ECOS4IN
REPORT ON EXISTING INFRASTRUCTURE FOR INDUSTRY 4.0 IN EUROPE

Deliverable D.T1.1.3

Final Version
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Objectives

The deliverable synthesizes the aims of the research and scanning activities performed by the project partners, the methods used to analyze the collected information and the main results of the analysis.

1. Description of the activity

The first work package of the project aimed at providing an updated representation of the **Industry 4.0 infrastructure in Europe**, with a particular focus on the participating regions and their **ecosystems**. The representation was oriented to categorizing actors and mapping the connection among them within local industry 4.0 ecosystems. Each partner in the project had to collect data according to a shared research protocol to allow the WP leader (Ca' Foscari University of Venice) to elaborate on the information and provide the project partnership with two results:

1. An encompassing analysis of the current infrastructure for Industry 4.0 in the participating regions;

2. The data to fill the project knowledge base, to be made searchable and public in the next phases of the project.

2. Methods

To guide the collection of data by partners, the WP leader developed a protocol. Such a protocol consisted in:

1. **An explication of the main categories of the analysis**. In fact, each Industry 4.0 ecosystem had to be broken down in terms of "species" (that is the different categories of actors participating in it, for instance: universities, private research centers, companies, public institutions, and the like) and policies. Each category of actors had to be populated by those organizations that each partner believed were the most important in the region (based on prior knowledge, expertise, awareness of their activities). Then, the policy cases had to be organized in categories. Partners were required to collect data on national, regional and local policies. The WP leader also analyzed initiatives and actors also outside of the participating regions;

2. **A guide to the collection of structural data** about the regions, to make the comparative analysis informed by underlying economic, social and demographic data regarding the structure of the region;

3. **A set of templates to guide data collection** and orient the systematic analysis of the collected information.

The protocol is attached to this report for thorough consideration (Annex 1). Fig. 1 summarizes the main steps, tools and expected data.

Fig. 1: a recap of the methods

METHODOLOGY RECAP

ECONOMIC STRUCTURE	SPECIES	POLICIES
Aim: • Mapping the economic and social structure of the region • Unpacking data and figures related the current readiness of economic operators in terms of digital transformation and industry 4.0, as well as to the indicators of potential evolution. • Comparing regional data	**Aim:** • Mapping actors / institutions involved industry 4.0 / digital initiatives; • Focus on universities and education institutions; research centres/labs (private and public); technology transfer entities; consultancy firms, technology providers; public institutions	**Aim:** • Unpacking the most relevant policies and initiatives related to Industry 4.0, particularly for (not not limited to) SMEs; • Understanding the state of implementation of Industry 4.0 in the partners' regions, their receptiveness and narrative around its objectives and importance, and the results achieved.

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3. Main results

The results of the activity consist of:

1. the **compiled and organized deliverables** reporting the collected data;

2. **A presentation** given in Krakow, summarizing the results of the analysis (Annex 2);

3. The **knowledge base** (DT1.3.1), currently residing in the projects' cloud and already organized according in categories to be then interrogated via online tools made available by the project leader to the public;

4. The **present report** providing the main results of the analysis.

The depth, articulation and level of detail of the collected data cannot be exhaustively described in a synthetic report. The reader is required to consult the knowledge base to appreciate the evidence and to search for information relevant to heterogeneous uses. The present report summarizes the results of the comparative analysis that guided the following development of the Ecosystem model by the leader of the second work package.

3.1 The working definition of Industry 4.0

Mapping ecosystems insisting on technological trajectories so complex and heterogeneous might be dispersive. Thus, according to accepted definitions in literature and among practitioners, the data collection aimed at capturing actors and policies on the following pillars of Industry 4.0:

- **Cyber physical systems (CPSs)** → the "integrations of computation and physical processes.

Embedded computers and networks monitor and control the physical processes, usually with feedback loops where physical processes affect computations and vice versa." (Lee, 2008).
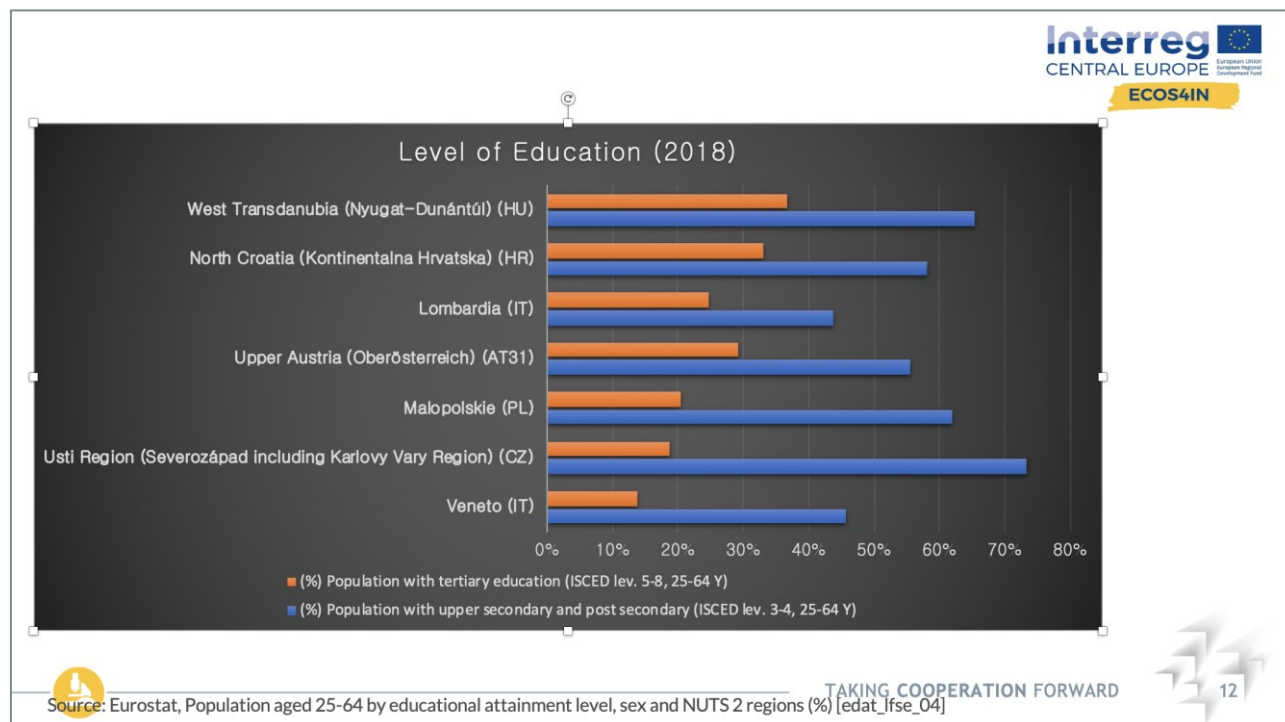
- **Internet of things (IoTs)** → considers "'things' and 'objects', such as RFID, sensors, actuators, mobile phones, which (…) interact with each other and cooperate with their neighboring 'smart' components, to reach common goals" (Giusto et al., 2010)

- **Smart factories** → combines the notions of IoTs and CPSs and by placing them inside the working space and at the core of operations.

- **Internet of services** → based on the concept that services are available through the internet so that private users and/or companies can create, combine and offer new kind of value-added services (Hofmann & Rüsch, 2017).

3.2 Structural analysis

As far as the economic indicators are concerned, the partners in the project represent different regions, with different levels of population and GDP. Such a diversity should allow the project partnership to elaborate, at the end of ECOS4IN, activities and guidelines for ecosystems in a wide variety of contexts. Lombardy and Veneto, the two Italian regions, are the larger in terms of GPD and population. Demographically the regions are quite homogeneous, with a percentage of people aged 20-34 at lower that 20 percentage points.

As far as human capital is concerned, the regions differ eminently in terms of the attainment of tertiary education credentials (see fig. 2). Two regions have 30% of the population with credentials at the tertiary level (North Croatia and West Transdanubia), while two display a percentage lower than 20 (Usti and the Veneto Region).
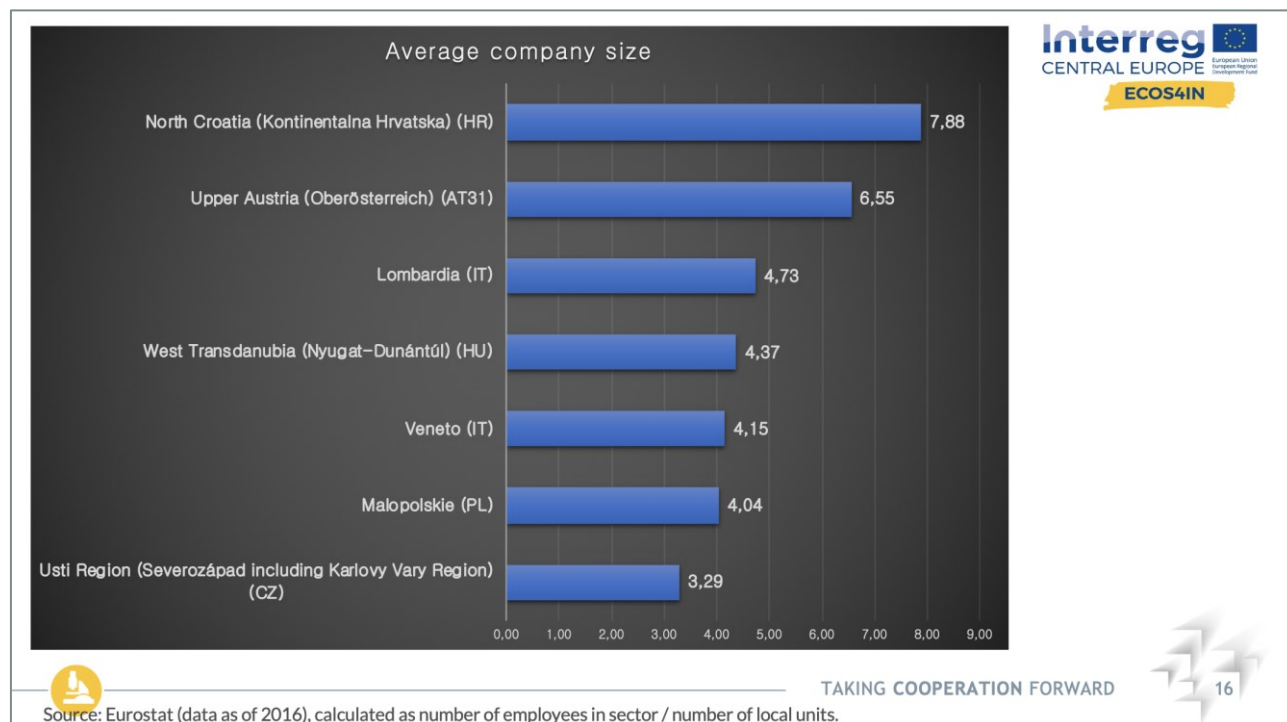
Fig. 2: educational attainment levels in the participating regions

Source: Eurostat, Population aged 25-64 by educational attainment level, sex and NUTS 2 regions (%) [edat_lfse_04]

While figures on employment are homogenous among the regions, what changes is the percentage of Human Resources employed in Science and technology, with some regions showing remarkable portions of their employed population working in Science and technology, such as Malopolskie (61%), Upper Austria (55%), North Croatia (52%).
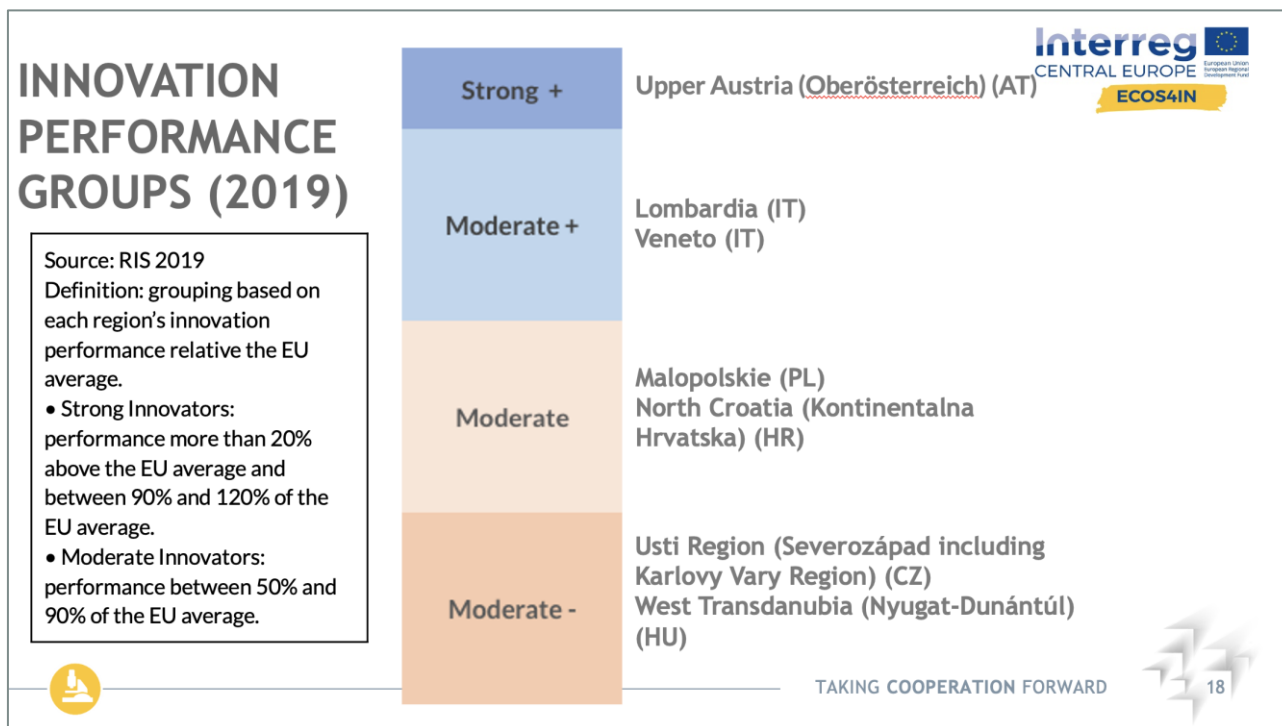
When business demography is taken into account, and beyond the obvious differences due to size, what emerges the most is the relative low number of high-growth firms in the regions. North Croatia and West Transdanubia are the two regions with the higher percentage of relatively new firm on the total organizational population, with, respectively, 7% and 6% of the total. Dimensions are those typical of regions characterized by the prevalence of small and medium size organizations (see fig. 3).

Fig. 3: average company size

Source: Eurostat (data as of 2016), calculated as number of employees in sector / number of local units.

The regions were also mapped in terms of their innovation performance based on the RIS (2019) indicators. In particular, all the regions were analyzed as to be distributed along a continuum (see fig. 4).

Fig. 4: Participating Regions' innovation performance

INNOVATION PERFORMANCE GROUPS (2019)

Source: RIS 2019
Definition: grouping based on each region's innovation performance relative the EU average.
• Strong Innovators: performance more than 20% above the EU average and between 90% and 120% of the EU average.
• Moderate Innovators: performance between 50% and 90% of the EU average.

Strong +	Upper Austria (Oberösterreich) (AT)
Moderate +	Lombardia (IT) Veneto (IT)
Moderate	Malopolskie (PL) North Croatia (Kontinentalna Hrvatska) (HR)
Moderate -	Usti Region (Severozápad including Karlovy Vary Region) (CZ) West Transdanubia (Nyugat-Dunántúl) (HU)

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3.3 Mapping the actors (species): main results

Partners mapped and categorized all the actors reputed as important in the local Industry 4.0 ecosystems. Fig. 5 provides a synthesis of the sheer number of reported organizations per each region.

Fig. 5: reported organizations

N. of reported organizations per region

Differences in the sheer number of reported organizations might be due to a variety of factors. First and foremost, obviously, the dimensions of the region; second, the results might be filtered by the evaluation of the partner. What interests the most to this analysis is the variety of actors represented in each region, vis-à-vis their numerosity. Ecosystems in the economy, in fact, thrive as those in nature thanks to diversity, co-specialization and the development of symbiotic relationships among actors providing with different resources.

Fig. 6 synthesizes the categories of actors mapped by the partners and collected in the knowledge base; fig. 7 synthesizes their distribution in each partner region

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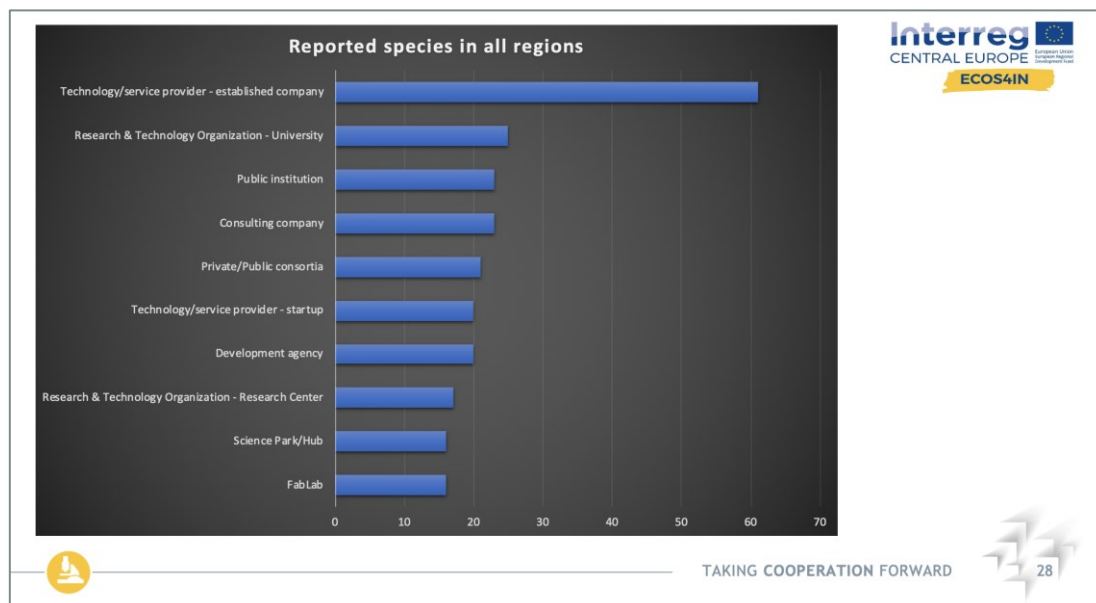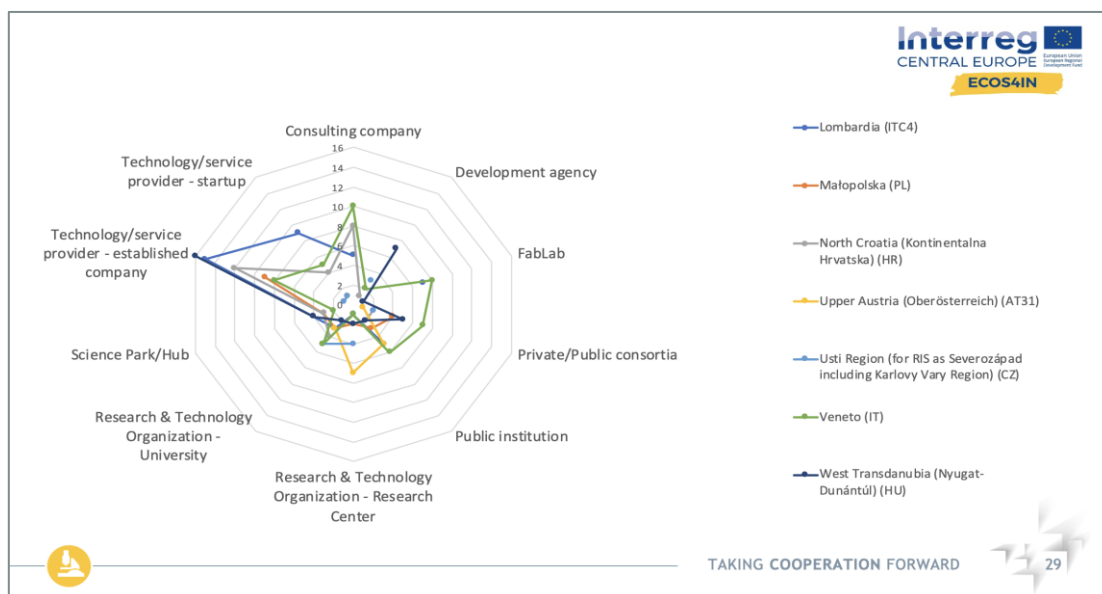*Fig. 6: Reported species in all regions*

Fig. 7: distribution in each region

Based on the results of the analysis, the Wp leader analyzed systematically the descriptions of the entities and organization mapped by each partner to single out the most relevant technologies upon which the actors are insisting. Through content analysis methods the team thus extracted a word cloud for each region, setting the thresholds to perform the cut to twenty occurrences. All the regions are quite heterogeneous in terms of represented technologies (See Annex 3 for a graphical representation of the specializations).
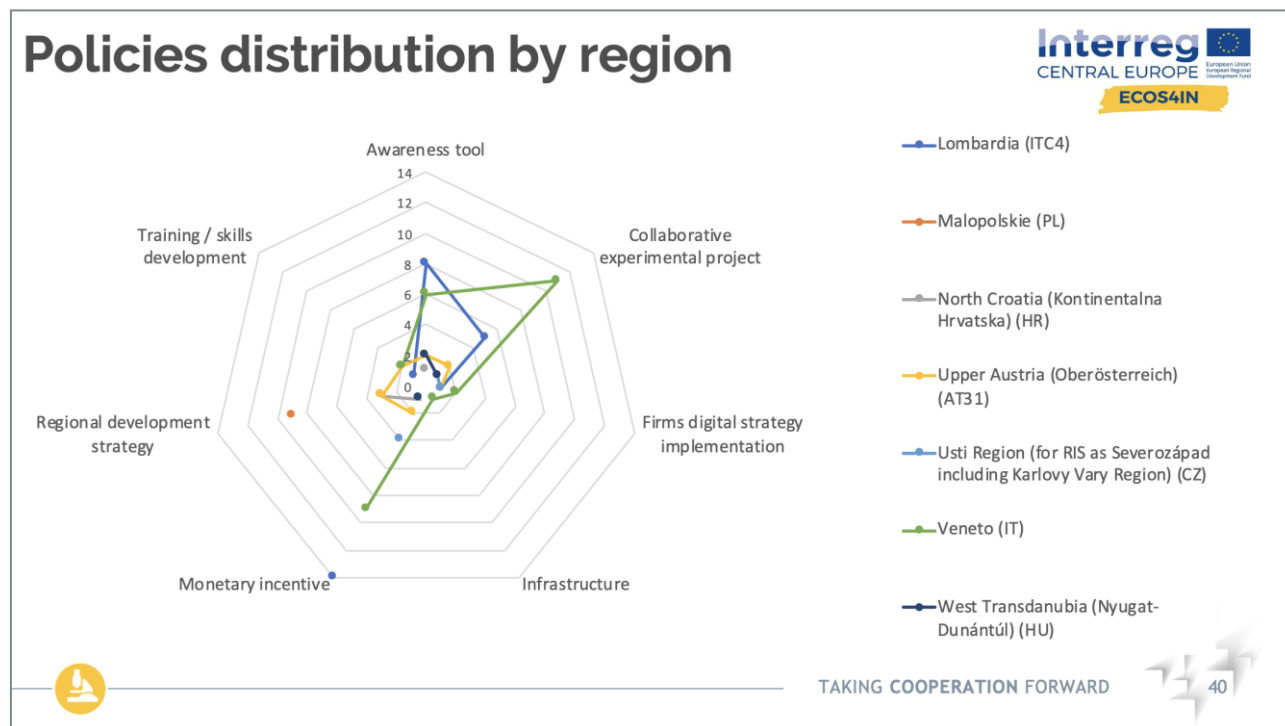
3.4 Mapping the policies

Dozens of policies were mapped, described and systematized according to the given categories in the protocol. As a result, the Wp leader proceeded to a comparative anlaysis of the initiatives put in place by public and private actors to appreciate the variety of initiatives sustaining the local ecosystems.

Policies were categorized according to the following scheme:

- Awareness tool
- Collaborative experimental project
- Firms' digital strategy implementation
- Infrastructure (e.g., connectivity)
- Monetary incentive
- Regional development strategy
- Training/skills development.

After a thorough consideration of each of the policies mapped by the partners, the Wp leader ascribed each policy to the adequate category. Fig. 8 synthesizes the representativeness of each category in the data compiled by each partner.

Fig. 8: policies distribution by region

Annexes

Annex 1: Methods (DT1.1.3_ANNEX1_Methods.DOC)
Annex 2: Krakow Final Presentation (DT1.1.3_ANNEX2_KrakowFinal PResentation)
Annex 3: Regions' technology specializations (DT1.1.3_ANNEX3_Technology specialization).

References

Giusto, D., Iera, A., Morabito, G., & Atzori, L. (Eds.). (2010). *The internet of things: 20th Tyrrhenian workshop on digital communications*. Springer Science & Business Media.
Hofmann, E., & Rüsch, M. (2017). Industry 4.0 and the current status as well as future prospects on logistics. *Computers in industry, 89,* 23-34.
Lee, E. A. (2008, May). Cyber physical systems: Design challenges. In *2008 11th IEEE International Symposium on Object and Component-Oriented Real-Time Distributed Computing (ISORC)* (pp. 363-369).