Urban Logistics Innovation Day

26 September 2023, Brussels

Break-out Session I B: Consumer engagement & Sustainability of Urban Freight

LEAD

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Sustainability score of urban freight logistic solutions: The STAR Logistic Methodology

Jose Manuel Vassallo
Professor of Transport
Universidad Politécnia de Madrid

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BACKGROUND

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Boom of on-demand logistics → stress last-mile delivery systems

- Customer: demand of customised products
- Marketplaces: provides instant delivery
- Cities: possible negative consequences

Growing interest to make last-mile logistics more sustainable

- Sustainability in last-mile logistics = environmental impact + economic growth +societal goals

LEAD PROJECT

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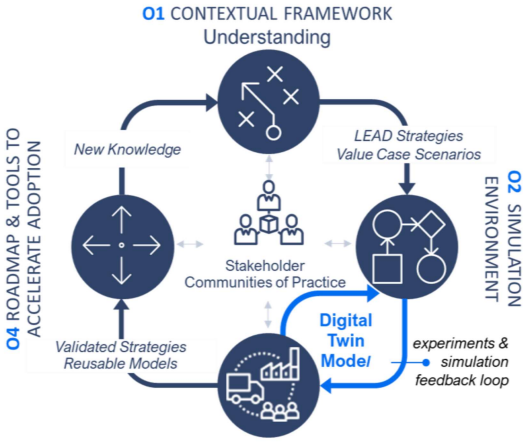
- Digital Twins for urban logistics services in 6 cities
- Demonstrated strategies by combining several measures (shared, connected, low-emission, etc.)
- Guidance on decision-making regarding on-demand logistics operations



STAR LOGISTIC METHODOLOGY

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Multi-Criteria Evaluation Methods → STAR Logistics Methodology (by UPM)

- Based upon sustainability KPIs (economic, environmental and social)
- Producing a sustainability performance rating
- Weights are estimated depending on both:
  - *expert stakeholders' preferences*
  - *context of the urban area*

What strategies should policy-makers prioritize based on sustainability targets?

How sustainable are the proposed last-mile solutions?

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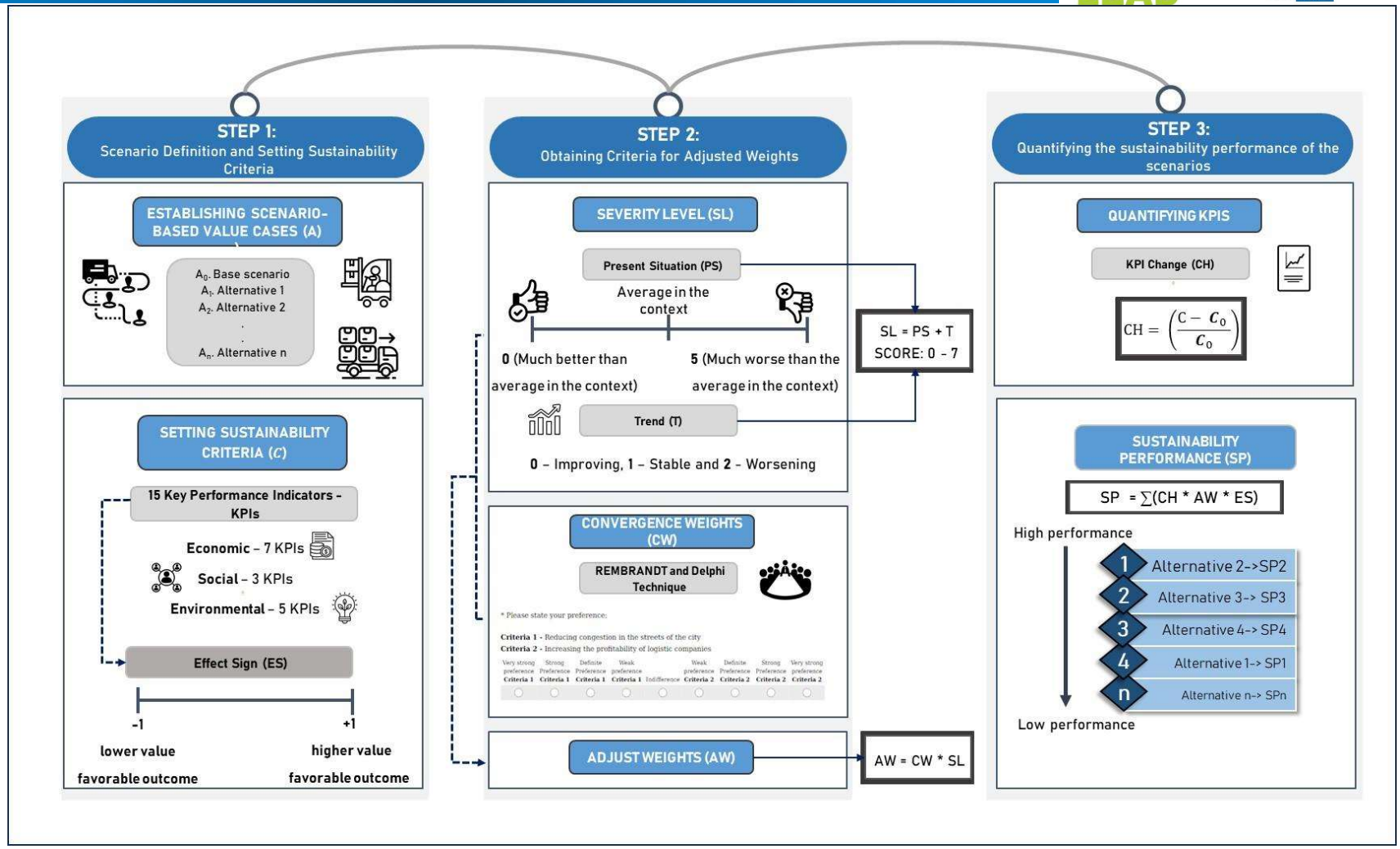

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STEP 1:
Scenario Definition and Setting Sustainability Criteria

ESTABLISHING SCENARIO-BASED VALUE CASES (A)

- A_0. Base scenario
- A_1. Alternative 1
- A_2. Alternative 2
- .
- .
- A_n. Alternative n

SETTING SUSTAINABILITY CRITERIA (C)

15 Key Performance Indicators - KPIs

Economic – 7 KPIs

Social – 3 KPIs

Environmental – 5 KPIs

Effect Sign (ES)

-1 lower value favorable outcome

+1 higher value favorable outcome

COMPONENT	NAME	UNIT	ES [A]
Social	Job Creation	Employee	+1
Social	Quality of the jobs	Value between 1 to 5	+1
Social	Neighbour quality of life	Value between 1 to 5	+1
Environmental	Energy consumption	MJ/delivery	-1
Environmental	GHG emissions	gCO2e/delivery	-1
Environmental	NOx emissions	gNO2e/delivery	-1
Environmental	PM emissions	gPM/delivery	-1
Environmental	Noise pollution	dBA*h/day	-1
Economic	Average delivery cost of the business model	€/delivery	-1
Economic	Congestion	%	-1
Economic	Urban storage & parking space	Square meters	-1
Economic	Financial Internal Rate of Return	%	+1
Economic	Shop retail benefits	Value between 1 to 5	+1
Economic	Delivery time	minutes/delivery	-1
Economic	Delivery reliability within the time windows	%	+1

[a](+1) More is better, (-1) Less is better

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STEP 2:
Obtaining Criteria for Adjusted Weights

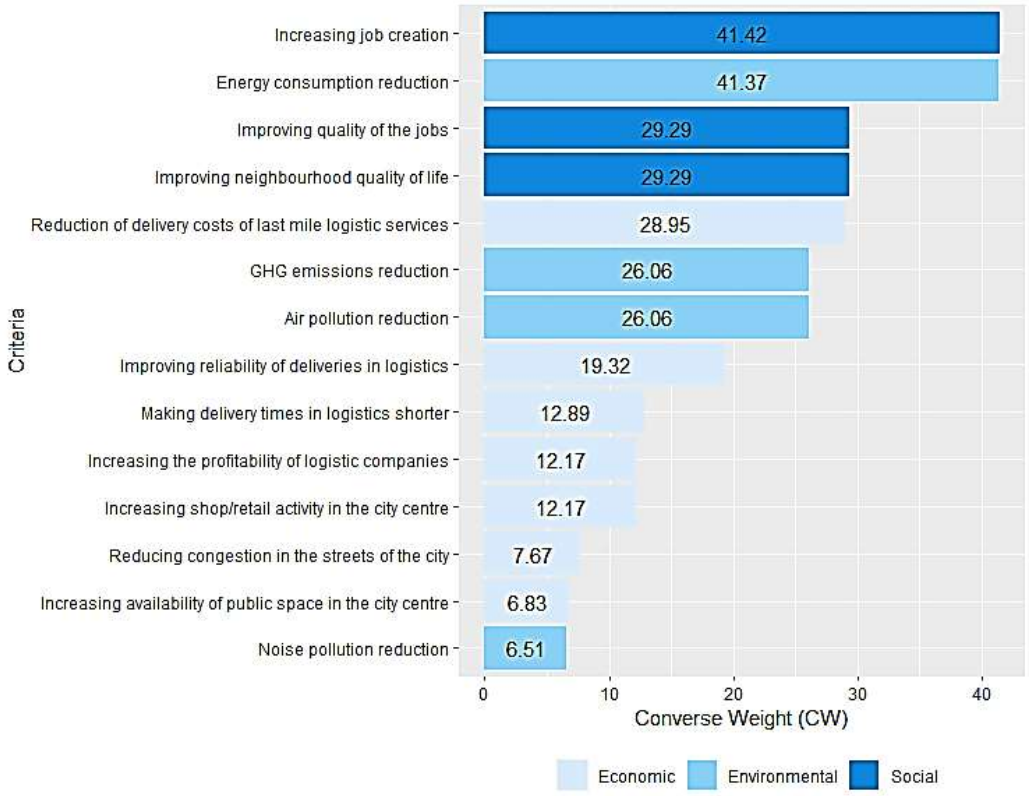
CONVERGENCE WEIGHTS (CW)

REMBRANDT and Delphi Technique

* Please state your preference:

Criteria 1 - Energy consumption reduction
Criteria 2 - GHG emissions reduction

Very strong preference **Criteria 1**	Strong Preference **Criteria 1**	Definite Preference **Criteria 1**	Weak preference **Criteria 1**	Indifference	Weak preference **Criteria 2**	Definite Preference **Criteria 2**	Strong Preference **Criteria 2**	Very strong preference **Criteria 2**
○	○	○	○	○	○	○	○	○



Survey Data available in Zenodo
10.5281/zenodo.7695814

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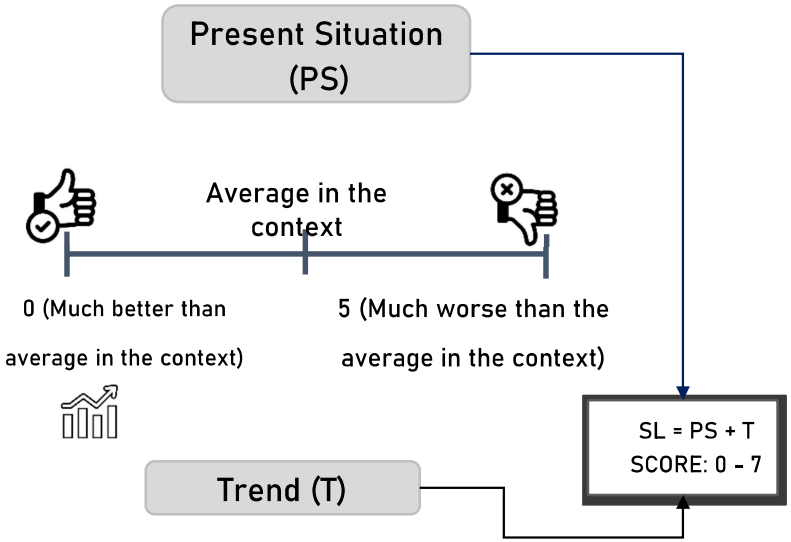
SEVERITY LEVEL (SL)



0 – Improving, 1 – Stable and 2 - Worsening

CRITERIA	MADRID		THE HAGUE		LYON		BUDAPEST		OSLO		PORTO	
	PS	T	PS	T	PS	T	PS	T	PS	T	PS	T
Job Creation	5	0	1	0	3	0	1	1	1	1	2	1
Quality of the Jobs	5	1	1	1	2	2	2	2	1	1	3	1
Neighbours' Quality of Life	3	2	1	0	1	0	3	2	1	2	1	1
Energy consumption	5	0	3	0	5	0	3	1	1	0	5	0
GHG emissions	3	0	3	0	0	0	3	0	3	0	3	0
NOx emissions	2	0	5	0	2	0	3	1	3	0	3	1
PM emissions	1	1	1	0	3	0	3	0	1	0	1	1
Noise pollution	1	0	4	2	4	0	4	2	5	1	1	2
Average delivery cost of the business model	3	1	3	0	3	2	4	2	3	2	3	2
Congestion	1	1	4	1	5	1	5	0	2	1	2	0
Urban storage & parking space	4	1	4	0	3	0	4	0	4	2	4	2
Financial Internal Rate of Return (FIRR)	2	2	2	0	4	0	3	0	2	0	2	1
Shop retail benefits	4	2	4	0	4	0	1	0	3	0	4	0
Delivery time	3	0	3	0	3	0	3	0	3	1	3	1
Delivery reliability within the time windows	3	1	3	2	3	1	3	2	3	1	3	0

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STEP 2:
Obtaining Criteria for Adjusted Weights

ADJUST WEIGHTS (AW)

AW = CW * SL

CRITERIA	MADRID	THE HAGUE	LYON	BUDAPEST	OSLO	PORTO
Job Creation	207.1	41.4	124.3	82.8	82.8	124.2
Quality of the Jobs	175.7	58.6	117.2	117.2	58.6	117.1
Neighbourhood Quality of Life	146.5	29.3	29.3	146.5	87.9	58.6
Energy consumption	206.9	124.1	206.8	165.5	41.4	206.8
GHG emissions	78.2	78.2	78.2	78.2	78.2	78.2
NOx emissions	52.1	130.3	52.1	104.2	78.2	104.2
PM emissions	52.1	26.1	78.2	78.2	26.1	52.2
Noise pollution	6.5	39.1	26.0	39.1	39.1	19.5
Average delivery cost of the business model	115.8	86.8	144.8	173.7	144.8	144.7
Congestion	15.3	38.3	46.0	38.3	23.0	15.3
Urban storage & parking space	34.1	27.3	20.5	27.3	41.0	41.0
Financial Internal Rate of Return (FIRR)	48.7	24.3	48.7	36.5	24.3	36.5
Shop retail benefits	73.0	48.7	48.7	12.2	36.5	48.7
Delivery time	38.7	38.7	38.7	38.7	51.6	51.6
Delivery reliability within the time windows	77.3	96.6	77.3	96.6	77.3	58.0

Minimum → 6.5

Maximum → 207.1

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STEP 3:
Quantifying the sustainability performance of the scenarios

QUANTIFYING KPIs

KPI Change (CH)

Change compared with the base Scenario

$$CH = \left(\frac{C - C_0}{C_0}\right)$$

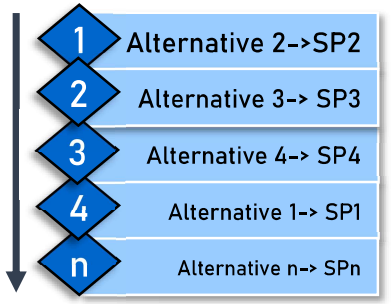
Data Sources

- Living Labs Digital Twins
- Logistic Operator Data
- Survey base

SUSTAINABILITY PERFORMANCE (SP)

$$SP = \sum(CH * AW * ES)$$

Ranking
From more Sustainability Performance to Less Sustainability Performance



SUSTAINABLE PERFORMANCE

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LIVING LAB	SCENARIO	SUSTAINABLE PERFORMANCE RATING
Madrid	B2C: BAU with E-van	433.736
	B2C: Hybrid van + UCC + E-scooter	492.029
	B2C: E-van + UCC + E-scooter	529.382
	B2C: Big E-van + UCC + E-scooter	555.566
The Hague	B2C: Crowdshipping	258.156
	B2C: Parcel Lockers	151.855
	B2C: Parcel Lockers (bikes) + Crowdshipping	352.536
Lyon	B2C: 3 UCCs + cargo-bikes today's demand of parcels	85.758
	B2C: BAU with 2030 demand of parcels	112.792
	B2C: UCC scenario with 2030 demand of parcels B2C	168.051
Budapest	B2B: Minihub (LNG vehicle) + permanent warehouse 24h/day	616.441
	B2B: Minihub (e-vehicle 16t) + continuous warehouse (7 am to 12 pm)	633.230
	B2B: Minihub (LNG vehicle) + 24h transshipment point	619.173
	B2B: Minihub (e-van) + transhipment point (7 am to 12 pm)	635.962
Oslo	B2C: E-vans	248.421
	B2C: E-vans + microhub	259.305
	B2C: E-vans + microhub + Crodwshipper	289.884
Porto	B2B: 25% e-vehicles	114.133
	B2B: 50% e-vehicles	186.284
	B2B: 75% e-vehicles	288.808

CONCLUSIONS

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- All the solutions of the living labs improve sustainability
- The results vary quite a lot depending on the context
- Discussing with stakeholders helps acquiring knowledge about LML solutions
- Digital Twins for synchronous last-mile are helpful to provide KPIs
- Policymakers can STAR to prioritize LML solutions

José Manuel Vassallo
josemanuel.vassallo@upm.es

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