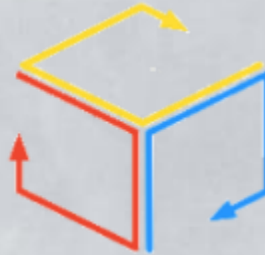


Simulation modelling in the sizing of city logistics systems – a study for concentrated delivery points



Budapest University of
Technology and
Economics,
Department of
Material Handling and
Logistics Systems

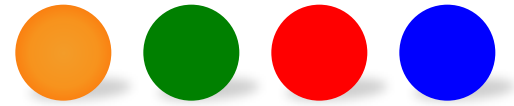


Krisztián Bóna PhD, Dávid Lajos Sárdi

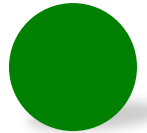


6th International Scientific Conference on Advances
in Mechanical Engineering (ISCAME), 2018

Agenda



Introduction



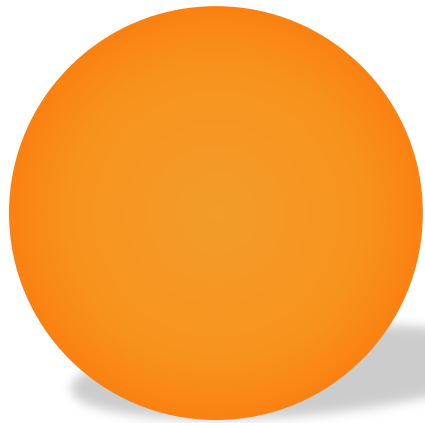
Developing methodology



Simulation modelling



Next steps



Introduction





Urban Freight

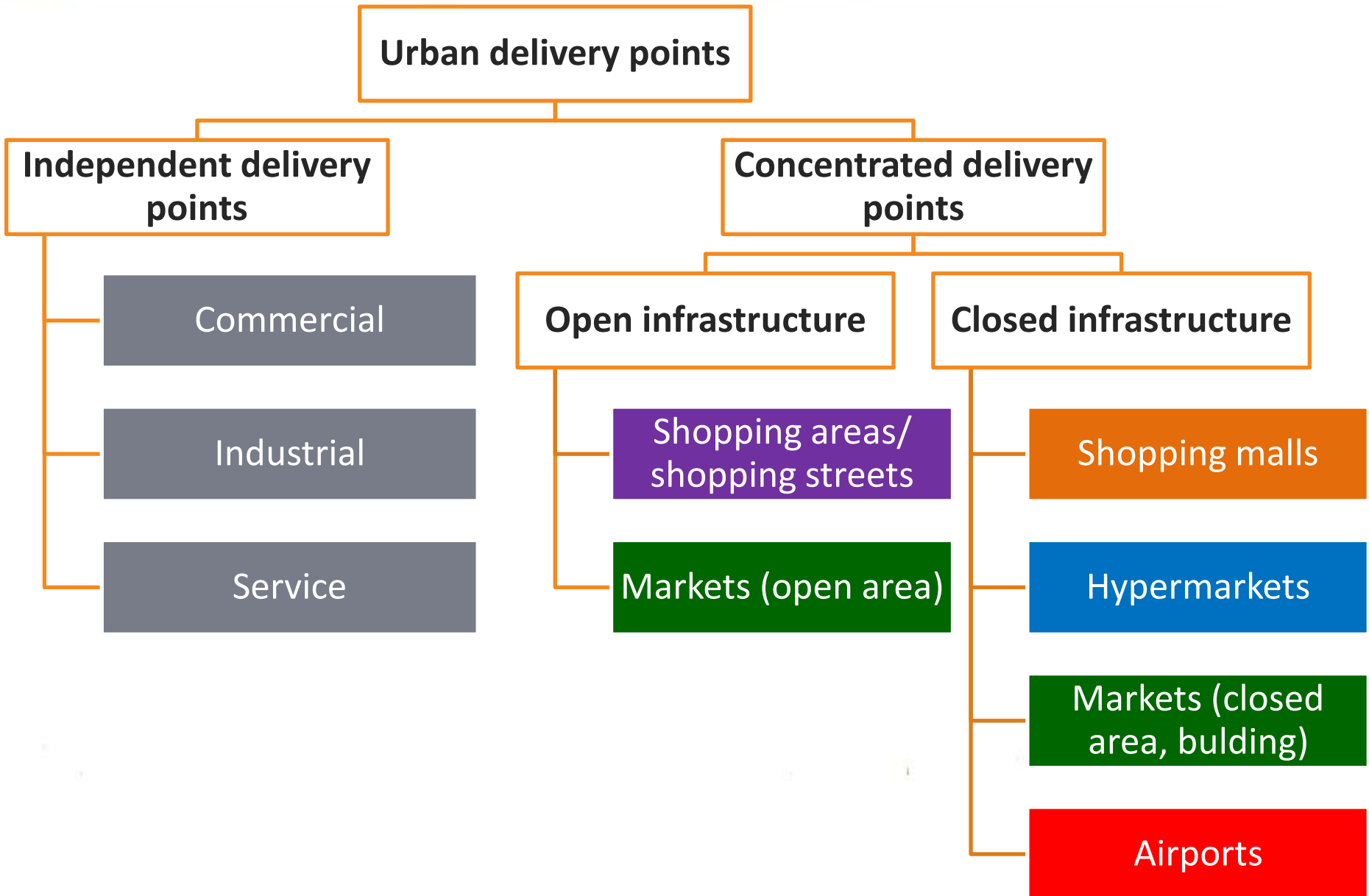
- Environmental pollution
- Noise pollution
- Damaging the infrastructure
- Congestion
- etc.

Concentrated delivery points

- Many stores in a condensed space
- 10% of all retail outlets in Budapest in shopping malls
- Logistics processes on the backburner
- etc.

Great potential in new, consolidated systems!

Concentrated delivery points



Budapest



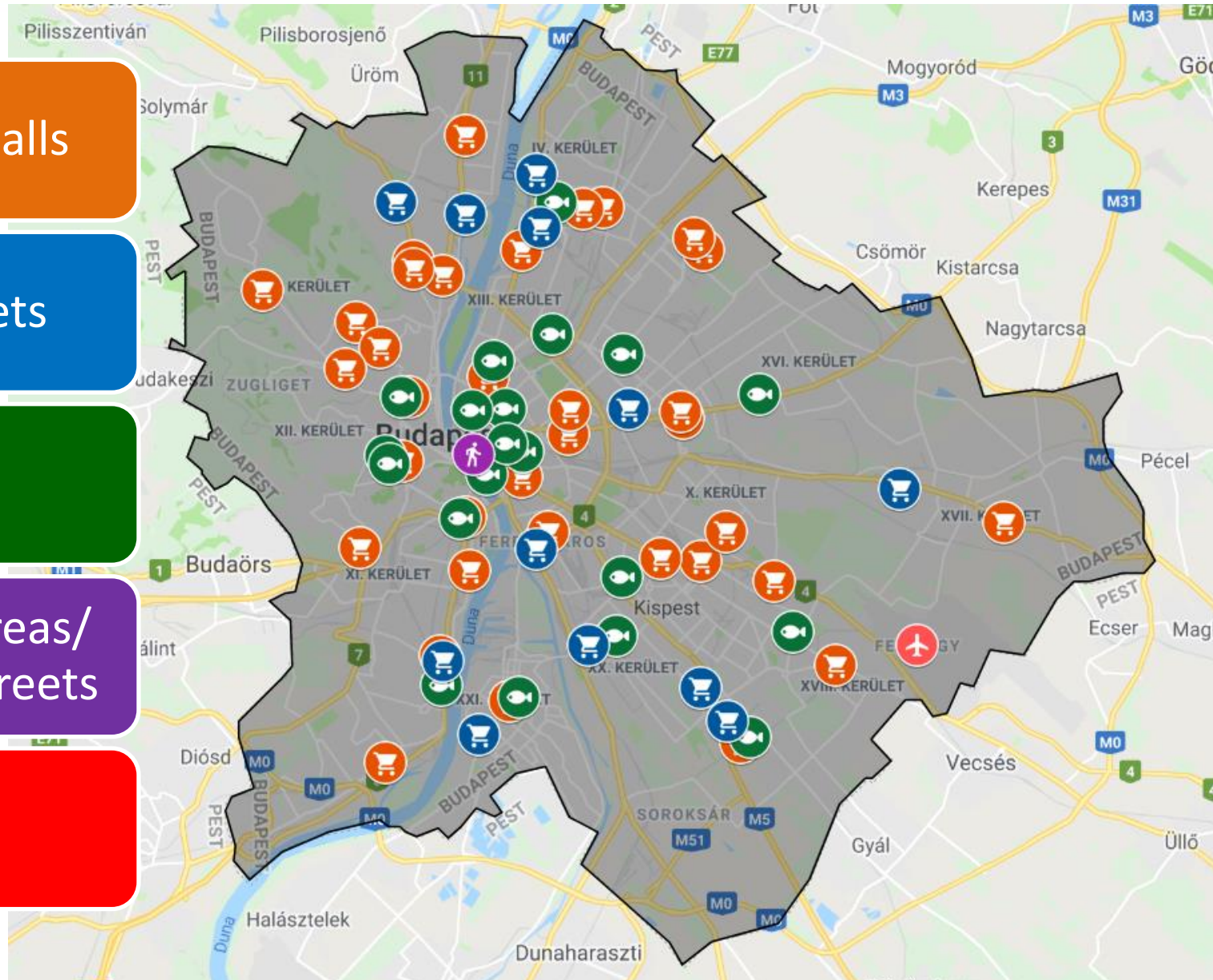
Shopping malls

Hypermarkets

Markets

Shopping areas/
shopping streets

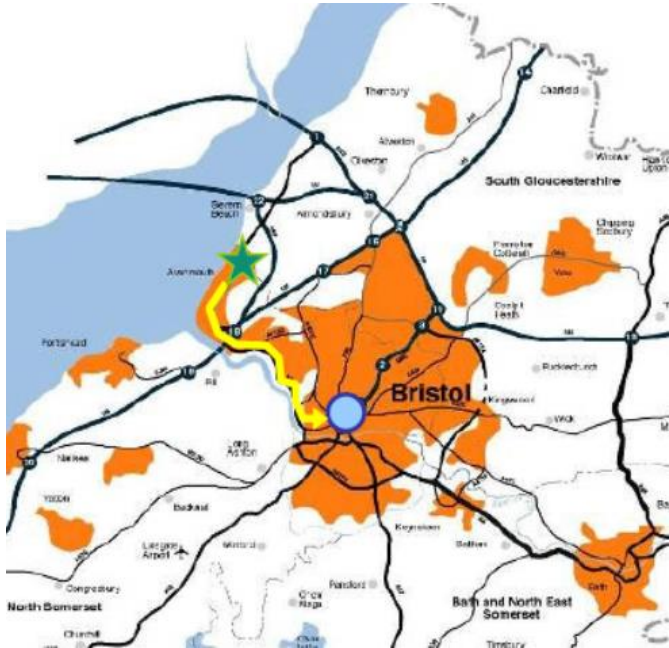
Airports



Solutions in Europe



Example: Bristol

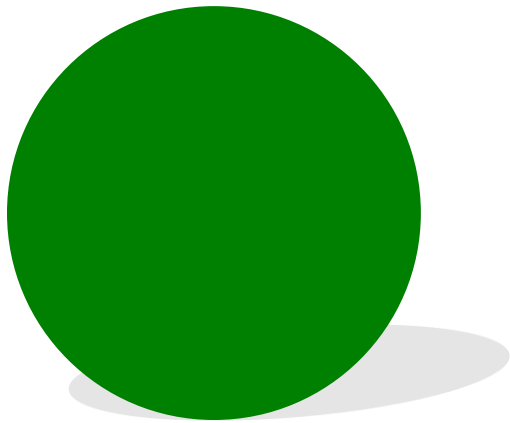


Vehicle movements reduced by 72%

Air pollution reduction: CO₂: 11 t, NO_x: 1,75 t, PM10: 243 kg

Improved reliability, 100% on time

Retailer satisfaction: 94% would recommend



Developing methodology



Foundation of such system



How much?

What kind?

From/to?

How often?

When?

In what?

etc.



No available data



Status quo?



**RESEARCH
METHODOLOGY**



Exploratory research

- Field study
- Expert interview (if possible)
- Bylaws

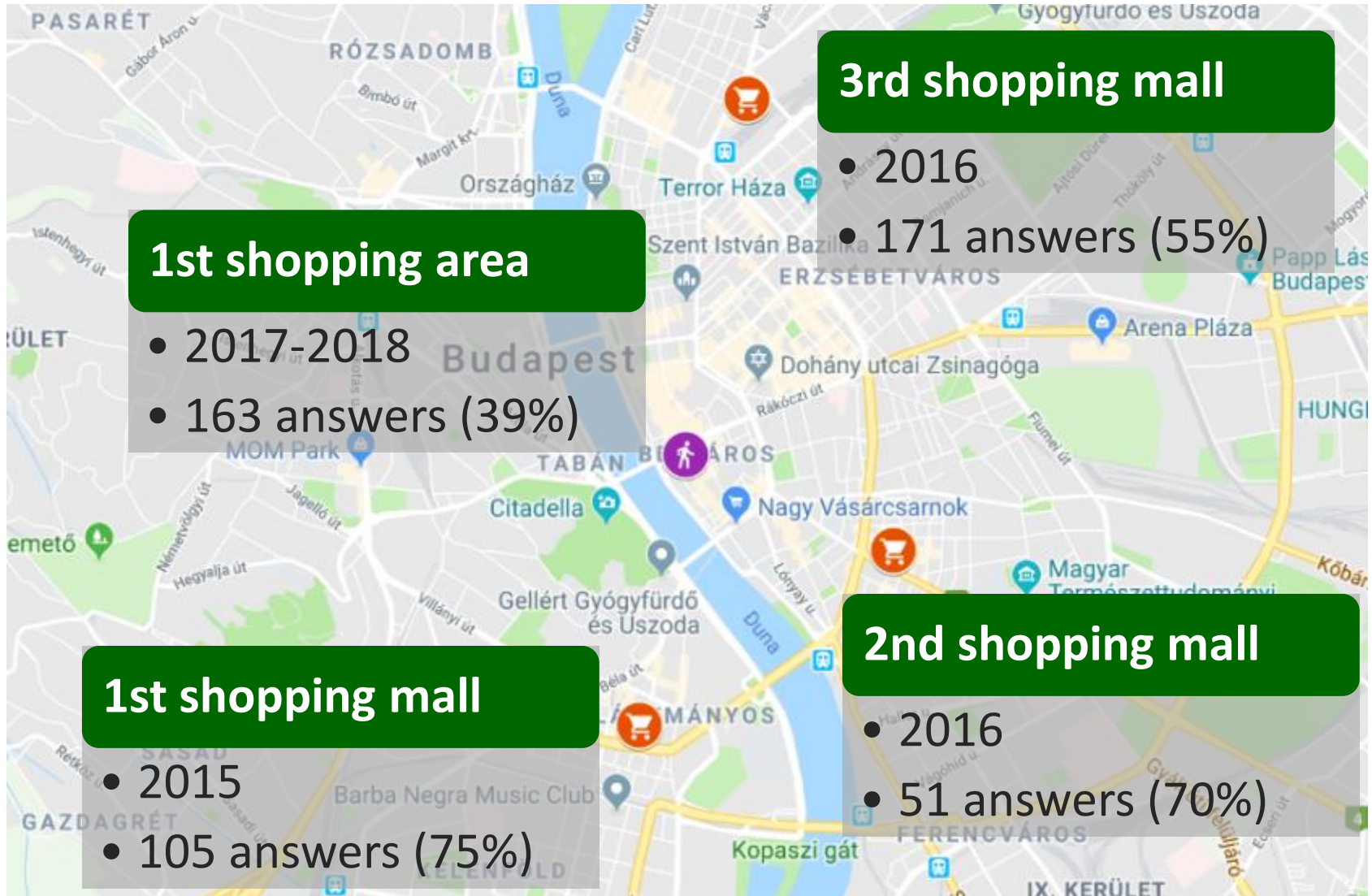
Descriptive research

- Questionnaire (31 questions)
- Evaluation
- Quantification



Standard research methodology!

Data collection



Detected problems



Lots of transactions

Small vehicles



Small, non-standard sized delivery units



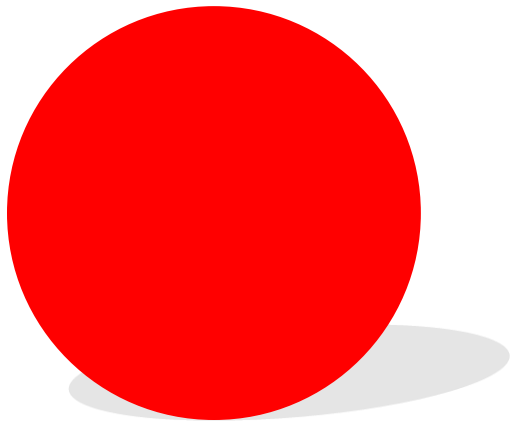
Loading in parking area



Big load for the roads



Consumption, emission



Simulation modelling



Modelling steps



Delivery processes

- Only in the city
- MS Excel simulation



Delivery processes

- Whole process
- MS Excel simulation



Cost structure

- Mathematical model
- MS Excel simulation

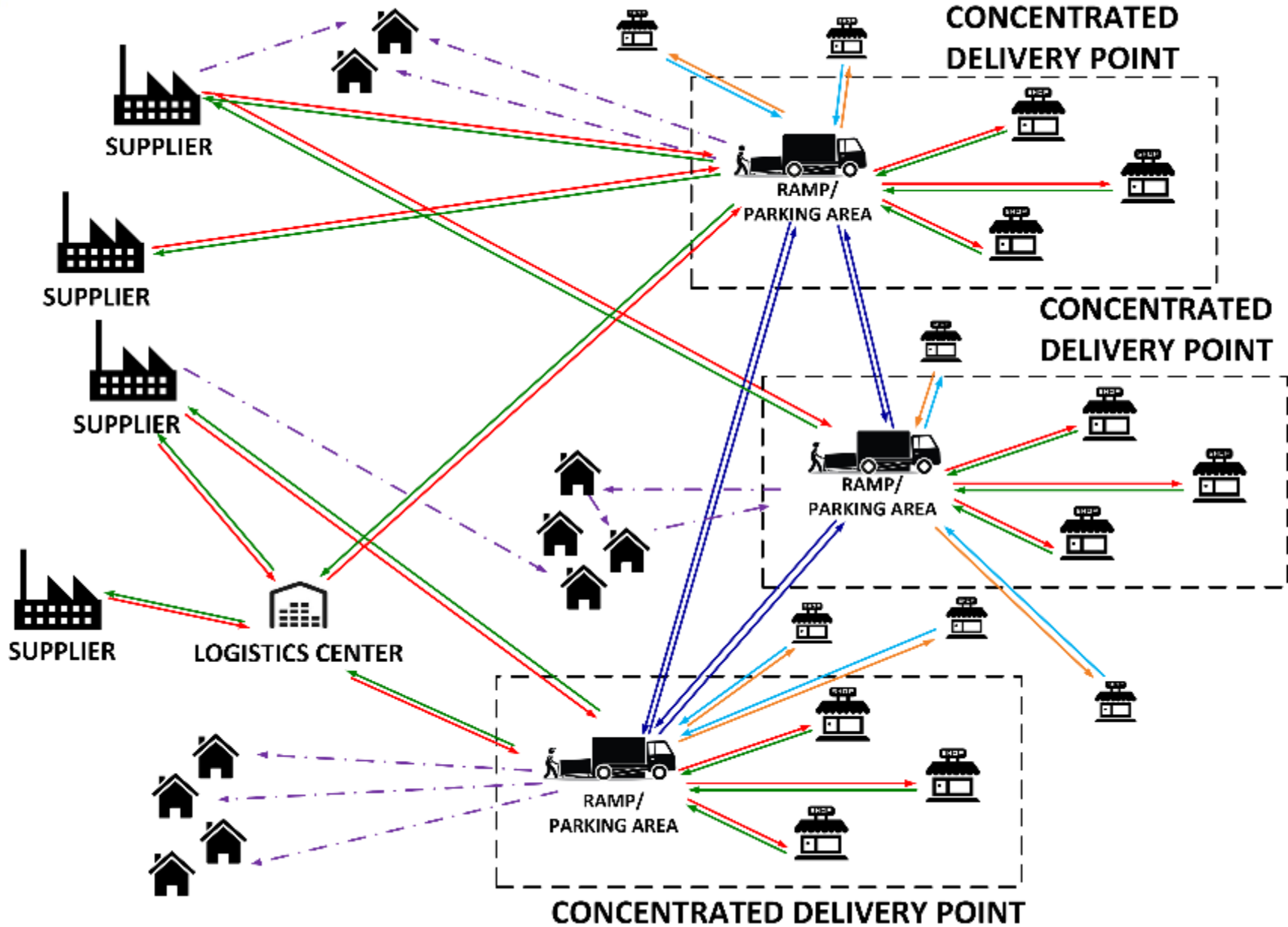


Empty handling and home deliveries

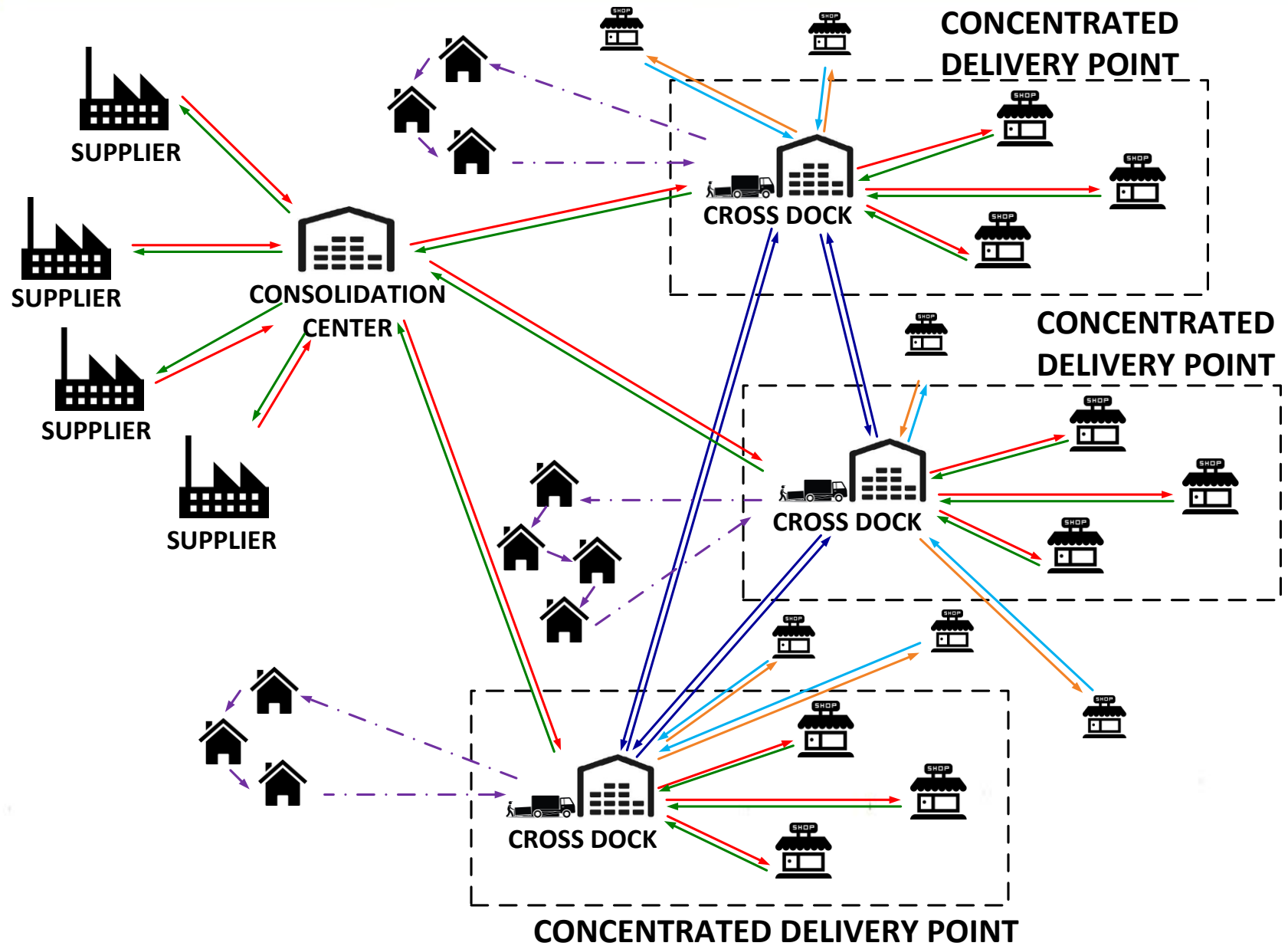
- MS Excel simulation

Mathematical model of logistics processes

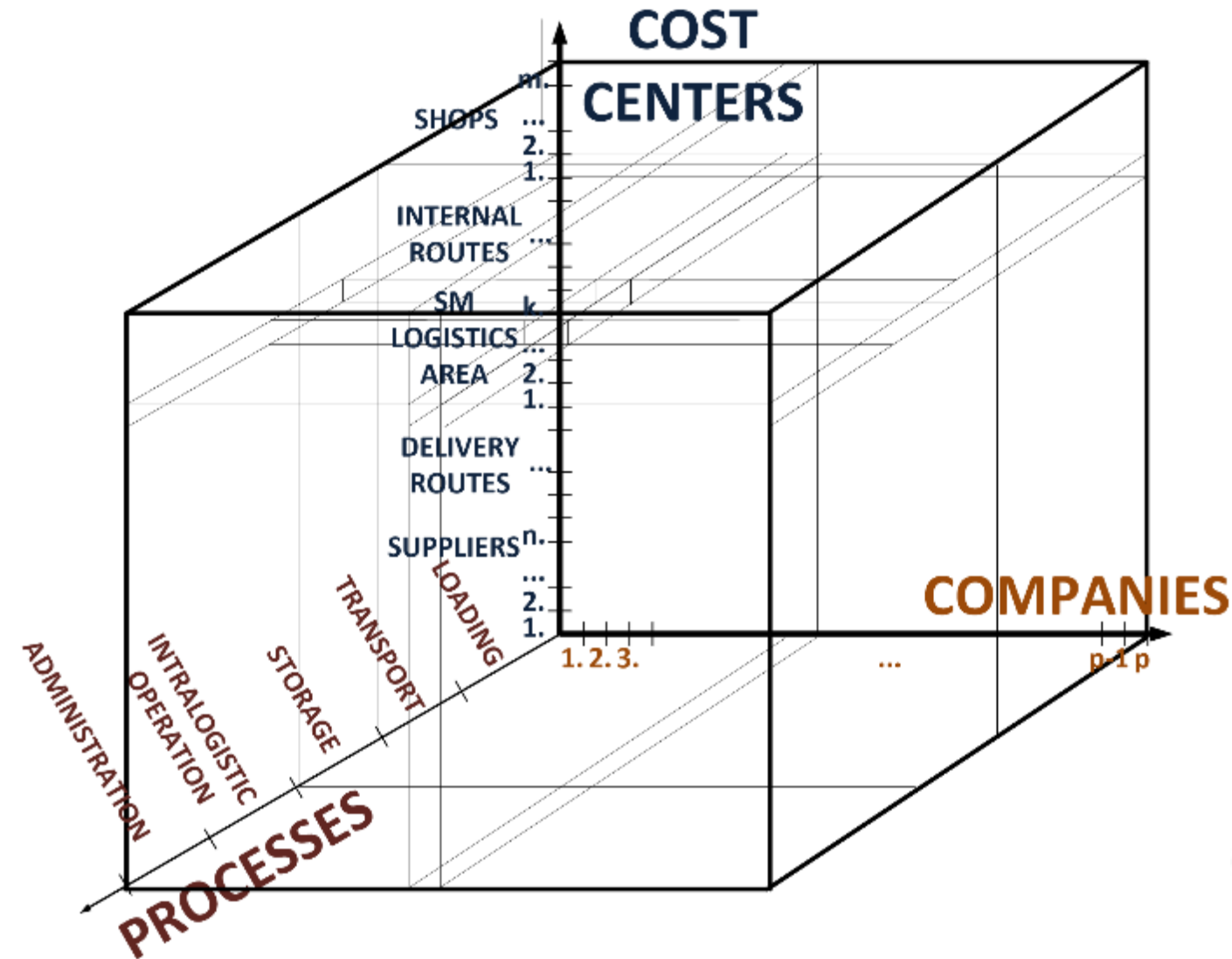
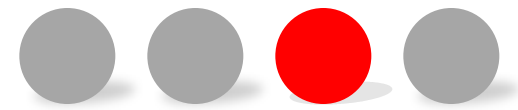
Current system



New solution



3D cost structure



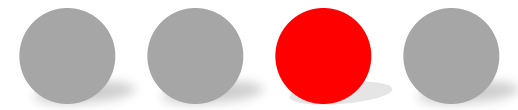
Costs of...

given companies,

in given processes,

in given cost centers.

Simulation model



Mesoscopic level

Two main components

Random generators

Based on data of 178 shops

modell_jelen_vlp2 - Excel

Fájl Kezdőlap Beszúrás Lapelrendezés Képletek Adatok Véleményezés Nézet Fejlesztőeszközök Mutasd meg, hogyan

Beillesztés Kivágás Másolás Formátummásolás Vágólap Betűtípus Igazítás Szám

Times New Roman 12

Sortöréssel több sorba

Általános

Feltételes formázás

SZUM

=HA(ÉS(X17=1;SF17<7);"";HA(SZUM(SH17:X17)<SF17;HA(VÉL(1;SG17;1;"";"")))

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Transports														
2	Transport informations				Count of transports										
3	Mall ID	Supplier ID	Shop ID	SKU ID	Monthly max	Transport days	Probability	Day	1	2	3	4	5	6	7
4	SM001	SUP0001	SH0001	SKU006	5	5	17%								1
5	SM001	SUP0002	SH0002	SKU005	4	4	13%		1					1	
6	SM001	SUP0003	SH0003	SKU003	8	8	27%			1				1	
7	SM001	SUP0004	SH0004	SKU002	61	30	100%		1	1	1	1	1	1	1
8	SM001	SUP0005	SH0005	SKU002	4	4	13%			1				1	
9	SM001	SUP0006	SH0006	SKU006	3	3	10%			1					
10	SM001	SUP0007	SH0007	SKU006	8	8	27%		1						
11	SM001	SUP0008	SH0008	SKU003	120	30	100%		1	1	1	1	1	1	1
12	SM001	SUP0009	SH0009	SKU003	8	8	27%		1		1				
13	SM001	SUP0010	SH0010	SKU003	4	4	13%		1						
14	SM001	SUP0011	SH0011	SKU001	20	20	67%		1	1	1	1	1	1	1
15	SM001	SUP0012	SH0012	SKU001	30	30	100%		1	1	1	1	1	1	1
16	SM001	SUP0013	SH0013	SKU003	8	8	27%				1	1			
17	SM001	SUP0014	SH0014	SKU002	76	30	100%		1	1	1	1	1	1	1
18	SM001	SUP0015	SH0015	SKU007	4	4	13%				1				
19	SM001	SUP0016	SH0016	SKU001	30	30	100%		1	1	1	1	1	1	1
20	SM001	SUP0017	SH0017	SKU003	8	8	27%								1
21	SM001	SUP0018	SH0018	SKU007	4	4	13%		1				1		
22	SM001	SUP0019	SH0019	SKU004	6	6	20%			1			1	1	
23	SM001	SUP0020	SH0020	SKU005	4	4	13%				1			1	

INPUT INPUT COSTS OUTPUT EXPERIMENTS TRANSPORTS (DAY) TRANSPORTS WEIGHT DAILY WEIGHT DAILY VOLUME SUP MAT HAND (T) SUP STOCK (W) STARTIN ...



Amount of goods

- Deliveries: ~1350 t/month
- Empties: ~45 t/month
- Home deliveries: ~50 t/month



Number of deliveries

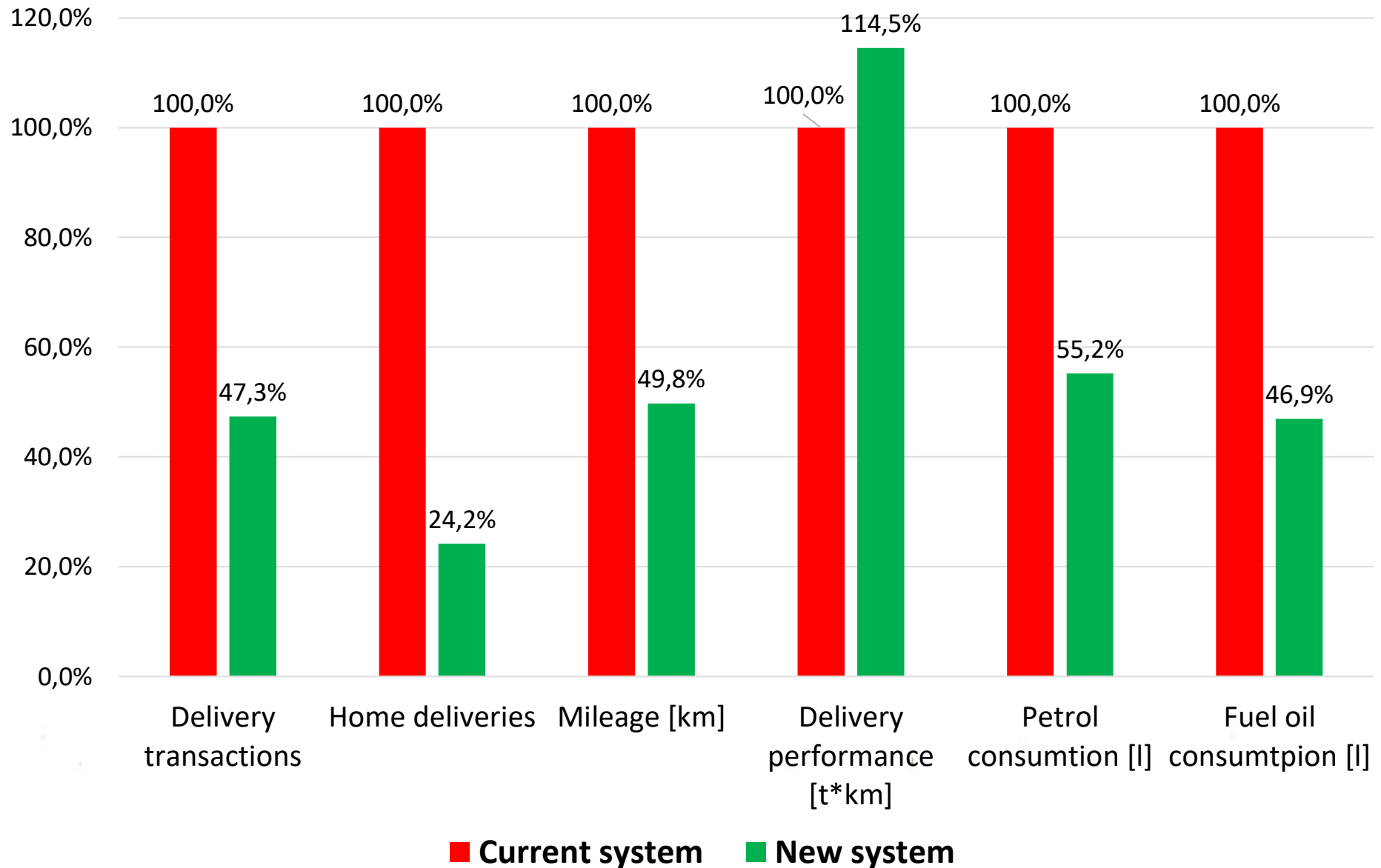
- 3397 deliveries in the current, 1608 in the new system (-52,7%)
- 4097 home deliveries in the current, 991 in the new system (-75,8%)



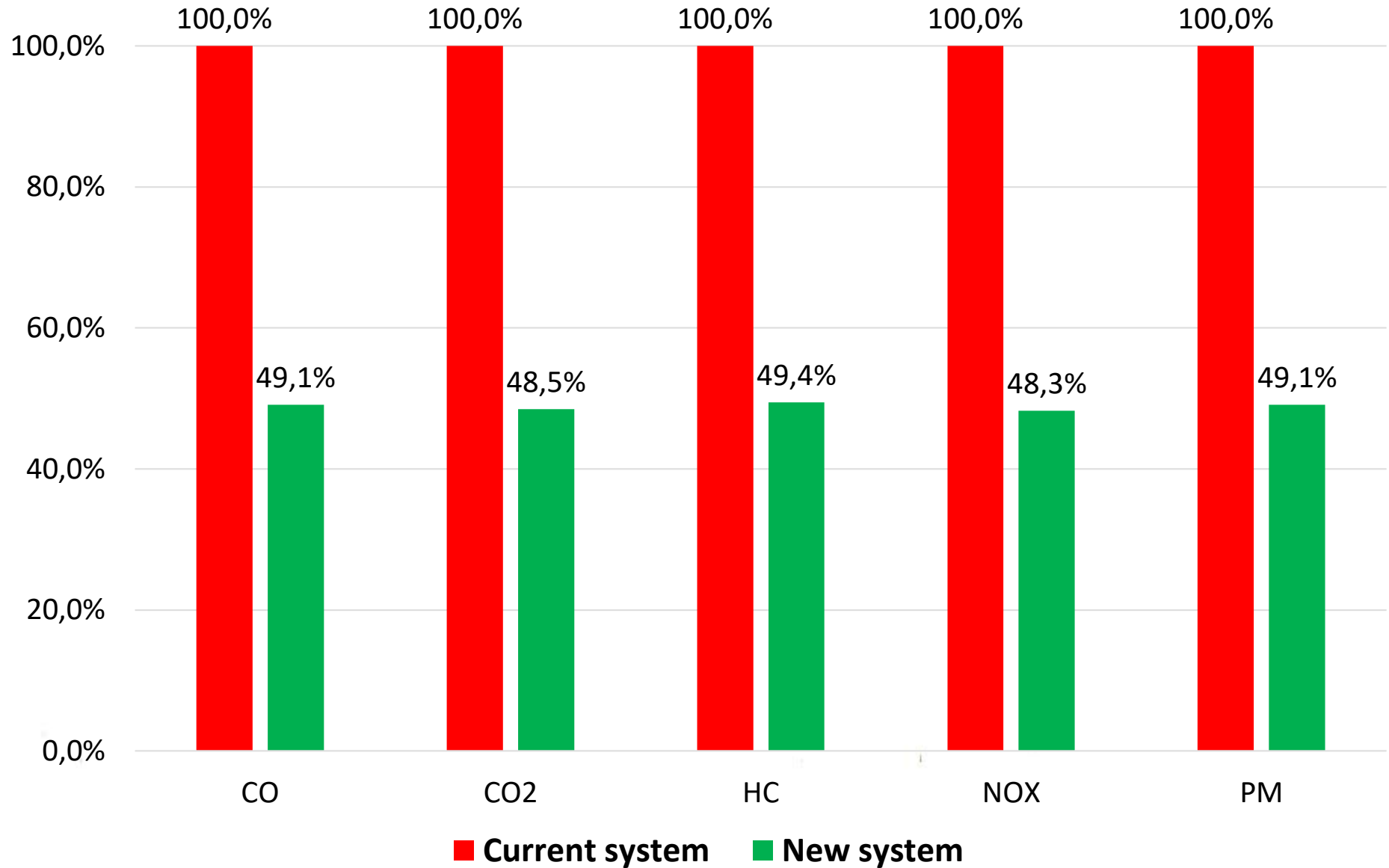
Performances

- Mileage: 635.400 km → 316.100 km (-50,2%)
- Delivery performance: 152.850 tkm → 175.000 tkm (+14,5%)
- CO₂ emission: 7,1 t → 3,5 t (-51,5%)

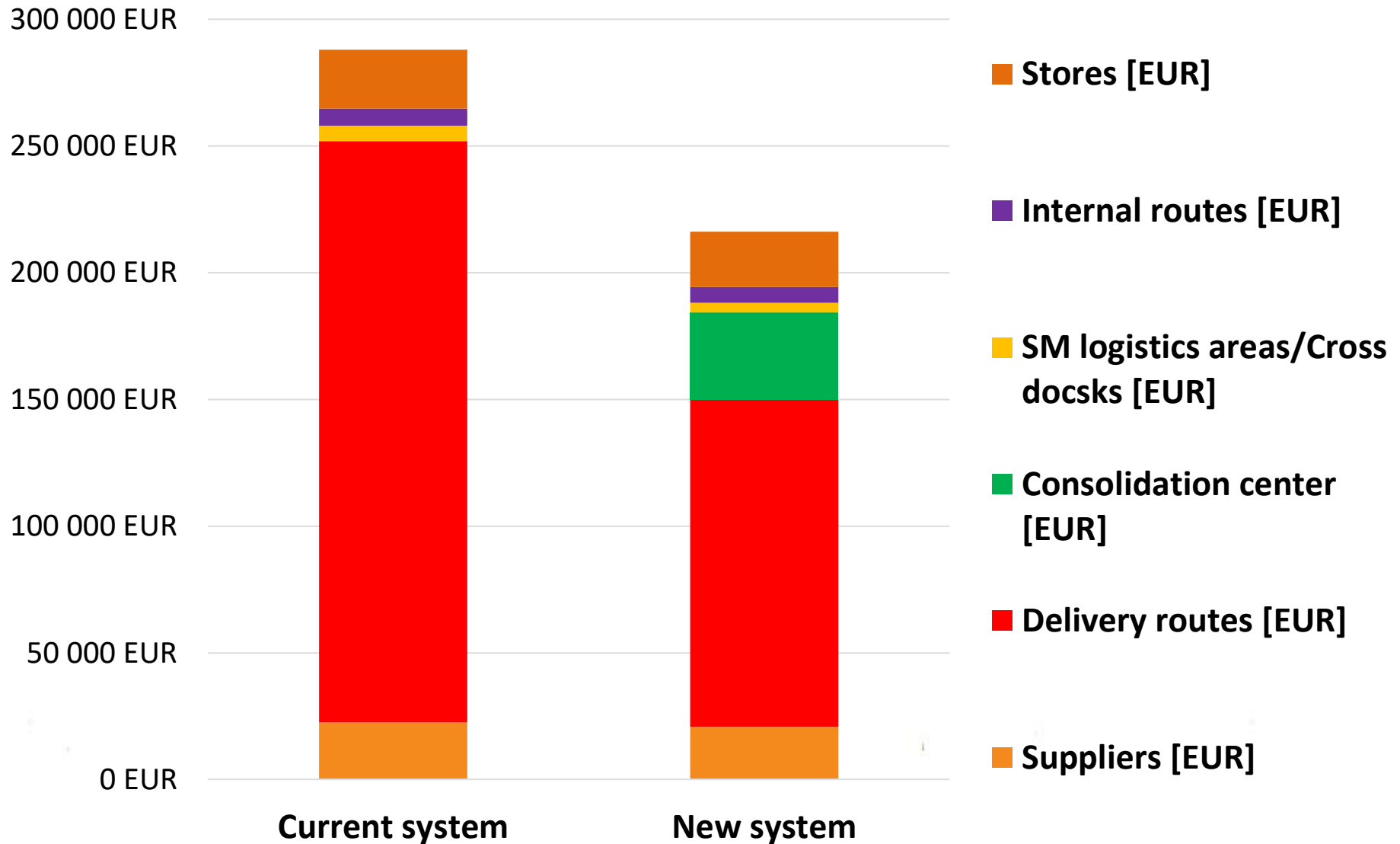
Performances

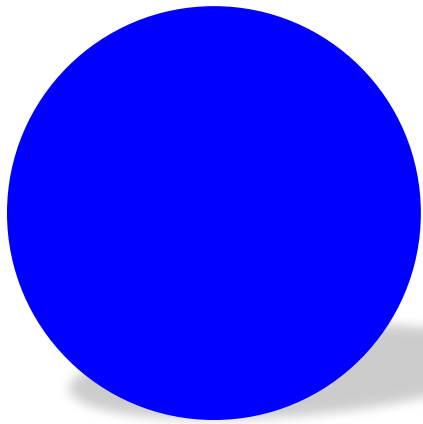


Emissions



Costs

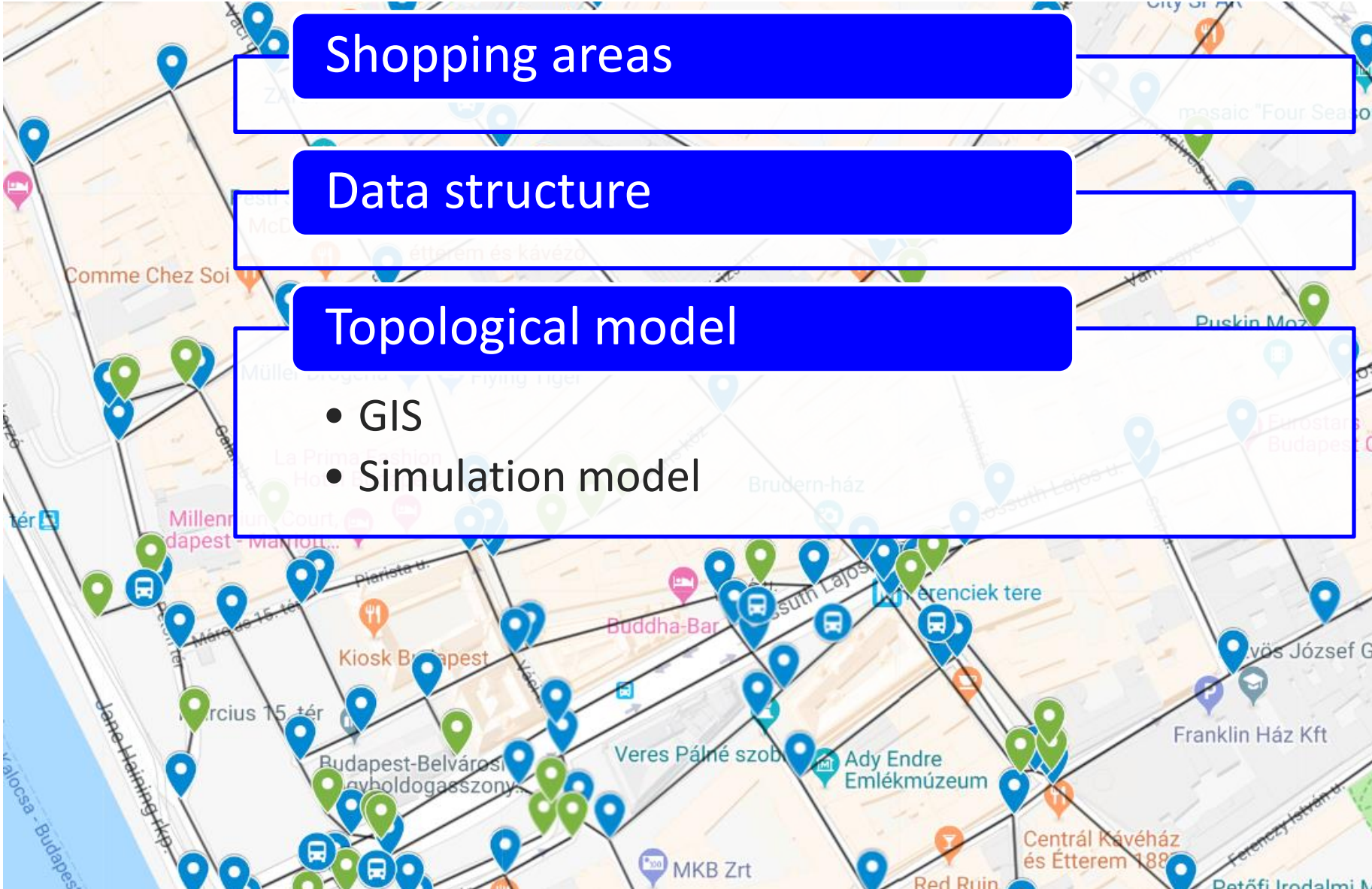




Next steps



Topological modelling

A map of Budapest, Hungary, serves as the background. It is covered with numerous location pins in blue and green. Overlaid on the map are three blue rectangular text boxes with white borders. The first box at the top contains the text 'Shopping areas'. The second box below it contains 'Data structure'. The third box at the bottom contains 'Topological model' followed by a bulleted list: '• GIS' and '• Simulation model'.

Shopping areas

Data structure

Topological model

- GIS
- Simulation model

New simulation software

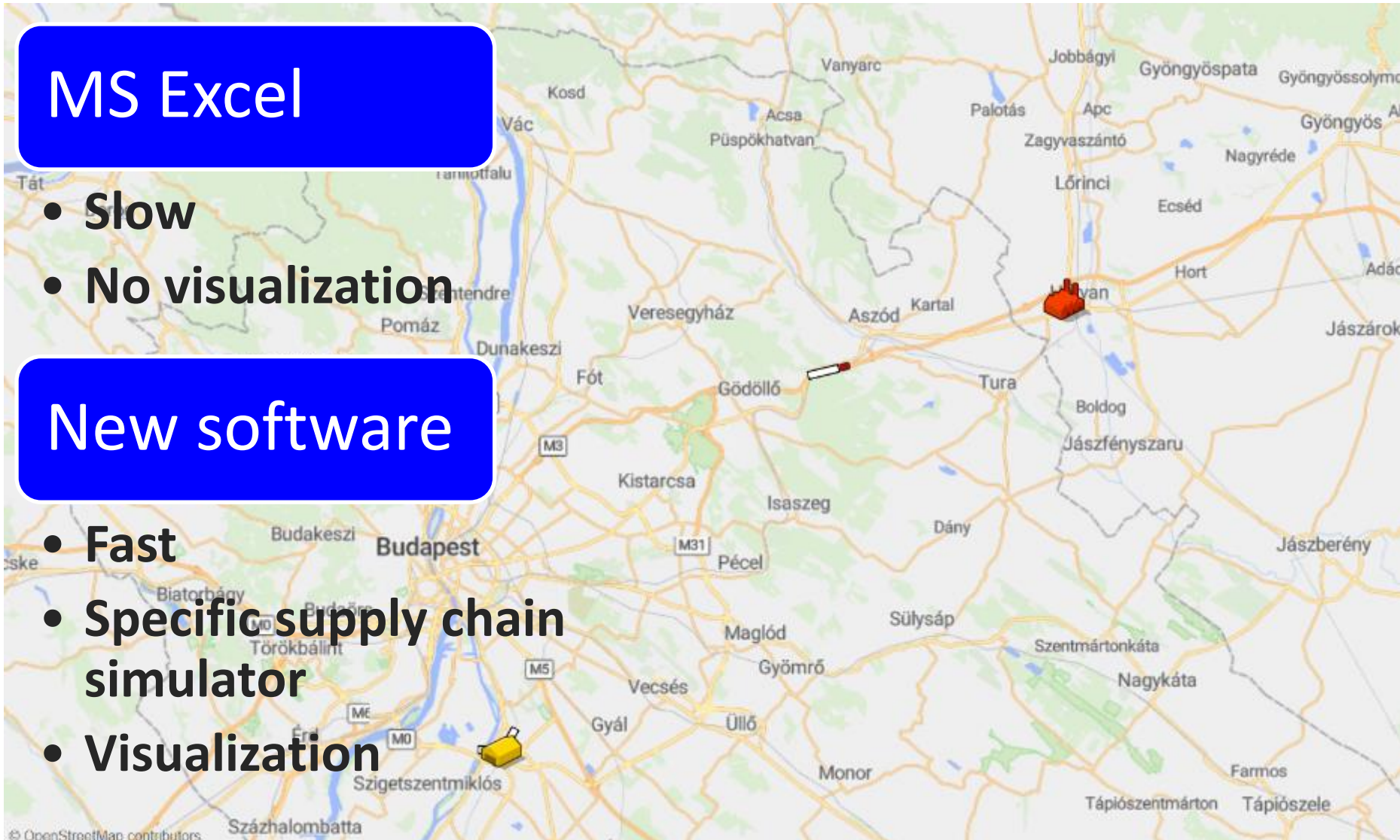


MS Excel

- **Slow**
- **No visualization**

New software

- **Fast**
- **Specific supply chain simulator**
- **Visualization**



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**UNIVERSITY of
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**INTERNATIONAL SCIENTIFIC CONFERENCE ON
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