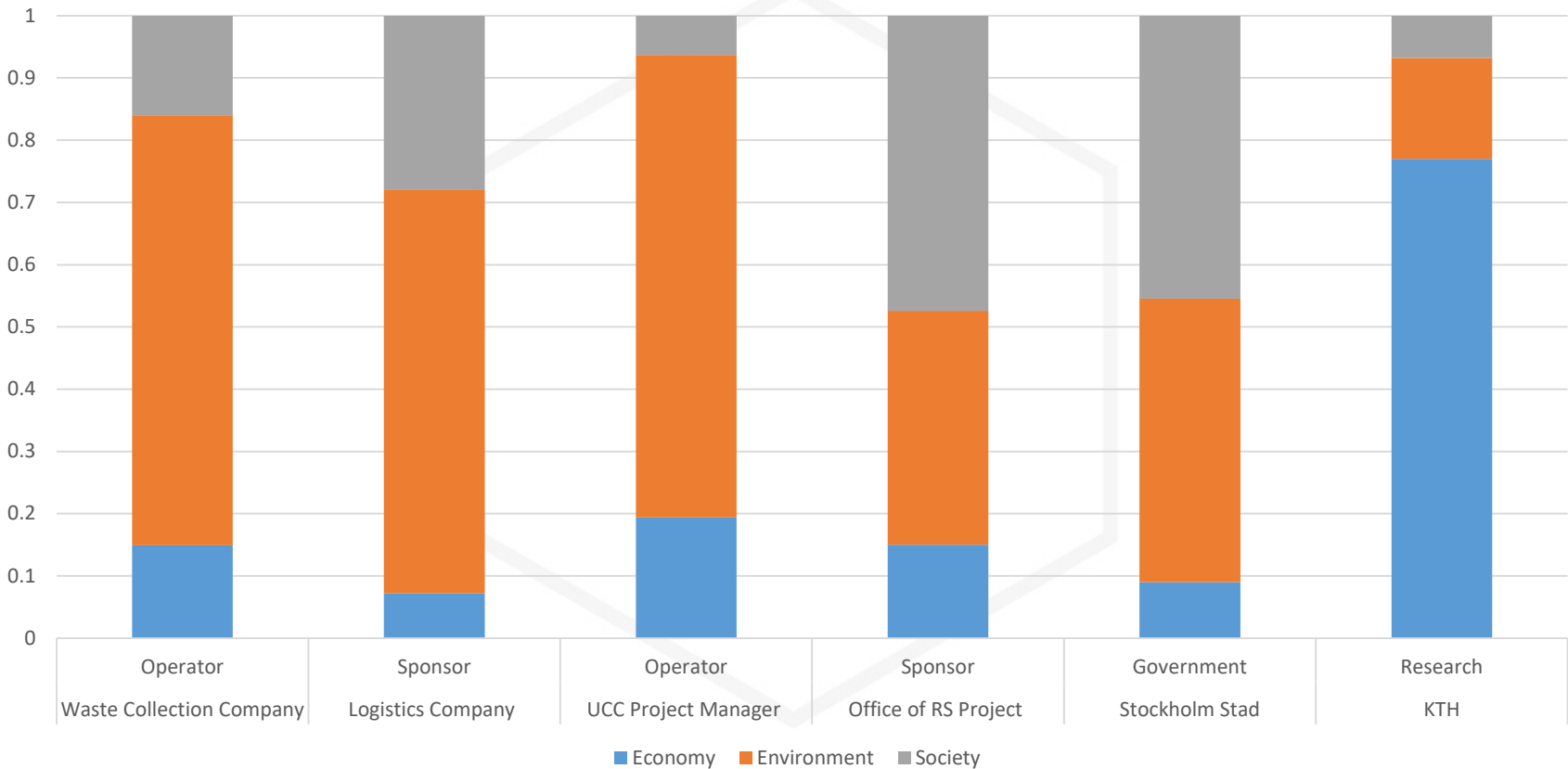


Dimensions	Indicators	Performance values of Indicators	
		CAUCC	RSUCC
Economy	AOC	-7.5%	+30%
	TDP	Equal to Average	-10% than Average
	ISUR	50MPE	75MPE
	GHEE	320	500
	DAR	100%	60%
	LTDU	2 hours	7 hours
Environment	PAV	100%	100%
	TLR	80%	60%
	TMUA	-30%	0
	NDT	-15%	-75%
Society	PFI	0	100%
	ASS	Equal to normal	Equal to normal
	WOU	0%	8.3%
	TTT	1	1.2
	TOP	2	0

Quantitative Results – SUL Dimensions



Weight of Three Dimensions of the SUL



Quantitative Results – SUL Dimensions



- In the case of the two UCCs, private and public stakeholders have quite similar views about the relative importance of Economic, Environmental and Social dimensions
 - In Stockholm City UCC, this is due to the careful planning and stakeholders' engagement phase that was conducted prior to the project launch
 - In Royal Seaport UCC, this is due to Government's 100% investment, so that they have the dominate power to requires the private stakeholders to stay on government's plan
- The council didn't "impose" the Stockholm City UCC project; they got together interested parties and let them find a mutually convenient deal
 - Combination of Forward and Reverse logistics elements is definitely a plus
 - Excellent communication
 - Mutual benefits

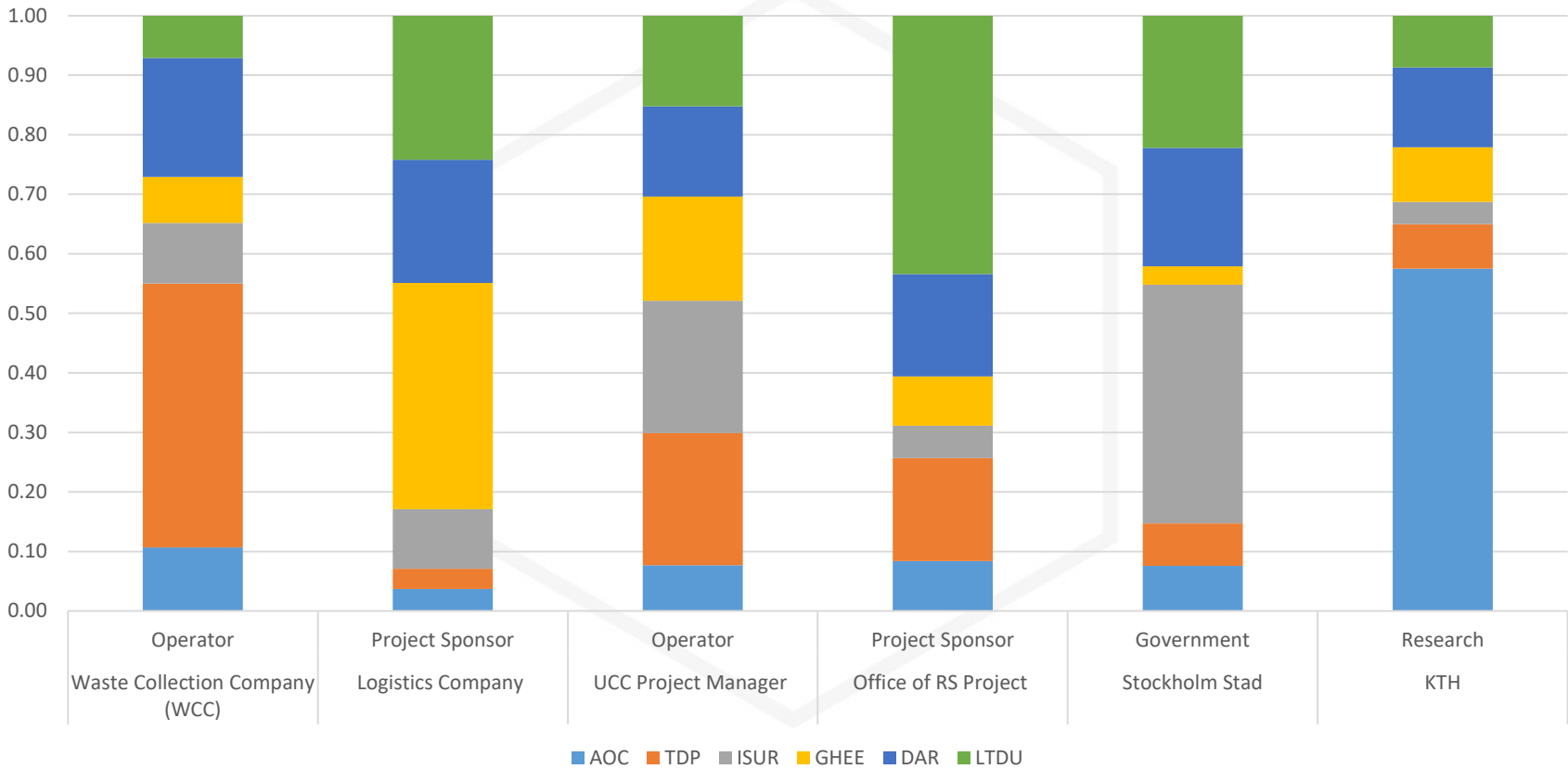
Quantitative Results – SUL Dimensions

- In the case of the Royal Seaport UCC, government directly invest the UCC, government “hire” private stakeholders to operate the UCC project. At the same time, government using mandatory policy to requires all of the construction companies in the Royal seaport to using such UCC.
 - Significantly Improve the environment of the service area.
 - A sound financial status due to the mandatory usage policy.
 - Social issues

Quantitative Results - Economic Indicators



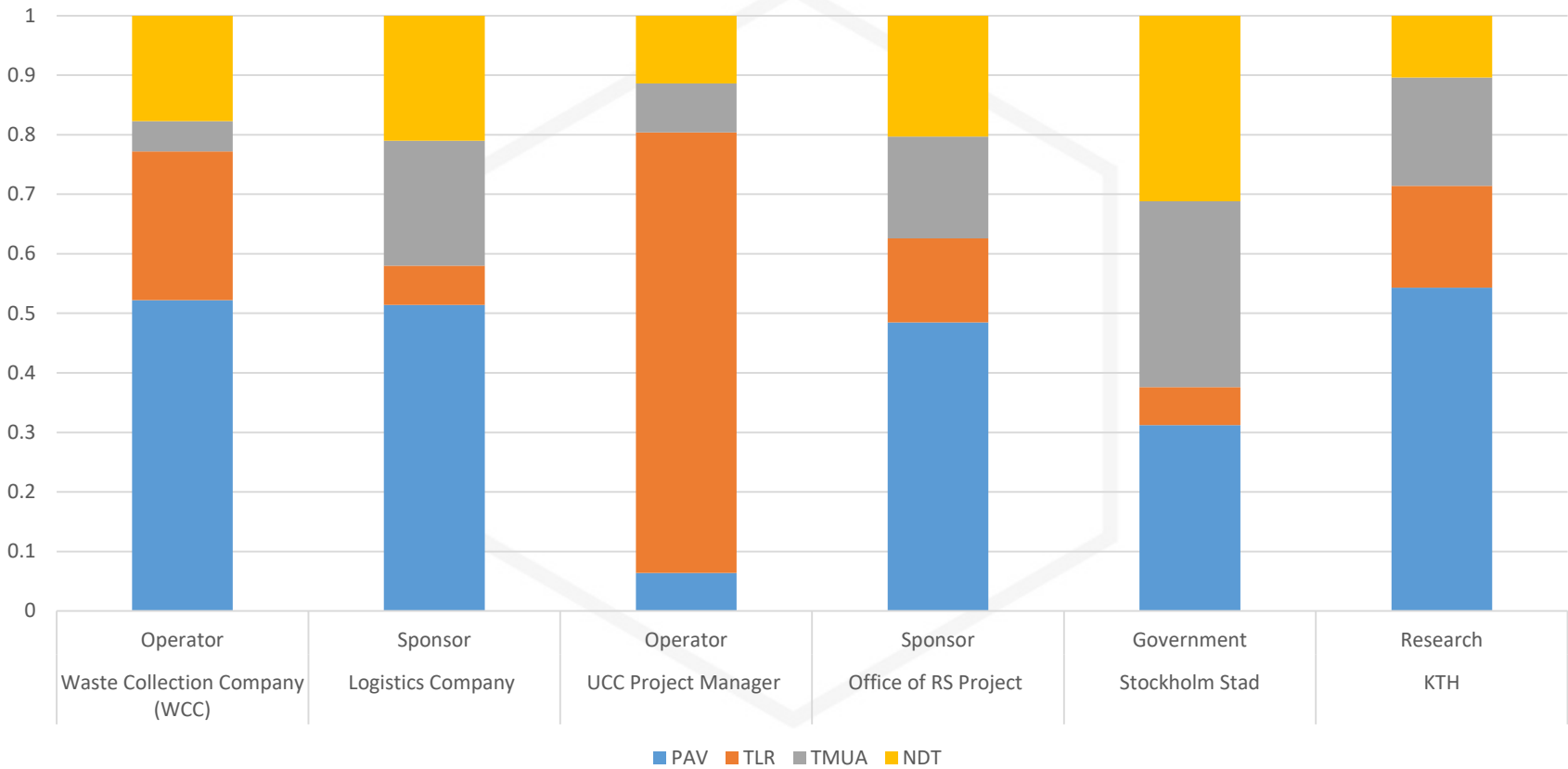
Weight of the Economic Indicators for UCC Stakeholders



Quantitative Results - Environmental Indicators



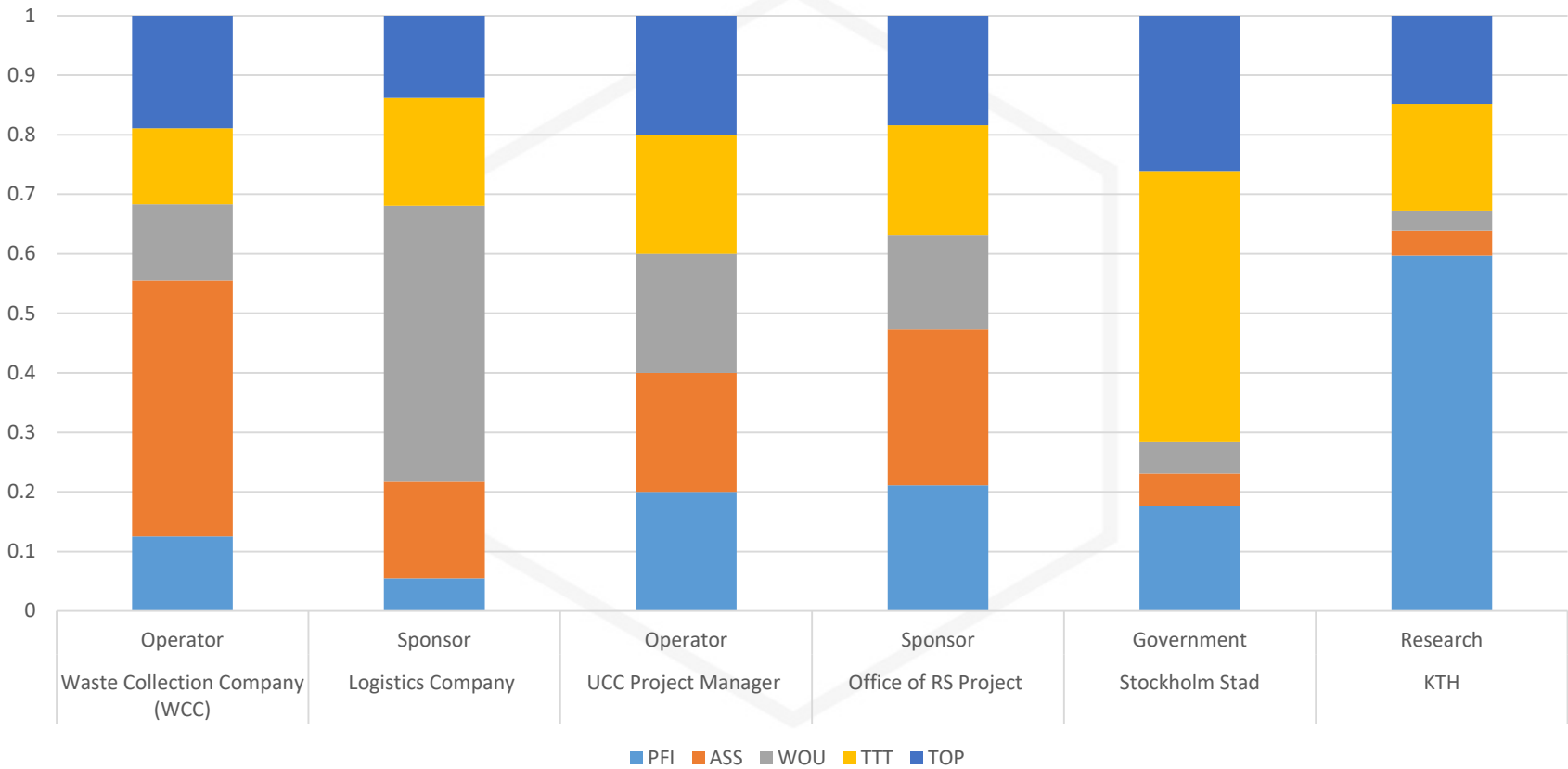
Weight of the Environmental Indicators for UCC Stakeholders



Quantitative Results - Social Indicators



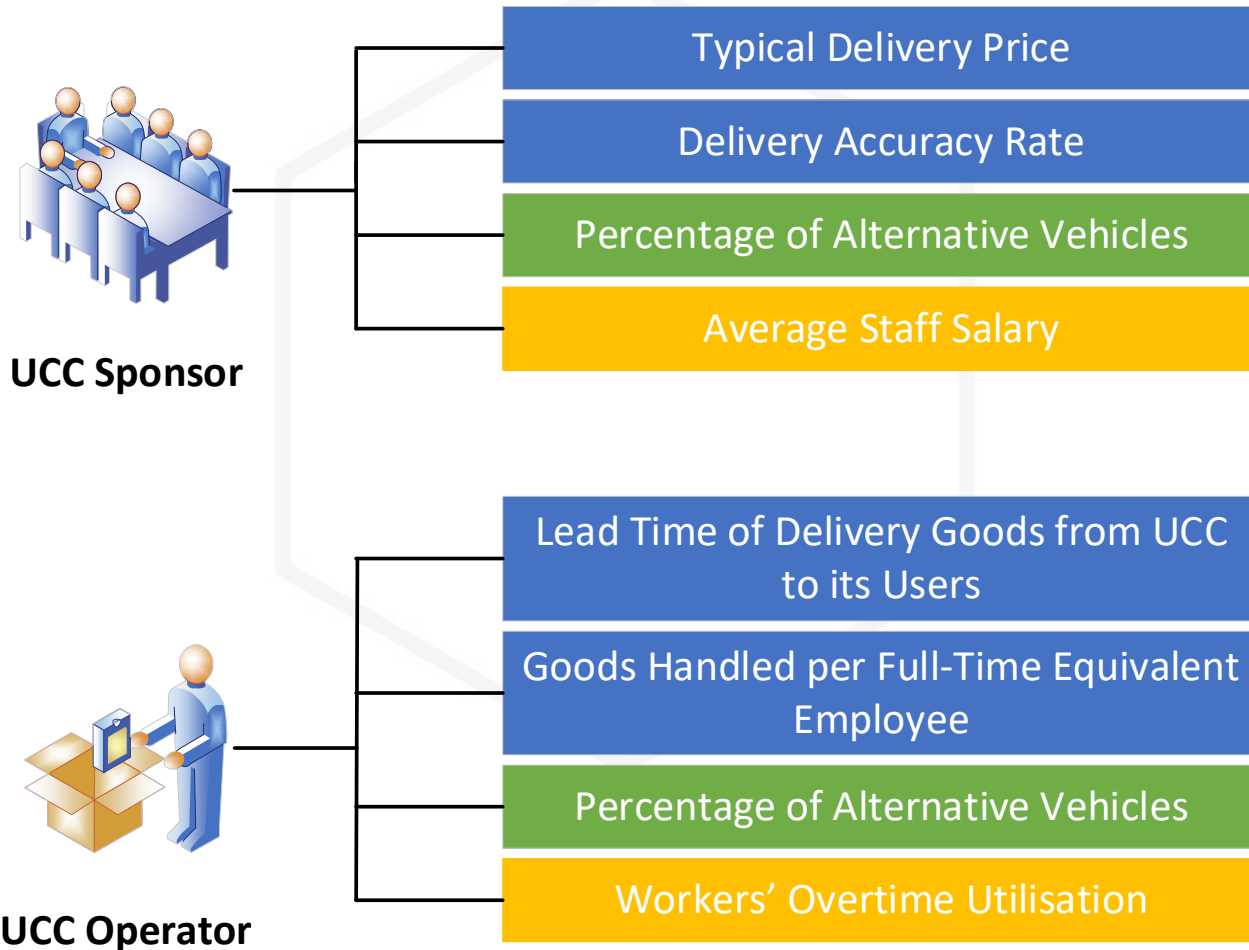
Weight of the Social Indicators for UCC Stakeholders



Indicators with Stakeholders' Strong Preference



City Centre UCC



Indicators with Stakeholders' Strong Preference

Royal Seaport UCC

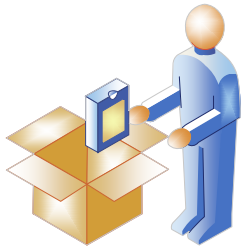


UCC Sponsor

Percentage of Alternative Vehicles

Average Staff Salary

Public Financial Investment

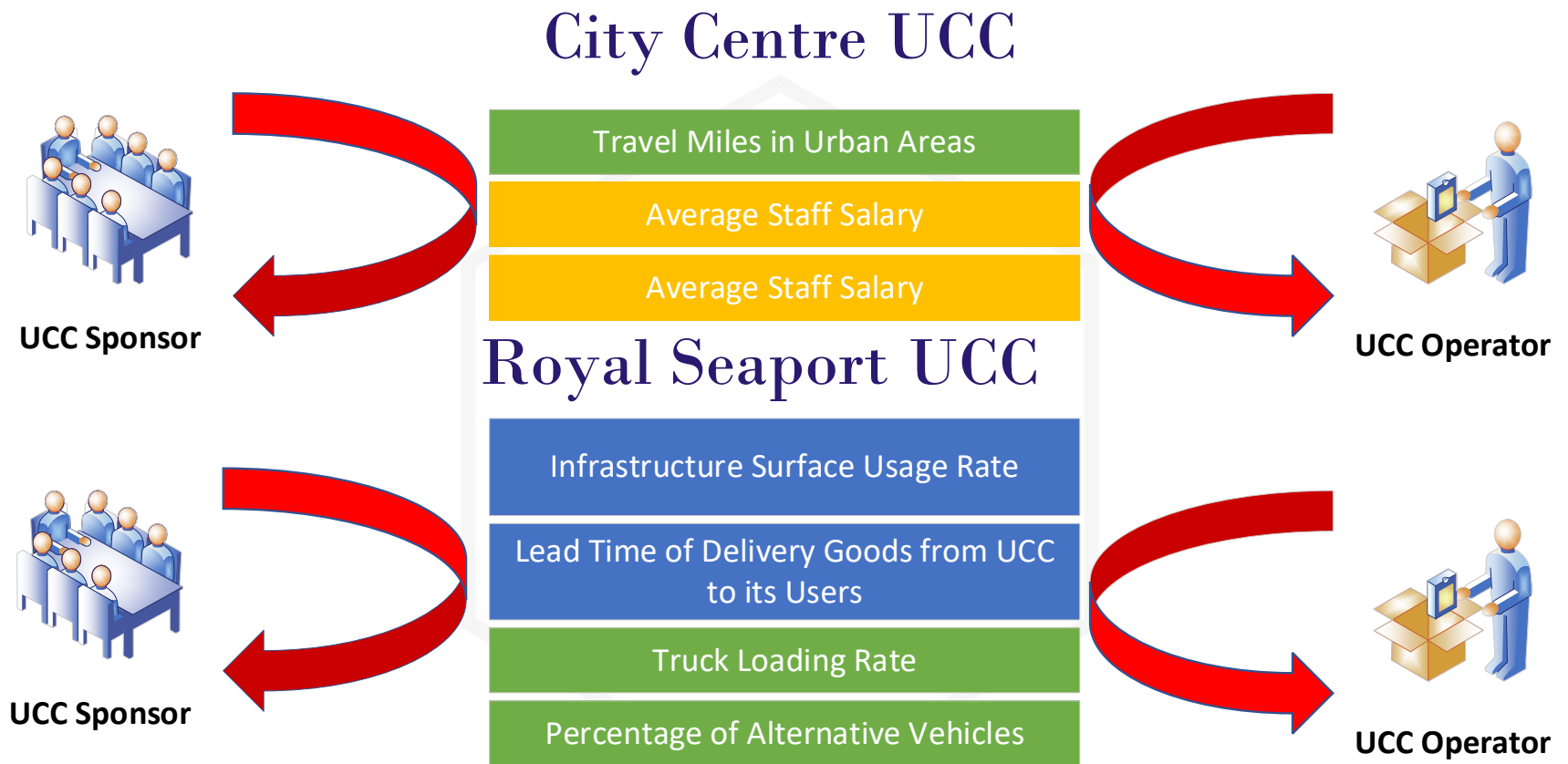


UCC Operator

Lead Time of Delivery Goods from UCC to its Users

Truck Loading Rate

Conflict Indicators Among Stakeholders



Quantitative Results – Summary



- The quantification of the relative importance assigned to categories and indicators seems to reveal a very good level of shared priorities across different stakeholders' categories
- This is the result of careful planning, identification of partners and engagement
- This seems to be a crucial element of the successful implementation of the projects and of their transferability

Qualitative Results-City Centre UCC



Key Targets for Public Stakeholders – City Centre UCC

Stockholm Stad

Less Emissions

Less Number of Vehicles

Less Road Congestion

Improve Road Safety

Less Noise

Public Awareness

KTH

More Funding for Research

Affordable New
Technology

Use of Environmental
Friendly Vehicles

Vehicle Efficiency

Reliability

Qualitative Results-City Centre UCC



Key Targets for Private Stakeholders – City Centre UCC

Bring

No Negative
Influence on the
Profit

Attracting more
Consumers

Setting up new
collaborations

Ragn- Sells

Attracting
more
Consumers

Vehicle Efficiency

Low Operating
Cost

Information
Sharing

Real Estate

Less Emissions

Less Vehicles

Less Road Congestion

Less Noise

Improve Road
Safety

Setting up new
collaborations

Qualitative Results-City Centre UCC

Open Issues for the UCC in City Centre

Private Stakeholders

Low Delivery Efficiency

Capacity of Electric Vehicles

Lack of Policy Support

Lack of Information
Sharing

Difficulties in hitting
business targets

Public Stakeholders

Lack of Private
Participators

Size of Service Area

Difficulties in measuring
achievements

Attracting more Financial
Investment

Qualitative Results-Royal Seaport UCC



Key Targets for Public Stakeholders – UCC in Royal Seaport

Office of Royal Seaport

Less Emissions

Less Number of Vehicles

Cost Reduction for Project of RS

Improve Road Safety

Improve the Service Choice

Public Awareness

Education and Training

Qualitative Results-Royal Seaport UCC



Key Targets for Private Stakeholders –UCC in Royal Seaport

UCC Project Manager

Business Promotion

Social Reputation

Qualitative Results-Royal Seaport UCC



Open Issues for the UCC in City Centre

Private Stakeholders

Strong Police Influence

Public Stakeholders

Cost Increasing

Service Limited types of Product

High Goods Damage Rates

Long lead Time

Thank You



Questions?
Comments?

