International Logistics

Management

- dr Marian Krupa

AGENDA:

1. Introduction to the International Logistics Management
2. International Supply Chain Management (SCM)
3. IT and International Logistics Management – ERP software overview
4. International transportation systems (optimization models)
5. International logistics structures and networks management
6. Strategic and operational information management in Logistics - towards Global Business Intelligence.
7. International Logistics Management – case study

4. International transportation systems

Transport / Shipping / Forwarding

1) Modes of transportation + innovation

2) Transportation model

3) Travelling Salesman Problem (TSP)

4) European Transportation Network

Transport
Shipping
Forwarding

International Transport Systems

TRANSPORT – definition:

- ✓ **The movement of goods and people from one location to another** (from point A to point B)**.**

- ✓ Now, transport is an integral part of SCM;
- ✓ Typically regarded as a non-value-adding activity.

- ✓ Traditionally it has been treated as a service that is easily available when required by suppliers and distributors.
- ✓ **International transport** – movement of goods between different countries / custom zones.

Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

International Transport Systems

SHIPPING and FORWARDING– definition:

- ✓ **SHIPPING** (delivering)- the physical process of transporting commodities and merchandise goods and cargo – the use of transportation shipment.
- ✓ **FORWARDING** (dispatching) – service in terms of planning, organizing, shipping and monitoring of all logistics activities for a supplier of goods.

Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

International Transport Systems

TRANSPORT – infrastructure (FIXED installations):

- ✓ **Transportation network** - (open /commercial, public) such as: roads, railways, airways, waterways, canals and pipelines etc.;
- ✓ **Terminals** (buildings) such as: airports, railway stations, bus stations, warehouses, trucking terminals, refueling depots (including fueling docks and fuel stations), and seaports, space terminals etc.
- ✓ IT software and hardware such as: RFID, mobile tracking devices, satelite, ERP, shipping software etc.

Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

Modes of transportation

International Transport Systems

TRANSPORT –

modes:

- ✓ road
- ✓ rail
- ✓ air
- ✓ water
- ✓ pipeline
- ✓ cable
- ✓ space

- **Combine / intermodal**

Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

TRANSPORT SYSTEMS - modes

1. Road / trucks – general characteristics:

- Vehicle (trucks, vans, buses) transport on roads of passengers and/or goods;

- Fixed cost is low / motorways are financed by public;
- Open access to motorways / public ownership;
- Speed, availability, dependability, flexibility.

- Pollution, noise, traffing jam– environmental issues.

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Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

TRANSPORT SYSTEMS - modes

1. Road / trucks – NEW characteristics:

- Self-driving systems
- Automatic control
- Indoor / Outdoor
- Reduction of fuel consumption
- Routing optimization
- High working comfort for drivers
- Full control of all the trucks on the move

TRANSPORT SYSTEMS - modes

1. **Road / trucks** – NEW characteristics:

STILL iGo neo / warehouse mgmt. systems

TRANSPORT SYSTEMS - modes

1. **Road / trucks** – NEW characteristics:

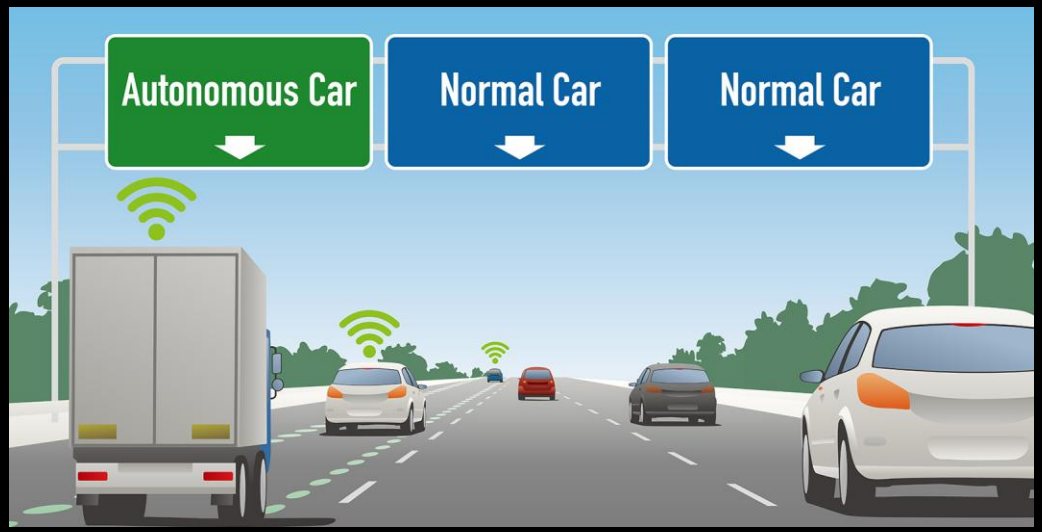
Project Daimler (Nevada, USA)

miamidadempo.org

TRANSPORT SYSTEMS - modes

1. **Road / trucks** – NEW characteristics:

Mercedes Benz F015 (Germany)
VOLVO Seamless Interface (Sweden)
TESLA Autopilot project (USA)



TRANSPORT SYSTEMS - modes

2. **Railway** – general characteristics:

- Transport of passengers and goods by way of wheeled vehicles running on rail tracks;
- Infrastructure cost is high and operational costs are low – economics of scale.
- Medium level on speed, dependability, large quantities of fright.
- Limited access (railway network), very little flexibility.

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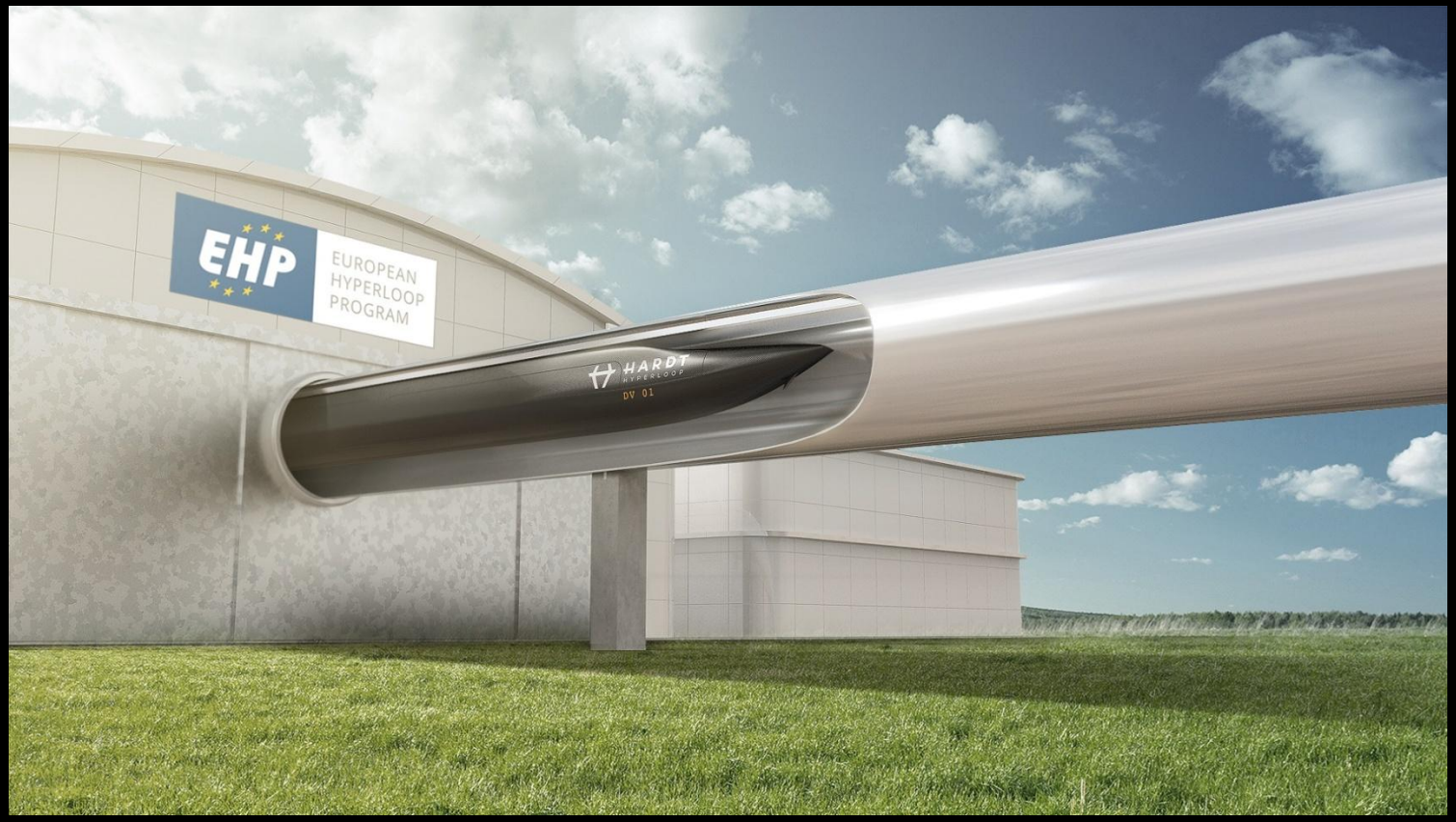
Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

TRANSPORT SYSTEMS - modes

2. **Railway** – Hyperloop:



European Hyperloop Program

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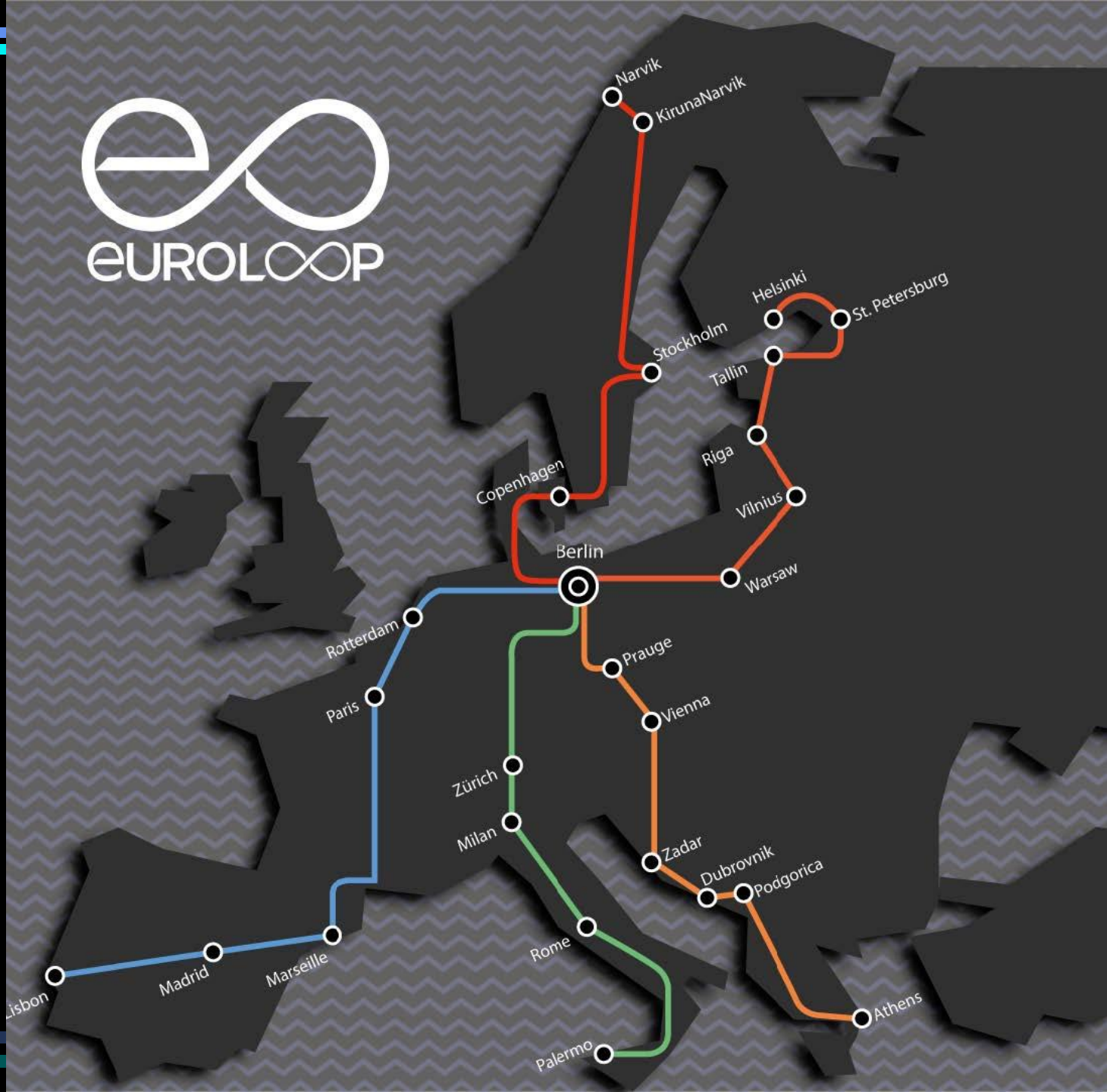
https://ec.europa.eu

European Hyperloop Program



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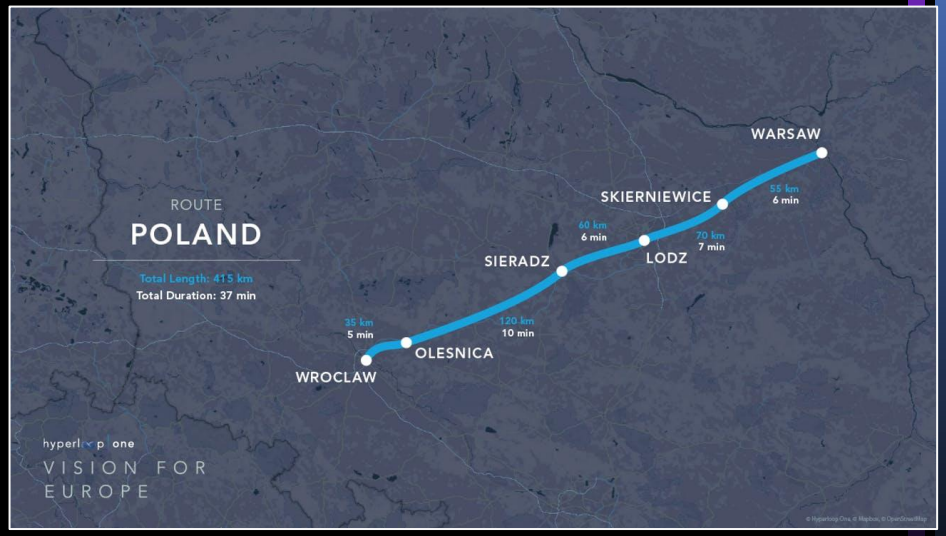
electrek



https://electrek.co

TRANSPORT SYSTEMS - modes

3. **Air** – general characteristics: (1/2)

- Transport of passengers and goods by air-plains;

- Both fixed and operational costs are high.
- Very good on speed (longer distances), limited dependability (weather factors), small quantities of fright (limited uplift capacities), limited flexibility.

- Limited access (air-ports), top safety procedures.

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Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

TRANSPORT SYSTEMS - modes

3. **Air** – NEW characteristics: (2/2)

- Transport of passengers and goods by DRONES;

- Both fixed and operational costs are VERY high.
- Very good on speed (SHORT distances), limited dependability (weather factors), small quantities of fright (limited uplift capacities), HIGH flexibility.

- New technology, VERY limited access, top safety procedures, no appropriate regulations etc.

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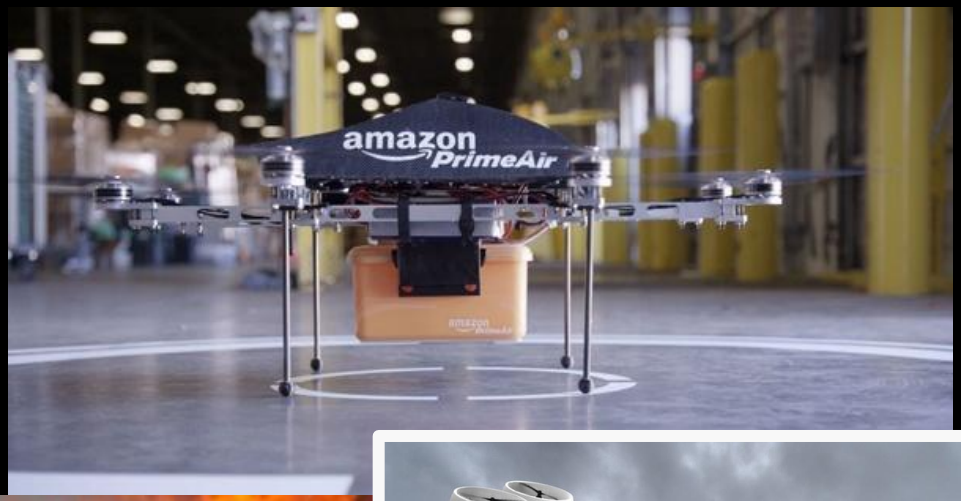
Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

TRANSPORT SYSTEMS - modes

3. **Air** – NEW characteristics:

- Transport of passengers and goods by DRONES



TRANSPORT SYSTEMS - modes

3. Air / drones

Projekt HERO

TRANSPORT SYSTEMS - modes

3. Air / drones

Projekt Lugano – the hospital transfer

TRANSPORT SYSTEMS - modes

3. Air / drones

EHANG – Air Taxi in Dubai

TRANSPORT SYSTEMS - modes

3. Air / drones

POP-up system – City car of the future

Innovation in transportation?
Self-driving cars, Drones…

- Drones are inevitable!
- Drones will be used as a **standard technology** across the transportation and logistics sector in North America and world wide ASAP.
- The introduction and acceptance of drones in the supply chain may be slow, however, more and more progressive.

TRANSPORT SYSTEMS - modes

4. **Sea** – general characteristics:

- Transport of passengers and goods by ships through the water / see;
- Both fixed and operational costs are at the medium level – economics of scale.
- The largest carrier of freight!
- Limited access (see ports), safety – pirates!

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Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

TRANSPORT SYSTEMS - modes

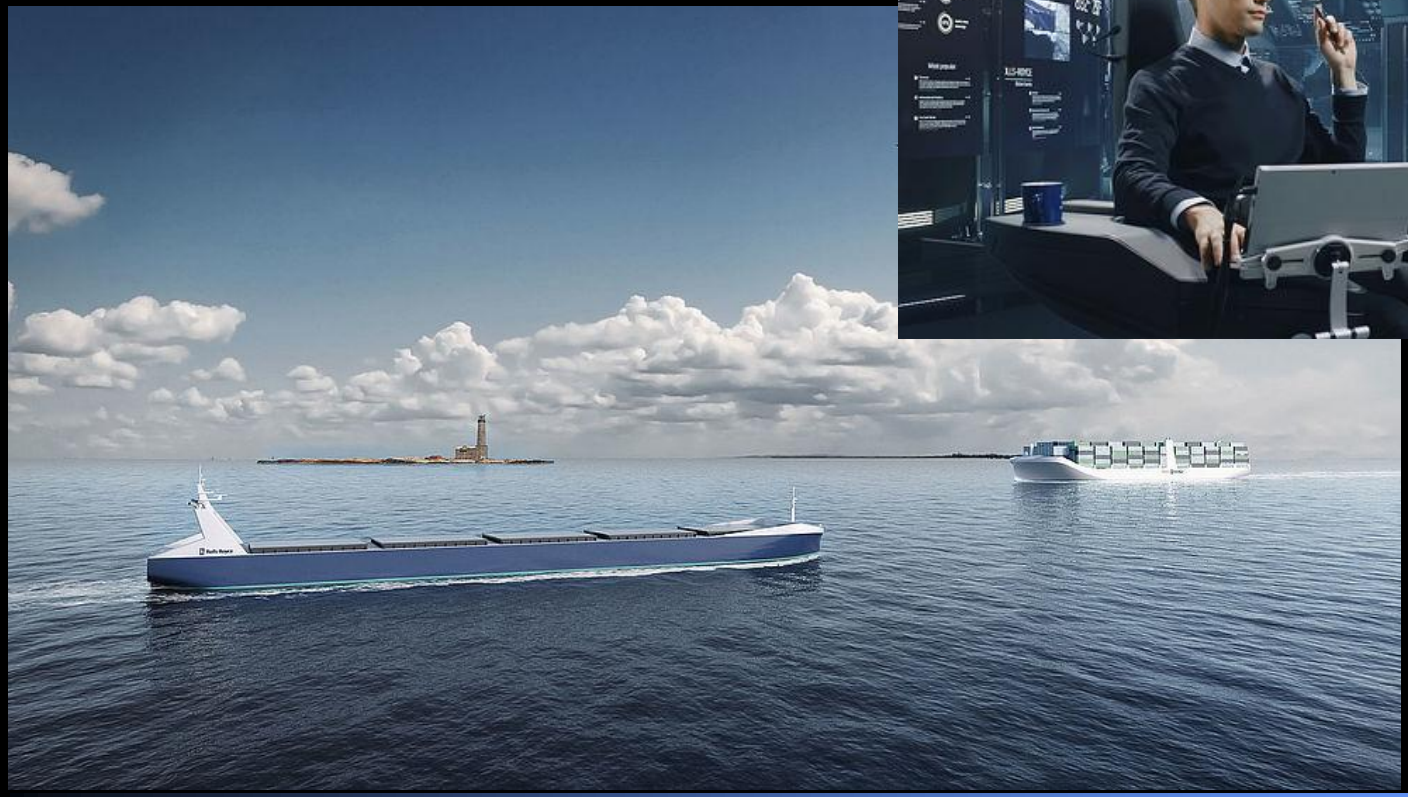
4. **Sea** – NEW characteristics:

- Self-sailing ships
- On-line control of the ship
- Real time monitoring
- Flexibility
- Optimization of speed, routing, weather conditions etc.
- ?

TRANSPORT SYSTEMS - modes

4. **Sea** – NEW characteristics:

Rolls Royce's Shore Control Centre:



www.marinelink.com

TRANSPORT SYSTEMS - modes

5. Pipeline – general characteristics:

- Liquids and gases are sent through a pipe (oil, natural gas);
- Fixed cost is high due to rights of way and construction of infrastructure. Operational costs are low – economics of scale.
- The very large volume of commodity.
- Limited access (see terminals), high safety procedures

Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

TRANSPORT SYSTEMS - modes

6. **Intermodal** (combined) – general characteristics:

- Involves the transportation of freight by using different modes of transportation (road + rail + sea);

1. Option 1 – there is one container (standard 20 ft containers) and different modes of transportation.

2. Option 2 – There are different containers and different modes of transportation.

TRANSPORT SYSTEMS - modes

6. **Intermodal** (containers)

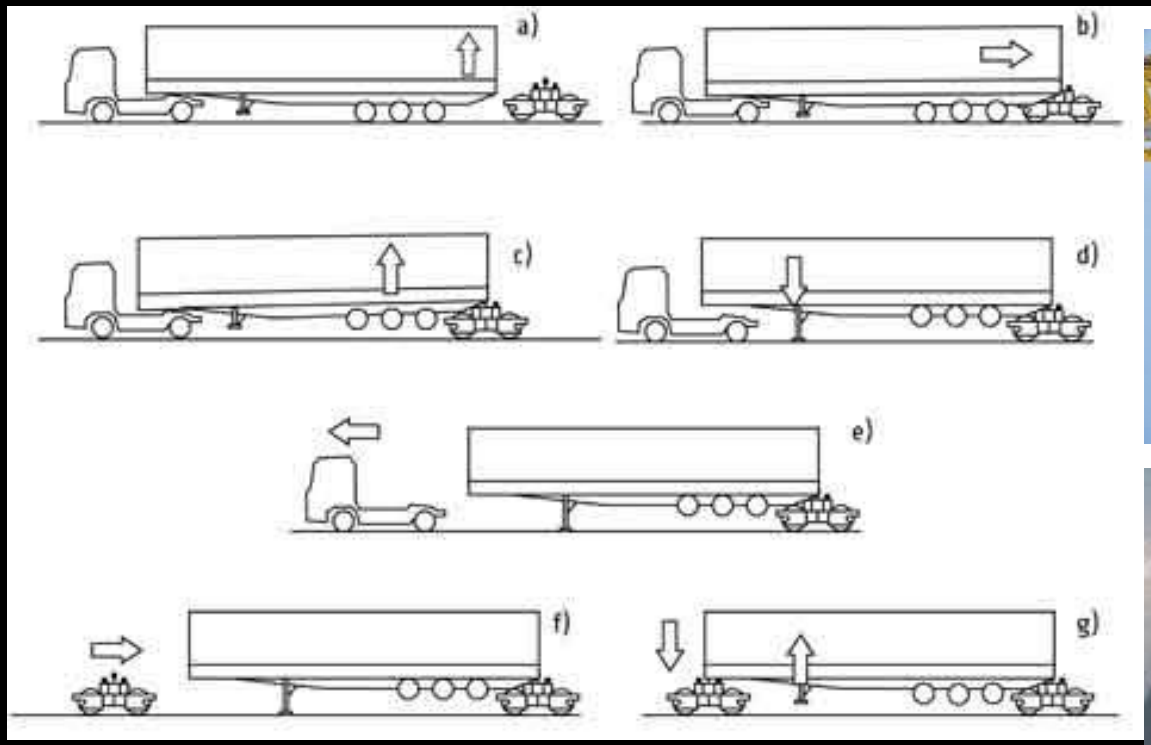
Option 1

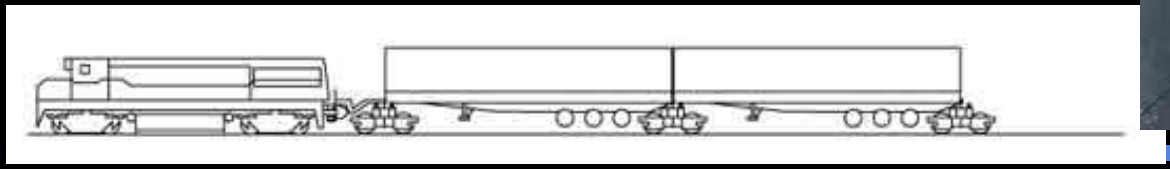
Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

TRANSPORT SYSTEMS - modes

Option 1

6. Intermodal – BImodal system (road-railer) - semi-trailer is specially equipped for use in railroad intermodal service (truck-trailer-railway)





TRANSPORT SYSTEMS - modes

Option 1

6. Intermodal (Ro-La) – Rollende Landstrasse / Rolling Highway: combined transport involving the conveying of road trucks by rail (truck with trailer + railway wagon/coach)

TRANSPORT SYSTEMS - modes

Option 2

6. Intermodal – all types of containers and all modes of transportation

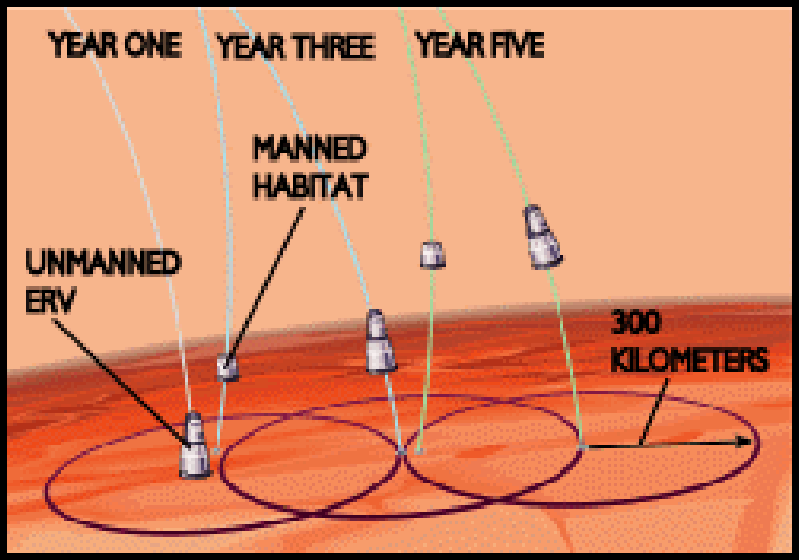
TRANSPORT SYSTEMS - modes

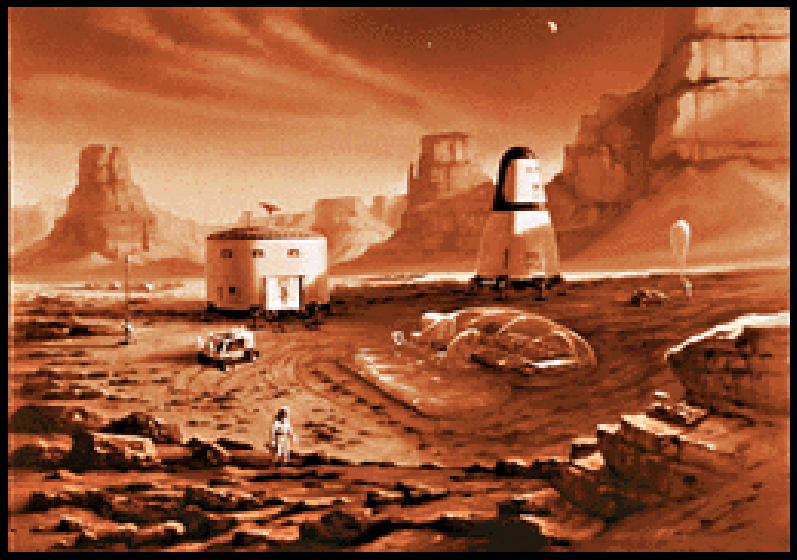
7. Space – transportations systems in the space

- Involves the transportation of freight by using space shuttles
- Science Projects
- Mining ventures
- New sttlements
- Travelling businesses
- Military projects

TRANSPORT SYSTEMS - modes

PROJEKT: **Mars Direct**





http://matus1976.com/local_mirrors/mars_direct_plan/Scientific_American_Mars_Direct.htm

Transportation modes evaluation and selection

International Transport Systems

TRANSPORTATION modes

- ✓ road
- ✓ rail
- ✓ air
- ✓ water
- ✓ pipeline
- ✓ cable
- ✓ space
- ✓ ?

Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

The best mode of transportation?

- Key Logistics Performance Indicators (KLPI)

KLPI: SCORE:	6 (max)	5	4	3	2	1 (min)
Speed od delivery	A	R	C	RL	WS	WL
Delivery on time	A	R	RL	C	WS	WL
Total costs	RL	WS	WL	C	R	A
Route flexibility	R	C	A	RL	WS	WL
Risk of delay	R	A	C	WS	RL	WL
Tracing option	A	R	WS	C	WL	RL
Inventory costs	A	R	C	RL	WS	WL

A– Air plane
R – Road / truck
RL – Railway
C – Combine transport (road&railway)
WS – Water Sea
WL – Water inland

The best mode of transportation?

- Key Logistics Performance Indicators (KLPI) / comparison-in-pair approach

KLPI (COST): What is less expensive?

	1	2	3	4	5	Points
1		1	1	1	1	4
2	0		1	1	1	3
3	0	0		1	1	2
4	0	0	0		1	1
5	0	0	0	0		0
						10

1	road
2	rail
3	air
4	water - sea
5	water - inland

Optimisation issues:

Transportation model

TRANSPORTATION MODEL

Transportation model – general characteristics:

- Total transport cost solution (system) of a single commodity that should be transported from given suppliers to a number of destinations.

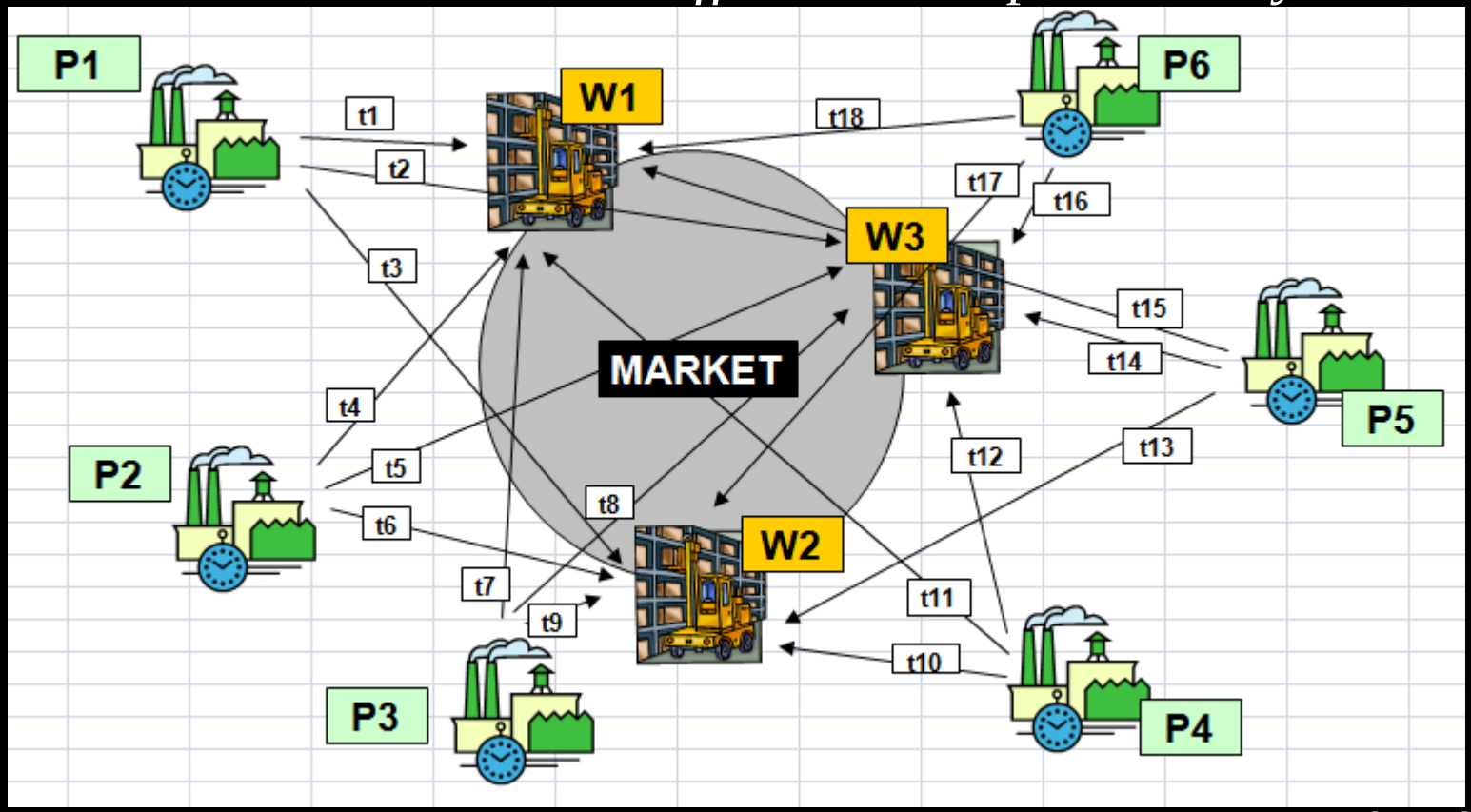
- It is neccessary to define the number of units that is required to be transported – **Supply** (spedition) side should equal **Demand** (delivery) one.

Mangan, Lalwani, Butcher, Javadpour, Global Logistics and Supply Chain Management, Wiley & Sons, 2012.

TRANSPORTATION MODEL

Transportation model – example:

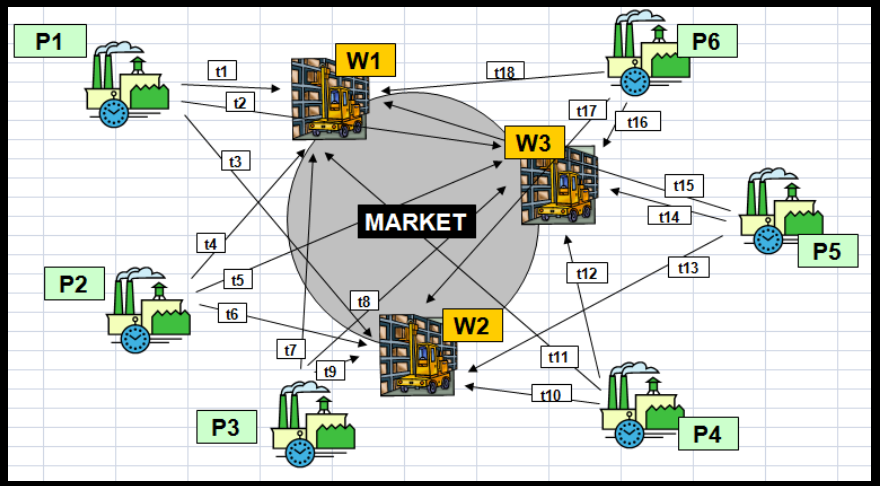
How to build the most cost effective transportation system?



TRANSPORTATION MODEL

Transportation model – example:

How to build the most cost effective transportation system?



Solution: linear programming / transportation model algorithm

Linear programming (LP, or linear optimization) - a mathematical method for determining a way to achieve the best outcome (such as maximum profit or lowest cost) in a given mathematical model for some list of requirements represented as linear relationships.

Travelling Salesman Problem

Travelling Salesman Problem

TSP – general characteristics:

- **Irish mathematician W. R. Hamilton defined the TSP in XIX century.**
- **TSP** was first formulated as problem in 1930 and is one of the most intensively studied problems in logistics / transportation optimization.

- How to find the shortest route when we take into consideration many cities – points of business?

Travelling Salesman Problem

TSP – computing a solution:

- How many solutions are there ?

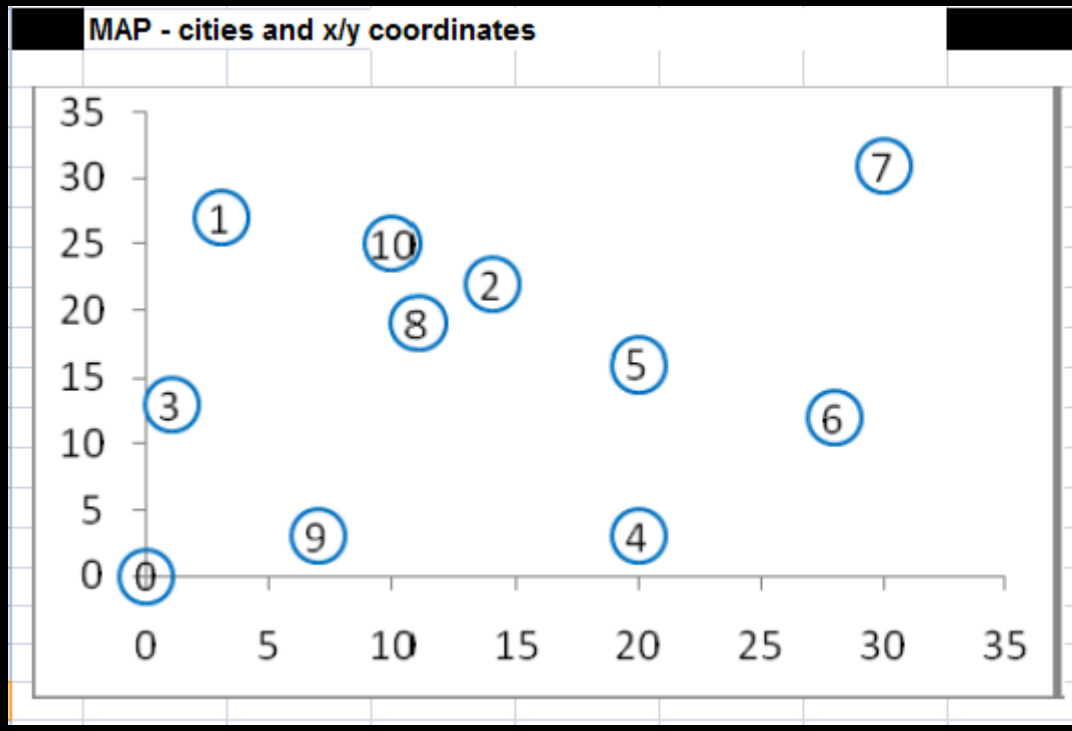
Formula = **(n** points **– 1)!** (factorial) **/ 2**

- For 10 points we have 181 440 solutions
- For 15 points we have 43 589 145 600 solutions

- SOLUTION: heuristic algorithms (probability) / software application

Travelling Salesman Problem

TSP – Example: Points (cities) and coordinates



City	Point	x	y
A	**0**	0	0
B	**1**	3	27
C	**2**	14	22
D	**3**	1	13
G	**4**	20	3
H	**5**	20	16
I	**6**	28	12
J	**7**	30	31
K	**8**	11	19
L	**9**	7	3
M	**10**	10	25

Travelling Salesman Problem

TSP – Distance table between 10 points:

DISTANCES between points

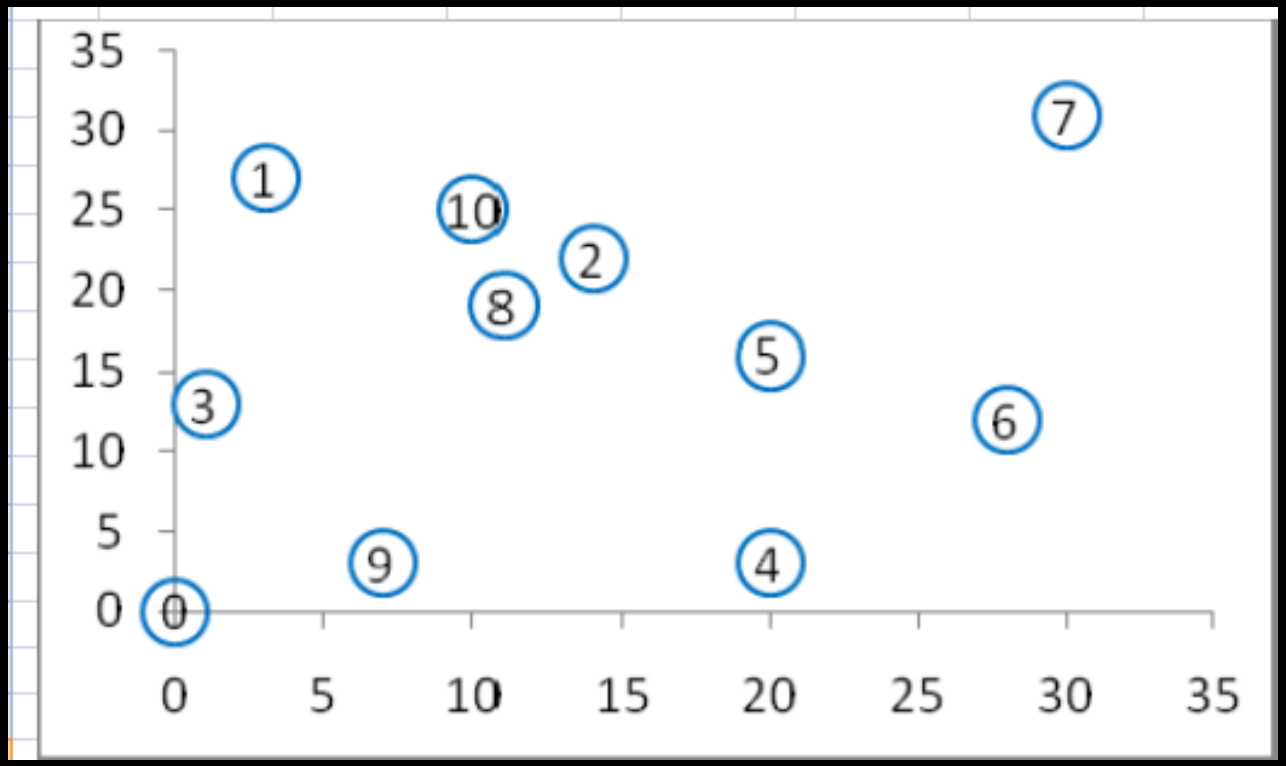
cj - distances between points (cities)

cj	0	1	2	3	4	5	6	7	8	9	10
0	0,0	27,2	26,1	13,0	20,2	25,6	30,5	43,1	22,0	7,6	26,9
1	27,2	0,0	12,1	14,1	29,4	20,2	29,2	27,3	11,3	24,3	7,3
2	26,1	12,1	0,0	15,8	19,9	8,5	17,2	18,4	4,2	20,2	5,0
3	13,0	14,1	15,8	0,0	21,5	19,2	27,0	34,1	11,7	11,7	15,0
4	20,2	29,4	19,9	21,5	0,0	13,0	12,0	29,7	18,4	13,0	24,2
5	25,6	20,2	8,5	19,2	13,0	0,0	8,9	18,0	9,5	18,4	13,5
6	30,5	29,2	17,2	27,0	12,0	8,9	0,0	19,1	18,4	22,8	22,2
7	43,1	27,3	18,4	34,1	29,7	18,0	19,1	0,0	22,5	36,2	20,9
8	22,0	11,3	4,2	11,7	18,4	9,5	18,4	22,5	0,0	16,5	6,1
9	7,6	24,3	20,2	11,7	13,0	18,4	22,8	36,2	16,5	0,0	22,2
10	26,9	7,3	5,0	15,0	24,2	13,5	22,2	20,9	6,1	22,2	0,0

Travelling Salesman Problem

TSP – Question?

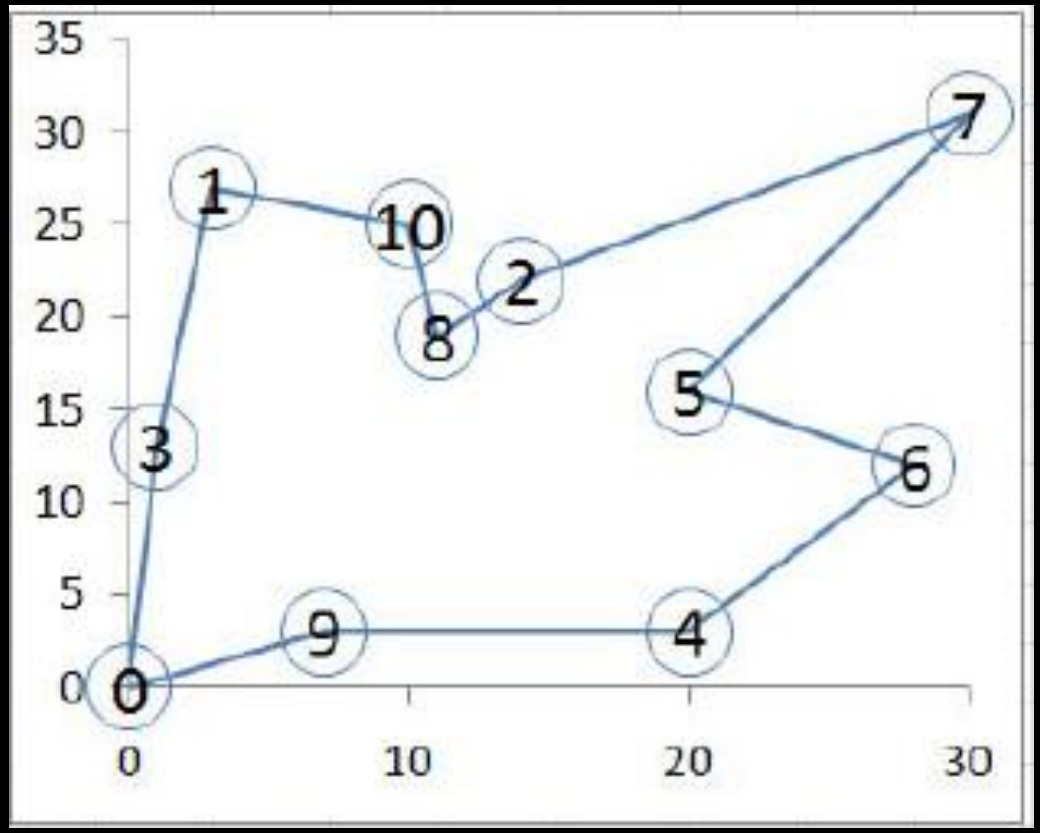
How to conect all point in the shortest way?



Travelling Salesman Problem

TSP – SOLUTION:

City	Route	*cj*
A	0	0,00
D	3	13,04
B	1	14,14
M	10	7,28
K	8	6,08
C	2	4,24
J	7	18,36
H	5	18,03
I	6	8,94
G	4	12,04
L	9	13,00
A	0	7,62
TOTAL distance:		**122,77**



Travelling Salesman Problem

TSP – POLAND:

CITY	point
Białystok	0
Bydgoszcz	1
Gdańsk	2
Katowice	3
Kielce	4
Kraków	5
Lublin	6
Łódź	7
Olsztyn	8
Opole	9
Poznań	10
Rzeszów	11
Szczecin	12
Warszawa	13
Wrocław	14
Zielona Góra	15

Travelling Salesman Problem

TSP – POLAND:

	CITY	point	cj
1	Białystok	0	0,00
2	Warszawa	13	188,00
3	Łódź	7	134,00
4	Kielce	4	143,00
5	Lublin	6	167,00
6	Rzeszów	11	170,00
7	Kraków	5	165,00
8	Katowice	3	75,00
9	Opole	9	113,00
10	Wrocław	14	86,00
11	Zielona Góra	15	157,00
12	Szczecin	12	214,00
13	Poznań	10	234,00
14	Bydgoszcz	1	129,00
15	Gdańsk	2	167,00
16	Olsztyn	8	156,00
1	Białystok	0	223,00
	TOTAL distance:		2521,00

TSP – EUROPE (1):

How to build the most cost effective transportation system for European capitals by implementing TSP?

TSP – EUROPE (2):

Rank	City	country
1.	Ankara	Turkey
2.	Moscow	Russia
3.	Baku	Azerbaijan
4.	London	United Kingdom
5.	Podgorica	Montenegro
6.	Rome	Italy
7.	Berlin	Germany
8.	Kiev	Ukraine
9.	Tbilisi	Georgia
10.	Zagreb	Croatia
11.	Madrid	Spain
12.	Skopje	Macedonia
13.	Budapest	Hungary
14.	Warsaw	Poland
15.	Prague	Czech Republic
16.	Sofia	Bulgaria
17.	Vienna	Austria
18.	Vilnius	Lithuania
19.	Bratislava	Slovakia
20.	Belgrade	Serbia
21.	Riga	Latvia
22.	Minsk	Belarus
23.	Oslo	Norway
24.	Ljubljana	Slovenia
25.	Reykjavík	Iceland
26.	Bucharest	Romania
27.	Yerevan	Armenia
28.	Amsterdam	Netherlands
29.	Stockholm	Sweden
30.	Helsinki	Finland
31.	Tallinn	Estonia
32.	Sarajevo	Bosnia and Herzegovina
33.	Chişinău	Moldova
34.	Dublin	Republic of Ireland
35.	Paris	France
38.	Copenhagen	Denmark
39.	Lisbon	Portugal
40.	Bern	Switzerland
41.	Luxembourg City	Luxembourg
42.	Tirana	Albania
43.	Athens	Greece
44.	City of Brussels	Belgium
45.	Andorra la Vella	Andorra
46.	Vaduz	Liechtenstein
47.	City of San Marino	San Marino
48.	Monaco	Monaco
49.	Valletta	Malta
50.	Vatican City	Vatican City

TSP for EUROPE?

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TSP – EUROPE (2):

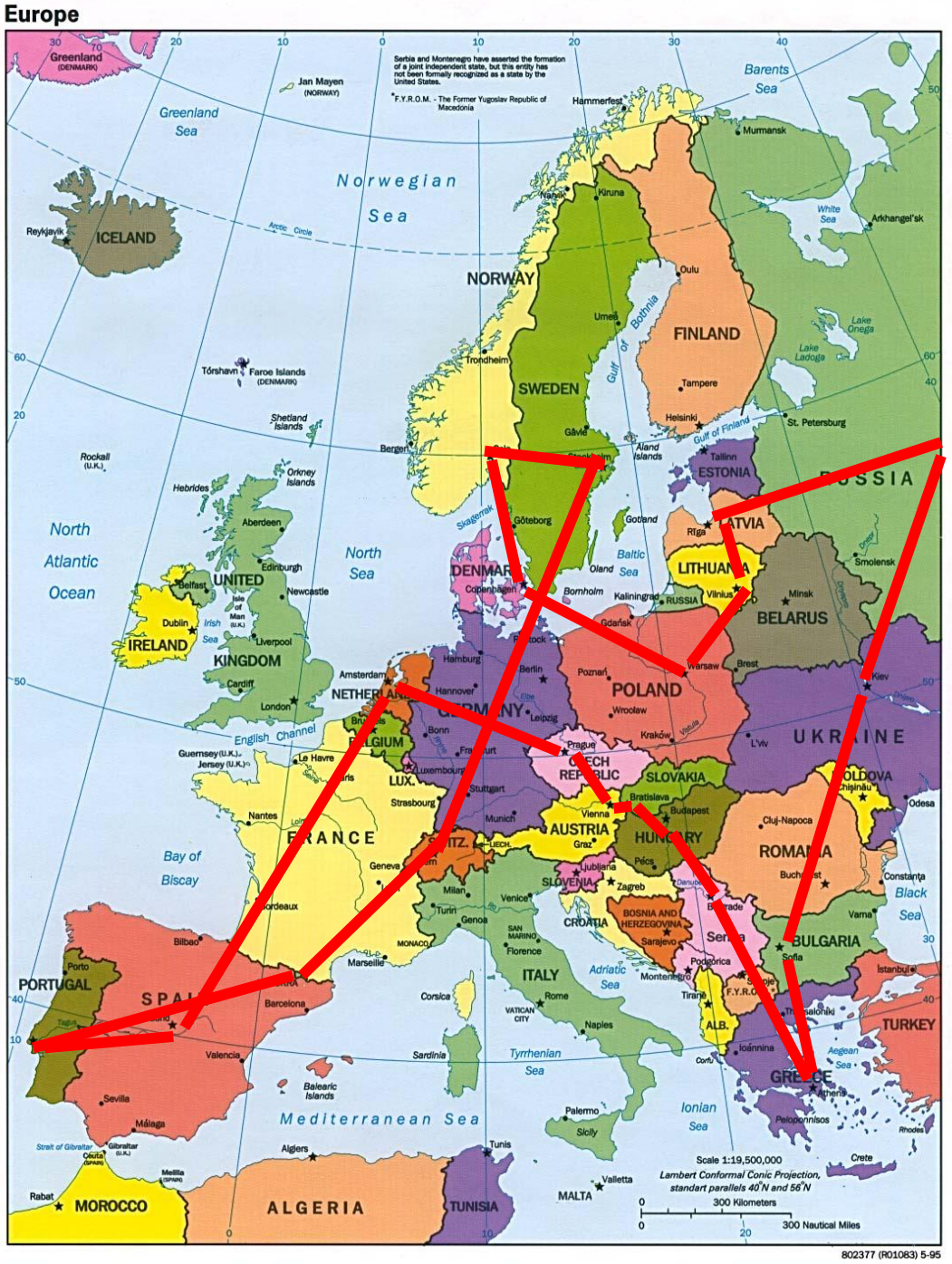
	CITY	point
	Warsaw	0
	Kiev	1
	Budapest	2
	Prague	3
	Amsterdam	4
	Stockholm	5
	Moscow	6
	Madrid	7
	Sofia	8
	Vienna	9
	Vilnius	10
	Bratislava	11
	Belgrade	12
	Riga	13
	Oslo	14
	Athens	15
	Copenhagen	16
	Bern	17
	Lisbon	18
	Andorra la Vella	19

TSP for EUROPE?

cj	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0	0	770	700	630	1 260	1 630	1 300	3 070	1 480	740	480	730	1 090	700	1 630	2 325	1 010	1 430	3 830	2 350
1	770	0	1 160	1 600	2 035	3 570	870	3 750	1 310	1 420	740	1 270	1 510	1 210	4 150	2 210	1 790	2 290	4 510	3 090
2	700	1 160	0	570	1 530	1 960	2 030	2 710	780	270	1 190	210	390	1 630	1 950	1 620	1 340	1 130	3 470	2 050
3	630	1 600	570	0	830	1 400	1 930	2 390	1 450	300	1 100	330	1 070	1 330	1 390	2 300	780	800	3 060	1 590
4	1 260	2 035	1 530	830	0	1 350	2 570	1 750	2 205	1 260	1 660	1 330	1 820	1 960	1 345	3 050	730	845	2 545	1 530
5	1 630	3 570	1 960	1 400	1 350	0	3 050	3 240	3 100	1 690	3 250	1 740	2 720	2 950	580	3 950	620	1 050	4 000	2 600
6	1 300	870	2 030	1 930	2 570	3 050	0	4 380	2 770	2 010	920	2 360	2 380	950	2 930	3 080	2 320	2 730	5 140	3 710
7	3 070	3 750	2 710	2 390	1 750	3 240	4 380	0	3 130	2 430	3 550	2 490	2 740	3 770	3 230	3 970	2 620	1 590	760	630
8	1 480	1 310	780	1 450	2 205	3 100	2 770	3 130	0	1 150	1 970	940	385	2 190	3 100	900	2 480	1 800	3 890	2 470
9	740	1 420	270	300	1 260	1 690	2 010	2 430	1 150	0	1 220	70	770	1 440	1 690	2 000	1 070	870	3 290	1 770
10	480	740	1 190	1 100	1 660	3 250	920	3 550	1 970	1 220	0	1 210	1 580	300	1 830	2 810	1 490	1 910	4 310	2 830
11	730	1 270	210	330	1 330	1 740	2 360	2 490	940	70	1 210	0	540	1 430	1 910	1 740	1 260	940	3 350	1 830
12	1 090	1 510	390	1 070	1 820	2 720	2 380	2 740	385	770	1 580	540	0	1 790	2 710	1 230	2 100	1 410	3 500	1 830
13	700	1 210	1 630	1 330	1 960	2 950	950	3 770	2 190	1 440	300	1 430	1 790	0	2 950	3 020	1 430	2 120	4 530	3 050
14	1 630	4 150	1 950	1 390	1 345	580	2 930	3 230	3 100	1 690	1 830	1 910	2 710	2 950	0	3 940	610	1 820	3 990	2 720
15	2 325	2 210	1 620	2 300	3 050	3 950	3 080	3 970	900	2 000	2 810	1 740	1 230	3 020	3 940	0	3 330	2 720	4 730	3 320
16	1 010	1 790	1 340	780	730	620	2 320	2 620	2 480	1 070	1 490	1 260	2 100	1 430	610	3 330	0	1 210	3 370	2 100
17	1 430	2 290	1 130	800	845	1 050	2 730	1 590	1 800	870	1 910	940	1 410	2 120	1 820	2 720	1 210	0	2 350	960
18	3 830	4 510	3 470	3 060	2 545	4 000	5 140	760	3 890	3 290	4 310	3 350	3 500	4 530	3 990	4 730	3 370	2 350	0	1 390
19	2 350	3 090	2 050	1 590	1 530	2 600	3 710	630	2 470	1 770	2 830	1 830	1 830	3 050	2 720	3 320	2 100	960	1 390	0

TSP – EUROPE (2):

	CITY	point	cj
1	Warsaw	0	0
2	Copenhagen	16	1 010
3	Oslo	14	610
4	Stockholm	5	580
5	Bern	17	1 050
6	Andorra la Vella	19	960
7	Lisbon	18	1 390
8	Madrid	7	760
9	Amsterdam	4	1 750
10	Prague	3	830
11	Vienna	9	300
12	Bratislava	11	70
13	Budapest	2	210
14	Belgrade	12	390
15	Athens	15	1 230
16	Sofia	8	900
17	Kiev	1	1 310
18	Moscow	6	870
19	Riga	13	950
20	Vilnius	10	300
1	Warsaw	0	480
	TOTAL distance:		15 950

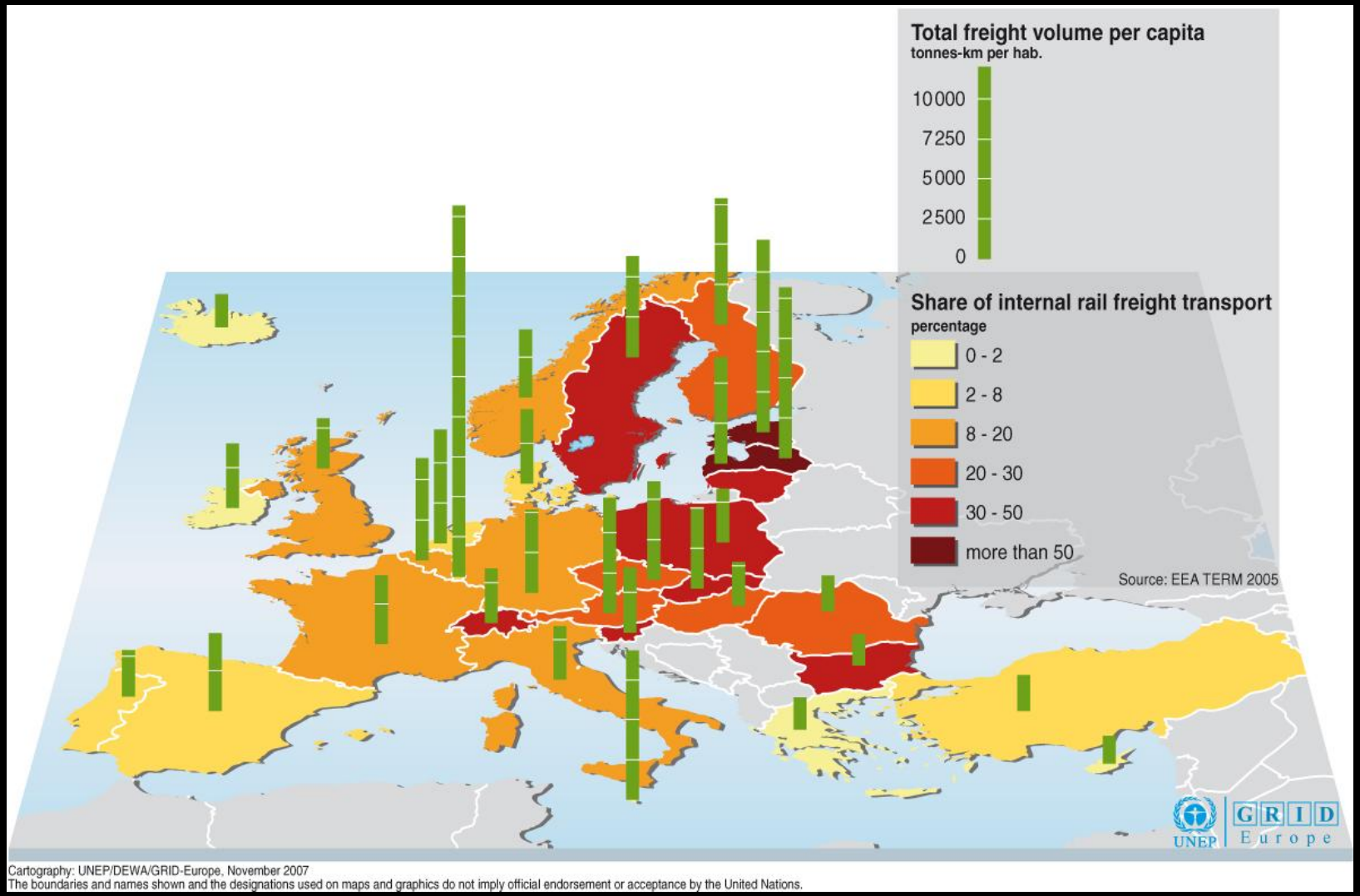


dr Marian Krupa

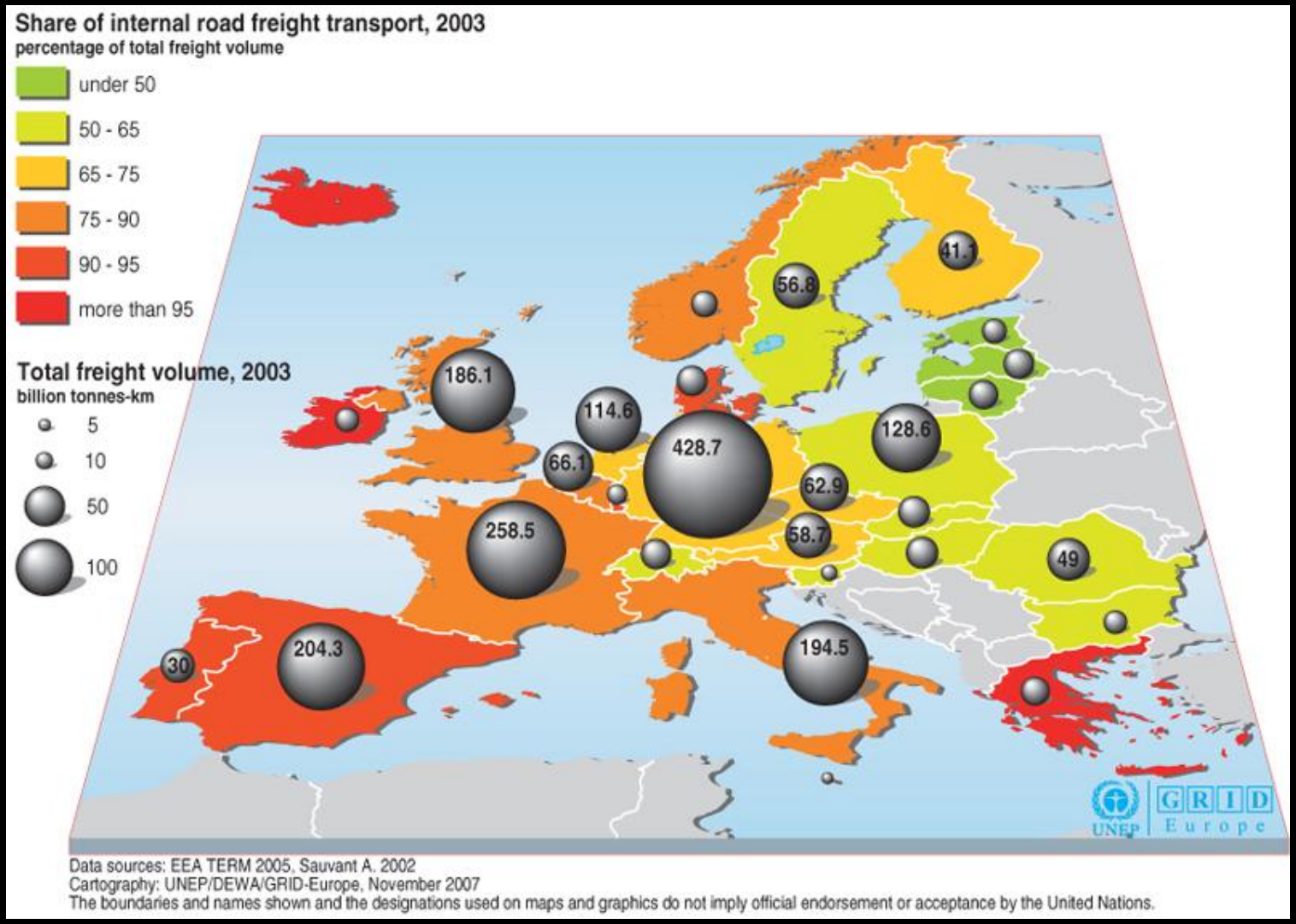
European Transportation Network

now and in the future

European Transportation System (volume / railway)



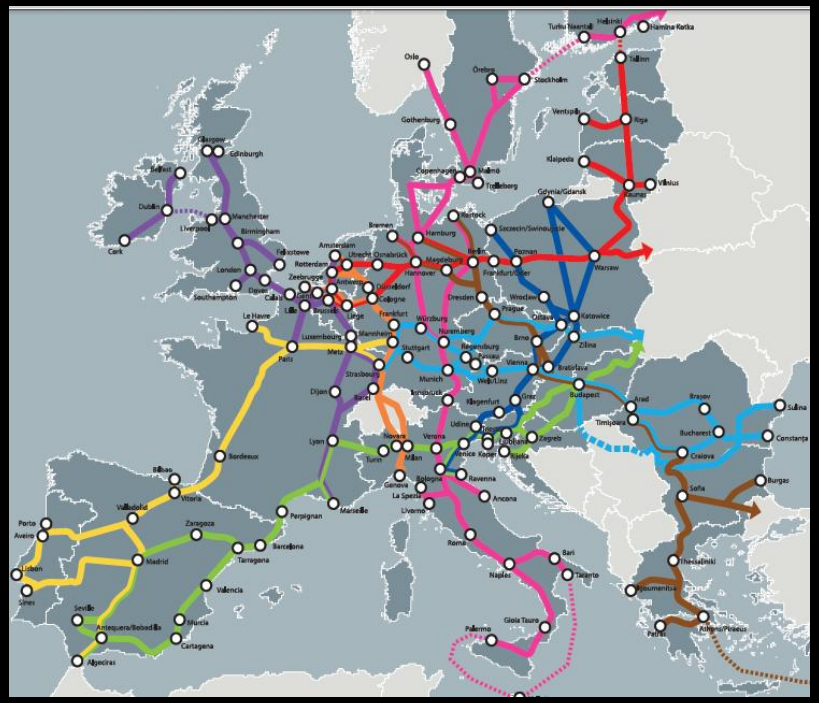
European Transportation System (road)



New EU infrastructure policy

TEN-T - Connecting Europe

European Commission



The core network will connect:

- ✓ 94 main **European see ports** with rail and road links
- ✓ 38 **key airports** with rail connections into major cities
- ✓ **15,000 km of railway line** upgraded to high speed
- ✓ **35 cross-border projects** to reduce bottlenecks

Legend

- BALTIC - ADRIATIC
- NORTH SEA - BALTIC
- MEDITERRANEAN
- ORIENT / EAST-MED
- SCANDINAVIAN - MEDITERRANEAN
- RHINE - ALPINE
- ATLANTIC
- NORTH SEA - MEDITERRANEAN
- RHINE - DANUBE

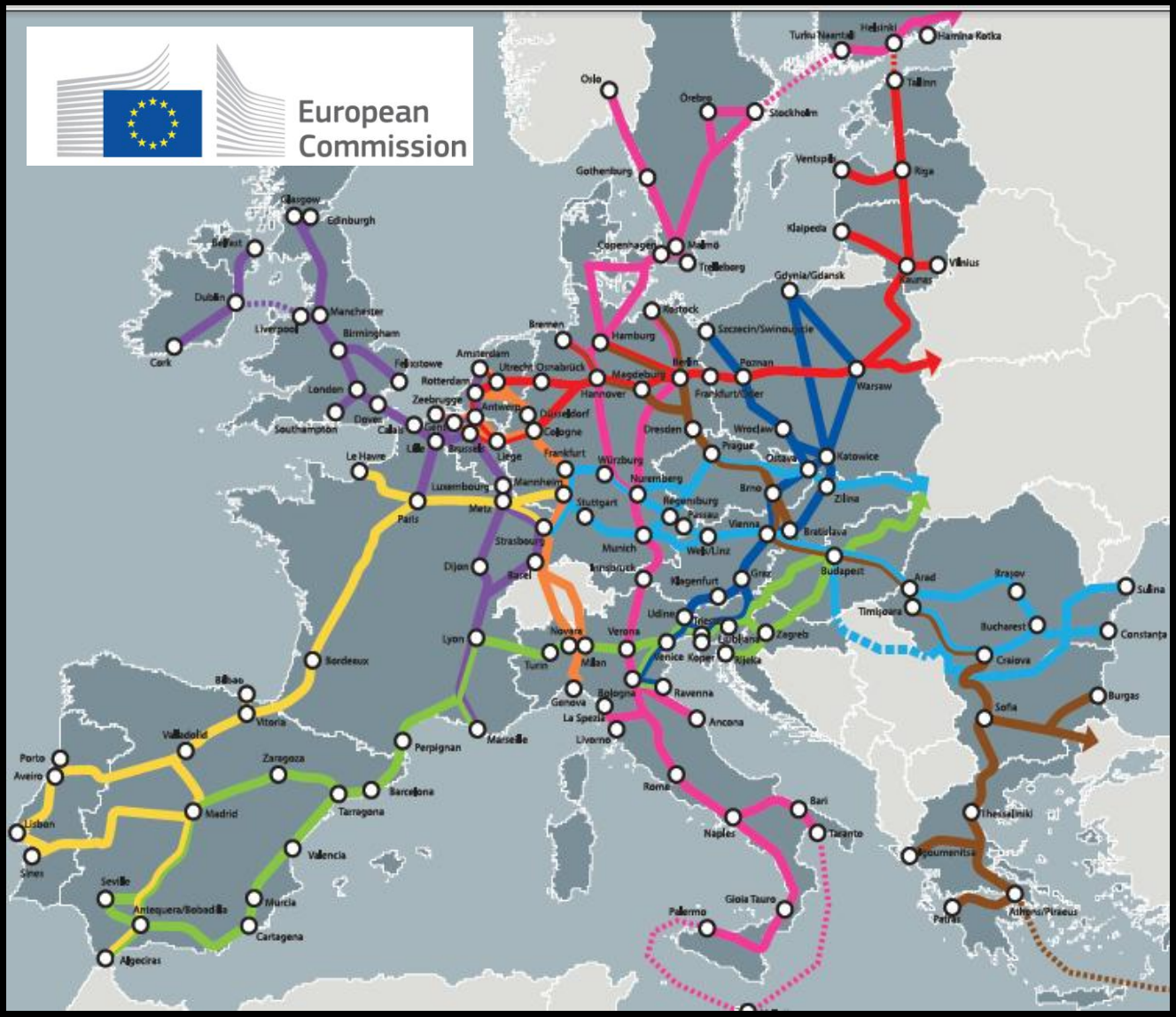
http://ec.europa.eu/transport/themes/infrastructure/news/ten-t-corridors_en.htm

New EU infrastructure policy

TEN-T - Connecting Europe

9 major corridors which will act as a backbone for transportation in Europe's single market

To match this level of ambition, EU financing for transport infrastructure will triple for the period **2014–2020** to **€26 billion**



http://ec.europa.eu/transport/themes/infrastructure/news/ten-t-corridors_en.htm

New EU infrastructure policy

TEN-T - Connecting Europe

Conclutions:

- ✓ This will be the **economic lifeblood of the single market**, allowing a real free flow of goods and people around the EU.
- ✓ By 2050, the great majority of Europe's citizens and businesses will be **no more than 30 minutes' travel time** from this comprehensive network.
- ✓ Taken as a whole, the new transport network will deliver:
  - ✓ **safer** and **less congested travel**
  - ✓ **smoother** and **quicker journeys**

http://ec.europa.eu/transport/themes/infrastructure/news/ten-t-corridors_en.htm

Questions ?

- dr Marian Krupa

Exam Questions (4):

- ✓ Highlight key terms and issues used in international transport systems;
- ✓ Identify the roles of distribution centers in the international distribution network management;
- ✓ Identify the range of issues to be considered in planning transport infrustructure (e.i. modes of transportation);
- ✓ Explain the application of a technique known as the transportation model.

TRANSPORTATION MODEL

Vogels Approximation Method: