SAPIENZA
UNIVERSITÀ DI ROMA

RESEARCH TEAM

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Riccardo Patriarca
PhD Student

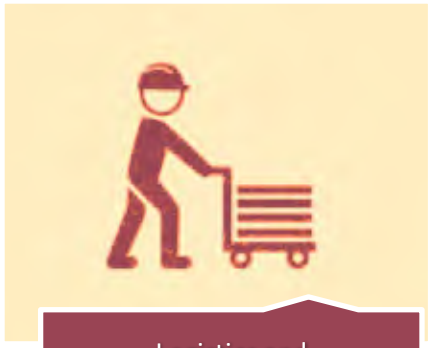
Andrea Falegnami
PhD Student

SSD 09-B2 (INGN-IND/17) Industrial Systems Engineering

-Design of industrial systems

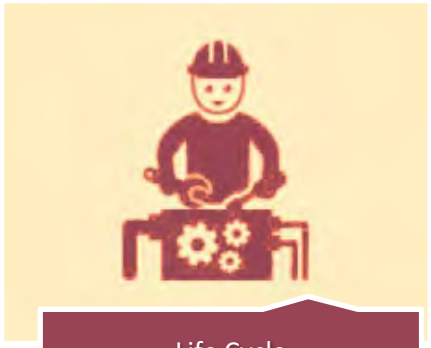
Risk Management

Operations management: design, control, monitoring, optimization

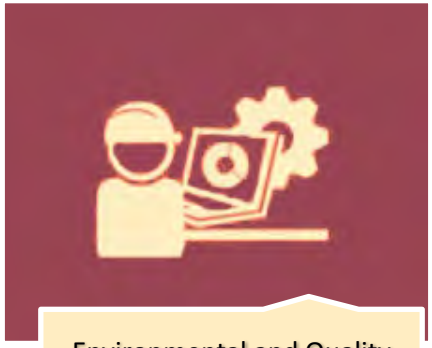


Logistics and Supply Chain Management

Safety and Maintenance



Life Cycle Assessment and Management



Environmental and Quality Management

RESEARCH ACTIVITIES

Current researches

- **Rating model for Health and Safety** (*Confindustria*, *INAIL, Dip. DICMA*)
- **Spare parts management for complex systems** (*Dip. MEMOTEF*)
- **Quality monitoring for airport ground handlers** (*ADR handlers*)
- **Industry 4.0** (*Cicero HuB, Microsoft Italia, Cassa Depositi e Prestiti, Confindustria*)
- **Resilience Engineering for complex systems**: Safety-II and Functional Resonance Analysis Method in Industrial Plants, Environmental Risks, Air Traffic Management, Aviation, Maritime operations, Space missions, Railway, Healthcare (*ANACNA, Lund University, Danish Maritime Accident Investigation Board, Umberto I, Duke NUS Singapore*)
- **Supply Chain rating model** (*University of Parma, University of Bologna, University of Florence, University of Bergamo, Marche Polytechnic University*)

LABS AND INFRASTRUCTURE

Licenced software

- System simulation software
  - *Witness*
  - *Simul8*
  - *Palisade DTS*
- Life Cycle Analysis
  - *SimaPro*
- Organization survey system
  - *Quaesitum*
- Statistics and data analytics
  - *SPSS*
  - *R*
  - *Microsoft Power BI*
- Maintenance and Reliability
  - *Relex*
- Multicriteria Analysis
  - *Super Decision Software*
- Neural Networks
  - *NeuroSolution*

Proprietary software

- *Safety Cube toolset*: risk simulator and visualizer
- *myFRAM*: FRAM model builder and analyser
- *MP quality manager*: multidimensional analysis tool for quality assessment

INDUSTRY UNIVERSITY COLLABORATIONS

UNIVERSITY SPIN-OFF

aiComply

PRODUCTS AND SERVICES

- Development and distribution of Governance, Risk and Compliance (GRC) Platform YouComply® and CRisk®
- Development and distribution of whistleblowing IT platform WBConfidential®
- Development of the opendata web platform OpenSafety®
- Consulting projects for GRC management
- Consulting projects for processes improvement

FUNDING AND PARTNERS

- **Research projects**

  Commissione Europea, Lazio Innova, Ministero del Lavoro e delle Politiche Sociali, Ministero dello Sviluppo Economico, Ministero dell'Istruzione, dell'Università e della Ricerca, CNR, ISPESL, INAIL

- **Research contracts**

  Public entities: ASL di Siena, ASL di Lecce, Banca d'Italia, Camera di Commercio di Arezzo, CNIM, Comune di Apiro, Comune di Colleferro, Provincia di Roma

  Private companies: Aeroporti di Roma, AGIC Consulting srl, ARC, Anas Spa, ATAC spa, Autodromo di Vallelunga, Consulta Spa, ENAV, ISED, ITALFERR, SEI-ENEL Real Estate, NOVA Consulting srl, Simav Spa

FUNDING AND PARTNERS

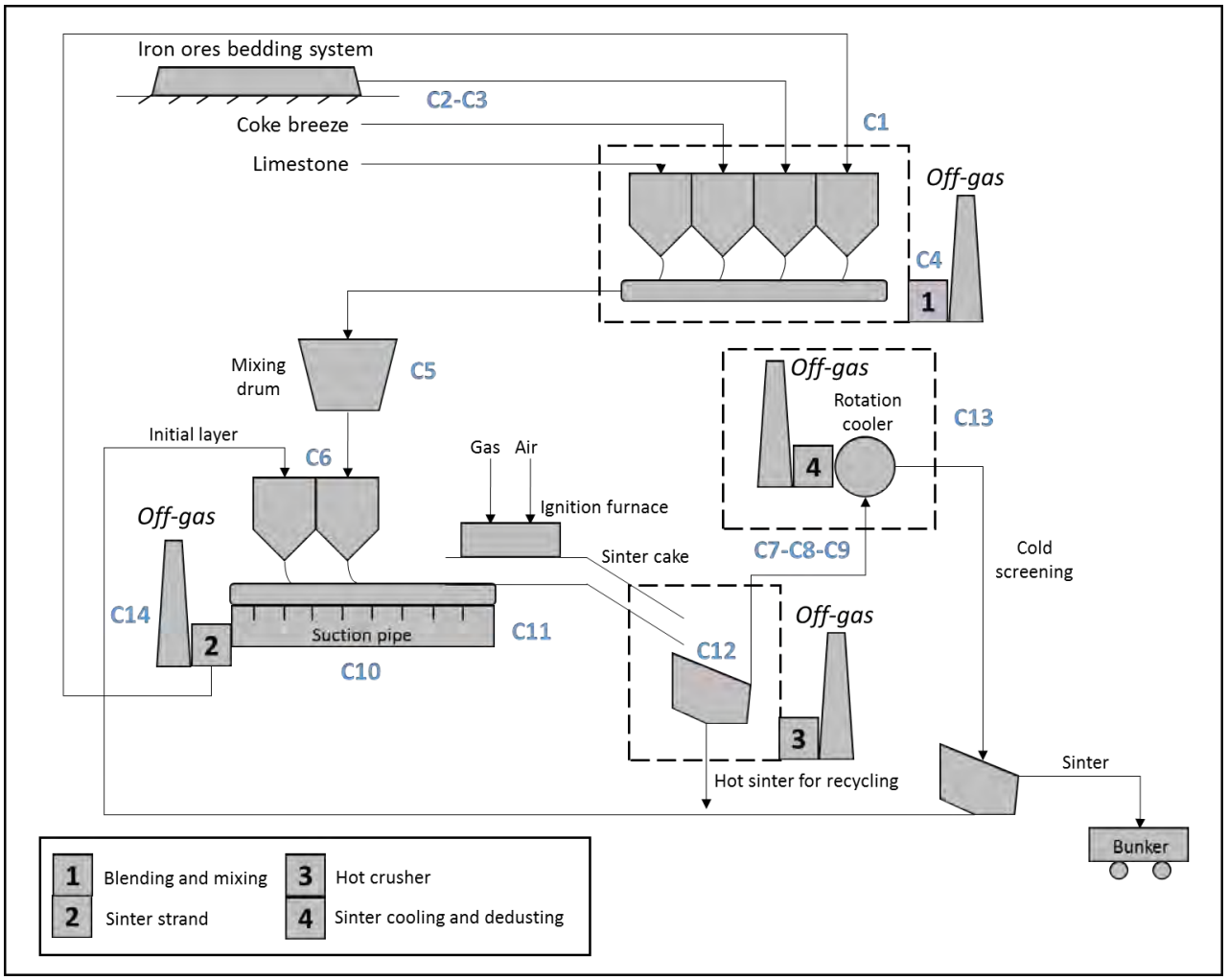
- **Project and research collaborations**

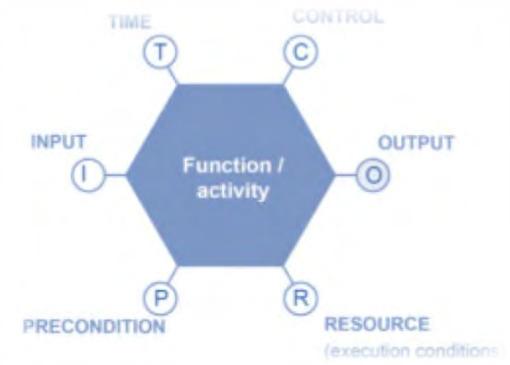
RESEARCH TARGET AND STRATEGIES

Resilience Engineering & Risk Management	*Became Excellence Center for RE* - Organization of FRAMily Event 2017 in Rome - Strengthen and extend the international partnerships - Patent new tools for RE - Apply for H2020 calls
Industry 4.0	*Be recognized as Reference Center for central Italy for the Industry 4.0* - Join Clusters, Hubs and dedicated networks - Update the literature state of the art - specific ontology and implementing framework
Supply Chain Management	*Be recognized as Reference Center for supply chain assessment and rating*
Safety and Maintenance	*Be recognized as Reference Center for methodologies and techniques for advanced maintenance and predictive safety*

Recent project: RESILIENCE ENGINEERING

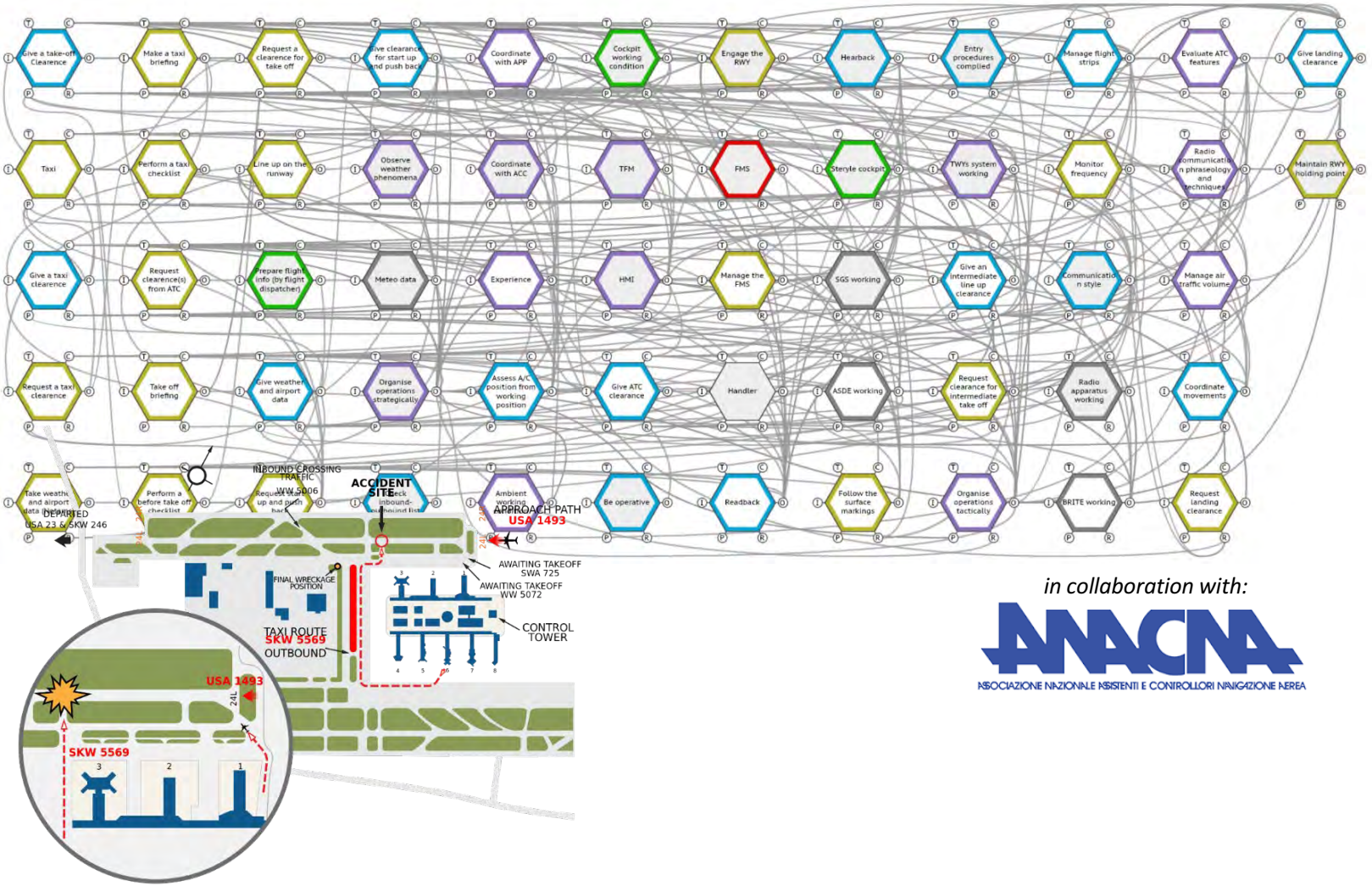
Environmental risks in a sinter plant





Recent project: RESILIENCE ENGINEERING

Runway Incursion for the Air Traffic Management system

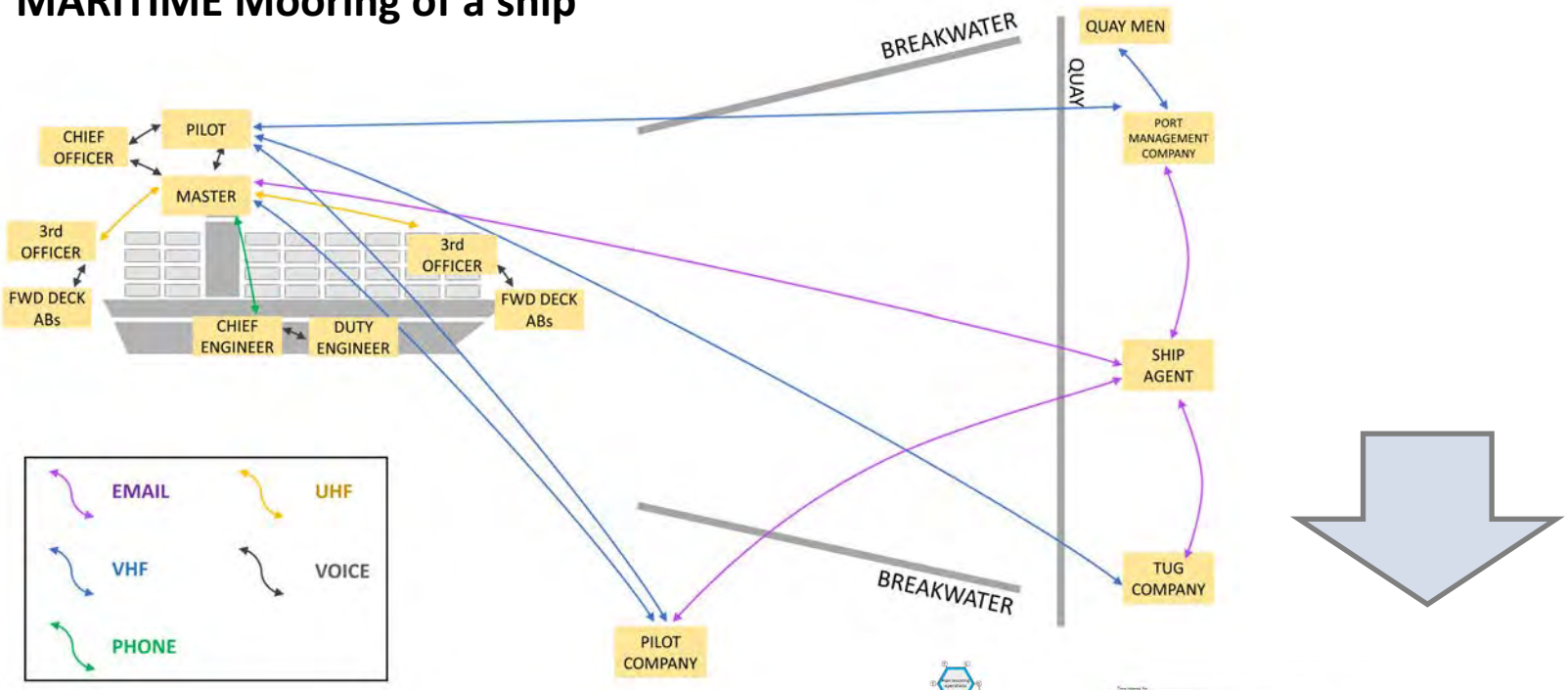


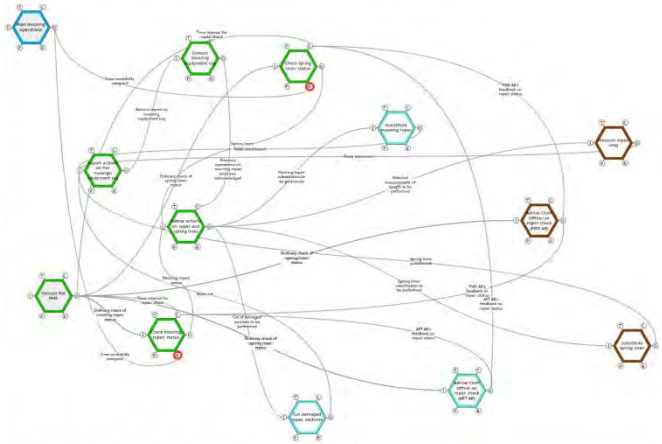
in collaboration with:

ANACNA
ASOCIAZIONE NAZIONALE ASSISTENTI E CONTROLLORI NAVIGAZIONE AEREA

Recent project: RESILIENCE ENGINEERING

MARITIME Mooring of a ship





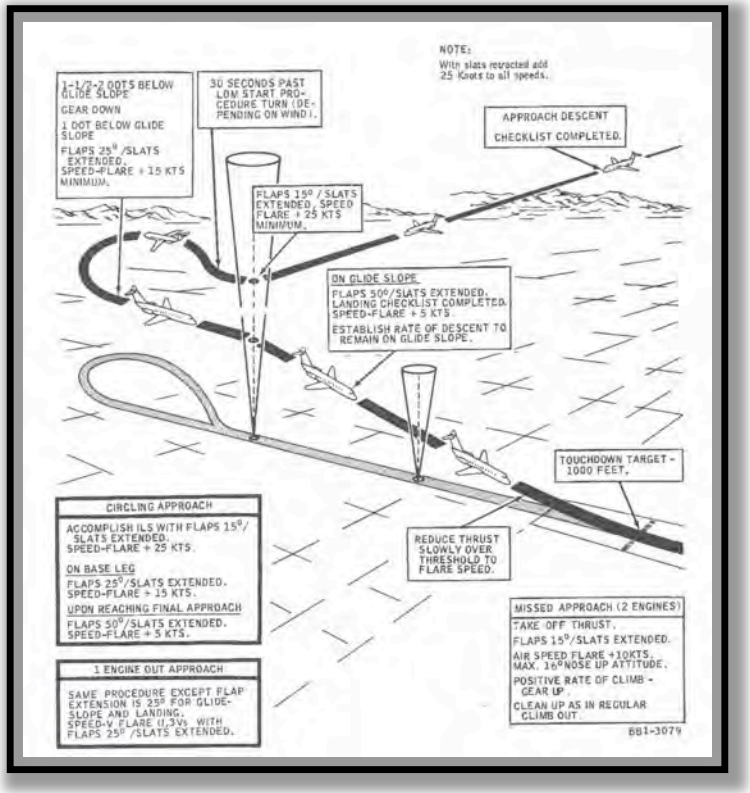
in collaboration with:

Danish Maritime Accident Investigation Board

LUND UNIVERSITY

Recent project: RESILIENCE ENGINEERING

SPEED SETTING in a DC 9



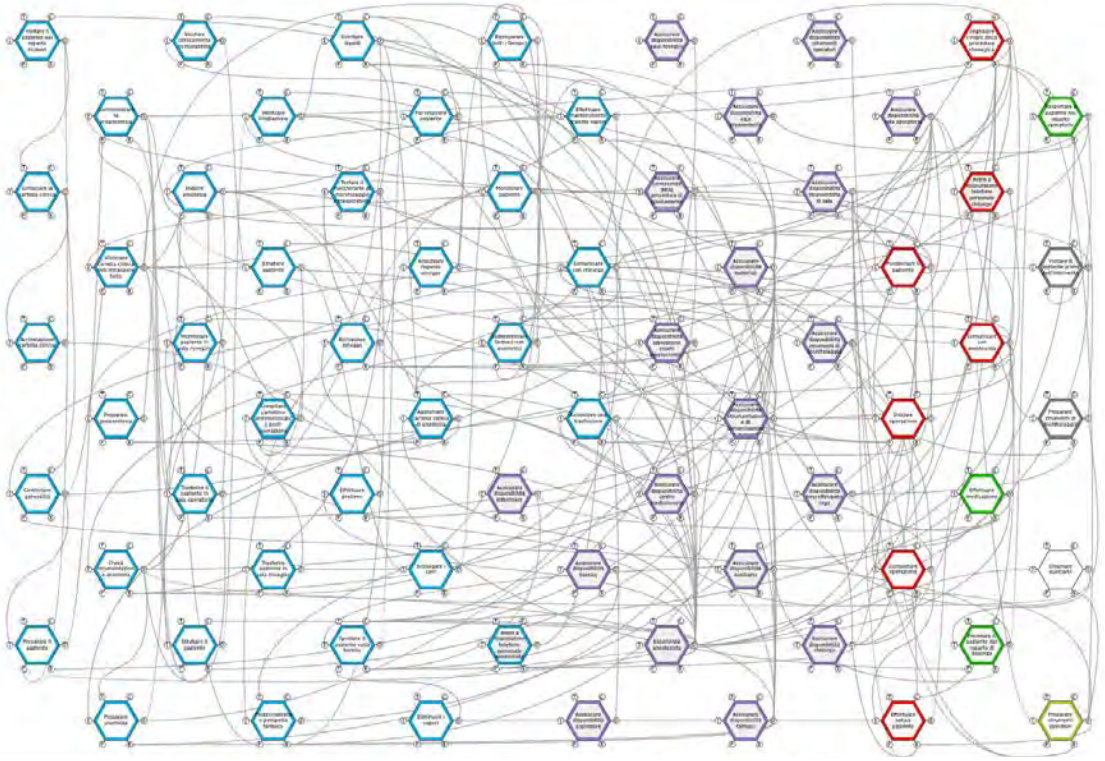
in collaboration with:

LUND UNIVERSITY

SAS

Recent project: RESILIENCE ENGINEERING

Administering drugs in neuro-anesthesiology

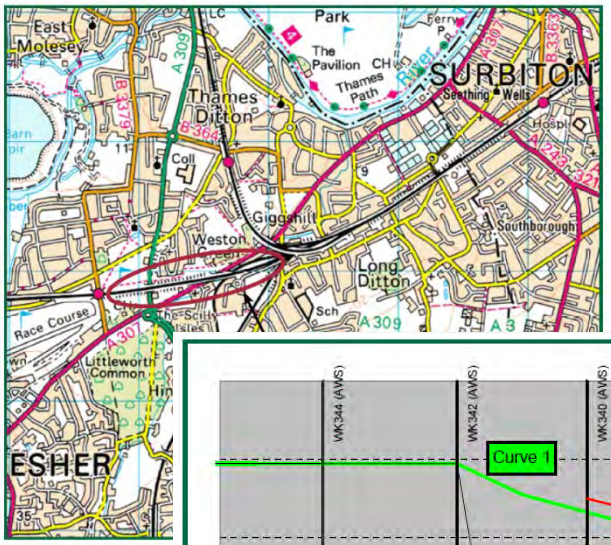


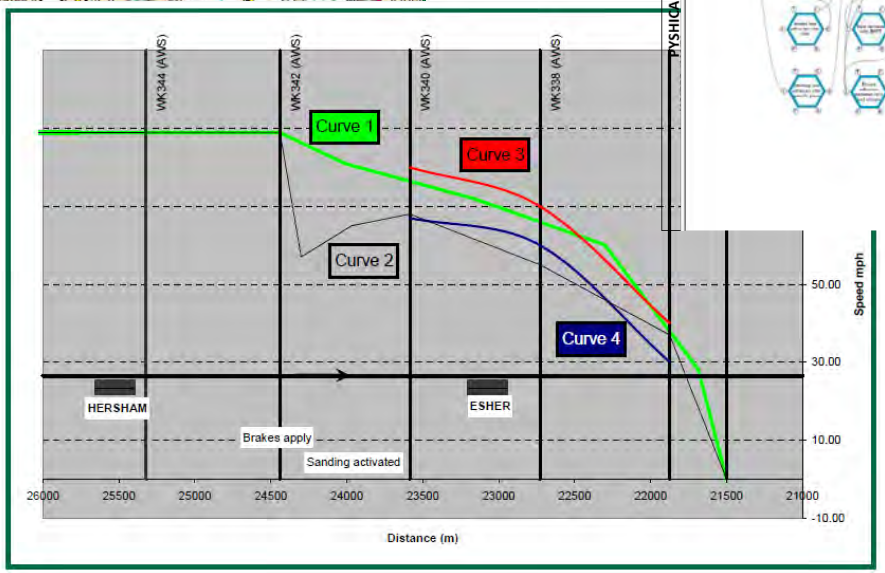
in collaboration with:

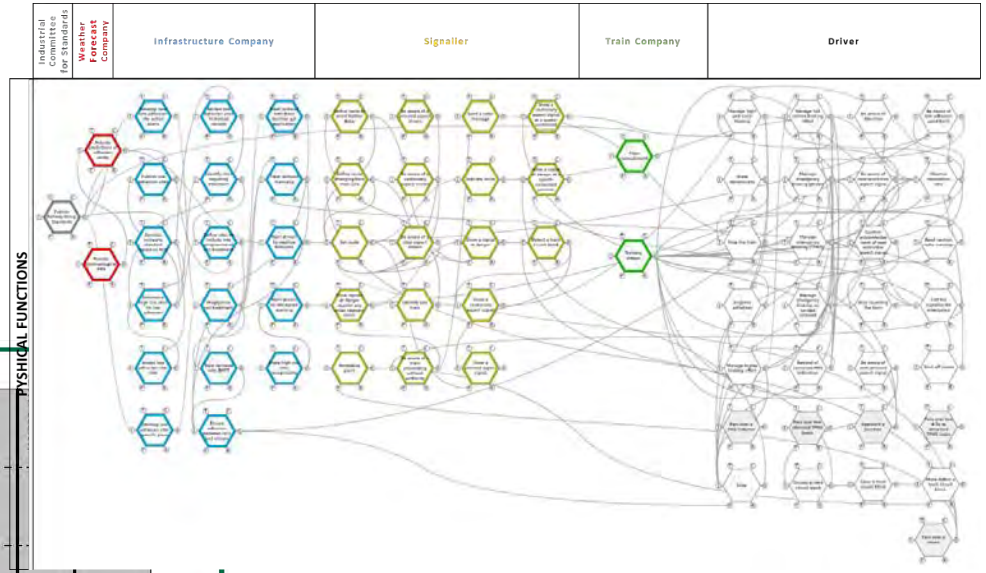
UMBERTO I
POLICLINICO DI ROMA

Recent project: RESILIENCE ENGINEERING

Accident analysis in the railway domain





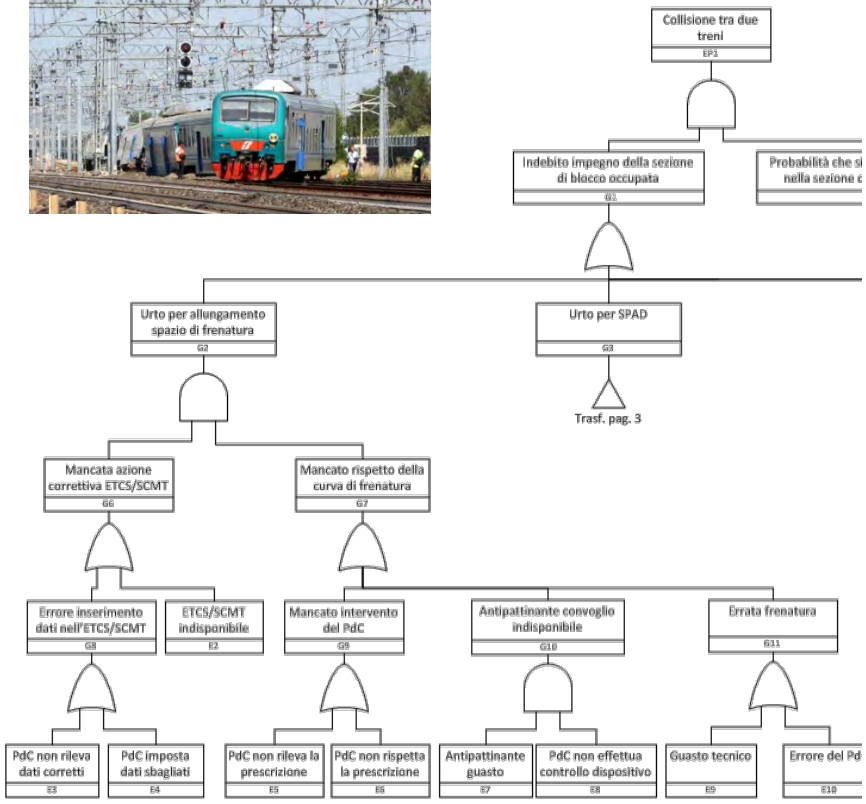


Recent project: RISK MANAGEMENT

Risk Analysis in railways considering topographic and traveling characteristics

Nuovo Trasporto Viaggiatori

Risk assessment model to integrate FTA analysis with a scenario simulation of the operational conditions



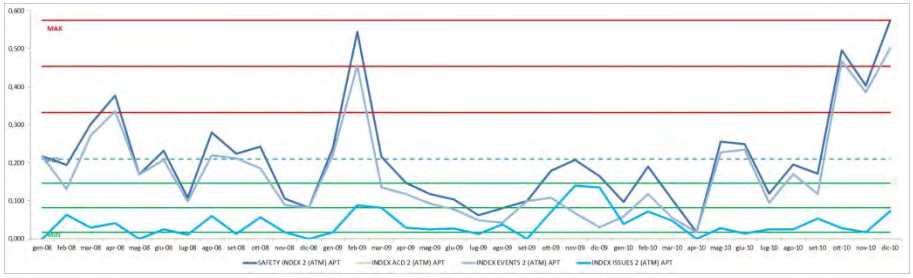
				Gravità			
				Insignificante	*Marginale*	*Critico*	*Catastrofico*
				Ferito lieve	Più feriti lievi	Da un ferito grave a un morto (o equivalente)	Più di un morto (o equivalente)
Probabilità	*Frequente*	Probabile che accada frequentemente. La situazione pericolosa si presenterà continuamente	0,020000	X	X	X	X
	Probabile	Accadrà parecchie volte. Ci si può aspettare che la situazione pericolosa si presenti spesso.	0,010000	X	X	X	X
	Occasionale	Probabile che accada parecchie volte. Ci si può aspettare che la situazione pericolosa si presenti parecchie volte	0,002000	X	X	X	X
	Remoto	Probabile che accada qualche volta nella vita del sistema. Ci si può ragionevolmente aspettare che la situazione pericolosa si presenti	0,000100	Tollerabile	X	X	X
	Improbabile	Improbabile che accada ma possibile. Si può assumere che la situazione pericolosa possa presentarsi eccezionalmente.	0,000010	Trascurabile	Tollerabile	Tollerabile	X
	Inverosimile	Estremamente improbabile che accada. Si può assumere che la situazione pericolosa possa non presentarsi.	0,000001	Trascurabile	Trascurabile	Trascurabile	Tollerabile

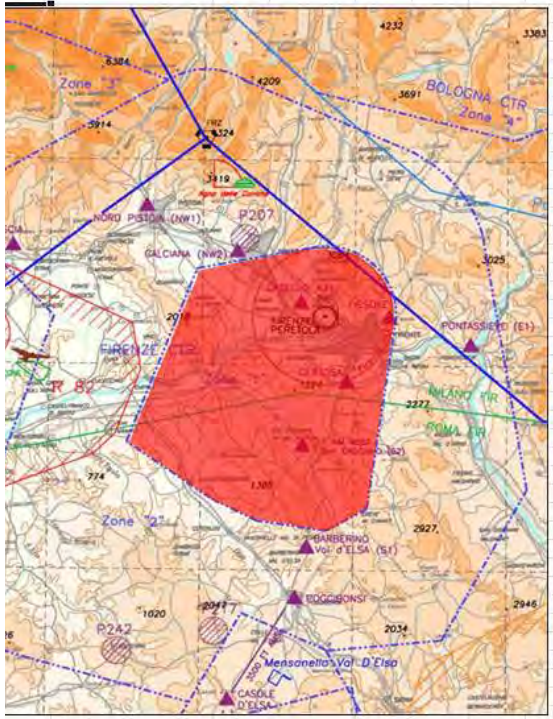
TRATTA			**Topografici**					
			Gallerie (> 1000 metri)	PL	Ponti (> 500 metri) e Viadotti	Attraversamento stazioni	Vicinanza a centri abitati	Vicinanza impianti chimici/elettrici/etc
TR1	Torino-Milano AV		0	0	1	0	0	0
TR2	Torino-Milano Tr		0	1	1	1	1	1
TR3	Milano-Bologna AV		0	0	1	0	0	1
TR4	Milano-Bologna Tr		0	1	1	1	1	1
TR5	Bologna-Firenze AV		1	0	0	0	0	0
TR6	Bologna-Firenze Tr		1	1	1	1	1	0
TR7	Firenze-Roma Dir		1	1	1	0	1	0
TR8	Firenze-Roma Lenta		1	1	1	1	1	0
TR9	Roma-Napoli AV		1	0	1	0	0	1
TR10	Roma-Napoli Formia		1	1	0	1	1	0
TR11	Roma-Napoli Cassino		1	1	0	1	1	0
TR12	Napoli-Salerno AV		1	0	1	0	1	0
TR13	Napoli-Salerno Tr		1	1	1	1	1	1
TR14	Bologna-Venezia		0	1	1	1	1	1
TR15	Napoli-Nola		0	1	0	1	1	0

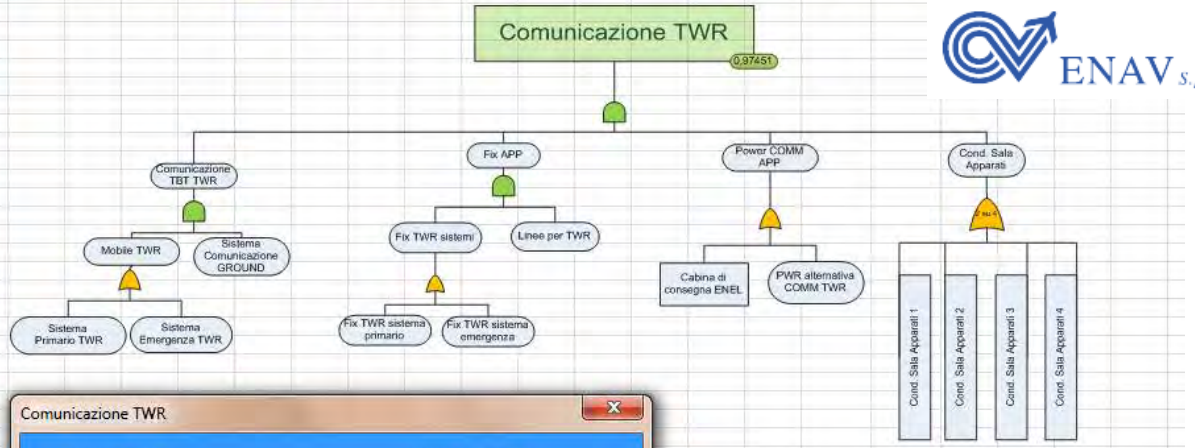
Recent project: RISK MANAGEMENT

Risk assessment for air traffic management

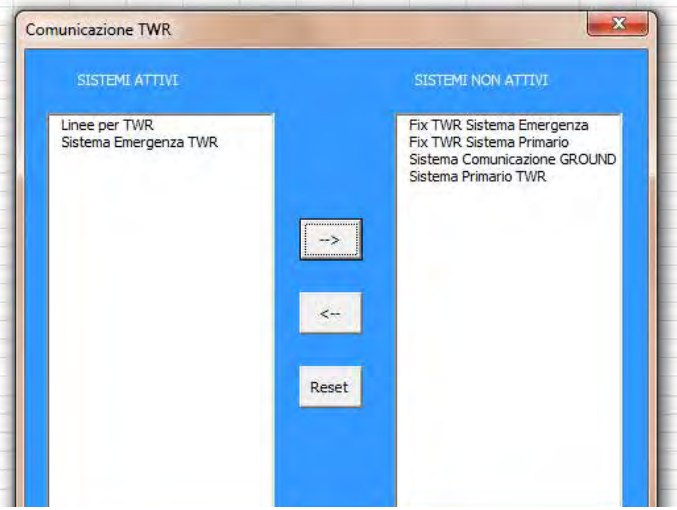
Measurement systems based on AHP/ANP to evaluate Safety performances of ATM and address risk assessment on organizational and technical changes

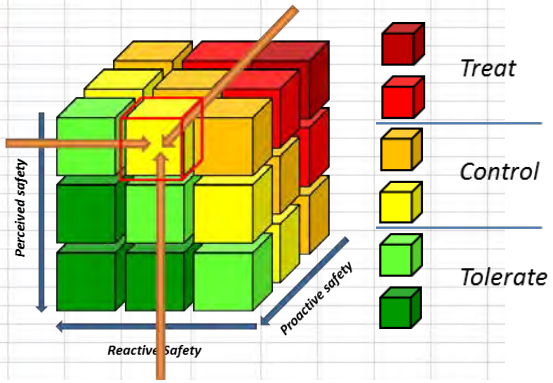






ENAV S.p.A.



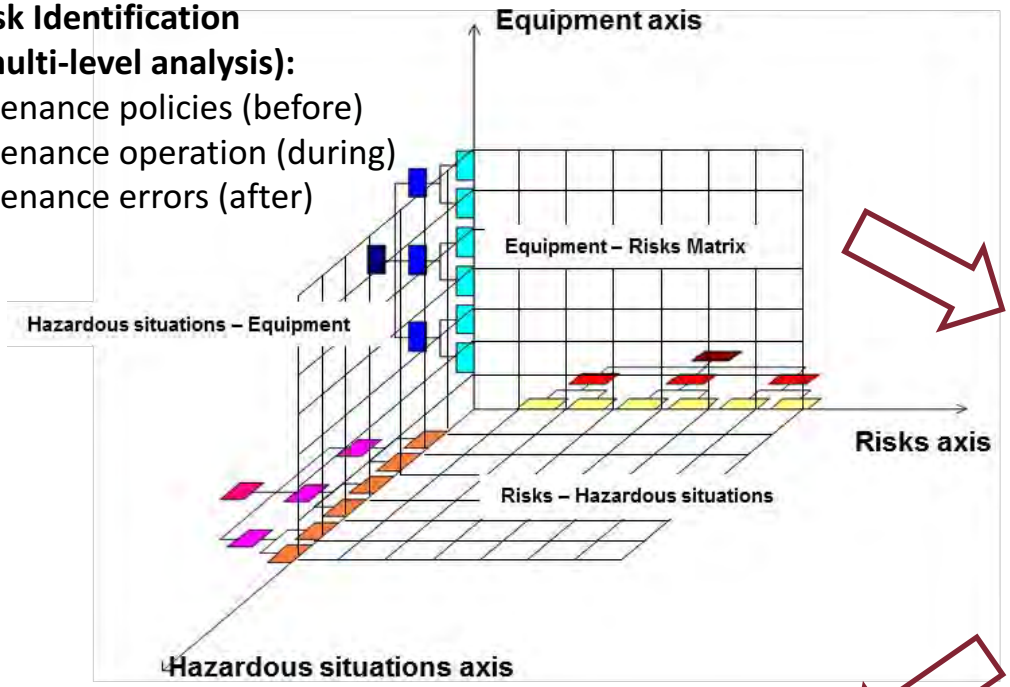


Recent project: RISK MANAGEMENT

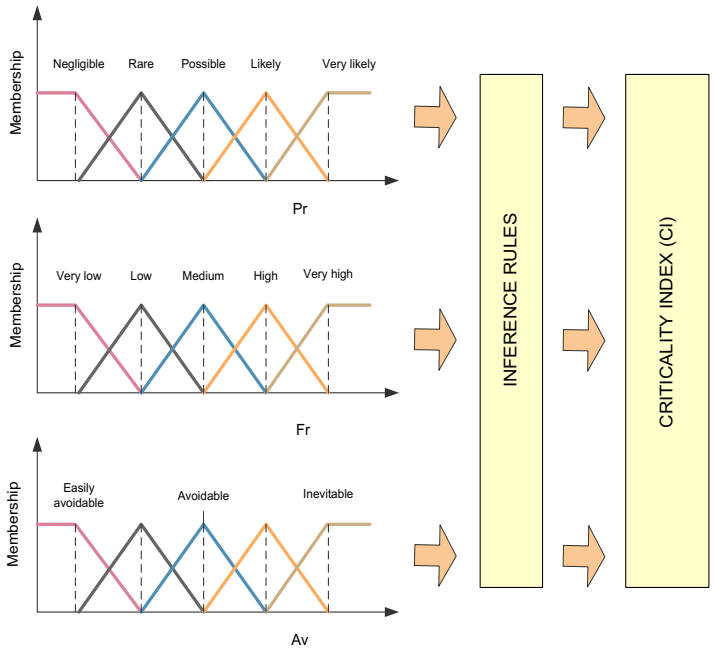
Accident prevention: before, during and after maintenance

1) Risk Identification (multi-level analysis):

- Maintenance policies (before)
- Maintenance operation (during)
- Maintenance errors (after)



2) Risk Analysis: R=Se x (Pr + Fr + Av)
Risk Scoring Method



3) Risk Treatment:

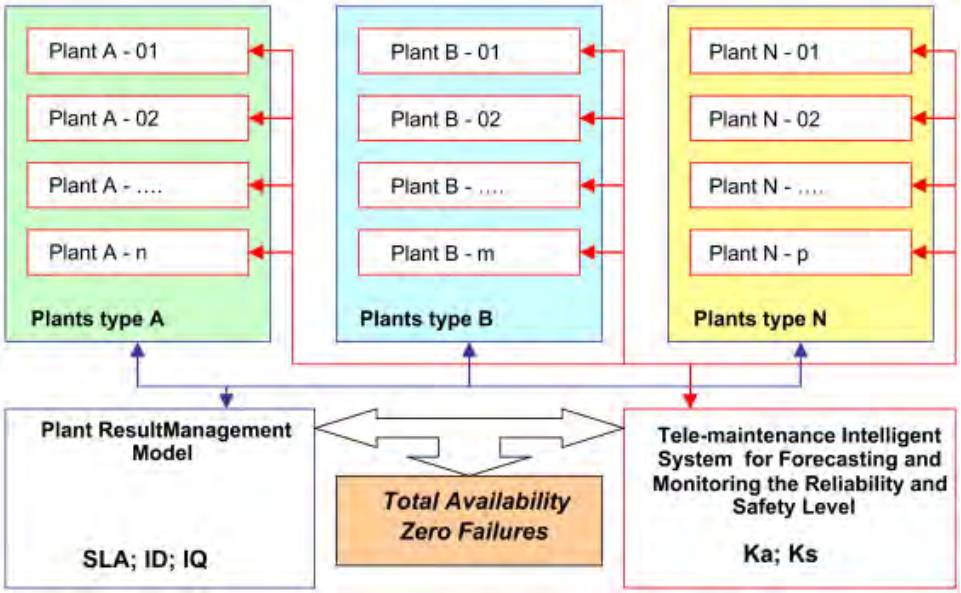
Index	I1	I2	I3	I4	I5	I6	I7
Cleaning machine							
Inadequate strategy	1	0	0,03	0	0,77	0,58	44%
Maintenance operation	7	4	0,54	0,30	1,23	0,92	29%
Operational errors	0	0	0	0	0,99	0,46	27%
Cream separator							
Inadequate strategy	5	0	0,16	0	0,92	0,69	45%
Maintenance operation	7	4	0,58	0,34	1,25	0,94	23%
Operational errors	4	0	0,15	0	0,80	0,60	32%
Pasteurizer							
Inadequate strategy	14	0	0,40	0	0,97	0,72	49%
Maintenance operation	11	2	0,78	0,14	1,31	0,99	25%
Operational errors	9	0	0,45	0	0,88	0,66	26%
Tot. Area							
Inadequate strategy	20	0	0,20	0	0,89	0,67	47%
Maintenance operation	25	10	0,64	0,26	1,26	0,95	25%
Operational errors	13	0	0,19	0	0,87	0,57	28%

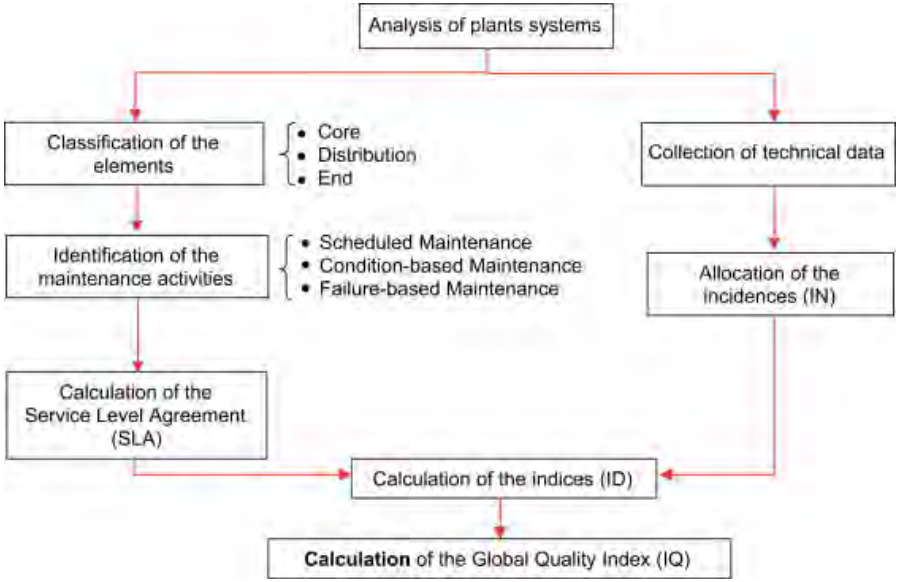
Training about safety risks of maintenance tasks

Recent project: MAINTENANCE

Tele-Maintenance and predictive Safety Intelligent System

Prototype of a “Smart” remote-controlled geographical system for maintenance management and integrated predictive safety



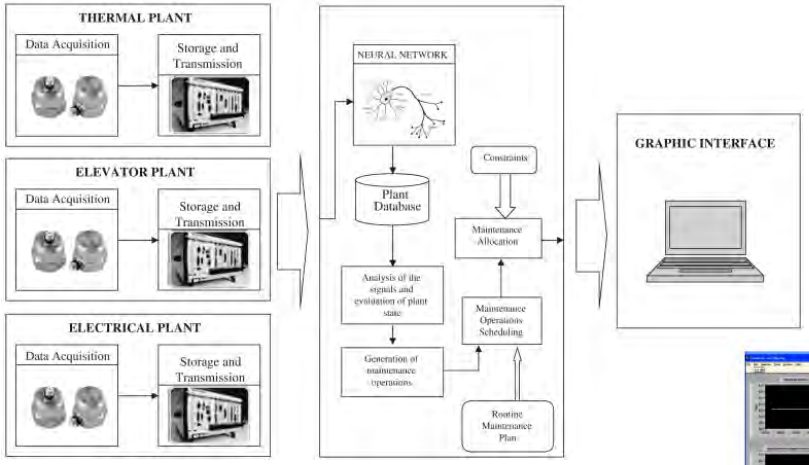


The research integrates:

- a Plant Result Management Model
- a Tele-maintenance Intelligent System to forecast performance levels and schedule operations
- a predictive Safety approach integrated in the productive systems

Recent project: MAINTENANCE

Tele-Maintenance and predictive Safety Intelligent System



All the data detected on the plants are regularly transmitted to the remote control center and recorded on the individual plant identification file in order to update the general plant database and for subsequent processing.

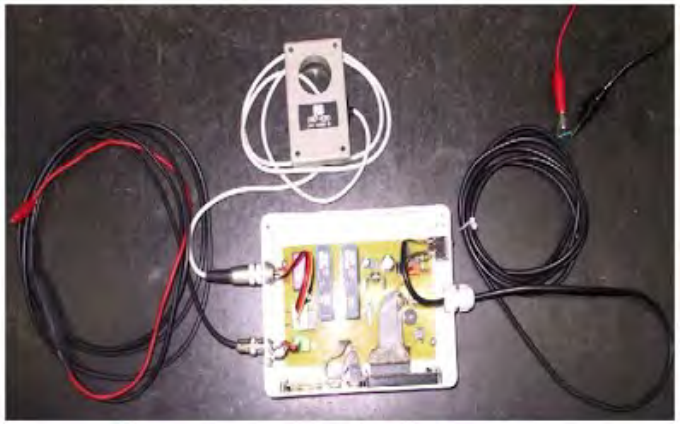
The Ka and Ks output values of each plant, resulting from the processing of the neural network, together with the data of the other monitored parameters, permit the implementation of an intelligent and integrated plant maintenance and safety system.

Fig. 10. A view of the software management tool.

Recent project: EVALBATT

The real time evaluation of the level of battery charge and the reliability of batteries is of capital importance in many applications: hybrid and electrical means of transportation, hybrid and electrical submarines, bio-medical systems, military equipments, airplanes.
As a matter of fact, the level of charge and the reliability of the electrochemical accumulators is a function of several variables not easily controllable.

Evalbatt is an innovative system used to evaluate the residual charge capacity in electrical batteries and the probability of failures, critical for lithium batteries.
Evalbatt solves some basic problems: the opportunity to get the residual range with low error (less then 20%) and the trouble to make successful evaluations “on line”, during the operation of the battery.
Major benefits will be therefore the better utilization of the batteries, the reduction of the loads and the predictability of stops and accidents.



Recent project: INNOVATION IN EDUCATION

GLOBAL EXPERIENCE IN ROME

Over spring break 2013, 20 Purdue undergraduate students teamed with 24 engineering students from University of Rome 'La Sapienza' to participate in an immersive, intercultural educational program focusing on engineering in the global service sector. The course was organized by professors Sara McComb and Pat Brunese, in collaboration with professor Lorenzo Fedele from La Sapienza and the Comitato Nazionale Italiano Manutenzione (CNIM, the Italian National Maintenance Committee). Educational activities were designed to help students apply a systems perspective to service activities and understand the commonalities in engineering challenges across different services. Combining classroom instruction with fascinating behind-the-scenes tours of industry, health care and cultural venues created a rich learning environment that expanded the students' views of how engineering can be applied in the service sector around the world. Topping off this amazing experience, the group was in Rome for the election of Pope Francis.

Dipartimento di Ingegneria Meccanica e Aerospaziale

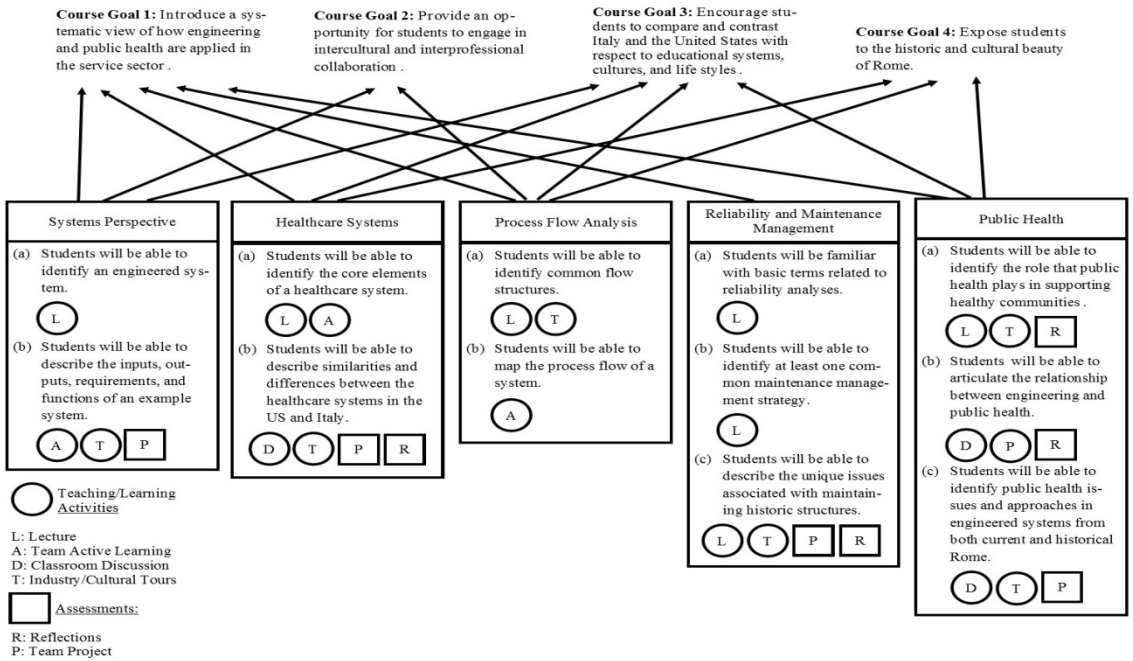
PURDUE UNIVERSITY — SAPIENZA Università di Roma

International Training

Engineering and Public Health in the Service Sector

an ITALY-USA Study Experience

within the Memeorandum of Understanding
Purdue University - Sapienza Università di Roma
for
Safety and Maintenance in Infrastructures and Industrial Healthcare Complex Systems

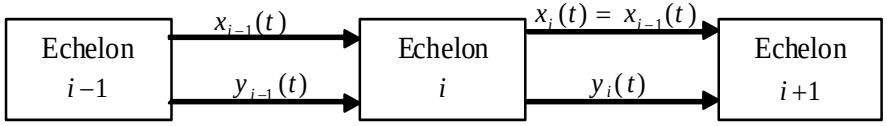


Faculty from Purdue University (School of Industrial Engineering) and Sapienza Università di Roma collaborated to design a course focused on engineering and public health in the service sector, in Rome. More specifically, the intersection of topics including systems, reliability, process flow, maintenance management, and public health are examined through case studies, field experiences, and assessments. Engineering students from both Universities participate in the program while the Purdue students are in Rome.

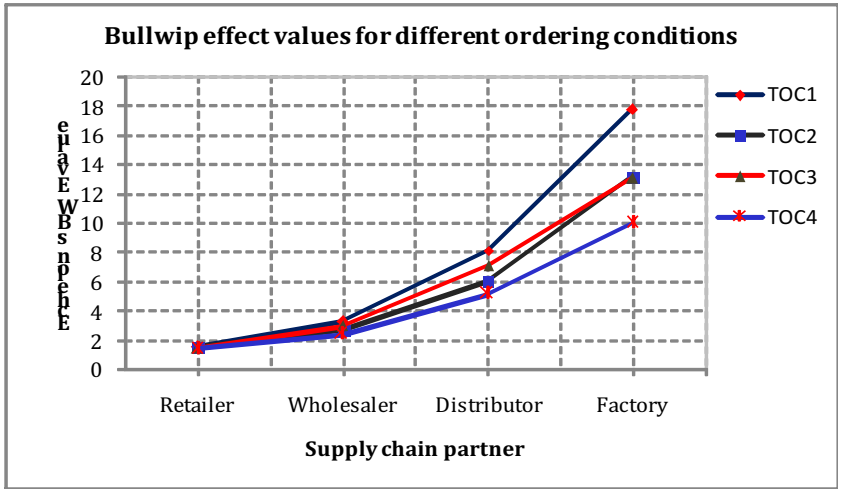
Recent project: SUPPLY CHAIN MANAGEMENT

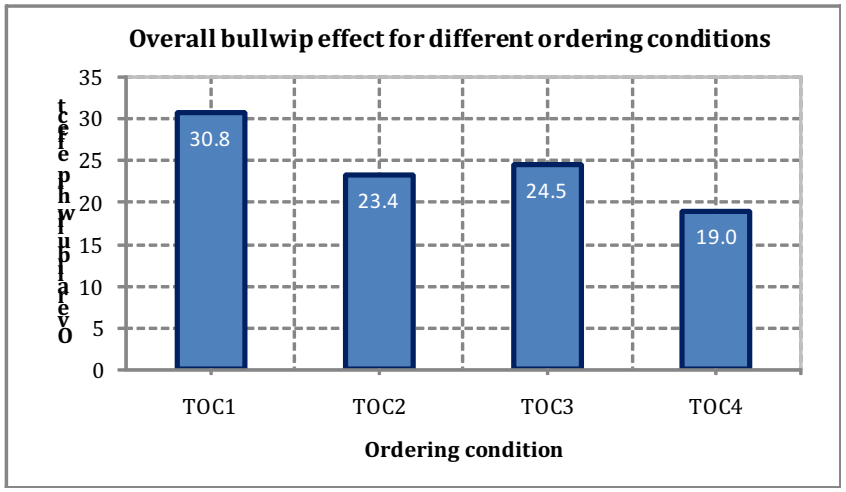
Supply chain disruption

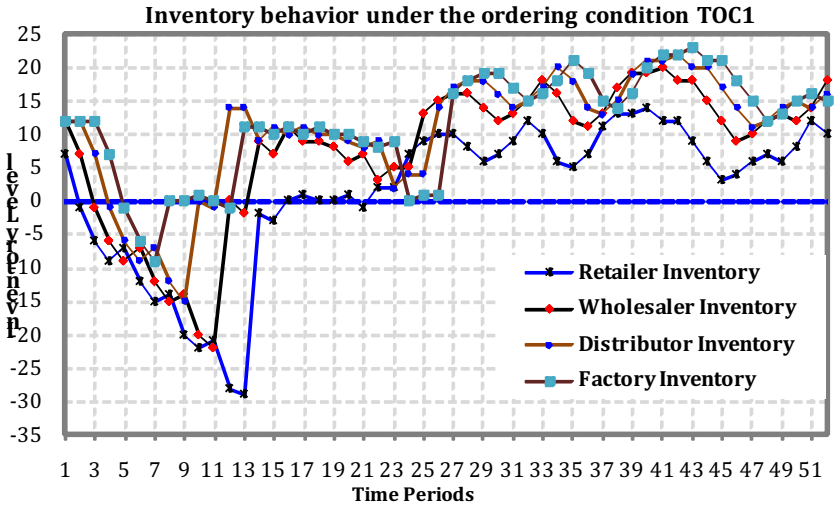
Simulation of ordering policies based on decentralized information sharing to increase resilience and decrease bullwhip effect.



$$y_i(t) = \begin{cases} 0, & \text{if } x(t) \le x(t-1) \\ y_{i-1}(t) + \alpha_i\big(x(t) - x(t-1)\big), & \text{if } x(t) > x(t-1) \end{cases}$$





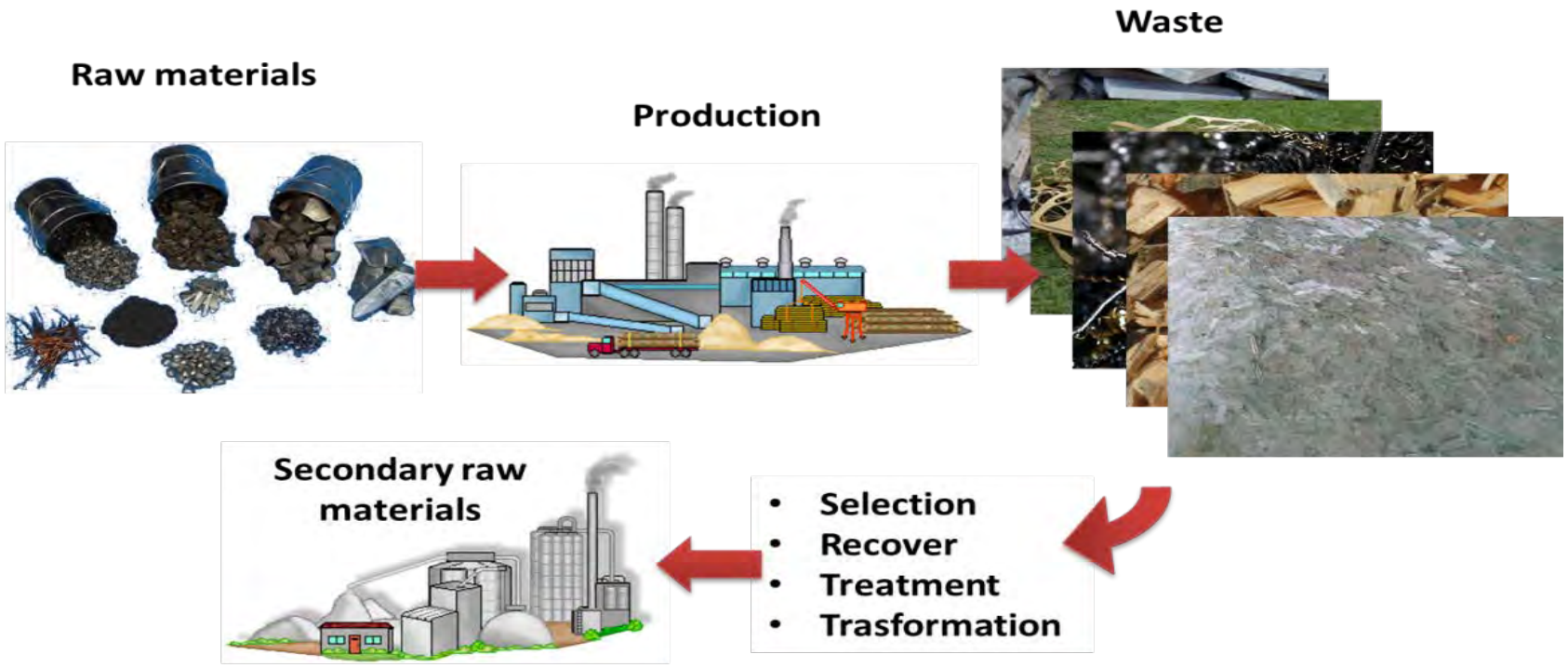


Recent project: SUPPLY CHAIN MANAGEMENT

Supply chain for secondary raw materials

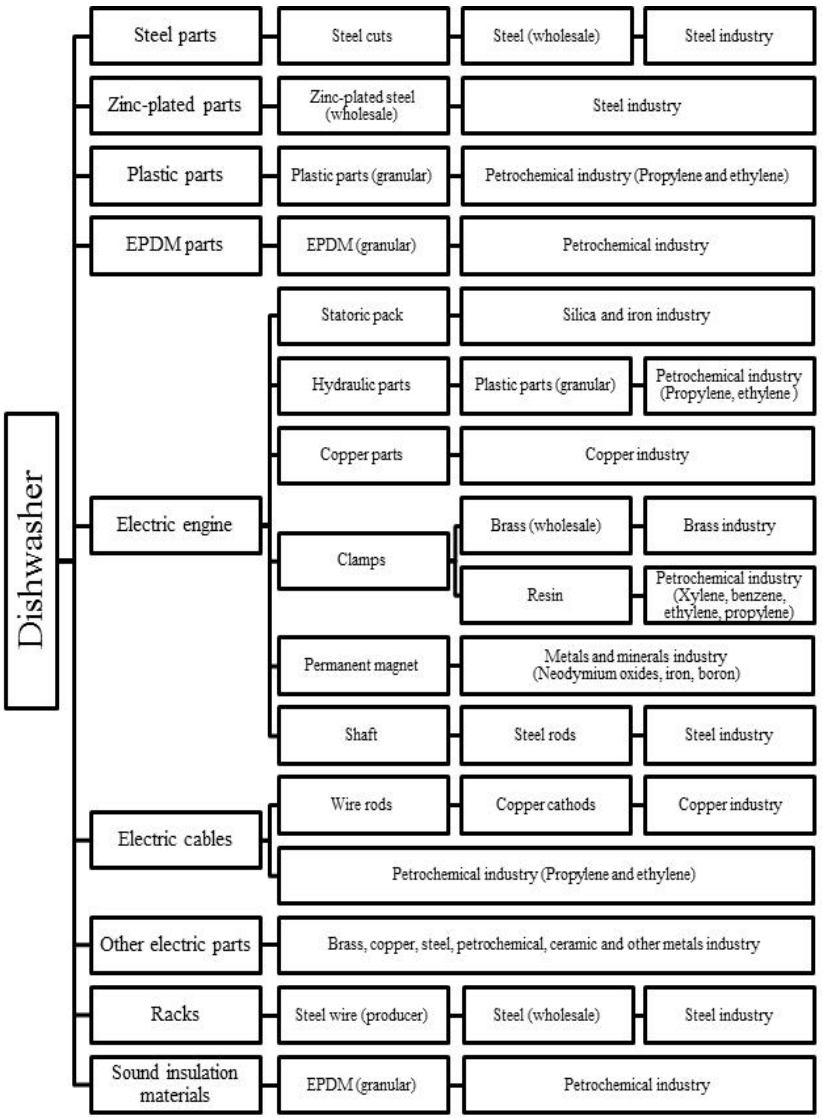
European project to close at a local level the supply chain of secondary raw materials (SRM):

- Mapping of local productions and opportunities
- Identification of origin / demand of SRM
- Analysis of production cycle and technical solutions
- Investment analysis for SRM

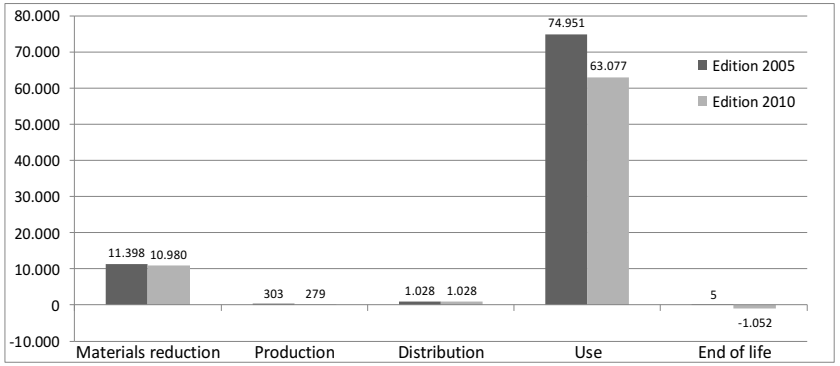


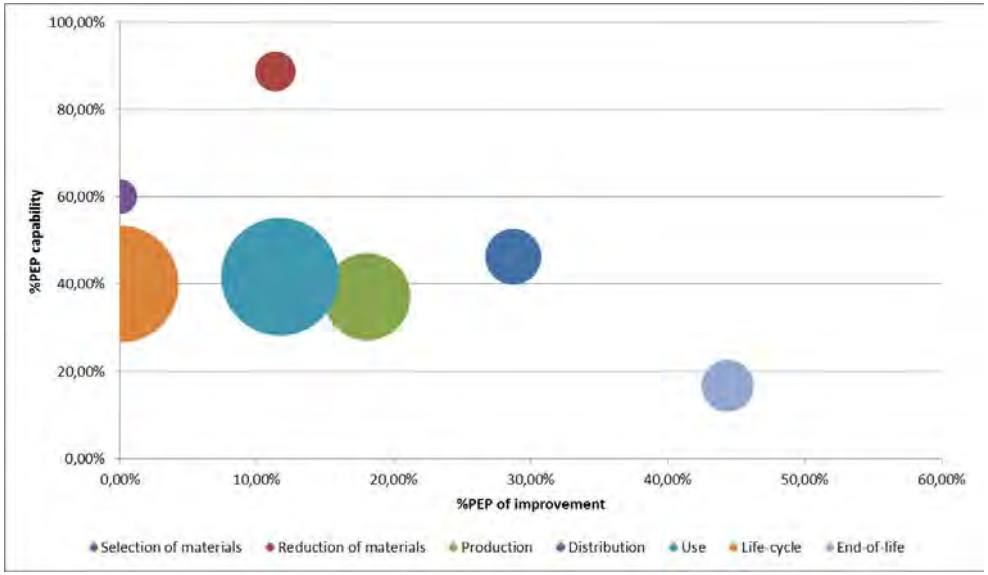
Recent project: SUPPLY CHAIN MANAGEMENT

Ecological Profile of supply chains



Innovative methodology to assess the capability of the environmental improvement, considering regulatory and voluntary requirements.





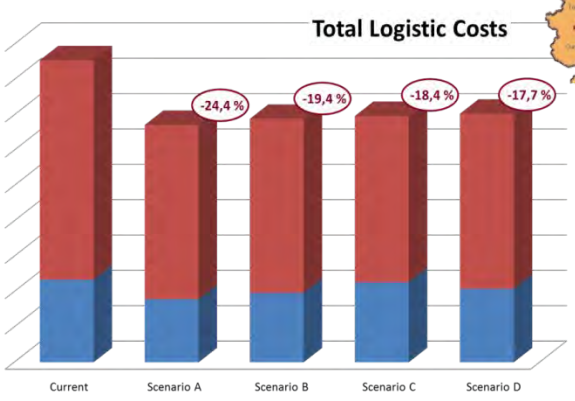
Recent project: LOGISTICS

Logistics processes reengineering for cost reduction

Logistics reengineering through the application of Lean Six Sigma methodology

Scoring Wharehousing					
Section	Subsection	Title	Weight Section	Weight Subsection	Score
1		**Company information**	0%		
2		**Proposed solution**	15%		
	a	Warehouse location		25%	
	b	Logistical assets		25%	
	c	Value Added Logistis services (VAL)		20%	
	d	Reliability		30%	
3		**Costs**	50%		
	a	WH Shuttle		10%	
	b	WH Handling		35%	
	c	WH Storage		40%	
	d	Administration services		10%	
	e	Value Added Logistis services (VAL)		5%	
4		**Experience**	10%		
	a	Oil products		40%	
	b	Packaging type		40%	
	c	On site management		20%	
5		**QSHE**	10%		
6		**IT**	15%		
	a	Management and monitoring		50%	
	b	Interface		50%	
				Total score	0

Q8 Oils



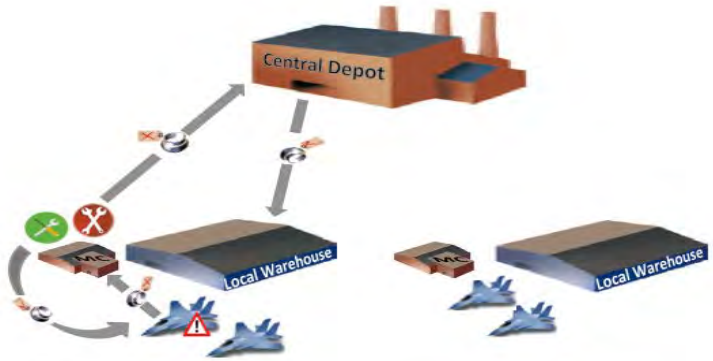
Integrated logistics model for e-business of Made in Italy SMEs

@bilita

Simulation model of logistics performances in complex markets:

- multi-product, multi-brand, multi-sources offers
- distributions and reverse logistics
- contemporary MTS and MTO policies
- national sourcing and global delivery

Performance Based Contract for civil aviation



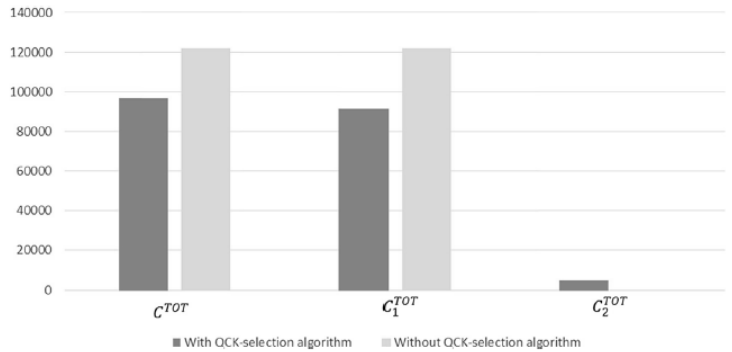


Fig. 4. Cost differences with or without the QCK-selection algorithm.

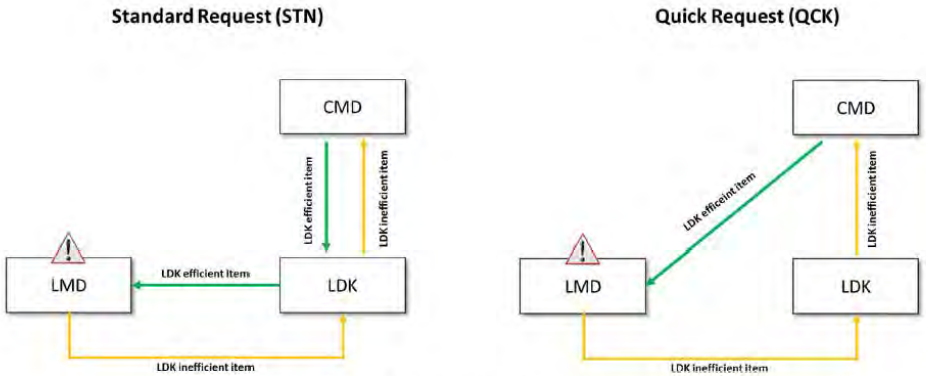
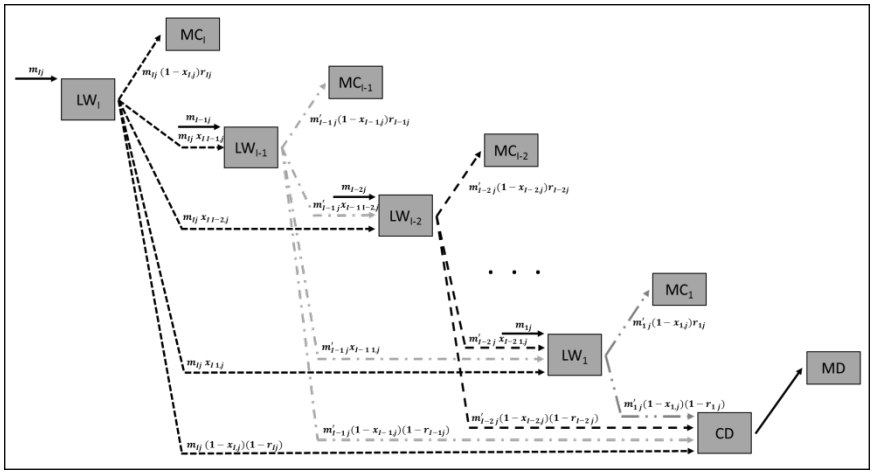
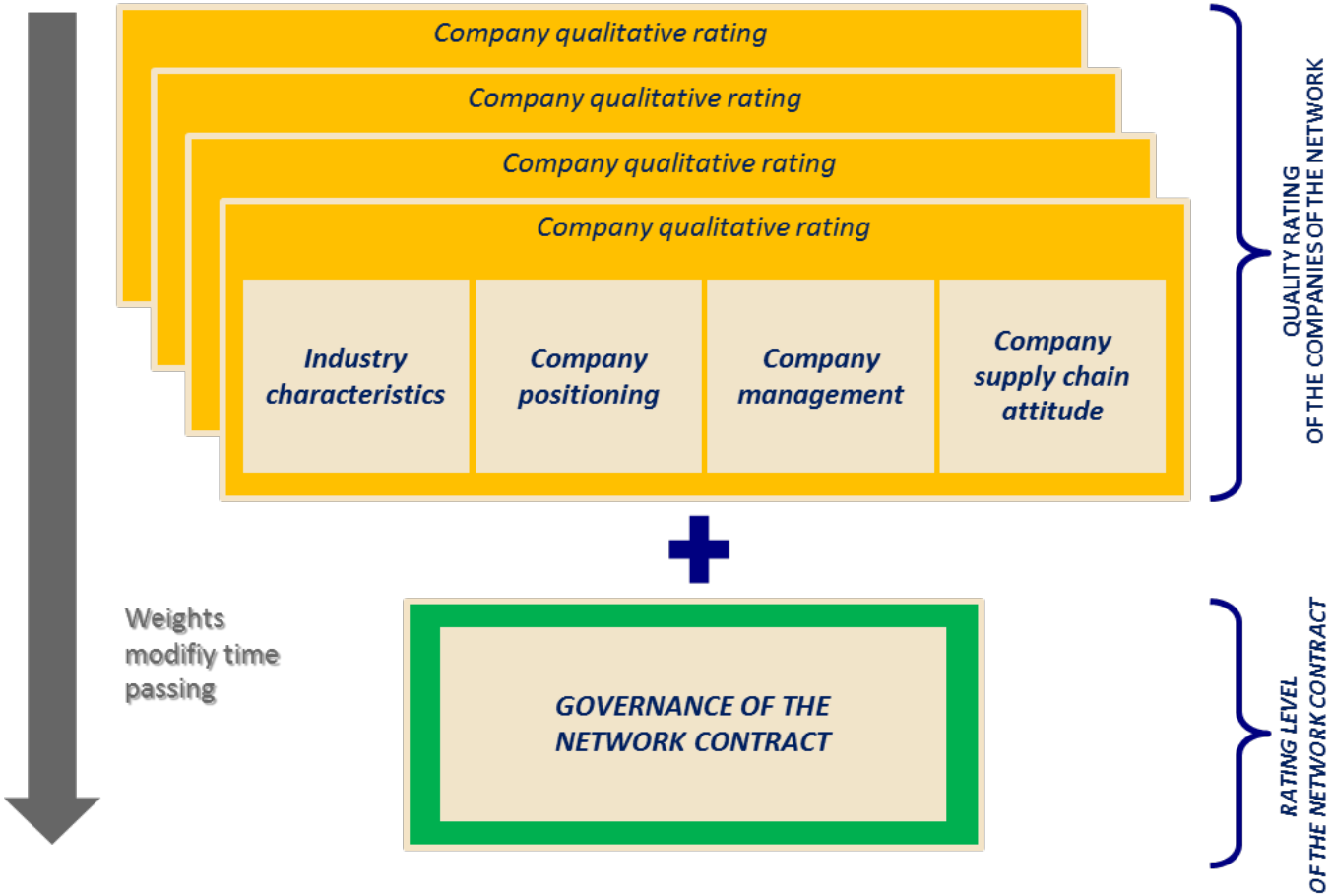


Fig. 1. The two transportation modes processes.



Recent project: PERFORMANCE MANAGEMENT

Rating of network contracts



BARCLAYS

CONFINDUSTRIA

Associazione Premio Qualità Italia

Definition of a Basilea 3 qualitative model of performance assessment to integrate bank Default Risk models. The dynamic rating evaluates extended enterprise governance and supply chain attitude of firms towards a “network contract”, combining EFQM and SCOR principles.