

An integrated method to support PSS design within the Virtual Enterprise

by

**Eugenia Marilungo, Margherita Peruzzini and
Michele Germani**

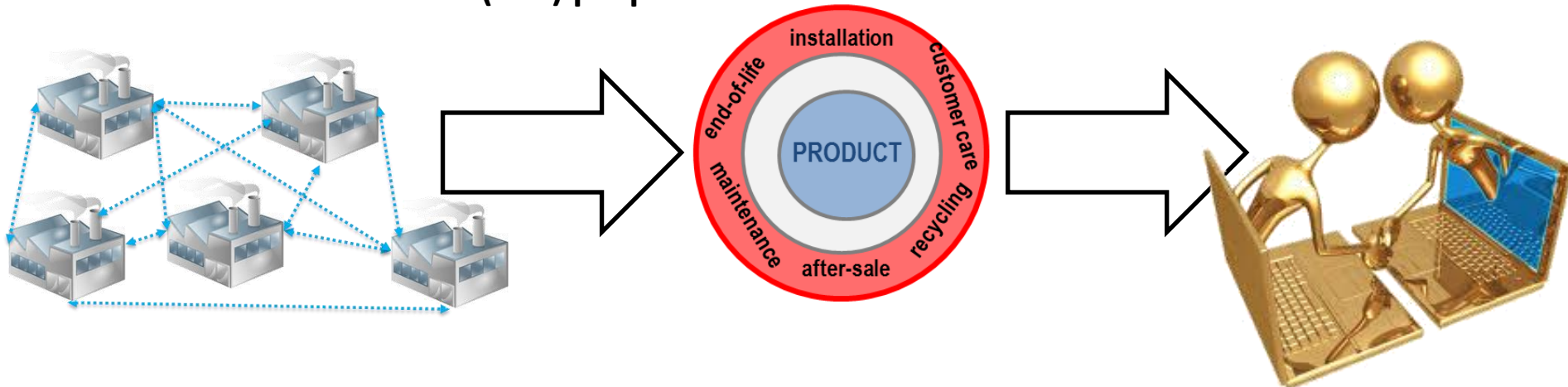
Presenting Author: Eugenia Marilungo
Università Politecnica delle Marche
Ancona, Italy
e.marilungo@pm.univpm.it

Research context

PRODUCT proposal



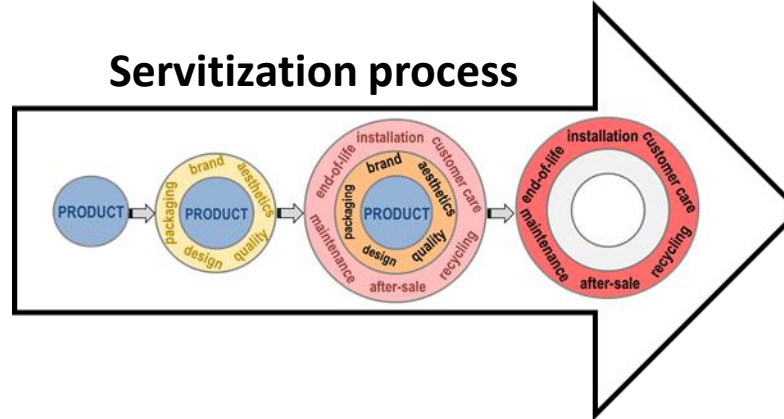
PRODUCT SERVICE SYSTEM (PSS) proposal



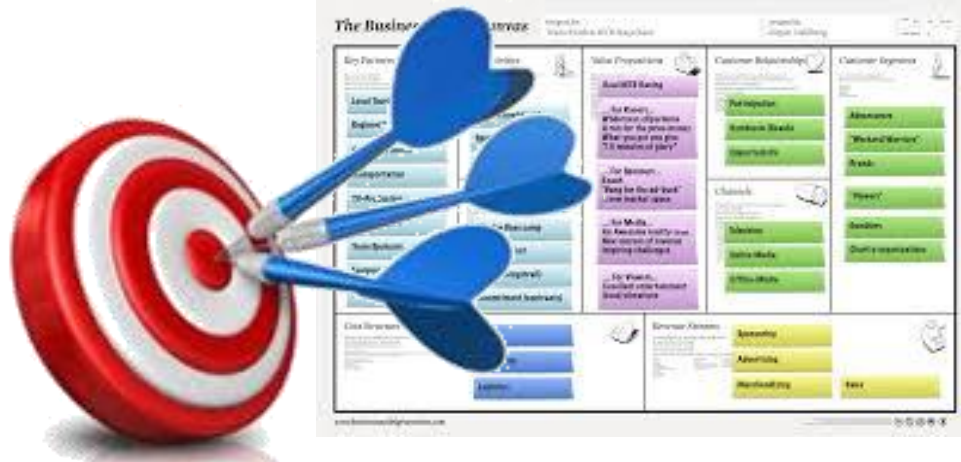
Research context



PRODUCT proposal

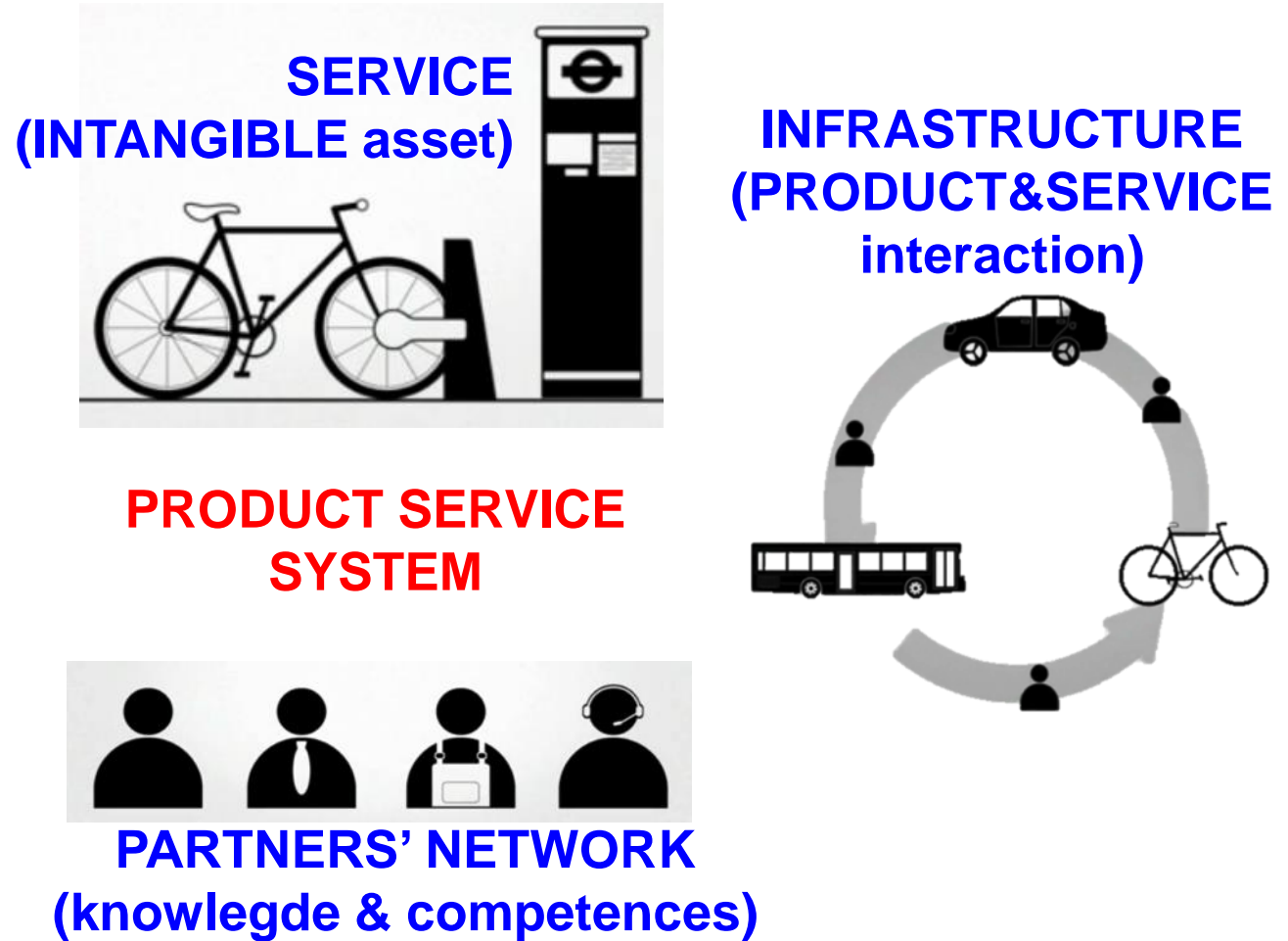


PSS proposal



VALUE PROPOSITION

Research context



PSS Design



Customer NEEDS

REQUIREMENTS ELICITATION

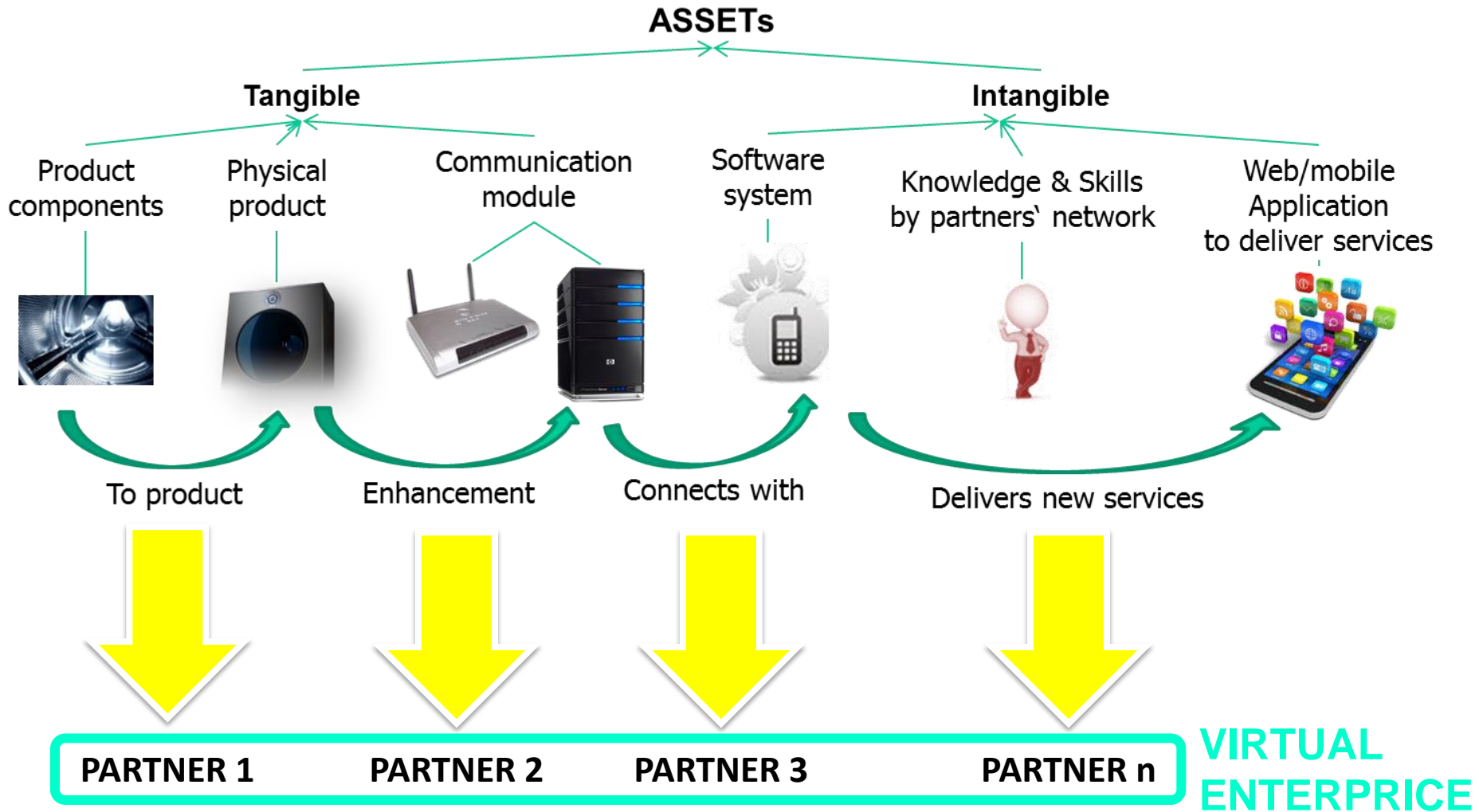
- **Design Structure Matrix (DSM):** to define PSS functionalities
- **Business Use Cases (BUC) analysis:** to define use-case model in terms of goal and interaction between actors involved
- **Serious Games:** to elicit PSS requirements
- **Quality Functional Deployment (QFD) matrixes:** to map customer needs and elicit final requirements



TECHNICAL MODELLING (UML, Petri- Nets, flowcharting, etc.):

PSS FUNCTIONALITIES

NETWORK of PARTNERS



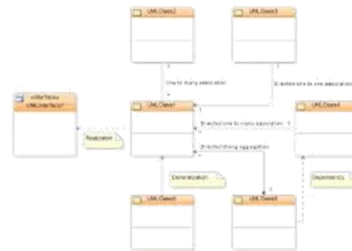
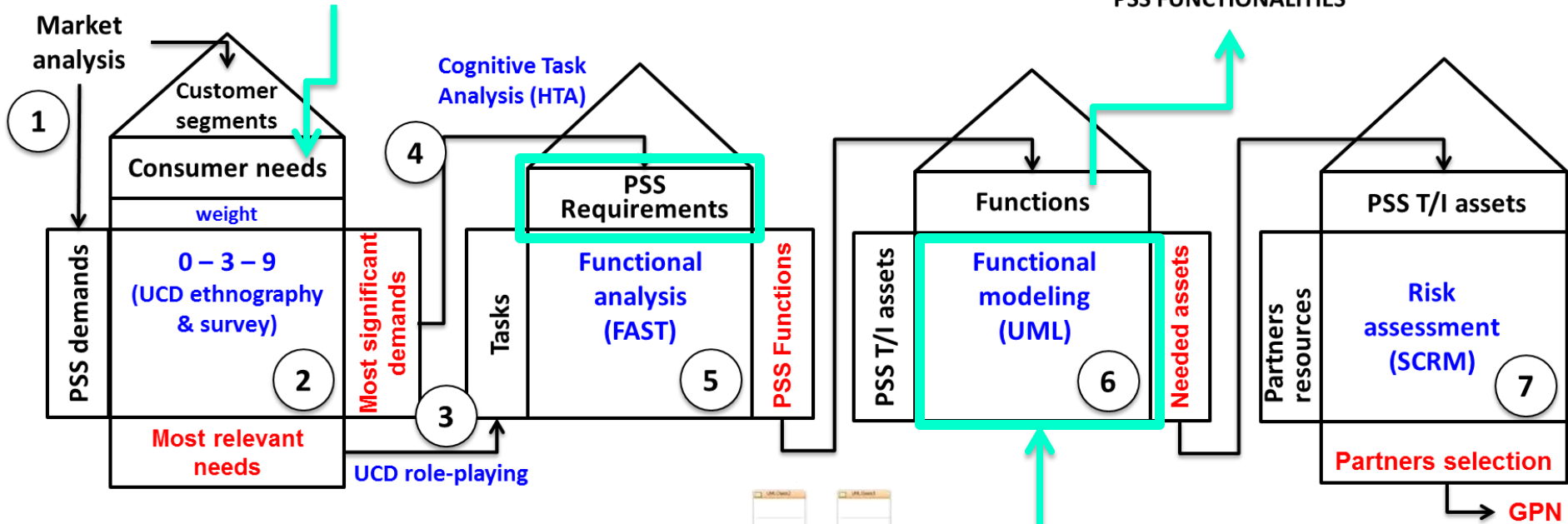
Methodology



Customer NEEDS

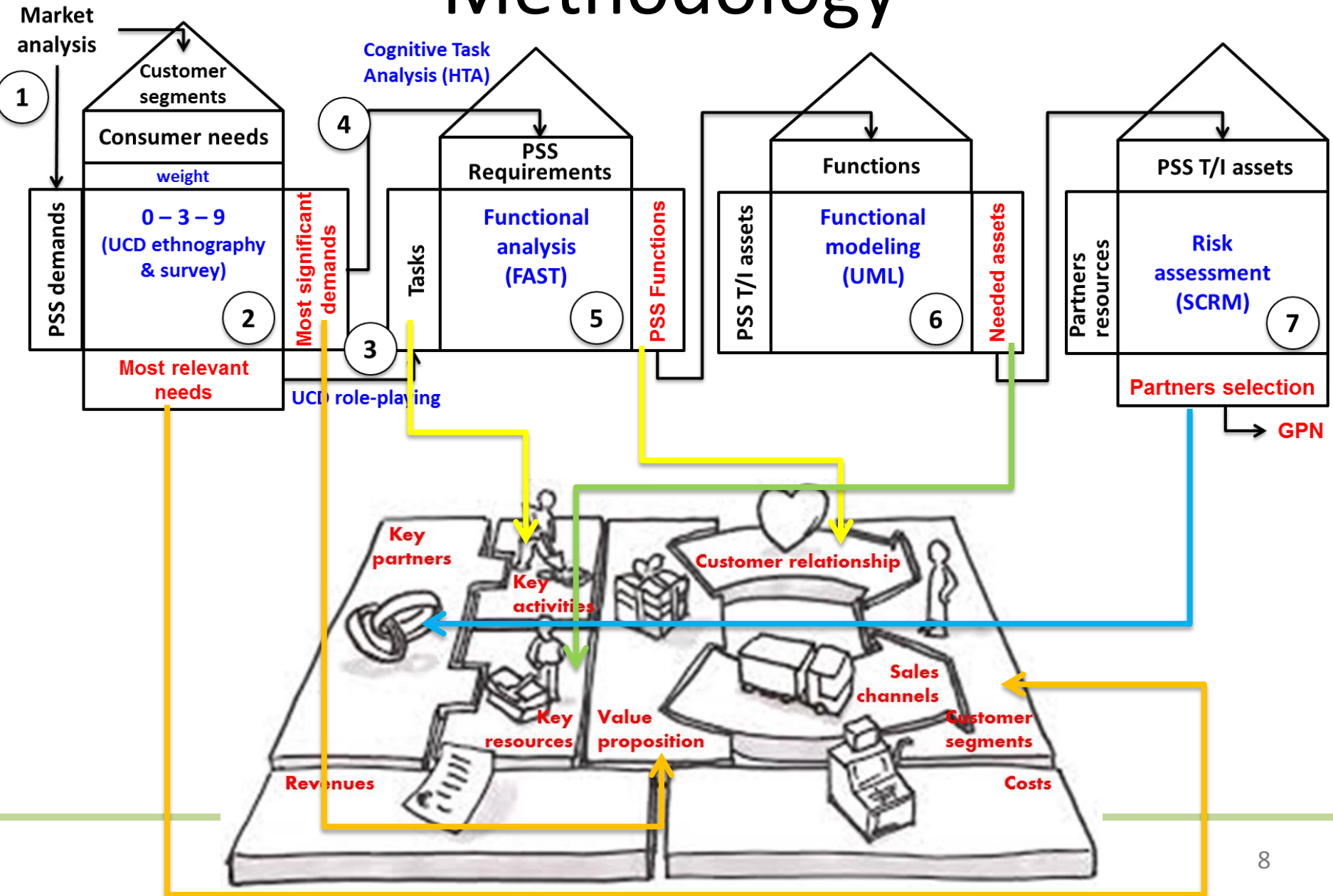


PSS FUNCTIONALITIES

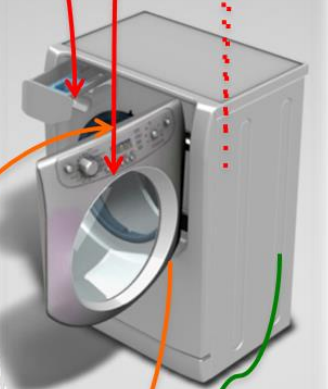
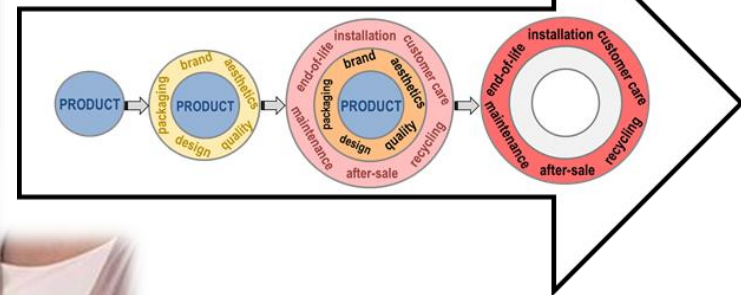


TECHNICAL MODELLING

Methodology



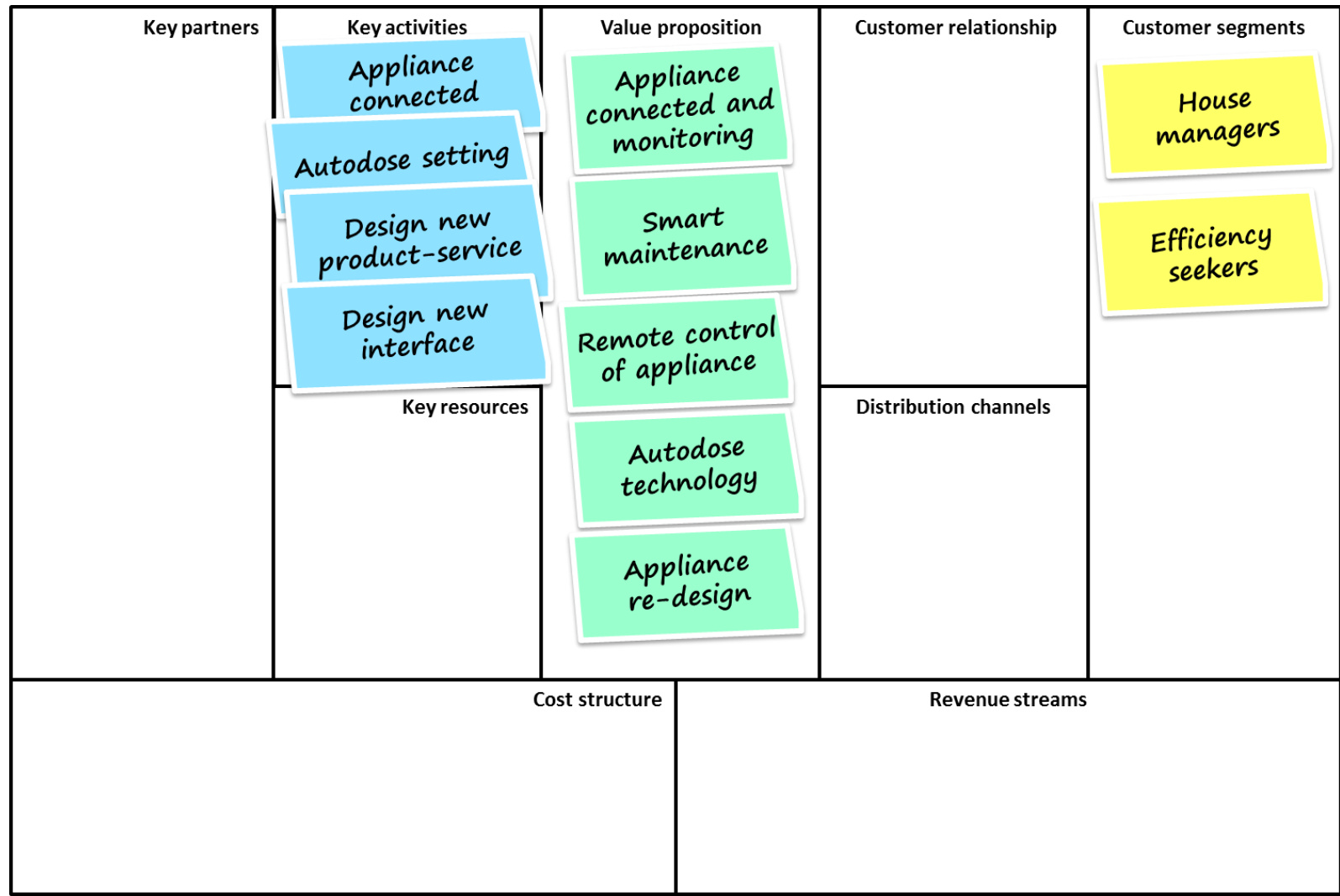
Case study



Case study

CONSUMER NEEDS	PSS DEMANDS														
	Weight	Autodose technology	WD provided of professional cycles	WD provided of led technology	New technology for treating coloured clothes	WD provided new technology for sweet wash/drying	New patented high temp. tech. for clothes anti-allergy	WD connected and monitoring	Smart maintenance	Call centre available 24-7	Appliance with smart interface	Detergents supply	Appliance with remote control	Tailored washing for each customer	MOST RELEVANT NEEDS
Clean clothes	5	9	3	4	3	3	3	1	1	0	0	9	0	0	180
Care for fibres	4	0	3	0	3	9	3	0	0	0	0	1	0	1	80
Care for colours	1	1	3	0	9	0	3	0	0	0	0	1	0	1	18
Cycles tailored on customer	4	0	3	0	3	3	3	9	3	1	0	9	3	9	184
WM able to load detergents	3	9	1	0	0	0	0	9	0	1	3	9	9	1	126
Wash at home any kind of clothes	1	1	9	0	1	3	1	0	0	1	0	1	0	3	20
High washing performance	5	9	9	1	9	9	9	1	1	1	3	1	3	9	325
High machine performance	5	9	1	3	1	1	1	9	9	3	9	0	9	0	275
New easier interface	5	0	0	9	0	0	0	3	0	1	9	0	0	3	125
Easier selection of program	3	0	0	3	0	0	0	1	0	1	9	0	0	0	42
Info. about energy consumption	3	0	0	0	0	0	0	9	0	0	0	0	9	0	54
Info. about each cycle	4	1	0	0	0	0	0	9	9	0	0	0	3	0	88
Energy and other resources efficiency	5	9	0	0	0	0	0	9	1	1	0	9	9	0	190
Balance between quality and price	4	3	3	3	3	3	3	3	3	0	3	3	3	0	132
Reliability and Durability	4	1	1	0	0	0	0	9	9	3	9	0	3	0	140
MOST SIGNIFICANT DEMANDS		229	120	106	111	128	105	292	156	53	189	176	207	107	

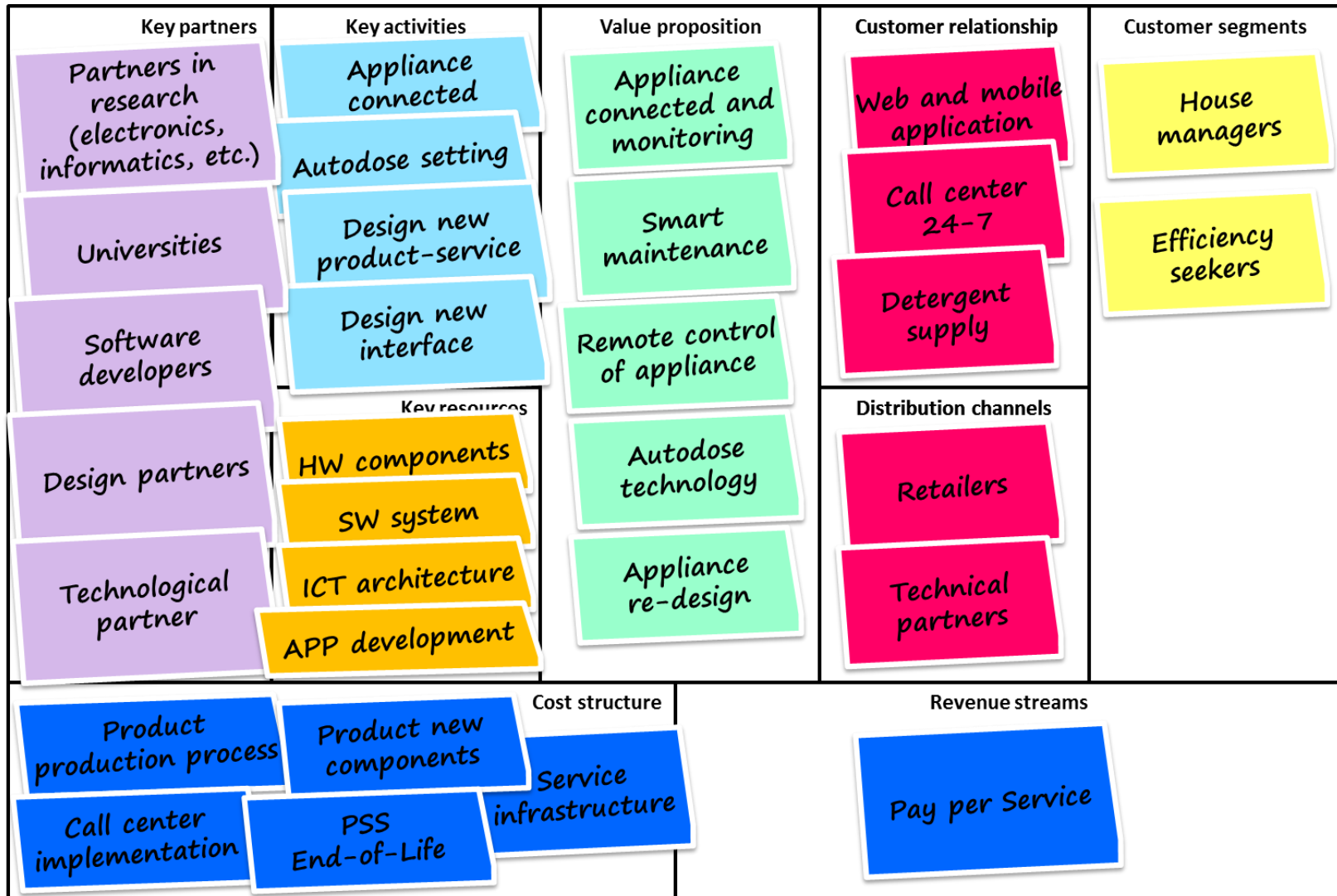
Case study



Case study

TASKS	PSS REQUIREMENTS												PARTNERS RESOURCES													
	provide autodose	provide detergent boxes for autodose	monitor WD	ICT infrastructure to connect WD	relayment	main board	DI interface	component to monitor WD by external devices	in to apply preventive maintenance	monitoring	stakeholders involvement	development	Rank	Partners in research (electronics, informatics, etc.)	Universities	Design partners	Detergent producers	Detergent providers	Energy utilities	Technological partners	Gyms and sport facilities	House builders	Smart Home providers	Software developers		
	Rank	Autodose	WD connected	WD monitoring																						
Insert clothes into													Sensors inside WD basket	4	9	3	0	0	0	0	1	0	0	0	1	
Load detergent													Sensors to monitoring WD running	4	9	3	0	0	0	0	1	0	0	0	1	
Select program													Sensors to identify detergent amount	3	9	3	0	0	0	0	1	0	0	0	1	
Use the correct program according to clothing type													Sensors to monitoring cycle's temperature	3	9	3	0	0	0	0	1	0	0	0	1	
Choose the program according to customer habits													Detergent boxes	2	0	0	9	3	3	0	0	0	0	0	0	
Control the program start													WD interface	4	1	0	9	0	0	0	3	1	1	1	3	
Use the right detergent amount per each cycle													SW system	4	3	3	1	0	0	0	0	0	0	0	9	
Use the short cycle for half load													ICT infrastructure to connect WD	4	9	9	1	0	0	0	3	0	0	0	0	
Control the program temperature													Knowledge in autodose technology	3	3	3	1	0	1	0	0	0	0	0	0	
Avoid the incorrect stop of cycle													Knowledge in machine connection and monitoring	4	9	9	1	0	0	0	3	0	0	3	1	
Use the antilimestone per each cycle													Delivery application	5	9	3	1	0	0	0	9	0	0	0	0	
Avoid more cycle with high speed													Rules to check WD status	4	1	9	0	0	0	0	9	0	0	0	1	
Clean the detergent													Rules to manage smart maintenance	5	1	9	0	0	0	0	9	0	0	0	1	
Clean the WD after 20 cycles													Rules to manage data collected	5	1	1	0	0	0	9	9	9	9	9	3	
													Rules to deliver different functionalities	3	1	1	0	0	0	9	9	9	9	9	3	
													WD components	5	0	0	9	0	0	0	0	0	0	0	0	
													KEY PARTNERS	285	239	119	6	9	72	248	76	76	88	99		
													KEY FUNCTIONALITIES	161	157	322	262	134	124	137	104	77	157	53	91	71

Case study



Conclusion

- Integrated method developed for PSS designing (**first draft**)
- **Business assessment** at the same time of design phase
- Good result by method application in the **real use case**
- **FUTURE WORKs**: dedicated tool develop



Eugenia Marilungo

DT&M Group

Department of Industrial Engineering and Mathematical Sciences (DIISM)

Polytechnic University of marche (UNIVPM)

Via Breccie Bianche 12, 60131 Ancona (ITALY)

Email: e.marilungo@pm.univpm.it