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"From Global Indicators to Local Applications"

#STI2022GRX

Poster

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Industry 4.0: Spanish patents of the largest technology companies¹

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Introduction

Industry 4.0 is a relatively recent concept, but it refers to advances developed in recent decades and profoundly changing the productive world. First coined at the 2011 Hannover Industrial Technology Fair, it is known as the Fourth Industrial Revolution or simply 4IR. The term revolution is perhaps very categorical, but the changes that the productive world is experiencing may be a revolution that conditions the future of societies in the medium term (Heiner et al., 2014).

There is no doubt that the countries are trying to have a good position in this new context through technological initiatives that do not always bear fruit. There are the largest technology companies interested in preserving the intellectual property of their constant innovation. These companies are powerful, and not only patent in their country of origin or the big offices in the United States (USPTO), Europe (EPO), or the world (WIPO), but also have the muscle to do it country by country. This paper will see which big technology companies patent in Spain and if they have any relationship with their global patenting capacity.

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Methods

Defining the scope of the 4IR concept is quite complex. However, it seems that many authors broadly agree to include within it smart factories, the Internet of Things (IoT), where there are some of the few patent studies (Trappey et al., 2017), cloud computing, blockchain (Clarke et al., 2020), cyber-physical systems, big data, and advanced manufacturing, which includes robotics and professional 3D printing, among many others.

Searching for this domain in bibliographic databases (i.e., WOS or Scopus) is difficult because only the words of the title/abstract/keywords are available (Cobo et al., 2018). In contrast, we also have a very complex and detailed classification system in patent databases: the Cooperative Patent Classification (CPC), which totals more than 250,000 entries (Jürgens & Herrero, 2017).

The EPO has exploited this classification to create a multidimensional Thematic System to identify the 4IR (Ménière et al., 2017). They identify three dimensions (core technology fields, enabling technology fields, and technology fields in applications domains) which are further subdivided into a total of 16 domains that are identified with 326 CPC code ranges chosen by EPO reviewers. Full details of the method can be found in the dataset 4IR-method.xlsx.

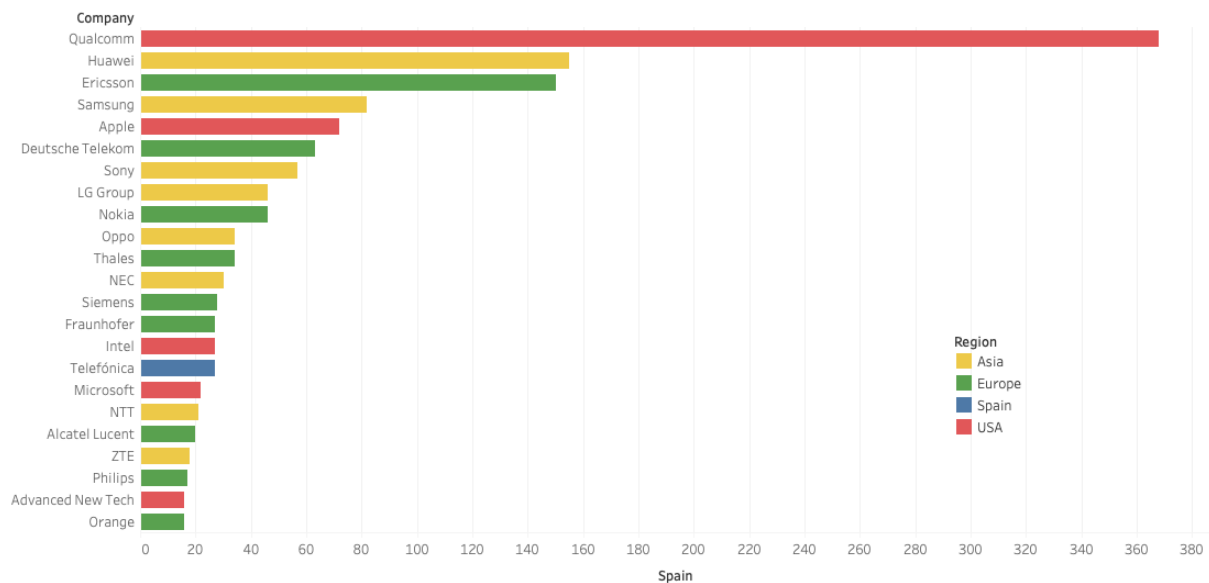
The Questel Orbit Intelligence database was used. This database was chosen because it has the most search options (Pires et al., 2020). It was also limited to all patents applied for and published in Spain. Patents with a first priority date from 2010 and up to 2021 were chosen.

Discussion and conclusion

A total of 2555 records were found, placing Spain in 15th position in the world, led by China and the USA, while Europe is in a discreet second place. European companies are mixed with Asian and US companies to a lesser extent. All three companies are heavily involved in the 5G technologies field. Figure 1 shows companies with at least 15 patents, where Qualcomm stands out, followed by Huawei and Ericsson. All three companies are heavily involved in the 5G technologies field.

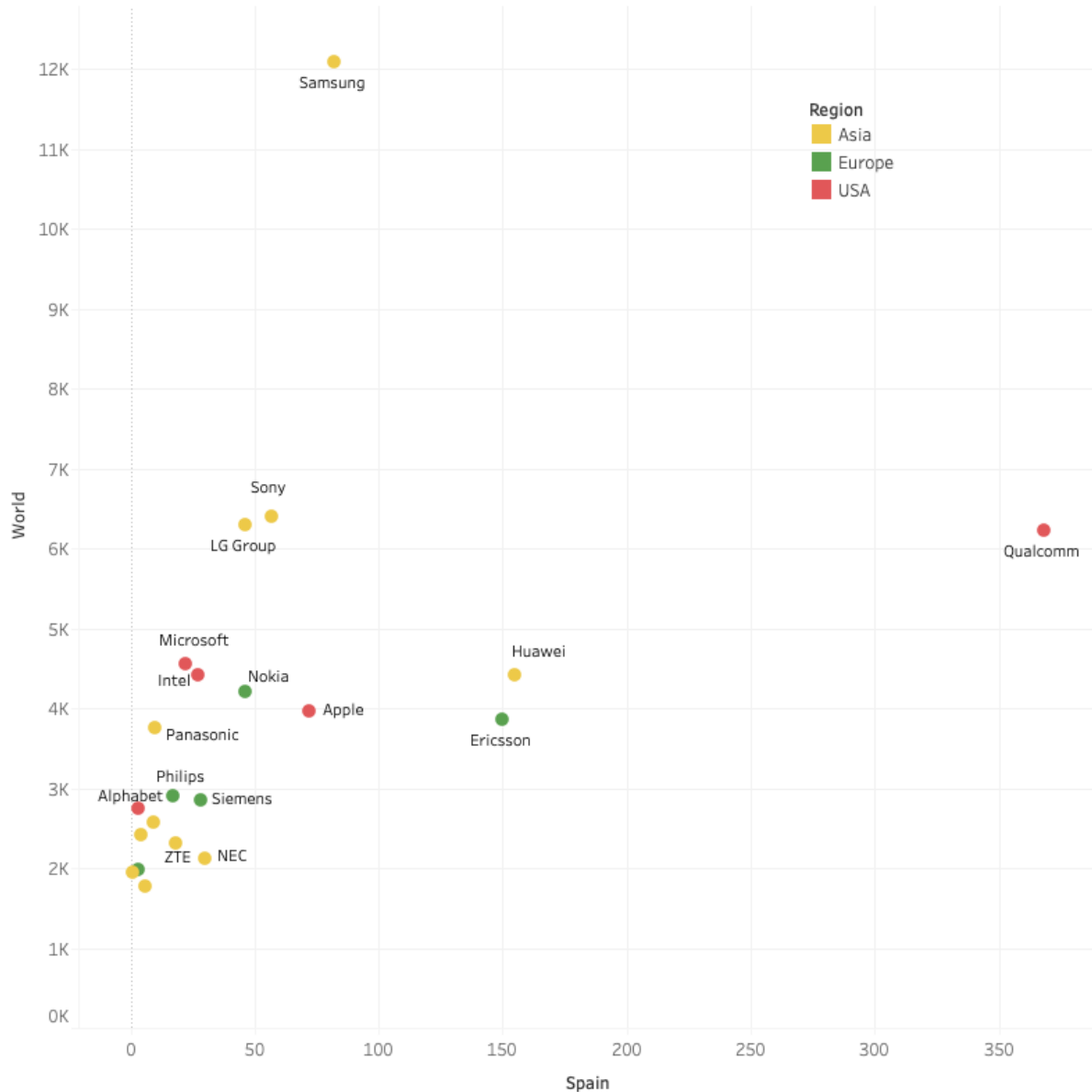
Most of these companies are technology companies specialized in microprocessors, computers, and telecommunications. Only one is not a company: the well-known German research institution Fraunhofer-Gesellschaft (mp3 developers). The only Spanish company in this ranking is Telefónica.

Figure 1. 4IR patents in Spain. Source: Orbit Intelligence



Although most companies are widely known, how important are they worldwide? Is there a relationship between their Spanish patents and their worldwide patents? For this purpose, we have constructed the chart in Figure 2, with the above information and the ranking of the 25 worldwide most essential companies by 4IR patenting in the last two decades made by the EPO (Ménieré et al., 2020).

Figure 2. 4IR patents Spain vs. World. Source: Orbit Intelligence & EPO



The first thing that stands out in the chart is the position of Qualcomm and Samsung (Korea). As shown in Figure 1, Qualcomm is the leader in Spanish patents, although it is not the world leader. The opposite is true for Samsung, the world leader with more than twice as many patents but very little presence in Spain. Then there are LG Group (Korea) and Sony (Japan), which have a world position like Qualcomm (more than 6k) and similar to Samsung in Spain. There are seven companies between 3k and 5k, but only Huawei and Ericsson stand out in Spain, as mentioned above. Below 3k, two European companies and one American, Alphabet, we thought we would find a little higher in the world ranking. As it appears, autonomous driving has not yet created many patents.

Samsung is the leader in 4IR patents and technology patents in general. Samsung Electronics alone has more than 255k patents in total, but if we add all the subsidiaries, it reaches a little less than 380k. There is little interest in Spain, with so many patents globally, which must have been covered with its EPO patents. The only European patent office that seems to take it seriously is the German one (DPMA).

Of the three companies that seem to pay attention to the Spanish office, we can only say that they are in the middle of the global war on 5G. The 5G battlefield leads companies to be very careful and cover their intellectual property even in small offices such as the OEPM. Huawei is the company that has taken the lead but is being censored by the USA. The only company with a comprehensive option for 5G (outside Huawei) is the European Ericsson. Apart from the political war over 5G, it must be remembered that Qualcomm has had an intense legal fight for patents with giants such as Intel or Apple in recent years. What is truly curious is that the European country where Qualcomm has the most patents is Spain.

References

- Clarke, N., Jürgens, B. & Herrero-Solana, V. (2020). Blockchain patent landscaping: An expert based methodology and search query. *World Patent Information*, 61. <https://doi.org/10.1016/j.wpi.2020.101964>
- Cobo, M., Jürgens, B., Herrero-Solana, V., Martínez Sánchez, M., & Herrera-Viedma, E. (2018). Industry 4.0: a perspective based on bibliometric analysis. *Procedia Computer Science* 139:364–371. <https://doi.org/10.1016/j.procs.2018.10.278>
- Heiner, L., Fettke, P., Kemper, H., Feld, T. & Hoffmann, M. (2014). Industry 4.0. *Business & Information Systems Engineering*. 6:239–242. <https://doi.org/10.1007/s12599-014-0334-4>
- Jürgens B. & Herrero-Solana, V. (2017). Monitoring nanotechnology using patent classifications: An overview and comparison of nanotechnology classifications schemes. *Journal of Nanoparticle Research*, 19(151). <https://doi.org/10.1007/s11051-017-3838-2>
- Ménière, Y., Rudyk, I. & Valdes, J. (2017). Patents and the Fourth Industrial Revolution: the inventions behind digital transformation. <http://epo.org/4IR>
- Ménière, Y., Philpott, J., Pose-Rodríguez, J., Rudyk, I., Wewege, S. & Wienold, N. (2020). *Patents and the Fourth Industrial Revolution: The global technology trends enabling the data-driven economy*. Munich : European Patent Office. <http://epo.org/trends-4IR>
- Pires, E., Ribeiro, N. & Quitella, C. (2020). Sistemas de Busca de Patentes: análise comparativa entre Espacenet, Patentscope, Google Patents, Lens, Derwent Innovation Index e Orbit Intelligence. *Cadernos de Prospecção*, 13(1):13-29. <https://doi.org/10.9771/cp.v13i1.35147>
- Trappey, A., Trappey, C., Gobindajaran, U., Chuang, A. & Sun, J. (2017) A review of essential standards and patent landscapes for the Internet of Things: A key enabler for Industry 4.0, *Advanced Informatics Engineering*. 33C:208-229. <https://doi.org/10.1016/j.aei.2016.11.007>