Main Industry 4.0 Initiatives in Member Countries of the OECD

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Abstract. The content of this article studies a phenomenon known as Industry 4.0, which refers to a new Industrial revolution leveraged by a set of new technologies, especially by cyber-physical systems. The main objective of this research is to obtain an overview of the state of art of Industry 4.0 initiatives among governments of the member countries of the OECD, as well as looking for the most representative architectures of development of Industry 4.0 to establish an analysis of similarities and differences between them in a subsequent investigation. These initiatives are made possible through programs either established completely by governments or by the collaboration of both public and private organizations with the objective of taking advantage of the phenomenon that Industry 4.0 supposes. The method used to identify Industry's 4.0 initiatives establishes 34 OECD member countries plus 5 in process of accession as a population and uses a standard search through conventional internet search engines based on the bibliographic study methodology, emphasizing governmental portals of economy and technology.

1. Introduction:

In a simple manner, the so-called Industry 4.0 can be referred to as the technological evolution of embedded systems to cyber-physical systems or Cyber-Physical Systems (CPS) (McDougall, 2014). Acatech in its publication Industria 4.0 Maturity Index (2017) defines Industry 4.0 as high volume of real-time data, multilateral communication, and interconnection between cyber-physical systems and people (Schuh, Anderl, Gausemeier, ten Hompel, & Wahlster, 2017). Schwab (2016) states that by creating intelligent factories, the fourth industrial revolution generates a world in which virtual and physical manufacturing systems cooperate with each other in a flexible way across the planet.

Due to the need to adapt to the new technological challenges and obtain a competitive advantage from them, the search for the correct and most effective path to migrate the different organizations public or private to an Industry 4.0 environment has been continuously intensified since the appearance of this concept.

The mission of the Organisation for Economic Co-operation and Development (OECD) is to promote policies that will improve the economic and social well-being of people around the world (Organisation for Economic Co-operation and Development, 2019). From this point of view, it is relevant and interesting to analyze the reaction of the member countries of the OECD regarding Industry 4.0 as well as to find any possible reference architectures to develop Industry 4.0 in different use cases, which would mean significant importance and effort on the part of that country.

2. Population:

39 countries have been defined as study population, 34 active member countries of the OECD and 5 countries in the process of accession making a total of 39 countries (Table 1).

3. Methodology:

To carry out the investigation, it is concluded to apply a methodology based on the documentary /bibliographic study (Bosch, 2008) adapted to this research, which is shown in figure 1. This type of study aims to collect information in a systematic and organized manner on a specific topic regarding other existing research and documents. The tools designated for this research are three of the most popular search browsers on the internet (Gil, 2019). Google, DuckDuckGo and Bing.

Table 1. *OECD member countries and y process of accession. Author's own elaboration based on OCDE, (2019).*

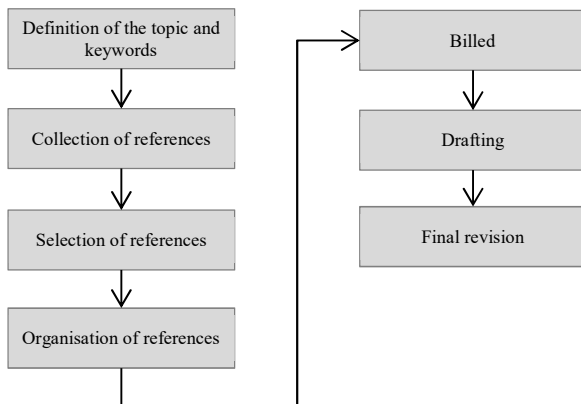| Name of the Country	Active member	In the process of accession
Australia	x	
Austria	x	
Belgium	x	
Brazil		x
Canada	x	
Chile	x	
China		x
Czech Republic	x	
Denmark	x	
Estonia	x	
Finland	x	
France	x	
Germany	x	
Greece	x	
Hungary	x	
Iceland	x	
India		x
Indonesia		x
Ireland	x	
Israel	x	
Italy	x	
Japan	x	
Korea	x	
Luxembourg	x	
Mexico	x	
Netherlands	x	
New Zealand	x	
Norway	x	
Poland	x	
Portugal	x	
Slovak Republic	x	
Slovenia	x	
South Africa		x
Spain	x	
Sweden	x	
Switzerland	x	
Turkey	x	
U.S	x	
UK	x	
∑	34	5

Figure 1. Methodology**.** Author's own elaboration based on Bosch, (2008).

3.1 Definition of the topic and Keywords

This research seeks to find Industry 4.0 government initiatives launched by member countries of the OECD. The keywords defined for this purpose are: Industry 4.0; Initiatives; Government; "Member Country of the OECD"; the population of 39 countries.

A search is generated for each member country of the OCDE (population) in every one of the three search engines. The statement is as follows in figure 2. Additionally, an advanced filter has been added to prioritize the pages that are part of the ".org" domain, which refers to non-profit organizations. Given the fact that government organizations are not for profit, this filter provides fidelity to searches.

Figure 2. Search browser structure. Author's own elaboration

3.2. Collection of References

In this stage, references extracted from web browsers are collected only taking into account the selection criteria of valid references those in which the title is related to the topic or seems to be relevant for the research. The references are limited to the first ten results that contain at least three of the four keywords which naturally are the most relevant; the results found outside of this criterion have not been taken into account. The final amount of valid references for this section is 83.

3.3. Selection of References

Each one of the references is reviewed through the analysis of abstracts, illustrations, tables or diagrams that the reference contains in order to define if it is useful for the research or not. The final amount of valid references for this section of the methodology is 29 provided the fact that these references contain relevant data for this investigation purposes according to their content, it is mainly based on whether it contains any Industry 4.0 development initiative or not. The results are shown in Table 2.

3.4. Organization of references

The useful references obtained in the previous point are organized in alphabetical order, chronological order and by area of interest.

3.5. Billed

This is a procedure in which the relevant content of the references is expressed. In this case, a description of each reference has been placed into a schema that summarizes the main aspects contents of the references.

3.6. Drafting

In this stage, an organized scheme that includes the references and their contents is developed.

3.7. Final revision

Finally, the scheme is reviewed by the author and by a colleague with knowledge of the methodology and the subject in search of various errors; in this case, it is reviewed by an IT specialist and a graduate student in engineering.

Table 2. *Industry's 4.0 initiatives by country. Author's own elaboration.*

Country	Name of Initiative
Austria	Production of the future
Austria	Austrian RTIS trategy
China	Made in China 2025
Czech Republic	National Initiative Industry 4.0
Finland	Vocational Education and Training in the Working World 4.0
France	Alliance Industrie du Future
France	Shared Action Plan
Germany	Industrrie 4.0 Plattform
Germany	Industry 4.0
Germany	NEW 4.0
Germany	Vocational Education and Training in the Working World 4.0
Germany	Digital Strategy 2025
Germany	Shared Action Plan
Indonesia	Making indonesia 4.0
Israel	Start-Up Nation Central
Italy	Piano nazionale Impresa 4.0
Italy	Vocational Education and Training in the Working World 4.0
Italy	Shared Action Plan
Japan	Industrial value Chain Initiative (IVI)
Korea	I-KOREA 4.0
Netherlands	Vocational Education and Training in the Working World 4.0
Poland	Vocational Education and Training in the Working World 4.0
South Africa	4IRSA
Spain	Industria Conectada 4.0
Spain	Vocational Education and Training in the Working World 4.0
Sweden	Vocational Education and Training in the Working World 4.0
Sweden	Made in sweden 2030
Switzerland	Vocational Education and Training in the Working World 4.0
U.S	Industrial Internet Consortium

4. Results.

The final table which is the resulting summary of the methodology is shown in Table 3.

As well, in Figure 3 it can be seen the total amount of initiatives by country in which the top is composed of Germany in the first place followed by Italy and four other countries with 2 initiatives per country.

In Figure 4, the release dates of the initiatives are expressed through a chart in which the major amount of initiatives was launched between the years 2016 and 2017. The most recurring type of sponsorship was of public origin with 21 of the initiatives which mean about 72% of the total, as can be seen in the chart of Figure 5.
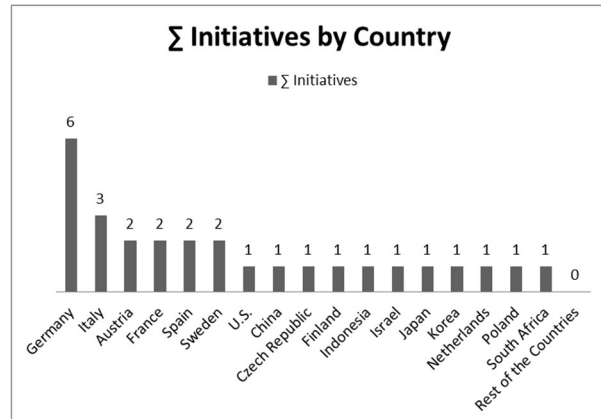

Figure 3. Amount of Initiatives by country. Author's own elaboration.
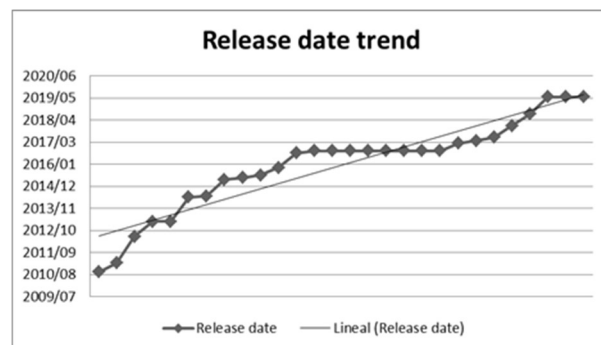

Figure 4. The trend of initiative's releases. Author's own elaboration.


Figure 5. Type of sponsorship. Author's own elaboration

Given the fact that some countries congregate more than one initiative, the total amount of initiatives can be found into 16 different countries, it means 41% of a population of 39, the rest of the member countries of the OECD have any kind of Industry 4.0 Initiative (Figure 6).

Table 3. Data collection Summary.

Country	Name of Initiative	Release date	Sponsorship	Relevant content / Objective
Austria	Production of the future	2012/07	Public	Aims to keep the manufacturing industry in Austria and to make it fit for the future.
Austria	Austrian RTI Strategy	2011/03	Public	"Realising Potential, Increasing Dynamics, Creating the Future: Becoming an Innovation Leader", the strategy addresses measures to strengthen national research structures with a focus on excellence, to foster the innovative capacity of companies, allow for thematic priority setting, raise the efficiency of governance, and link research, technology and innovation to the education system.
China	Made in China 2025	2015/05	Public	To comprehensively upgrade Chinese industry. The initiative draws direct inspiration from Germany's "Industry 4.0" plan.
Czech Republic	National Initiative Industry 4.0	2016/08	Public	To guarantee a strategic approach to the challenges of Industry 4.0.
Finland	Vocational Education and Training in the Working World 4.0	2016/10	Public	The project VET 4.0 deals with the impacts of the fourth industrial revolution on future working processes and on the competence requirements in a technical, organizational and social perspective in the fields of electronics and mechatronics.
France	Alliance Industrie du Future	2015/07	Public and private	To support French companies and, in particular, SMEs in the modernization of their industrial tools and the transformation of their business models through new digital and non-digital technologies.
France	Shared Action Plan	2019/06	Public and private	Roadmap for trilateral cooperation on Digitizing the Manufacturing Industry between (France, Germany and Italy).
Germany	Industrrie 4.0 Plattform	2013/04	Public and private	Germany's central network for driving forward digitalization in manufacturing.
Germany	Industry 4.0	2010/10	Public	One of the furure projects in the Action Plan "High - tech strategy 2020".
Germany	NEW 4.0	2015/12	Public	A unique project initiative in Hamburg and Schleswig-Holstein combining the forces of business, science and politics.
Germany	Vocational Education and Training in the Working World 4.0	2016/10	Public	The project VET 4.0 deals with the impacts of the fourth industrial revolution on future working processes and on the competence requirements in a technical, organizational and social perspective in the fields of electronics and mechatronics.
Germany	Digital Strategy 2025	2017/04	Public	I. Growth and Employment // II. Regulatory framework // III. Strengthen trust and security
Germany	Shared Action Plan	2019/06	Public and private	Roadmap for trilateral cooperation on Digitizing the Manufacturing Industry between (France, Germany and Italy).
Indonesia	Making indonesia 4.0	2018/07	Public	An integrated roadmap to implement a number of strategies to enter the Industry 4.0 era.
Israel	Start-Up Nation Central	2014/07	Public	Not defined
Italy	Piano nazionale Impresa 4.0	2017/02	Public and private	Aims to operate in a logic of technological neutrality for companies.
Italy	Vocational Education and Training in the Working World 4.0	2016/10	Public	Intervene with horizontal and non-vertical or sectoral actions among education.
Italy	Shared Action Plan	2019/06	Public and private	Roadmap for trilateral cooperation on Digitizing the Manufacturing Industry between (France, Germany and Italy).
Japan	Industrial value Chain Initiative (IVI)	2015/06	Public and private	The Industrial Value Chain Initiative (IVI) is a forum to design a new society by combining manufacturing and information technologies, and for all enterprises to take an initiative collaboratively.
Korea	I-KOREA 4.0	2018/01	Public	This initiative is the Moon Administration's grand S&T strategy or policy direction to meet the 4th Industrial Revolution.
Netherlands	Vocational Education and Training in the Working World 4.0	2016/10	Public	Enhancing interactions with general public in promoting and implementing S&T policies.
Poland	Vocational Education and Training in the Working World 4.0	2016/10	Public	The project VET 4.0 deals with the impacts of the fourth industrial revolution on future working processes and on the competence requirements in a technical, organizational and social perspective in the fields of electronics and mechatronics.
South Africa	4IRSA	Not defined	Public	4IRSA is a platform that creates space for stimulating dialogue, understanding and action to shape a coherent 4IR plan for South Africa.
Spain	Industria Conectada 4.0	2014/06	Public	The Idustria Conectada 4.0 initiative has been launched to promote the digital transformation of Spanish industry through the joint and coordinated action of the public and private sectors.
Spain	Vocational Education and Training in the Working World 4.0	2016/10	Public	The project VET 4.0 deals with the impacts of the fourth industrial revolution on future working processes and on the competence requirements in a technical, organizational and social perspective in the fields of electronics and mechatronics.
Sweden	Vocational Education and Training in the Working World 4.0	2016/10	Public	The project VET 4.0 deals with the impacts of the fourth industrial revolution on future working processes and on the competence requirements in a technical, organizational and social perspective in the fields of electronics and mechatronics.
Sweden	Made in sweden 2030	2017/06	Public and private	This strategic research and innovation agenda is proposing a new vision for production in Sweden 2030 and recommending long term efforts that are necessary to strengthen innovation, development and production of goods and services in Sweden.
Switzerland	Vocational Education and Training in the Working World 4.0	2016/10	Public	The project VET 4.0 deals with the impacts of the fourth industrial revolution on future working processes and on the competence requirements in a technical, organizational and social perspective in the fields of electronics and mechatronics.
U.S	Industrial Internet Consortium	2013/04	Public	To deliver a trustworthy IIoT in which the world's systems and devices are securely connected and controlled to deliver transformational outcomes.

Source. Author's own elaboration.
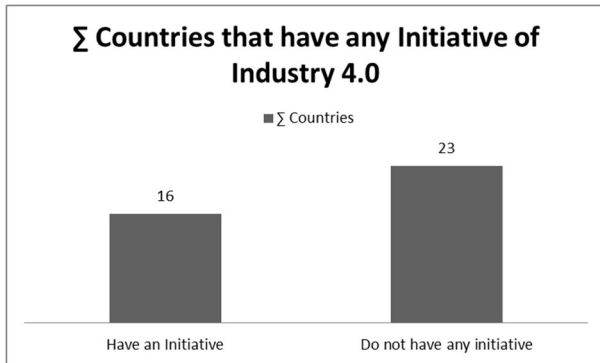
Figure 6. The number of countries with an Industry 4.0 initiative. Author's own elaboration.
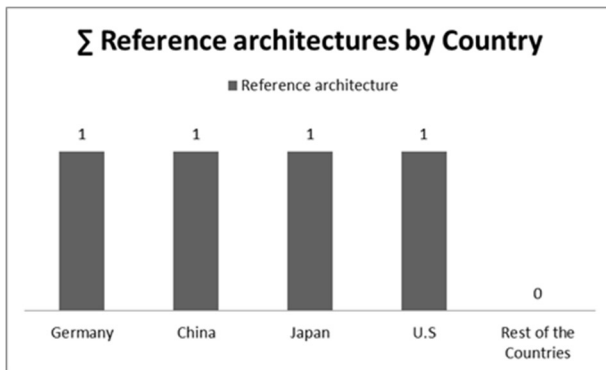
Figure 7. Countries that have reference architecture. Author's own elaboration.

Only 4 out of 39 OECD countries count with a reference architecture (model) to develop Industry 4.0 along with the organizations and enterprises. The names of this architectures are placed below:

- RAMI: Reference Architecture Model Industria 4.0 (Germany)
- IIRA: Industrial Internet Reference Architecture (U.S.)
- IVRA: Industrial Value Chain Reference Architecture (Japan)
- IMSA: Intelligent Manufacturing System Architecture (China)

7. Discussions.

It is clear that within the OECD member countries the trend revolves around the development of the new stage of Industrial development called "Industry 4.0" specially between 2016 and 2017, however much remains to be done regarding the findings, for example, about the fact that less than half of these countries do not have any industry 4.0 development initiative.

It is not unexpected that Germany being the pioneer country in the topic has the largest number of Industry 4.0 initiatives; on the other hand, it is unexpected that the United States does not have many initiatives of this origin. From the point of view of this author, this is due to the fact that said country avoids naming any related work to the term Industry 4.0 since in the reality the development and technological push are of great magnitude in that country.

Approximately three-quarters of the initiatives found are primarily sponsored by public entities belonging to the government, this is clear proof that Industry 4.0 is very attractive for the economic development of nations.

A fundamental element in the development of organizations towards Industry 4.0 is the use of methodological tools that guide action in the different real-world use cases. In this regard, four countries: Germany, The United States, Japan, and China have developed Architectures of reference of the precepts that represent industry 4.0, this is especially important in addition to providing a topic of analysis between different technological perspectives.

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