Special track 2 (Plenary Session)

"**L'ingegneria dei sistemi e i nuovi mercati dei trasporti**"

Analisi della domanda per la valutazione della fattibilità economica di servizi ferroviari di Alta Velocità in regime di concorrenza

Pierluigi COPPOLA – "Tor Vergata" University of Rome

SIET annual conference

Venezia, 20th September 2013

EU STRATEGIES FOR TRANSPORT BY RAIL

- EU Directive 440/1991/CEE
- First Railway package (2001)
- Second Railway package (2004)
- Third Railway package (2007)
- Fourth Railway package (2013 proposal)

Safety and Inter-operability

Opening the market to competition

EU Directives for Transport by Rail

EU Directive 440/1991/CEE

- **Separation of Infrastructure Manager (IM) and Railway Undertaking's (RU's)**

Vertical separation in the European Railway sector (pioneered by Sweden in 1988; in Italy : D.Lgs 149/99)

First Railway package (2001)

- Opening of the market for **international freight transport** by rail (as of 2008)
- License and Safety Certificates to Railways Undertakings
- Regulation of Rail infrastructures capacity e fares

Second Railway package (2004)

- Safety and Interoperability (towards ERMTS)
- Opening of the market for the **whole freight transport** by rail (as of 2006)
- European Railway Agency (ERA)

Third Railway package (2007)

- Opening of the market for **international passenger transport** by rail (as of 2010)

Incoming of private Railways Undertaking, mainly in freight transport, but in some cases also in passenger transport*

Fourth Railway package (2013 proposal)

- Opening of the market for **domestic passenger transport** by rail
- Safety and Interoperability (simplification and harmonization)

*Sweden, UK, Germany and Italy (D.Lgs 183/2003) unilaterally opened their **passenger domestic market**

Effect of EU Directives for Passenger HSR Transport

Railways Undertaking (RU) ownerships	Examples of Long Distance RU's
Entirely Public	**SNCF, DB, Trenitalia , …**
Public with minor participation of private	**TGV Lyra** (France-Switzerland)
Public-Public Joint Venture	**Thalys**
Public-Private Joint Venture	**Eurostar**
Entirely Private	• **NTV (Italy, April 2012),** • **LOCOMORE (Germany, July 2012)**

HSR demand analysis in a competing market

- Effects within the HSR market (competition among RU)
  - Service quality
  - Fares
- Impacts on different market (modal competition)
  - New services
  - Modal shares
- Wider Economic Effects
  - Economic Growth
  - Tourism
  - Relocation of workplace and residents
  - …

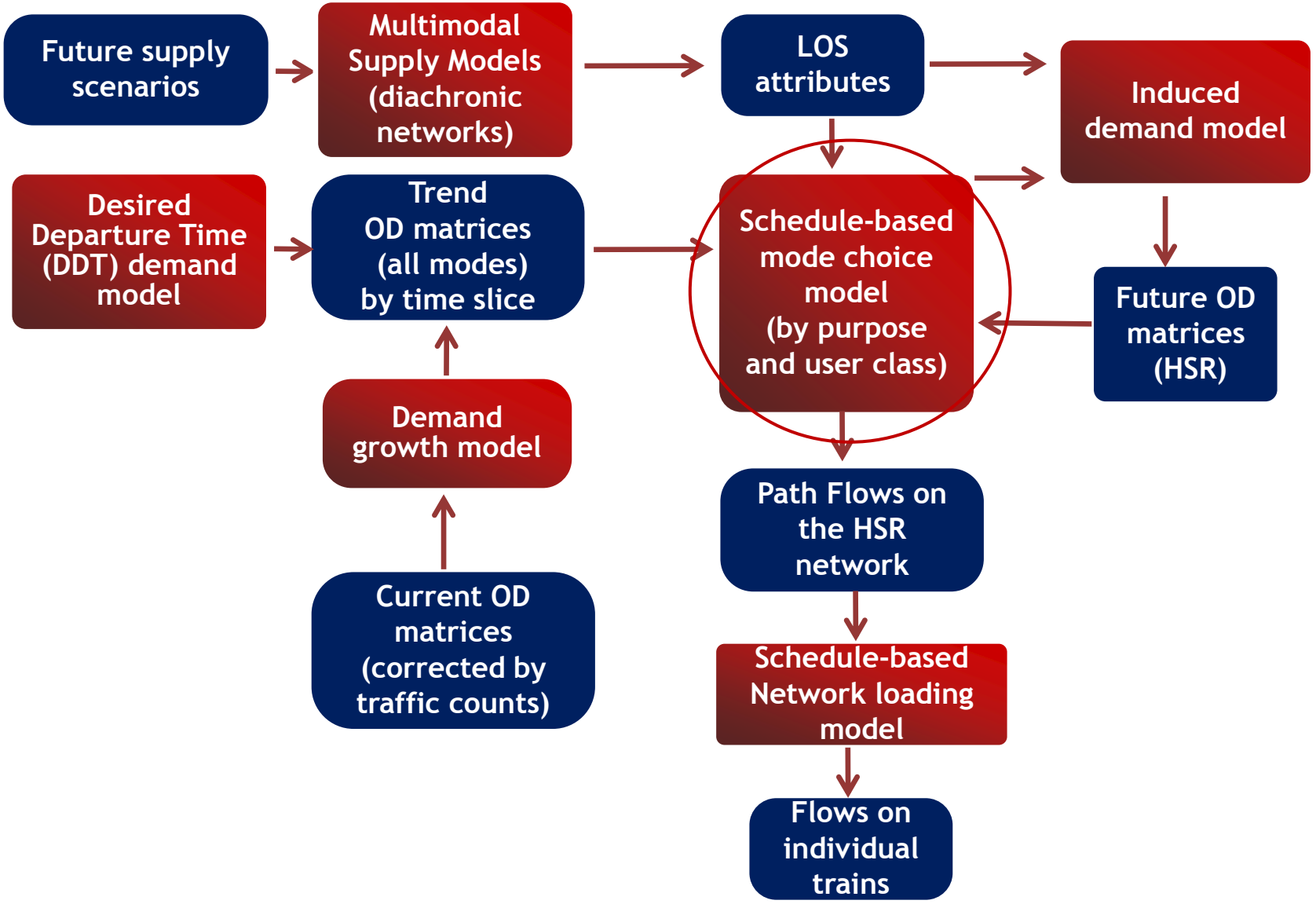
HSR DEMAND FORECASTING

- **Taxonomy of demand on HSR services**

DIVERTED DEMAND	from other modes	*e.g. shift from air/auto to HSR*	**endogenous factors**
	from other rail services	*e.g. shift from Intercity to HSR*	
INDUCED DEMAND	direct	*e.g. increase of trip frequency, change of trip destination*	
	indirect	*e.g. increase of mobility due to change in life-styles and land use*	**exogenous factors**
DEMAND GROWTH		*e.g. increase of mobility due to economic growth*	

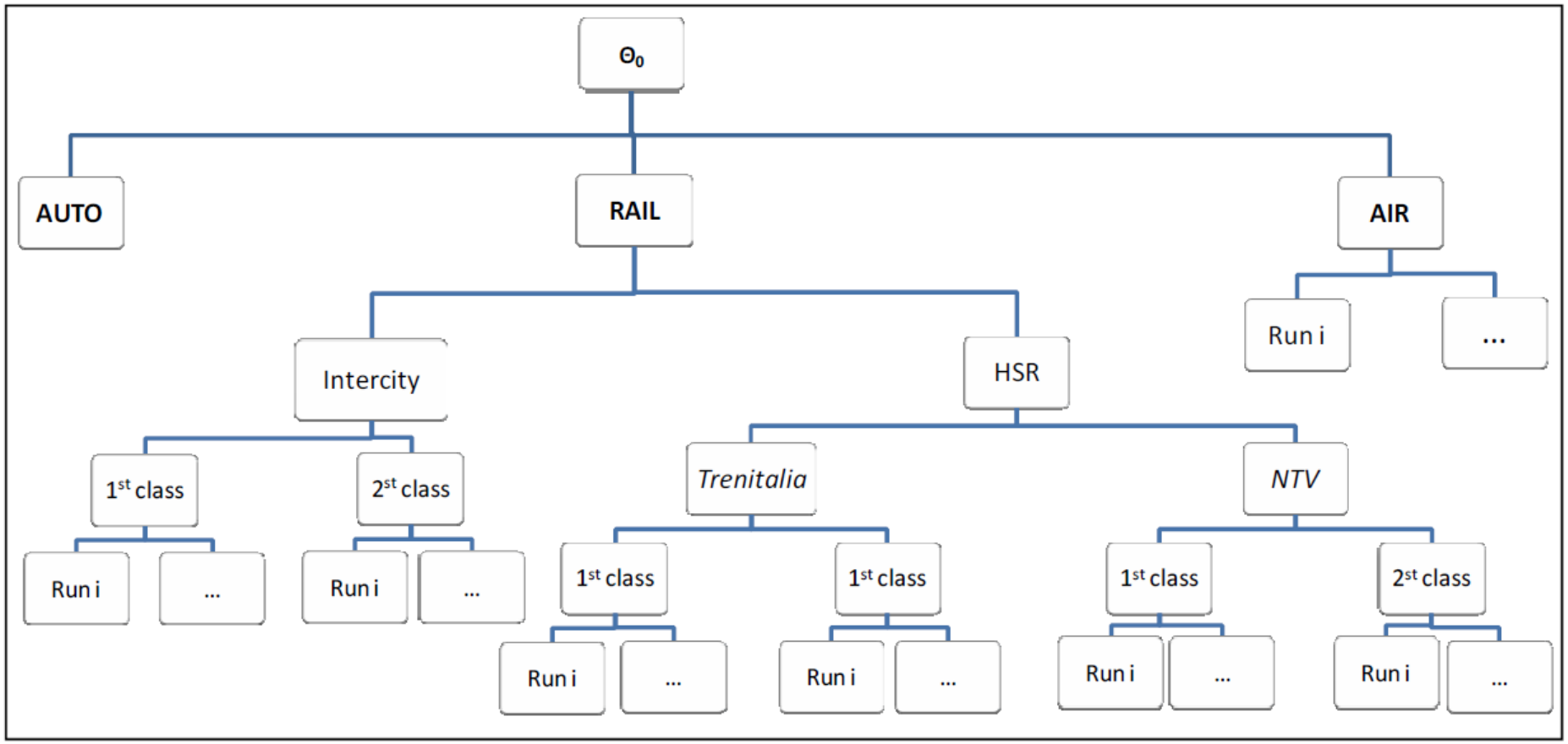
THE METHODOLOGY FOR HSR DEMAND FORECASTING:

Elastic demand multimodal scheduled-based assignment model



The schedule-based mode choice model

Nested logit models with a nesting structure to capture higher degrees of substitutions among specific subsets of modal alternatives, particularly the HSR alternatives provided on the same route by different operators, NTV vs. HSR-Trenitalia



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APPLICATIONS

Design of strategic policies

- **Services and Rolling Stock**
- **Fares**

Design of operational policies

- **Timetable**

APPLICATIONS

Strategic policies tested: service and rolling stock

Alternative scenario:

No services between Napoli and Salerno + new services on the "Torino-Milano-Venezia"

+ new services on the Adriatic corridor

APPLICATIONS

Operational policies tested: fares

Fares "war" among the two HSR competitors

	HSR Service supply (invariant)		Ref. Scenario				Alternative scenario 1				
	TrainKm/day	SeatKm/day (mil.)	1st class	2nd class	paxKm (mil.)	%	1st class	2nd class	paxKm (mil.)	*delta%*	%
Trenitalia	78.162	43,9	Base	Base	**7.128**	**66,6%**	-20%	-20%	**8.066**	*13,2%*	**71,5%**
NTV	35.238	15,9	base	base-8%	**3.569**	**33,4%**	=	=	**3.209**	*-10,1%*	**28,5%**
					10.697	**100,0%**			**11.275**	*5,4%*	**100,0%**

	HSR Service supply (invariant)		Ref. Scenario				Alternative scenario 2				
	TrainKm/day	SeatKm/day (mil.)	1st class	2nd class	paxKm (mil.)	%	1st class	2nd class	paxKm (mil.)	*delta%*	%
Trenitalia	78.162	43,9	Base	base	**7.128**	**66,6%**	-20%	-20%	**7.715**	*8,2%*	**67,2%**
NTV	35.238	15,9	base	base-8%	**3.569**	**33,4%**	-20%	-26,6%	**3761**	*5,4%*	**32,8%**
					10.697	**100,0%**			**11.476**	*7,3%*	**100,0%**

APPLICATIONS

Strategic policies tested: fares

MODEL ELASTICITIES

direct elasticity of total HSR demand with respect to HSR fares : -0,37

cross elasticity of individual HSR operator w.r.t. fares of competing HSR operator: +0,74

OBSERVED ELASTICITIES

Direct elasticity of total travel demand w.r.t. fares (in 2012) included in a range between -0,30 and -0,40

Operational policies tested: timetable

Example of timetable setting to increase flows

orig	dest	dep. Time	arr. Time	1st class	2nd class	total flow
ROMA OSTIENSE	ROMA TIBURTINA	06.06	06.16	4	12	16
ROMA TIBURTINA	MILANO ROGOREDO	06.20	09.05	56	69	125
MIANO ROGOREDO	MILANO P.GARIBALDI	09.07	09.17	45	66	111

orig	dest	dep. Time	arr. Time	1st class	2nd class	total flow
MILANO P.GARIBALDI	MILANO ROGOREDO	06.45	06.55	37	60	97
MILANO ROGOREDO	ROMA TIBURTINA	06.57	09.42	52	80	132
ROMA TIBURTINA	ROMA OSTIENSE	09.46	09.56	5	14	19

dep. Time	arr. Time	1st class	2nd class	total flow
07.06	07.16	12	36	48
07.20	10.05	90	168	278
10.07	10.17	75	150	225

dep. Time	arr. Time	1st class	2nd class	total flow
07.15	07.25	63	131	194
07.27	10.12	73	153	226
10.16	10.26	16	50	66

APPLICATIONS

Operational policies tested: timetable

Example of timetable setting to balance train loads

orig	dest	dep. Time	arr. Time	total flow
MILANO P.GARIBALDI	MILANO ROGOREDO	07.00	07.10	201
MILANO ROGOREDO	BOLOGNA Centrale	07.12	08.07	235
BOLOGNA Centrale	FIRENZE S.M.N.	08.10	08.47	238
FIRENZE S.M.N.	ROMA TIBURTINA	08.57	10.27	246
ROMA TIBURTINA	ROMA OSTIENSE	10.31	10.41	95

orig	dest	dep. Time	arr. Time	total flow
VENEZIA S. LUCIA	PADOVA	06.54	07.20	67
PADOVA	BOLOGNA C.LE	07.22	08.17	148
BOLOGNA Centrale	ROMA TIBURTINA	08.20	10.12	195
ROMA TIBURTINA	ROMA OSTIENSE	10.16	10.26	122

Direct service from Bologna to Roma

Train OD matrices

	BOLOGNA Centrale	FIRENZE S.M.N.	ROMA TIBURTINA	ROMA OSTIENSE
MILANO P.GARIBALDI	77	67	35	23
MILANO ROGOREDO	13	11	6	4
BOLOGNA Centrale		93	-	-
FI S.M.N.			111	68

	PADOVA	BOLOGNA Centrale	ROMA TIBURTINA	ROMA OSTIENSE
VENEZIA S.LUCIA	17	23	11	16
PADOVA		63	13	22
BOLOGNA Centrale			49	84

No pax from Bologna to Roma boarding on this train at Bologna Centrale

CONCLUSIONS

Competition within the HSR market is an additional element of complexity in demand analysis

- **forecasting impacts on services supply (e.g. fares)**
- **impacts on demand among operators within-mode (e.g. market shares)**

Surveys and mathematical models are essential for strategic planning, for monitoring the HSR market and for designing services

Operations	Strategic Planning
• Schedule-based models	• Schedule-based vs. frequency- based models • Induced demand models