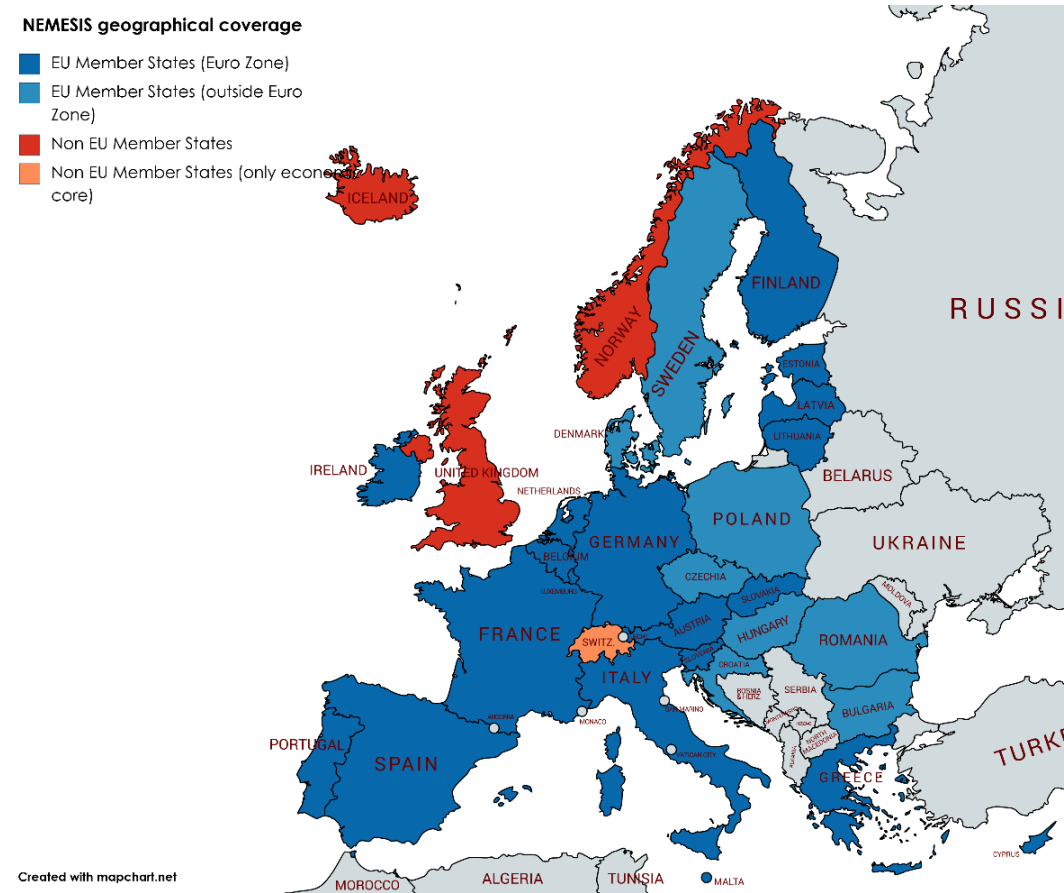# NEMESIS overview

NEMESIS is macro-econometric model for EU that covers each EU Member State individually, plus the United Kingdom, Norway, Iceland and Switzerland (only the economic core for the latter).

The rest of the world is defined through a set of assumptions according to economic development, good and services prices and exchange rates.

The model covers 30 different economic activities, 27 consumption purposes and four production factors

The model is based on the consolidated of several databases from Eurostat, OECD, WIOD, EEA, etc.

NEMESIS geographical coverage
- EU Member States (Euro Zone)
- EU Member States (outside Euro Zone)
- Non EU Member States
- Non EU Member States (only economic core)

Created with mapchart.net

NEMESIS update and Upgrade

Objectives

- Update NEMESIS and upgrade the model with a detailed representation of digital technologies and the ICT sectors

Three steps

- Update of NEMESIS in "the state of the art"

- NEMESIS for AI: Introduction of a detailed ICT module and a precise mapping of Jtag (ICT) technologies and AI

- NEMESIS for 4IR: Introduction the other WIPO digital in the preceding framework

Adds

- Introduction of green technologies with their relations with Jtag and WIPO digital ones

- Rest of the world closure of the model

1- Update of NEMESIS in the State of the Art

Current innovation mechanisms: Principles

- **Innovations come from three complementary assets:**

  - **R&D (private and public)**

  - **ICT**

  - **Other intangibles: Software/databases and training**

- **Innovations in a sector have two effects:**

  - **Increase productivity**

  - **Increase products quality**

- **Inter-sectoral dynamic indued by innovations:**

  - **Transaction goods matrices for intermediate consumptions, final consumption, investment, imports/exports**

- **Macroeconomic feedbacks from: Consumption/savings, labour market, prices**

Current innovation mechanisms: Functioning at a sectoral level
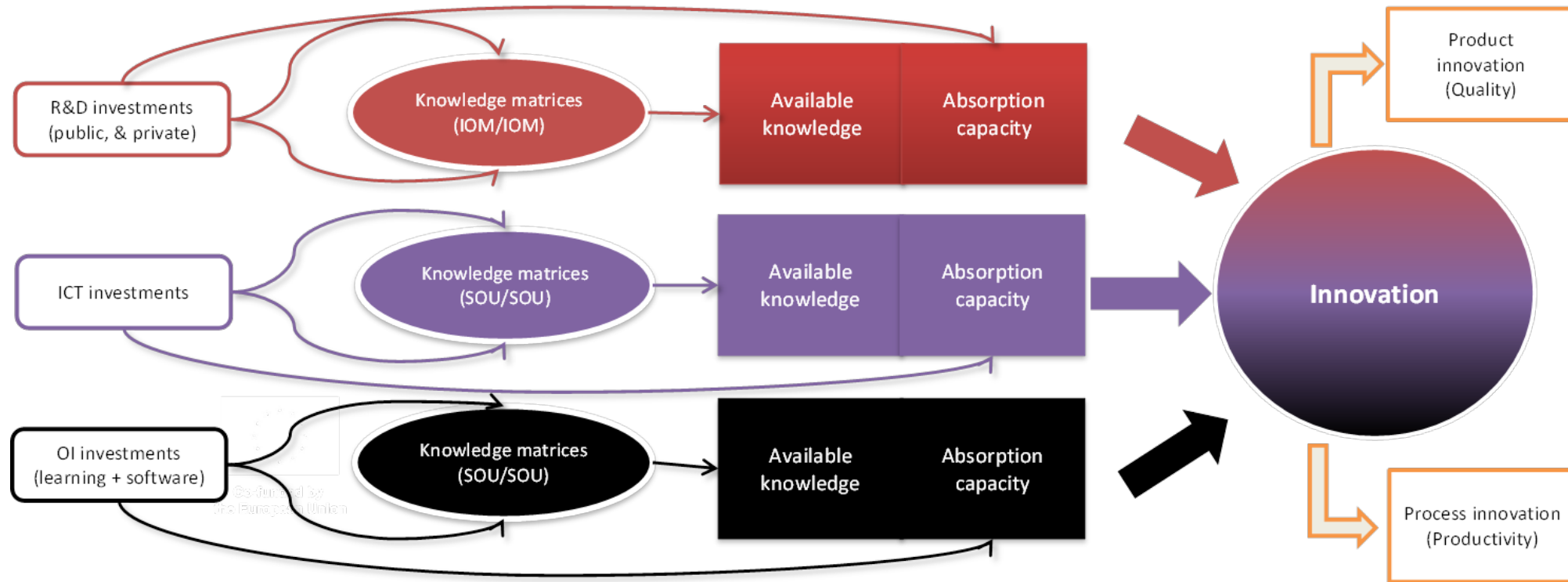
2- NEMESIS for AI

Objectives

- **Increased detail on the sectors that make the R&D investments and industrialize the ICT and AI technologies**

- **Introduce distinct knowledge matrices for the different categories of ICT technologies and for AI**

2- NEMESIS for AI

ICT sectors

- **They are defined by OECD (2007 and 2011).**

- **The definition of ICT technologies was refined by Takashi Inaba and Mariograzia Squicciarini (OECD 2017) that proposed the 13 groups of Jtags**

Technology	Technology Description	C20 Chemicals	C24 Basic metals	C262 Computers and peripheral equipment	C263 Communication equipment	C265 Instr. and appliances for measuring, testing and nav.	C27 Electrical equipment	C28 Machinery and equipment n.e.c.	C29 Motor vehicles, trailers and semi-trailers	C30 Other transport equipment	C32 Other manufacturing	J62 Computer programm., consult. and related act.
JTag_1	1. High speed network	0.04%	0.00%	5.22%	76.65%	2.69%	2.41%	2.23%	0.54%	0.12%	0.68%	1.44%
JTag_2	2. Mobile communication	0.03%	0.00%	1.46%	88.78%	2.63%	1.38%	2.15%	0.71%	0.25%	0.67%	1.32%
JTag_3	3. Security	0.10%	0.01%	32.26%	25.94%	0.70%	0.75%	16.00%	0.40%	0.09%	1.18%	21.20%
JTag_4	4. Sensor and device network	0.16%	0.02%	1.33%	34.74%	31.54%	16.67%	7.13%	1.69%	0.69%	2.33%	1.05%
JTag_5	5. High speed computing	0.01%	0.00%	85.79%	6.75%	1.32%	0.67%	1.54%	0.33%	0.07%	0.59%	1.51%
JTag_6	6. Large-capacity and high speed storage	0.27%	0.09%	32.56%	4.29%	1.36%	1.16%	34.62%	0.25%	0.08%	0.90%	1.24%
JTag_7	7. Large-capacity information analysis	0.11%	0.05%	24.28%	3.00%	2.50%	7.54%	6.39%	1.59%	0.44%	1.57%	51.88%
JTag_8	8. Cognition and meaning understanding	0.05%	0.01%	36.74%	5.00%	3.73%	1.23%	44.59%	1.29%	0.19%	3.01%	2.58%
JTag_9	9. Human-interface	0.27%	0.03%	38.25%	25.11%	1.74%	4.38%	5.32%	1.61%	0.21%	17.21%	1.16%
JTag_10	10. Imaging and sound technology	0.09%	0.01%	14.39%	56.23%	1.98%	1.73%	15.08%	0.91%	0.22%	2.48%	0.56%
JTag_11	11. Information communication device	2.83%	0.06%	9.44%	14.48%	1.95%	6.59%	4.14%	0.27%	0.06%	1.97%	0.01%
JTag_12	12. Electronic measurement	0.15%	0.02%	1.26%	4.63%	80.71%	1.74%	4.18%	1.86%	0.92%	1.75%	0.35%
JTag_13	13. Others (Computer input-output and others)	0.11%	0.02%	62.33%	4.58%	2.18%	2.16%	17.90%	0.44%	0.10%	2.02%	3.83%

2- NEMESIS for AI

Sectors that contribute to 4IR technologies

Technology	Technology Description	C20 Chemicals	C24 Basic metals	C262 Computers and peripheral equipment	C263 Communication equipment	C265 Instr. and appliances for measuring, testing and nav.	C27 Electrical equipment	C28 Machinery and equipment n.e.c.	C29 Motor vehicles, trailers and semi-trailers	C30 Other transport equipment	C32 Other manufacturing	J62 Computer programm., consult. and related act.
AI_ML	Artificial intelligence and/or Machine Learning	0.22%	0.10%	40.38%	5.53%	10.41%	3.10%	22.93%	2.21%	0.32%	6.79%	6.20%
AutonmSys	Autonomous Systems	0.53%	0.09%	1.56%	2.90%	9.03%	5.97%	22.16%	14.37%	38.19%	1.83%	0.74%
BigData	Big Data	0.57%	0.05%	35.65%	8.13%	9.22%	3.91%	12.17%	0.80%	0.31%	4.49%	19.77%
CloudComp	Cloud Computing	0.08%	0.01%	71.50%	11.02%	1.46%	0.96%	5.03%	0.25%	0.09%	1.04%	7.68%
IoT	Internet of Things	1.07%	0.07%	3.56%	29.58%	18.44%	9.41%	20.30%	1.21%	0.44%	5.87%	4.66%
Quantum	Quantum (computing, sensors, clocks)	14.03%	0.05%	13.37%	16.47%	18.02%	1.40%	0.92%	0.00%	0.05%	0.97%	0.34%
Robots	Robotics	0.14%	0.09%	0.78%	0.43%	3.80%	4.19%	67.85%	5.92%	0.63%	14.01%	0.17%
SmartCities	Smart City Technologies	0.00%	0.00%	2.33%	36.80%	8.57%	45.25%	3.55%	0.38%	0.03%	0.13%	2.11%
Blockchain	Blockchain Technologies	0.01%	0.00%	17.84%	29.24%	0.26%	0.29%	1.85%	0.10%	0.05%	0.51%	49.69%
Virt_Aug_Reality	Virtual/Augmented Reality	0.03%	0.02%	53.68%	5.56%	1.69%	0.42%	4.84%	0.44%	0.24%	24.26%	4.38%

2- NEMESIS for AI

Sectors that contribute to green technologies

Technology	Technology Description	C20 Chemicals	C24 Basic metals	C262 Computers and peripheral equipment	C263 Communication equipment	C265 Instr. and appliances for measuring, testing and nav.	C27 Electrical equipment	C28 Machinery and equipment n.e.c.	C29 Motor vehicles, trailers and semi-trailers	C30 Other transport equipment	C32 Other manufacturing	J62 Computer programm., consult. and related act.
Y02A	0. Technologies For Adaptation To Climate Change	9.35%	0.05%	0.90%	0.52%	4.73%	6.70%	57.49%	0.50%	0.76%	1.59%	0.79%
Y02B	5. Climate Change Mitigation Technologies Related To Buildings	0.84%	0.03%	0.33%	0.74%	1.12%	63.84%	27.76%	0.76%	0.14%	0.89%	0.14%
Y02C	3. Capture, Storage, Sequestration Or Disposal Of Greenhouse Gases	30.20%	0.13%	0.02%	0.12%	0.73%	0.71%	61.31%	0.29%	0.20%	0.67%	0.05%
Y02D	8. Climate Change Mitigation In I.C.T.	0.07%	0.00%	33.84%	51.13%	3.47%	1.29%	4.18%	0.33%	0.12%	0.78%	1.68%
Y02E	2. Climate Change Mitigation Technologies Related To Energy	6.03%	0.23%	0.37%	0.25%	1.66%	60.58%	16.27%	1.18%	0.54%	1.03%	0.23%
Y02P	7. Climate Change Mitigation Technologies In The Production Of Goods	13.61%	10.64%	0.93%	0.28%	6.20%	12.81%	29.35%	0.16%	0.10%	0.48%	1.76%
Y02T	4. Climate Change Mitigation Technologies Related To Transportation	1.49%	0.11%	1.47%	0.41%	1.84%	15.98%	14.87%	52.23%	7.59%	0.44%	0.36%
Y02W	6. Climate Change Mitigation in Waste Management and Wastewater Treatment	36.94%	2.39%	0.12%	0.06%	0.43%	5.23%	20.51%	0.31%	0.26%	12.09%	0.54%
Y04S	9. Power network operation, smart grid integration, and energy efficiency	0.05%	0.08%	4.13%	3.79%	15.05%	46.48%	2.41%	6.43%	0.14%	0.17%	20.51%
EvT_1_1	1.1 Environmental Management - Air Pollution Abatement	4.34%	0.32%	0.12%	0.05%	0.86%	1.17%	79.44%	9.85%	0.18%	1.30%	0.01%
EvT_1_2	1.2 Environmental Management - Water Pollution Abatement	82.48%	0.10%	0.02%	0.05%	0.54%	0.87%	12.51%	0.11%	0.68%	1.00%	0.03%
EvT_1_3	1.3 Environmental Management - Waste Management	23.54%	3.17%	0.02%	0.02%	0.19%	1.97%	45.74%	0.30%	4.04%	1.88%	0.05%
EvT_1_4	1.4 Environmental Management - Soil Remediation	80.81%	0.02%	0.01%	0.00%	0.92%	0.37%	13.90%	0.04%	0.01%	0.36%	0.05%
EvT_1_5	1.5 Environmental Management - Environmental Monitoring	0.61%	0.04%	0.48%	38.06%	13.18%	1.07%	35.77%	6.11%	0.20%	1.51%	0.31%

2- NEMESIS for AI

Adaptation of NEMESIS sectors to ICTs

Nace code	NEMESIS adaptation
	ICT manufacturing industries
C26	Manufacture of computer, electronic and optical products
C261-C262	Manufacture of electronic components, boards, computers and
C263-C264	Manufacture of communication equipment and consumer
C265-C266-	Manufacture of instruments and appliances for measuring,
C27	Manufacture of electrical equipment
	ICT services industries
J61	Telecommunications
J58	Publishing activities
J62-63	Computer programming, consultancy and related activities,
J59-60	Audiovisual and broadcasting activities

2- NEMESIS for AI

Modelling methodology investigated

1. Split of R&D data by JTag categories plus AI using patent counts

    - R&D data by NACE sectors are by "*Main activity*"

    - For each NACE sector, it will be split by technology using the work done with patent counts. A category "*Other*" will group all the technologies (patents) that are neither JTag nor AI

    - By summing all the R&D invested on a technology by the different sectors in one country/region we will have the total R&D invested by this country/region on the technology

2- NEMESIS for AI

Modelling methodology investigated

2. Create conceptual sectors for every technology.

   - For JTag technologies, the adaption by the market will take place through investments in ICT, software and database by firms, households and public sector. We will assume that the benefits in the different sectors will be proportional to their R&D contribution to the different Jtag techs

   - For AI we have not useable data on the adoption of these technologies by the different economic activities and actors so:

     - Assumption: the market of AI in each country represents a fraction of their turnover calculated as the percentage of the R&D the different sectors invest in AI over their total R&D investments.

     - The underlying assumption (to discuss) is that firms in the different sectors tend to equalize the marginal and average returns of their technologies portfolio. As for JTags, the sector benefits of AI will be proportional to their contribution to the technology in terms of R&D investments.

2- NEMESIS for AI

Modelling methodology investigated

3. Modeling of R&D knowledge externalities

    - The explicit knowledge externality between the different groups of JTags technologies, between JTags and AI techs, and between these two and all other technologies will be explicitly modeled and measured from the methodology presented in WP2

2- NEMESIS for AI

Modelling methodology investigated

4. Other aspects

- Compared to current NEMESIS model, the main difference is that a sector will not invest in only one generic technology but in a technology portfolio. The relative benefits occurring from each will be proportionated to the amount of R&D they invest in each.

- On the demand side, except for the ICT technologies (JTags) and software/database for which we will have market shares, the impacts will come from the transaction matrices and the macroeconomic feedback, as currently

- In the modelling IT and CT are consider as a whole and will be separated in the modeling as IT are the most important driver of AI adoption

3- NEMESIS for 4IR

Objective

- Introduce the other WIPO digital categories into the model

Methodology

- Same as for AI (as just presented) with the creation of (pseudo-)sectors for the different 4IR technologies

Remarks

- For some technologies, as "Robots" and "3D printing" the market share calculated in the model could be confronted to other evaluations using other approaches as in Foster, Mc Greggor, Nomaler, Verspagen (2019) using trade data.

- Frontier between, on the one hand, 4IR technologies that are related to smart and connected devices and which combine features of computing, connectivity and data exchange, and, on the other hand, JTags (computerized information) still unclear.

THANK YOU!

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