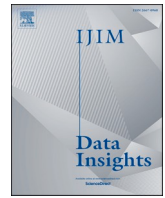




Contents lists available at ScienceDirect

# International Journal of Information Management Data Insights

journal homepage: [www.elsevier.com/locate/jjimei](http://www.elsevier.com/locate/jjimei)

## Content, formats and licensing of datasets from autonomous communities: Value generation, sustainability and proposals for improvement

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## ARTICLE INFO

## Keywords:

Autonomous communities  
Open government data  
Spain  
Industry  
Public information

## ABSTRACT

Open government data (OGD) initiatives, established at all levels of public administration and globally, have significant potential for value generation. However, their actual implementation often reveals significant shortcomings that hinder their potential for value creation. This study addresses a critical gap in the literature by evaluating the design of OGD policies in Spain, focusing specifically on the industrial sector at the autonomous community level. The research assesses the available data's content, formats, and licensing through a population-based analysis of all datasets labeled under the "industry" category across the 17 Spanish autonomous communities. The findings reveal a fragmented and inconsistent landscape: of over 46,000 datasets published by autonomous community governments, only 532 were initially labeled as industry-related, and after a rigorous selection process—removing duplicates, outdated records, and mislabeling entries—only 316 were deemed valid. The study highlights a predominance of non-reusable formats such as HTML and a lack of standardisation in the categorization of information. While most datasets use open licenses (mainly Creative Commons BY), the variability in download options and formats limits their automated processing and reuse. These results underscore the need for standardization criteria, improved data quality, and strategic alignment of OGD initiatives with sectoral priorities such as industrial competitiveness and sustainability. The paper concludes with four contributions to enhance coherence, usability, and impact of open industrial data, aiming to support OGD policy-making and foster innovation ecosystems at the autonomous community level.

### 1. Introduction

It is the age of data (Cerrillo-Martínez, 2018), with data being "the new oil for the digital age" (Kroes, 2012). When data is provided as open data, that is, easing its location and making it available without legal or technical restrictions (Cerrillo-Martínez, 2014) and use or permission requirements (López & Ramírez, 2023), both its usefulness (Ruvalcaba, 2020) and its value (Curto-Rodríguez, 2017) increase, contributing to the improvement of public services (Lnenicka et al., 2024). OGD, the subset of open data provided by public administrations, has become a cornerstone of 21st-century governance (Liang et al., 2025), as these institutions produce, store, manage, and distribute the most significant amount of data, providing information without being required to do so, i.e., proactively (Kempeneer et al., 2023).

These OGDs are generally offered through online platforms or repositories called OGD portals (Mabillard & Keuffer, 2020), specialized websites where a publishing interface allows datasets to be uploaded, equipped with high-quality metadata, and organized into a searchable catalogue (Máková & Lnenicka, 2017).

In a marked environment of digital society development (Hrustek et al., 2024), new information technologies will contribute not only to e-governance but also to sustainability (Khan et al., 2024), a key aspect in smart cities (Antwi-Afari et al., 2021) that rely on data to generate innovative initiatives. Among these can be found the contribution to green strategies or the conservation of the natural environment (Calza et al., 2020). Therefore, academic interest in OGD has increased (Alexopoulos & Saxena, 2023), although aspects such as its theoretical and methodological foundations have not been extensively analyzed (Tang & Li, 2024).

Recent research on OGD initiatives reveals persistent challenges and opportunities for improvement in data quality, platform design, and stakeholder engagement. Sadiq and Indulska (2017) highlight the uncertainty surrounding OGD quality, which undermines its usability and value, while Nikiforova (2018) identifies systemic flaws and a lack of verification even in official datasets, compromising their reliability for business decisions. The broader impact of OGD remains unclear, as noted in (Wilson and Cong, 2021), where the authors argue that expanding its reach requires moving beyond hackathons and tech

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<https://doi.org/10.1016/j.jjimei.2025.100369>

startups to more inclusive strategies. Ali et al. (2024) observe that, despite substantial investments, the social and economic returns of OGD have been limited and recommend improving collaboration between stakeholders and creating interoperable portals. Lnenicka et al. (2022) assess smart city data portals and find most at a “Managed” maturity level, lacking best practices and full stakeholder integration. Ali et al. (2022) emphasize the absence of unified standards in metadata, APIs, and data visualization, which hinders effective reuse. Soosaar and Nikiforova (2025) illustrate that organizational, technological, and legal barriers restrict local data sharing even in digitally advanced Estonia. To address these issues, initiatives such as the EU Open Data Days 2025 bring together leading experts to share knowledge and propose solutions. At this meeting, Nikiforova (2025) explored eight AI functionalities that improve data ecosystems in her presentation “Data for AI or AI for Data.” At the same time, Aksamitauskas (2025) offered strategies for enhancing transparency and decision-making. Hawkins (2025) focused on open energy data, highlighting its role in the transition to clean energy and identifying data availability, consistency, and openness gaps. Collectively, these studies underscore the need for continued innovation, collaboration, and the adoption of best practices to realize the full potential of OGD.

Although Vetró et al. (2016) note that approaches to OGD quality lack a comprehensive theoretical framework (and evaluations tend to focus more on platforms than on the datasets themselves), the value of OGD is indisputable. For instance, the European Union’s public data can directly generate a value of 40 billion a year, so it is not surprising that the supply of OGD has grown exponentially (Gao et al., 2023, Wibowo et al., 2023).

As the European Data Portal recently mentioned, OGD is becoming a relevant tool for sustainability by enabling transparency, innovation, and informed decision-making in all sectors and governments (European Data, 2024). To this end, well-structured and high-quality datasets must be available. When information is supplied in a fragmented manner, additional effort is required to compile it—an effort that would only be feasible if the datasets follow a similar structure. Furthermore, automated data processing becomes significantly hindered if the formats in which the information is provided are of low reusability quality.

## 2. Framework

Spain is a leader in OGD regarding the number of portals (Abella et al., 2022). It ranks among the top positions worldwide in comparative studies such as the OURdata (Open-Useful-Reusable Data Index) conducted by the OECD. The 2023 edition ranked fifth after South Korea, France, Poland, and Estonia (OECD, 2023). Fig. 1 shows the situation

regarding portals and the number of datasets offered in mid-November 2024.

Likewise, Spain is a largely decentralized country (Martínez-Vázquez, 2014), among the most decentralized in Western Europe (Rodríguez-Pose & Gill, 2003). This results in significant political autonomy for its seventeen autonomous communities (Fernández Leiceaga & Lago Peñas, 2013) and the management of a high volume of public resources, allowing them to implement OGD initiatives, among other things. Additionally, the fact that the autonomous communities manage key competencies in areas such as innovation, infrastructure, or the economy will enable them to provide industry-specific OGD that reflects the characteristics and particularities of each region.

Hence, it is understandable that, in recent years, a continuous process of integrating autonomous communities into OGD initiatives has been identified. By 2019, the 17 autonomous communities had already implemented their autonomous portals, which could be easily located in two ways: either through the OGD section of each official autonomous OGD website or through the section reserved for this purpose within the national portal (<https://datos.gob.es/es/iniciativas/nivel/administracion-autonomica-1963>).

As it is not the aim of this research to address a regulatory review, the focus will be placed only on the dataset categorization instructions indicated in the Technical Interoperability Standard for the reuse of information resources (Ministerio de Hacienda y Administraciones Públicas, 2013), which establishes the standard conditions on the selection, identification, description, format, conditions of use and availability of information. To this end, this standard must comply with the provisions of Ley 37/2007, of November 16, on the reuse of public sector information, which has transposed into Spanish law the European Directive 2003/98/CE and which has been subsequently amended by Ley 18/2015, of July 9. Annex IV of the aforementioned interoperability standard is of manifest interest insofar as it indicates the taxonomy of primary sectors, which can be seen in Fig. 2. This annex, based on the document “proposal for a common taxonomy for electronic procedures and services within the framework of Law 11/2007,” indicates the primary sectors where the related topics of each one are specified. However, they are accompanied by a vague indication of the content; for example, for industry, it is only indicated that it must contain mining information.

In Spain, the industry is a sector of great relevance due to its contribution to GDP, its contribution to employment and export capacity (Magadán-Díaz & Rivas-García, 2021), and although the impact of the pandemic has distanced it from 2008 levels (Myro, 2021), its turnover increased by 26.5% in 2022, reaching 928,151 million euros (Prades & Tello, 2020). Due to the importance mentioned above and the



Fig. 1. Datasets and OGD initiatives in Spain. Source: Spain’s OGD portal: <https://datos.gob.es/en>

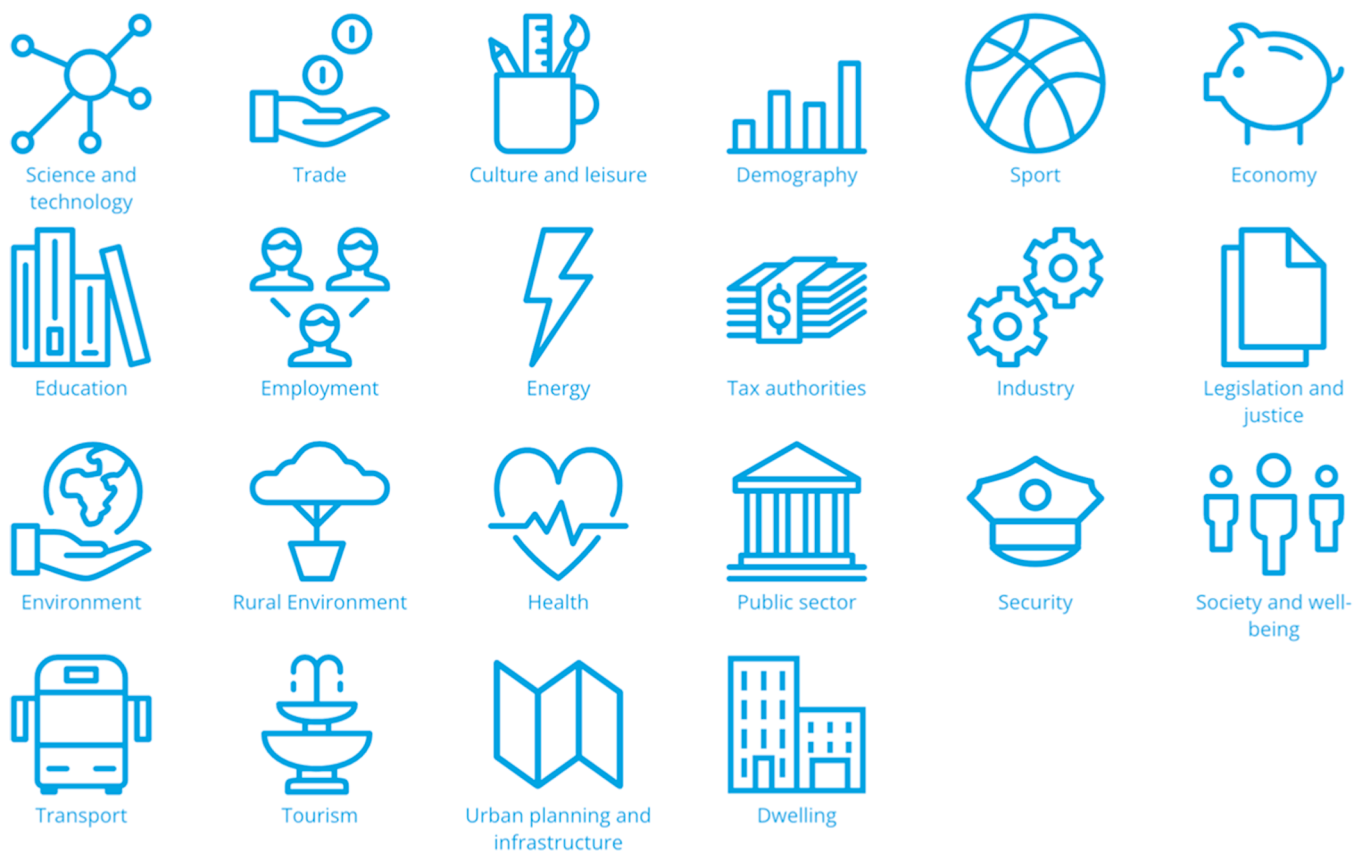


Fig. 2. Categories of information.  
 Source: Castilla - La Mancha OGD portal: <https://datosabiertos.castillalamancha.es/>

potential to facilitate informed decision-making, promote greater efficiency in the productive sectors, foster research and innovation, improve competitiveness or identify market opportunities, OGD on industry is expanding.

Thereby, the main objective is to delve deeper into the research gap that evaluates the “performance” of OGD policies, as critical opinions or doubts about their efficiency have been found, and to offer an assessment of the design and implementation of such policies by focusing on their actual potential use.

Based on this primary objective, the following theoretical and practical objectives are specified. At the theoretical level, the research aims to fill a knowledge gap observed in the literature due to the scarcity of studies on OGD, especially in the industrial sector. Thus, it will improve the understanding of the initiatives’ approaches through a case study analysis of a specific type of information, level of government, and country.

On a more practical level, it aims to showcase the content, licenses, and formats of the various initiatives for the benefit of reusers and application developers (demand perspective). Correspondingly, from the supply side, by presenting the proposals of the seventeen autonomous communities comparatively, performance can be evaluated, identified shortcomings addressed, or managers in autonomous communities can implement some of the improvement proposals presented by the research.

Following the introduction and background, the third section describes the methodology used to achieve the objectives outlined above, and the results are presented in a fourth section. In the fifth section, these results are analyzed, followed by a discussion of them in the sixth section. The seventh section presents the research’s contributions and implications, both theoretical and practical. In the eighth section, the main limitations, conclusions, and future lines of research are indicated.

The study concludes by presenting the primary bibliographic references to prepare this research.

### 3. Methodology

The methodology used is the case study: OGD in the industry in Spain’s autonomous communities. Firstly, the selected country is advanced in OGD initiatives according to international studies; therefore, adequate performance is expected to be achieved, and good practices that can be replicated will be identified. Secondly, the choice of the intermediate level of government is considered appropriate, as autonomous communities manage around 35% of public spending, giving them sufficient capacity to implement OGD policies more effectively than smaller entities such as municipalities.

It is worth noting that a sustained growth in the number of datasets offered, as highlighted in Curto-Rodríguez’s research (2020a), is still evident at the time of this research, as shown in Table 1.

The fieldwork, which began with collecting information from the datasets labeled under the industry category, was completed in the first half of November, and the results obtained are summarized in Table 2.

Since, as shown in Table 1, only certain autonomies have an API for downloading information, a manual collection of the tagged datasets was conducted to ensure greater uniformity in the study. The industry data was reviewed after accessing the repository’s main page (some autonomous communities use different terminology, categories, and labels). Additionally, various issues were identified, such as the inability to automatically download the contents or other more significant problems, like not being able to sort alphabetically (which would have made it easier to identify and group related datasets).

This has slowed down the data collection process beyond what was necessary, which is striking in the case of OGD, whose primary purpose

**Table 1**

Name of the portals of the autonomous communities and their content in the number of datasets. October 2024.

Autonomous community	Web Address	Datasets	Download API
Canary Islands	<a href="https://datos.canarias.es/portal/">https://datos.canarias.es/portal/</a>	20 856	YES
Basque Country	<a href="https://opendata.euskadi.eus/inicio/">https://opendata.euskadi.eus/inicio/</a>	12 493	YES
Aragon	<a href="https://opendata.aragon.es/">https://opendata.aragon.es/</a>	2 849	YES
Foral Community of Navarra	<a href="https://gobiernoabierto.navarra.es/open-data">https://gobiernoabierto.navarra.es/open-data</a>	1 586	YES
Valencian Community	<a href="https://portaldadesobertes.gva.es/es">https://portaldadesobertes.gva.es/es</a>	1 494	YES
Principality of Asturias	<a href="https://transparencia.asturias.es/web/gobierno-abierto/open-data">https://transparencia.asturias.es/web/gobierno-abierto/open-data</a>	1 387	NO
Catalonia	<a href="https://portaldadesobertes.gva.es/es">https://portaldadesobertes.gva.es/es</a>	1 279	YES
Andalucía	<a href="https://www.juntadeandalucia.es/datosabiertos/portal/">https://www.juntadeandalucia.es/datosabiertos/portal/</a>	979	NO
Murcia	<a href="https://datosabiertos.regiondemurcia.es/">https://datosabiertos.regiondemurcia.es/</a>	975	YES
Castilla and Leon	<a href="https://datosabiertos.jcyl.es/web/es/datos-abiertos-castilla-leon.html">https://datosabiertos.jcyl.es/web/es/datos-abiertos-castilla-leon.html</a>	744	YES
La Rioja	<a href="https://web.larioja.org/dato-abierto">https://web.larioja.org/dato-abierto</a>	528	YES
Galicia	<a href="https://abertos.xunta.gal/portada?langId=es_ES">https://abertos.xunta.gal/portada?langId=es_ES</a>	512	NO
Balearic Islands	<a href="https://www.caib.es/sites/opendatacaib/es/inicio_home/?campa=yes">https://www.caib.es/sites/opendatacaib/es/inicio_home/?campa=yes</a>	363	NO
Castilla-La Mancha	<a href="https://datosabiertos.castillalamancha.es/">https://datosabiertos.castillalamancha.es/</a>	346	NO
Cantabria	<a href="https://datos.icane.es/">https://datos.icane.es/</a>	291	NO
Community of Madrid	<a href="https://www.comunidad.madrid/gobierno/datos-abiertos">https://www.comunidad.madrid/gobierno/datos-abiertos</a>	250	NO
Extremadura	<a href="http://gobiernoabierto.juntaex.es/datos/">http://gobiernoabierto.juntaex.es/datos/</a>	13	NO
<b>TOTAL DATA SETS</b>		<b>46 942</b>	

**Note:** Although the Principality of Asturias portal exists, the latter has been considered due to the higher number of syndicated datasets in the national portal. ([https://datos.gob.es/es/catalogo?publisher\\_display\\_name=Principado±de±Asturias](https://datos.gob.es/es/catalogo?publisher_display_name=Principado±de±Asturias))

Source: Own elaboration.

is precisely its reuse. It is making it difficult to process and perform the laborious, detailed analysis shown in the following section.

#### 4. Results

As can be seen in Table 2, fifteen of the seventeen Spanish autonomous communities (all except Galicia and the Community of Madrid) offer some datasets labeled in the industry category, resulting in a total of 532 datasets (1.13% of the 46,942 total, and only 25% of the expected content that would be obtained by dividing the overall total disclosed among the 22 categories proposed by the technical standard for interoperability). It can also be seen that the distribution by autonomous community is highly irregular since the expected average of 31.29 datasets per autonomous community is only surpassed by the Canary

**Table 2**

The datasets from the autonomous communities are labeled under the industry category. November 2024.

CNR	ARA	VAS	AST	CNT	CAT	AND	CTM	NAV	RIO	MUR	BAL	CTL	EXT	VAL	GAL	MAD
166	110	108	55	26	16	13	9	6	6	5	3	3	3	3	0	0

**Note:** CNR, Canary Islands; ARA, Aragon; VAS, Basque Country; AST, Principality of Asturias; CNT, Cantabria; CAT, Catalonia; AND, Andalusia; CTM, Castilla-La Mancha; NAV, Foral Community of Navarra; RIO, La Rioja; BAL, Balearic Islands; CTL, Castilla and Leon; EXT, Extremadura; VAL, Valencian Community; GAL, Galicia; MAD, Community of Madrid.

Source: Own elaboration (2024).

Islands, Aragon, the Basque Country, and Principality of Asturias, while the remaining thirteen autonomous communities are offering several datasets below the average.

In any case, cleaning up the information provided will be necessary, as it will become clear after reviewing each autonomous community's content, licenses, and formats, which will be done in alphabetical order.

#### 4.1. Andalusia

This autonomous community offers thirteen datasets within the industry activity sector, all under a CC-BY license. Once this category is accessed, it is mentioned that the datasets hosted there can be used in several ways (through API or open-source code) to generate value and improve how the industry works. It is also indicated that the classified information is data on industrial strategy indicator systems, incoming order indices, business or industrial production figures, and structural company statistics. In reality, given that the portal performs multiple labelling of the datasets to various categories, many of them are more general.

Some examples could be "Statistical Yearbook of Andalusia ", which in CSV offers general information on the environmental, demographic, etc. The "Spatial Reference Data of Andalusia (DERA)", with cartographic bases on relief, hydrography, transport and communications (wms, wfs, html, shp and cpkg); "Provincial Situation Bulletin", which in csv shows a compendium of statistical information of this type; "Inventory of jobs of the Andalusian Public Foundation-Institute of Studies on the Public Finances of Andalusia, M.P." (xls, ods). This group includes three indicators of generic information not directly related to industry: "Multi-territorial Information System of Andalusia (SIMA)", which is a database that offers a large amount of multi-thematic and multi-territorial statistical information (csv); "System of indicators for the monitoring and evaluation of the Agenda for Employment" (csv), and "System of indicators of Sustainable Development of Andalusia for the 2030 Agenda" (csv, html, json).

With a theme closer to industry, six data sets are offered in csv. Two of them are surveys: "Construction industry structure survey", which shows relevant economic variables of the companies and their main characteristics, and "Annual industrial survey of products", which provides the quality and price levels of each product. The remaining two are indexes: "Industrial Production Index of Andalusia (IPIAN)", whose purpose is to measure the supply of goods produced monthly by the Andalusian industry, and "Industrial Turnover Indexes (ICNI)", which employs short-term indicators to calculate the monthly evolution of the activity of industrial companies based on their business figures. Finally, it is located in "Structural Statistics of companies: industrial sector", which provides information on relevant economic variables of industrial companies, and "System of Indicators of the Industrial Strategy of Andalusia 2020", which aims to be a reference to generate an extensive, diversified, strong, and sustainable business fabric.

#### 4.2. Aragon

With 110 datasets labeled in the industry category, Aragon is the second Spanish autonomous community that supplies more information of this type, only behind the Canary Islands. Like the Canary Islands, the largest portal supplier in this category is the statistics institute, which,

unlike the island community, performs single labelling in each dataset (the Canary Islands performs multiple labelling).

The analysis of the licenses shows that all the datasets are under the CC-BY license. At the same time, in the formats, the two most common options are exclusive supply in html or csv and px, with some exceptions, as already mentioned.

The first dataset highlighted is "Mining Cadastre. UTM coordinates" and is offered in shp, xml, xls, csv, and shp. Next, there are fifteen datasets, each titled "Turnover by geographic destination of sales" (one dataset per year of the 2015-2019 series). They are categorized by five employment strata, five branches of activity, and another five by *Clasificación Nacional de Actividades Económicas* (CNAE, 2019) sections and divisions. It is intriguing that the 2015 datasets are available in csv and px, while the rest are only in html.

Subsequently, another set of 29 datasets is available (in csv and px formats) on the Aragonese industry accounts. First, those offered in blocks of four are shown, i.e., by activity groupings, employment strata, branches of activity, and activity subgroupings, which contain information on stocks, expenses, income, investment, economic macro-magnitudes, personnel, and economic variables. Finally, it should be highlighted that "Aragonese industry accounts. Main variables by activity subgroup. Aragon and Spain" has been added to the 28 data sets listed above.

Further on, there is a series of individual datasets, such as "Expenditure of Aragonese industry on energy products," "Industry expenditure on energy products. Aragon and Spain," and 'Indicator of energy intensity in Aragonese industry', all three in html, accompanied by the set 'Installations subject to industrial safety regulations with special characteristics'.

Once again, there is grouped information, also observing that the 2015 data are offered in csv and px, while the rest are only in html. On the one hand, there are 15 datasets relating to investment available by three breakdowns: by branches of activity, by sections and divisions, and by employment strata (one dataset per year within the 2015-2019 series). On the other hand, there is the 13 that refers to the leading activity indicators that are also offered by branches of activity, by sections and divisions, and by employment strata (2015-2019 series), with the only exception that by employment strata only exists for the years 2015, 2016, and 2017.

In addition, 15 data sets refer to the main magnitudes by activity and 15 relate to operating results (with the usual segmentation by branches of activity, sections, divisions, employment strata, and the 2015-2019 time series).

The revision of this autonomy ends with the data sets "Statistical series. Industrial production indices. Base 2021 (xls) and "Land and industrial estates in Aragon" (xml, xls, csv, json).

#### 4.3. Balearic islands

It has three datasets in the industry category, all in geojson format (a format that allows the representation of simple geographic elements) and under CC-BY license. They are "Authorized perimeter mines," "Areas of mining interest," and "Low enthalpy geothermal," which provide information on the energy obtained by extracting natural heat from the earth's interior.

#### 4.4. Basque country

It is the third autonomous community regarding the datasets disclosed to the industry. However, when multiple labelling of the datasets is carried out, the content sometimes deviates from what is expected. The two leading suppliers are, on the one hand, Eustat, the Basque statistics institute, which tends to formulate the data sets mostly in csv and xls formats, and, on the other, the Basque government, whose datasets are usually available in lod, api, rest, xls, pdf, json and csv. Except for three datasets indicating "European Union public license",

the licenses used are offered under the CC-BY license.

The one-hundred-eight datasets can be classified into specific content blocks. Their statistical nature stands out, such as the one composed of twenty-four datasets related to municipal sustainability indicators (women employed in the fishing sector, percentage of establishments in the primary sector, service sector value, etc.). There are also nine datasets of industrial production indexes of the Basque Country and another five sets dealing with industrial prices.

There are (in addition to those mentioned above) nineteen other data sets that contain the word industry or industrial in their title. Their diverse nature makes it difficult to group them, although they will be analyzed in two sections.

The first is of the datasets that are offered in pairs as "Foreign Trade of industrial goods of the Basque Country by main exported items" (together with another that refers to the autonomous communities), "Technological Content of the Industry of the Basque Country, by Autonomous Communities" (together with another that refers to the Autonomous Communities); "Technological Content of the Industry of the Basque Country, by Territories" (together with another that refers to the Autonomous Communities). of the Basque Country, by Historical Territories and Technological Level CNAE, 09 thousands of euros" (accompanied by the information segmented by sectors and concept); 'Macro magnitudes of the Industry and energy sector of the Basque Country, by Historical Territory (thousands of euros) which is offered with another dataset that adds the activity field'. The latter refer to GDP as "GDP p/m and GVA Industry at current prices of the Basque Country - Interannual growth rates (%)" together with another one that collects chained volume indexes or "Profit and loss account of the Industry and Energy sector of the Basque Country, by Historical Territory (thousands €) accompanied by a dataset that also incorporates the activity.

Secondly, there are nine sets that are not offered individually: "Personnel costs of the industry in the Basque Country by historical territory and region (thousands of euros)", "Sectorial distribution of the industrial added value of the Basque Country. Current prices (%)", "Industrial establishments in the Basque Country by Historical Territory and region (%)", "Evolution of the industrial sectorial added value of the Basque Country. Current prices (%)", "Gross operating surplus of the industry in the Basque Country by historical territory and region (thousands of euros)", "Realized investment of the industry in the Basque Country by historical territory and region (thousands of euros)", "Operating result of the industry in the Basque Country by historical territory and region (thousands of euros)", "Value added at factor cost of industry in the Basque Country by historical territory and region (thousands of euros)" and "Net sales of industry in the Basque Country by historical territory and region (thousands of euros)".

Five datasets related to the manufacturing sector have also been found. Three are related to employment, and two other datasets deal with the generation of value in this sector: "Added value of the manufacturing sector as a proportion of GDP, by historical territory. Agenda 2030 indicators. C.A. de Euskadi" and "Added value of the manufacturing sector per capita by information coding territory. Agenda 2030 indicators. C.A. of Euskadi."

The review of the content of the Basque Country ends with a series of data sets with varied information such as "Energy efficiency certificate registers in the Basque Country", "Distribution of employment in the Basque Country by branch of industry. of the Basque Country by branch of activity according to average size and stratum of people employed", "Employed personnel in the industry of the Basque Country by sex, activity (A38) and Historical Territory (%)", "Energy intensity of the Basque Country and the countries of the European Union", "Transport companies in the Basque Country. 2014-2021" or "Air Quality web in Euskadi".

#### 4.5. Canary islands

The Canary Islands is the autonomous community with the largest

number of data sets in the industry category, so a more exhaustive review has been devoted to it. Of the 166 datasets offered, 158 are supplied by the Canary Islands Statistics Institute. Hence, the nature of these data and their standard license (which is none other than the terms provided for in [Ley 37/2007](#)) indicate the particular conditions of use of APIs, ISTAC-bot, widgets, and connectors.

Moving on to the analysis of the existing information, it should be mentioned that some interesting datasets do not have autonomous scope: "Energy generation infrastructures in Tenerife", "Maps of industrial estates in Tenerife", "Industrial companies in Tenerife", "Activities in industrial estates in Tenerife" or "Energy produced and consumed in photovoltaic plants and wind farms in Tenerife". Sixty-eight other datasets are of the affiliations typology (agricultural regimes, ordinary general regime, by sex, age groups, etc.), six more whose title begins with the word employment and another six called "Persons" and others such as "Remuneration of employees and total and salaried employment (persons and hours) according to branches of activity -Canary Islands and years- since 2000", which seem more typical of the employment category. Finally, "Aggregates by Canary Islands and years" offers the main macro-magnitudes of the Canary Islands economies (json, xml, tsv, csv, xls), with four other datasets of operational concepts of purely statistical content and six other datasets on energy consumption (by Tenerife council, by Canary Islands municipalities, etc.), which do not seem to belong 100% to the industry category (more to the economy or energy).

Others, however, are closer to the object of study, such as "Census of industrial land" (csv and ods), "Market shares of AIEM Annex II products -Canary Islands by years- since 2015 (json, xml, tsv, csv and xls)", "Geographical destination of sales according to activity groupings (CNAE, 2009) - Canary Islands by years- 2008-2014" (json, pc-axis, csv) and "Geographical destination of sales according to activity groupings (CNAE, 93) in Canary Islands by years. 1993-2007" (pc-axis and csv), accompanied by others of interest such as 'Electrical energy according to gross production, domestic demand and final consumption - the Canary Islands by periods' 'Scheme of operational concepts for Industry Survey in the Canary Islands (ISTAC: CSO\_C00080A)' or 'Gross Fixed Capital Formation according to branches of activity - the Canary Islands and years - since 2000', all of them in json, xml, tsv, csv and xls formats.

However, as expected (the portal's leading supplier is the Statistics Institute), multiple data sets of statistical content or indexes exist, which are sometimes so segmented that it is tough to differentiate them.

In terms of turnover, the following stand out: "Index of turnover in industry-Spain and autonomous communities by months-(base year 2015)", "Index of turnover in industry - Spain and autonomous communities by months. (base year 2021)", "Index of turnover in industry - Spain and Canary Islands by months-(base year 2015)" and "Index of turnover in industry. Spain and Canary Islands by months-(base year 2021)", all of them available in json, xml, tsv, csv and xls.

There are also several price indices displayed in three blocks. The first one related to industrial prices, offering in json, xml, tsv, csv and xls formats two datasets of the economic activity in Spain and the Canary Islands by months (one with base year 2010 and another with base year 2015); three datasets regarding the Industrial price indexes segmented according to economic destinations of goods -Spain and autonomous communities by months- (one with base year 2010, another with base year 2015 and the last one with base year 2021), accompanied by "Industrial price index according to economic destinations of goods autonomous communities by periods -Canary Islands. 2002-2012" (pc-axis, json and csv). Finally, three other datasets offer the information classified according to divisions, activity, and sections of the industry in Spain and the Canary Islands for the period 2002-2012.

The second deals with consumer price indexes (all in base year 2021), which can be downloaded in json, xml, tsv, csv and xls formats. On the one hand, there are "Consumer Price Indices according to ECOICOP-Spain groups and autonomous communities by months" and "Consumer Price Indices according to ECOICOP-Spain groups and

provinces by months". On the other hand, note the "Consumer Price Indices according to special groups. Spain and Autonomous Communities by months" and "Consumer Price Indices according to headings".

Thirdly, refer to industrial production indices, available in json, xml, tsv, csv and xls formats, observing ten data sets. The first one, called "Industrial production index according to economic activity-Spain and the Canary Islands by months (base year 2010)" is accompanied by four according to economic destination: "Industrial production index according to economic destination of goods. Autonomous Communities by periods. Canary Islands, 2002-2013", "Industrial production index by economic destination of goods. Spain and autonomous communities by months-(base year 2010)", "Industrial production index by economic destination of goods. Spain and autonomous communities by months (base year 2015)" and "Industrial production index by economic destination of goods. Spain and autonomous communities by months (base year 2021)". Three of the Industrial Production Index (CNAE,2009) also stand out. Spain and the Canary Islands by periods. 2002-2013 (according to divisions, activity groups and sections), together with "Industrial production indexes. Spain and the Canary Islands by months-(base year 2015)" and "Industrial production indexes. Spain and the Canary Islands by months-(base year 2021)".

To conclude the review of this autonomy, other data sets with varied information are mentioned: "Impact of COVID-19 on the industrial production index in base year 2015. Canary Islands and months" (html, pc-axis-json); 'News from the Department of Tourism, Industry and Commerce of the Canary Islands' (rss), 'Indicators of Sustainable Development of the Canary Islands' (zip and xls), "Average price according to types of fuels. Canary Islands by weeks" (json, xml, tsv, csv and xls), "Geographical origin of purchases according to activity groupings (CNAE, 2009) in the Canary Islands by years. 2008-2014" (json, pc-axis, csv), "Geographical origin of purchases according to activity groupings (CNAE, 93) in the Canary Islands by years. 1993-2007" (pc-axis, csv), and 'Wholesale cement sales by Canary Islands and periods' (json, xml, tsv, csv and xls), which are accompanied by five datasets relating to various macro-magnitudes.

#### 4.6. Cantabria

It offers twenty-six datasets labeled as industry and downloadable in html, rdf, xls, pc-axis, sdmx and json formats. Regarding the license, the datasets indicate the ICANE license, which is identified with an OGD label that redirects to the Open Knowledge Foundation website mentioning that the license must be compatible with other open licenses, that is, that it meets conditions such as free use, redistribution or sale, creation of derivative works under the same terms as the original work (all for any purpose).

The individualized analysis identifies a series of data sets with concise names that collect information on production, value, exports etc., of these industries: "Food", "Footwear", "Rubber", "Agrofood industries", "Machinery and electrical equipment", "Transport equipment", "Non-metallic minerals", "Mining and quarrying", "Paper", "Metallic products", "Chemicals", "Register of industrial establishments", "Iron and steel", "Textile" or "Value of industrial production".

A second block of datasets is related to indexes and statistics: the Industrial Turnover Index", "Industrial New Orders Received Index", "Industrial Price Index (IPRI)", "Industrial Production Index (IPI)" and "Structural Statistics of Companies: Industrial Sector" which is accompanied by "Quarterly Accounting of Cantabria" with information on indexes and prices.

Finally, there are "Denomination of Origin" with information on the cheese industry, "Protected Geographical Indication", with data on the meat industry, "Enrollments" with the content of registered vehicles and two surveys: "Industrial product survey" and "Industrial Situation Survey".

#### 4.7. Castilla and leon

It has three datasets labeled as industry, all under CC-BY license. Two contain vehicle information: "Vehicle Technical Inspection Centers in Castilla and Leon" and "Vehicle Repair Shops," both downloadable in CSV. In addition, there is a section entitled "Installation and Maintenance Companies in Castilla and Leon," with the list of companies authorized by the different regulations (Low-Voltage Installations, Elevators, Thermal Installations in Buildings, Oil Installations, etc.) available in XML format.

#### 4.8. Castilla-La mancha

This autonomous community labels its datasets multiple times and has nine datasets available under the "Industry" thematic, all under the CC-BY-SA license.

Initially, there is "Authorized ITV stations in the territory of Castilla-La Mancha", which in xls and csv offers this list, accompanied by "Rates for the Technical Inspection of Vehicles (ITV) in Castilla-La Mancha" with the maximum rates in this regard (pdf).

Below are four records: "List of companies registered in the Registry of Companies with Asbestos Risks of the autonomous community of Castilla-La Mancha" (available in pdf, csv, xls and json); "Regional Register of Priority Associative Entities of Regional Interest of Castilla-La Mancha", Administrative Register of associations whose turnover reaches a previously established amount (xls and csv); "Entities adhered to the EMAS Registry" which shows, in ods and csv format, all the organizations that wish to improve their environmental performance and have subscribed to the voluntary mechanism called Eco-Management and Audit Scheme and "Cadastre of mining rights of Castilla-La Mancha", an updated public file of all the mining rights existing in the autonomous community (html, xls and csv).

Finally, there are three databases: "Geographic Database of the Junta of Communities of Castilla-La Mancha" (html); "Industrial land in Castilla-La Mancha", which contains the geographic relation of these plots in csv and xls format; and "Castilla-La Mancha Statistical Service Data Bank" with the organic structure and competences of the bodies integrated into the Presidency of the Junta of Communities of Castilla-La Mancha" (html).

#### 4.9. Catalonia

This autonomous community uses its license called "Open license for the use of information - Catalonia", which allows users to freely share, modify, and flexibly use the information, respecting certain conditions, such as citing the source of the information (section c). However, it does not allow the sublicensing of the data (section o) or imposing additional conditions of use (section p). Although it is expressly mentioned that the individual license that a dataset may have in a specific way prevails over this general license, none of the sixteen datasets labeled in the industry category show this exception.

As for the available formats, two groups of datasets are worth mentioning. Firstly, those that redirect to the Statistical Institute of Catalonia, which have been classified as html, as they do not allow direct downloading of the information. To this first group belong the "Competitive position of the industrial sector", which contains the price competitiveness and revealed competitiveness indexes, and another series of indexes: "Industrial order entry index", which measures the evolution of activity; "Industrial price index", which shows the monthly evolution of sales prices at the factory gate; "Industrial production index", which measures the evolution of the volume of gross value added generated by the industrial branches; and "Industrial turnover index", which considers the turnover figures. Also noteworthy is the "Industrial product survey" or "Structural statistics of companies in the industrial sector", which studies the characteristics of industrial companies (number of establishments, employees, production, sales, exports,

intermediate consumption, investment, etc.) and estimates their main macro-magnitudes.

Secondly, a group of data sets can be exported in various formats such as csv, rdf, rss, tsv, and xml. Here belong: "CCPA 2014", Catalan classification of products by activities; "ECOICOP 2016", European classification of individual consumption by purpose; "NC 2023 (foreign trade products)", which contains a classification of products for trade with foreign countries or "PRODCOM EIP 2021" which offers the classification of the Industrial Products Survey with data for the year 2021. Two other datasets are related to the company "Industrial Promotion and Localization of Catalonia", which has the objective of promoting industrial restructuring and providing technical, administrative and economic support to companies, such as "Avançsa investee companies" (Companies in which Avançsa has a stake) and "Participative loans granted by Avançsa" (Participatory loans granted by Avançsa). Finally, it is worth heeding the "Register of professional vegetable operators in Catalonia", "Register of agri-food laboratories in Catalonia", and "Greenhouse gas emissions from installations under the emission rights trading scheme".

#### 4.10. Extremadura

This autonomous community offers three datasets within the industry category, all available for download in Excel and csv without expressly indicating the license of use.

The datasets are: "Industrial Estates in Extremadura", which offers a list of Industrial Estates promoted by the autonomous community of Extremadura and their geolocation data; "Electric Vehicle Recharging Stations in Extremadura", which mentions the electric charging stations in Extremadura with coordinates in UTM European Terrestrial Reference System 1989 (ETRS89) notation and "Broadcasters in Extremadura", with data on the audiovisual, radio and television communication service entities in the autonomous community.

#### 4.11. Foral community of navarra

The six datasets offered by Navarra in the industry group are CC-BY licensed. Three of them are available for download in csv, json, ods, tsv, xls, xml and xsd, and contain data relating to companies and entities that carry out in Navarra any of the activities by which they are classified: "Industrial Register of Navarra. Division A companies" (procurement, repair, maintenance, transformation or reuse of industrial products and disposal of waste or by-products, etc.), "Industrial Register of Navarra. Companies division B" (service companies authorized in the field of industrial safety) and "Industrial Register of Navarra. Companies division C" (accreditation entities, control bodies, laboratories and other agents in the field of industrial safety and quality).

Finally, "Directory of companies with economic activity in Navarre," "Directory of establishments with economic activity in Navarre," and "Companies with economic activity in Navarre" offer a wide variety of formats: csv, json, ods, tsv, xls, and xml (those specified above, except the XSD format, which is an xml-type format but more precise).

#### 4.12. La rioja

It has six datasets in the industry category. Only one of them, "Register of Agri-Food Industries," is under a CC-BY-NC license and can be downloaded in xls, xml, csv, and json formats.

The other five are CC-BY license. The first two are: "Evolution of the Industrial Price Index (IPRI) by divisions", with information on ex-factory sales prices and "Evolution of the Industrial Production Index (IPI) by activity divisions", which refers to industrial branches -excluding construction- (xls, xml, csv and json). The three remaining datasets contain a link to the website "Catalogue of geographic data and services of the Government of La Rioja". These are "Registration of facilities that use organic solvents in their activities" which can be

downloaded in geojson; "Mining rights", with several files in wms and wfs and "Medium combustion plants" available in wms and wfs.

#### 4.13. Murcia

Unexpectedly, the five labeled sets have the same name: "Limusa Containers" (Lisuma is Municipal Cleaning Public Limited Company). In addition, the supplier is the municipality of Lorca, so it can be confirmed that these are datasets without autonomous content.

The detailed analysis of the Spanish autonomous communities labeled in the industry category ends with Murcia. In the following sections, the necessary selecting of the observed data will be carried out, the results will be discussed, and the main conclusions reached by this research will be stated.

#### 4.14. Principality of asturias

After performing the initial access to the public information catalogue of the Principality of Asturias, three tabs are identified: transparency, which leads to the Asturian transparency portal; participation, which leads to the portal (in maintenance) "Principality of Asturias Participates"; and OGD, which redirects to the national portal data.gob.es with the selected label "publisher Principality of Asturias", where 1,387 datasets are offered.

Although this is an exception, given that the rest of the autonomous communities' portals consulted host the datasets in their repositories, it is noted that the classification of the information complies with the technical standard and that, when the industry category is selected, 55 datasets are available, all of them under CC-BY license. In any case, the individualized analysis shows that the labelling of the datasets is not unique (predominating, in addition to industry, rural environment, economy, and science and technology), so it is not surprising that the information obtained is very varied.

The analysis, which will be carried out in alphabetical order, shows a first block of datasets referring to the primary sector, such as "Foods of differentiated quality in the Principality of Asturias" (xls and ods), "Aid to the agri-food industry in Principality of Asturias" (which is duplicated, being offered once in xls and once in xls and ods), 'Early cessation of agricultural activity in the Principality of Asturias (xls)' and 'Production of ciders and other apple products in the Principality' (xls and ods).

This is followed by a block of eleven data sets entitled "Industrial survey of companies in Principality of Asturias" (main indicators, hours worked, operating costs, etc.) available in html format. This is accompanied by nine entitled "Structural statistics of companies in Principality of Asturias" with information on production value, turnover, etc. (html).

After the "Indicators of the Sustainable Development Goals in the Principality of Asturias" available for download in html, xls and zip (and labeled in all categories of the technical standard) and "Synthetic indicators of production of metallurgy and non-metallic mineral products (base year 2015), five relating to the Industrial Price Index in Principality of Asturias are shown: four according to destination (base years 2005, 2010, 2015 and 2020) and one by sections (base year 2015), all of them in html, a format shared by the following three called "Industrial Production Index in Principality of Asturias" (according to economic destination, according to branches of activity and according to sections), also in html.

The following thirteen titles begin with the word industry and offer information on their production, destination, factors limiting development, degree of underutilization, etc.; most are formulated in html format only.

#### 4.15. Valencian community

This autonomous community hosts three datasets under the industry category, all with CC-BY license. Two are related and are provided in CSV: "Business parks of the Valencian Community 2021", which shows

the snapshot for that year, and "Business parks of the Valencian Community", which contains the updated information. It is accompanied by "Serious accident establishments in the Valencian Community", a geographical layer of the establishments affected by Royal Decree 840/2015 (which approves measures to control the risks inherent to serious accidents involving hazardous substances), which is available in wms, wfs, csv and pdf.

## 5. Analysis

The detailed review carried out in the previous section shows the need to purge the datasets labeled in the industry category for various reasons: duplicate datasets, information that is not related to that category datasets offered, which refer to a single, very narrow and non-continuous period, or, finally, datasets not applicable at the autonomous community level.

The data were cleaned based on the dataset title, and when doubts arose, the dataset's content was accessed (description section). The following is an example of each of the four cases of exclusion. Firstly, "Lisuma Containers" (Region of Murcia) as the dataset is offered five times; secondly, "Reference Spatial Data of Andalusia", (Andalusia) with cartographic bases on relief, hydrography, transport and communications, unrelated to the industry category; thirdly, "Turnover by geographical destination of sales" (Aragon) because it contains data from the 2015-2019 series and, finally "map of industrial estates of Tenerife" (Canary Islands) which includes data from a province and not from the autonomous community.

Once it has been clarified how the selected has been carried out. The result, after applying these exclusion criteria, is shown in [Table 3](#).

Fourteen autonomous communities now contain information at the autonomous level in the industry category. Murcia, which had five sets of data labeled in the industry category, now joins Galicia and the Community of Madrid as autonomous communities with no information in this respect. It can also be seen that after the initial results were cleaned, the total amount of information related to the industry category dropped by 40% (from 532 to 316 datasets), which leaves the percentage of this data with respect to the total of the autonomous community at a meagre 0.7%. [Fig. 3](#) shows graphically the impact of selected in each autonomous community.

[Fig. 3](#) shows that eight autonomous communities (of the fifteen that had some dataset labeled in the industry category) maintain the number of datasets after selected the initial offer: Balearic Islands, Cantabria, Catalonia, Castilla-La Mancha, Castilla and Leon, Foral Community of Navarra, Extremadura and La Rioja. On the other hand, another seven have reduced their contribution. The three autonomous communities that have seen the most information discarded are the Canary Islands, 99 datasets (60% less); Aragon, 74 datasets (67% less); and Basque Country, 29 datasets (27%) less. Three other autonomous communities, Andalusia, Murcia and the Valencian Community, also decreased their performance by seven, five and one dataset (accompanied by the Principality of Asturias, which also discarded one dataset, although the percentage impact was less than 2%). [Fig. 4](#) shows graphically the final contribution of each autonomous community.

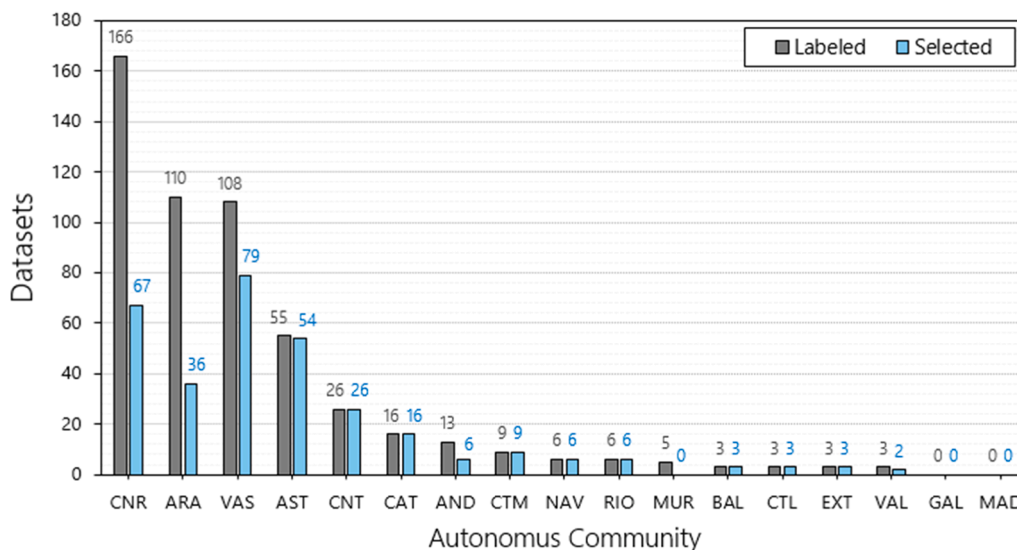
[Fig. 4](#) evaluates the role of three autonomous communities that, together, account for more than the rest: the Basque Country, the Canary Islands, and Principality of Asturias. It also shows a correlation between the total supply of autonomous communities and the data sets labeled and/or selected in the industry category, as shown in [Table 4](#).

As can be seen in [Table 4](#), Pearson's correlation coefficient shows significance in both correlations at levels below 1%. It shows a positive correlation of 87.7% between the labeled data sets and the total autonomous community supply, which is reduced to 78.8% when referring to the data sets that the study selected with respect to the total autonomous community supply. This implies that the amount of information relating to the industry of each of the autonomous communities is directly related to their total individual supply.

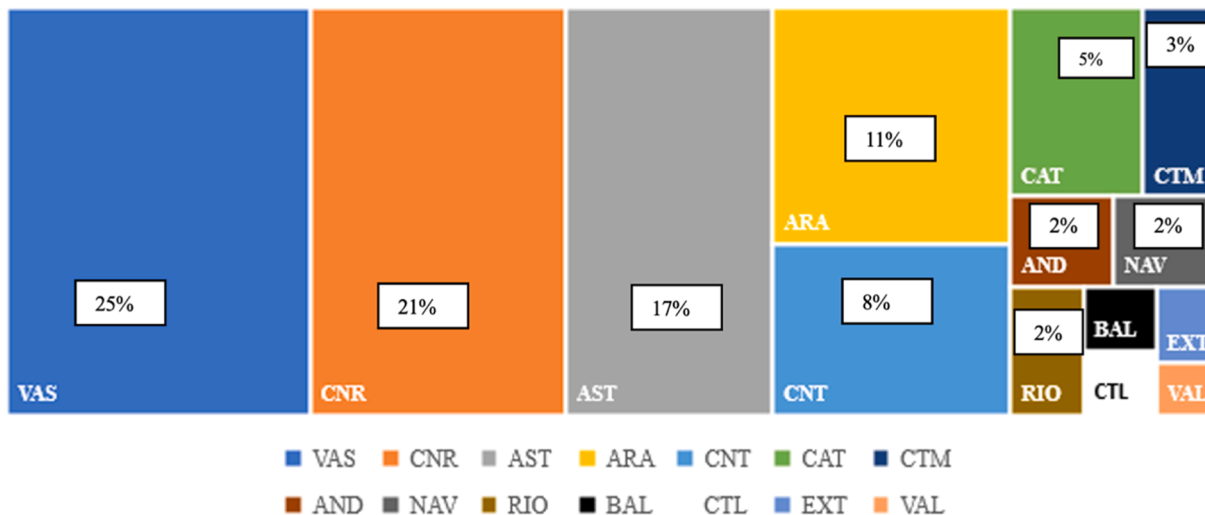
**Table 3**  
The datasets from autonomous communities after selected belonging to the category industry.

VAS	CNR	AST	ARA	CNT	CAT	AND	CTM	NAV	RIO	BAL	CTL	EXT	VAL	Total
79	67	54	36	26	16	6	9	6	6	3	3	3	2	316

Note: CNR, Canary Islands; ARA, Aragon; VAS, Basque Country; AST, Principality of Asturias; CNT, Cantabria; CAT, Catalonia; AND, Andalusia; CTM, Castilla-La Mancha; NAV, Foral Community of Navarra; RIO, La Rioja; BAL, Balearic Islands; CTL, Castilla and Leon; EXT, Extremadura; VAL, Valencian Community.  
Source: Own elaboration (2024).



**Fig. 3.** Datasets in the industry category initially tagged by the portal and finally selected by the survey  
Note: CNR, Canary Islands; ARA, Aragon; VAS, Basque Country; AST, Principality of Asturias; CNT, Cantabria; CAT, Catalonia; AND, Andalusia; CTM, Castilla-La Mancha; NAV, Foral Community of Navarra; RIO, La Rioja; BAL, Balearic Islands; CTL, Castilla and Leon; EXT, Extremadura; VAL, Valencian Community; MAD, Community of Madrid; GAL, Galicia.  
Source: Own elaboration (2024).



**Fig. 4.** Autonomous communities' contribution of datasets in the industry category (and percentage of total cleaned).  
Note: CNR, Canary Islands; ARA, Aragon; VAS, Basque Country; AST, Principality of Asturias; CNT, Cantabria; CAT, Catalonia; AND, Andalusia; CTM, Castilla-La Mancha; NAV, Foral Community of Navarra; RIO, La Rioja; BAL, Balearic Islands; CTL, Castilla and Leon; EXT, Extremadura; VAL, Valencian Community; MAD, Community of Madrid; GAL, Galicia.  
Note 2. The Balearic Islands, Castilla and Leon, Extremadura and Valencian Community do not reach 1%.  
Source: Own elaboration (2024).

Finally, before analyzing the results obtained in comparison to other existing results in the literature, [Table 5](#) presents a summary comparison of the autonomous community for the industry category.

[Table 5](#) shows that the disparity observed in the autonomous communities' open government initiatives at a general level is also present for the subset of data relating to industry: unequal supply in number,

**Table 4**

Total correlation of portal datasets, datasets labeled in the industry category and selected by the research.

		Total	Labelling	Selected
Total	Pearson correlation	1	.877**	.788**
	Sig. (bilateral)		.000	.000
	N	17	17	17
Labeling Industry	Pearson correlation	.877**	1	.896**
	Sig. (bilateral)		.000	.000
	N	17	17	17
Selected Industry	Pearson correlation	.788**	.896**	1
	Sig. (bilateral)		.000	.000
	N	17	17	17

Note: \*\* The correlation is significant at the 0.01 level (bilateral).

Source: Own elaboration (2024).

three autonomous communities that carry out a single labelling of data sets compared to the rest, different percentages of statistical data available and even the formats in which the information is being offered. To highlight some commonalities, it is worth noting the widespread use of Creative Commons licenses, the least restrictive of this family, which are present in nine autonomous communities.

## 6. Discussion

Before analyzing the results, it is worth highlighting some studies that have helped establish a conceptual framework for research on OGD. The first of them indicates how to assess the quality of portals at the national level (Máchová & Lnenicka, 2017). The second one deals with the usability of OGD portals, addressing three aspects (Máchová et al., 2018) discoverability, accessibility, and reusability, while the most recent one (Lnenicka et al., 2025) performs a competitive analysis of smart city OGD portals: addressing the aspects of usability framework, design recommendations, and a roadmap for sustainable data ecosystems.

While Lnenicka et al. (2025) emphasize, in terms of download functions, the possibilities of obtaining information in certain machine-readable formats such as CSV, JSON, TXT, RDF, and XML—which enable both manual and automated analysis by users and developers—these findings are not consistent with the results of our research, which highlight the scarcity of advanced formats according to the five-star data scale.

Moving on to the assessment of the academic production in our

**Table 5**

Autonomous communities summary information in the industry category.

CC.AA	Datasets labelling	Type of labeling	Selected datasets	Majority license	% min. info statistics	Major formats	2° Major formats
AND	13	Multiple	6	cc-by	50%	csv	-
ARA	110	Only	36	cc-by	75%	html	px, csv
AST	55	Multiple	54	cc-by	50%	html	xls, ods
BAL	3	Multiple	3	cc-by	0%	Geojson	-
CAT	16	Multiple	16	Open CAT	50%	csv, rdf, rss, tsv, xml	html
CNR	166	Multiple	67	Ley 37/2007	75%	json, xml, tsv, csv, xls	json, pc-axis, csv
CNT	26	Multiple	26	Icane	50%	html, rdf, xls, pc-axis, sdmx, json	-
CTL	3	Multiple	3	cc-by	0%	csv	xml
CTM	9	Multiple	9	cc-by-sa	0%	xls, csv	html
EXT	3	Multiple	3	-	0%	xls, csv	-
MUR	5	Multiple	0	-	-	-	-
NAV	6	Multiple	6	cc-by	0%	tsv, xls, xml, xsd	csv, json, ods
RIO	6	Only	6	cc-by	50%	xls, xml, csv, json	Wms, wfs
VAL	3	Only	2	cc-by	0%	csv	wms, wfs, csv, pdf
VAS	108	Multiple	79	cc-by	75%	csv, xls	lod, api, rest, xls, pdf, json, csv
<b>TOTAL</b>	<b>532</b>		<b>316</b>				

Note:

AND, Andalusia; ARA, Aragon; AST, Principality of Asturias; BAL, Balearic Islands; CAT, Catalonia; CNR, Canary Islands; CNT, Cantabria; CTL, Castilla and Leon; CTM, Castilla-La Mancha; EXT, Extremadura; MUR, Murcia; NAV, Foral Community of Navarra; RIO, La Rioja; VAL, Valencian Community; VAS, Basque Country.

Source: Own elaboration (2024).

country and, as a general assessment, it is necessary to point out that a search in the Scopus database, introducing the key terms OGD and Spain, has only returned 104 articles, which can be considered very scarce since OGD is a very cross-cutting topic. Of all of them, none deals with data pertaining to industry; therefore, although it would have been desirable to include real examples of academic studies on the use of these datasets by companies and/or identify success stories for startups or researchers, only some general aspects can be highlighted below.

Firstly, and in a Spanish key, the report on the characterization of the infomediary sector (ONTSI, 2020) identifies 708 companies related to the exploitation of data, artificial intelligence or big data. For its part, the national portal highlights 100 examples of good practices, including eight companies that reuse industry data: ISETIC, desideDatum, Iberinform, Hispatec, Grupo Sociedad de Tasación, Geograma, SRM Consulting, and Stratos Global Solutions. Secondly, at the international level, it is the research of Raptis et al. (2019) that offers an overview of data management applied to industrial environments, collecting a series of relevant studies in the following areas: Industrial Data Management for Dedicated Applications, Data-Driven, Manufacturing, Cloud Manufacturing, Industrial Wireless Standards, IIoT Technologies, Scheduling and Synchronization, Product-Service Systems and Industrial Cognitive Radio.

After highlighting the absence of studies on industry datasets in Spain, the work of two groups of researchers who stand out for their attention to OGD at the national level is summarized. This summary, which shows the two most extensive lines of research on open data in Spain, simply aims to show what is most widely published in the country.

The first group would be that of Ricardo Curto-Rodríguez, who, together with other researchers, analyzes the role of OGD in Spain: for the development of transparency in its early stages (Curto-Rodríguez, 2015), the impact of national law on transparency, access to public information and good governance (Curto-Rodríguez, 2017), the determinants of this data supply (García-García and Curto-Rodríguez, 2018) or the options for interaction, participation and collaboration (Curto-Rodríguez, 2019). There is also a typological analysis (Curto-Rodríguez, 2020a), another using cluster methodology (Curto-Rodríguez, 2020b) and a comparative review with Mexico, also a highly decentralized country (Curto-Rodríguez, 2023). The most recent work is introspective of OGD, and open government carried out on Spanish autonomous community leaders (Curto-Rodríguez et al., 2024).

The second group would be composed of Alberto Abella, Marta Ortiz

de Urbina and Carmen de Pablos. One of the main themes of these authors is the formulation of a metric to evaluate the reuse of OGD called MELODA (Abella et al., 2014) that has evolved to its version 5.0 (Abella et al., 2019) or the enumeration of criteria for the identification of inefficient data portals (Abella et al., 2022). These authors (sometimes together with others) have developed a series of reports to measure how data dissemination is being performed in Spain, with the last report published in the year 2024 (Abella et al., 2024).

To highlight some of the conclusions of this latest report, it is worth noting the statistical deepening observed, which has increased by more than 5% (being this type of data the main responsible for the increase in data produced in recent years), the lack of standardization, the infrequent updating, the lack of maintenance of OGD services, the high use of formats not suitable for reuse or that most of the published data do not follow a standard, which makes it difficult to consolidate data common to different sources. Although these reports are made through sampling, and not through the population analysis used in this article, their assertions are in line with the findings of the present research: excessive statistical information, datasets that are not updated, an abundance of datasets formulated in html that occupies the bottom rung of Tim Berners-Lee's five-star scale of reusability (Berners-Lee, 2010), and a compilation of data that makes it difficult to combine datasets offered by different providers (it is almost impossible to find in the more than 500 datasets analyzed in the present paper any with common content).

It seems that, unfortunately, the Spanish Frankenstein concept of OGD (Garriga Portolá, 2013) is still in force, which will make it difficult for OGD to create value. Therefore, we share the opinion of Gao et al. (2023) on the growing concern about the quality of OGD in Europe, as well as that of Ortiz-de-Urbina-Criado et al. (2023) regarding the necessity of reducing heterogeneity in the publication of OGD, is shared. As Ortiz-de-Urbina-Criado et al. (2023) point out, many OGD portals are not designed for professional use. In fact, as shown by the present research, they are not even designed for non-professional use, i.e., for a profile other than a computer expert in reuse: it is not possible to download searches, sort in the desired way, etc.

## 7. Contributions and implications

In terms of theoretical implications, contributes to confirming that OGD is an underexplored area of research due to the scarcity of academic studies in this field. It has also highlighted the heterogeneity in the implementation of initiatives, which will make it difficult to combine and aggregate information into databases. Finally, the finding that initiatives are susceptible to significant improvement aligns with the current research on OGD and the suggestions made in studies on data portals.

In terms of practical contributions, by presenting the reality of existing information from autonomous communities on the industry offered in OGD, as well as its formats and licenses, the research contributes to a series of proposals to address the identified deficiencies.

- Firstly, and at the central government level, since it is responsible for the technical standard for interoperability, each of the 22 categories formulated should be defined in greater detail to provide clarity since it is not enough to mention that the industry category should contain mining data or that the commerce category should include consumer information.
- Secondly, the group of directors from the autonomous communities should hold meetings that somehow allow reaching a consensus on the minimum content of information to be disclosed, as has been done, at its level, by the Spanish Federation of Municipalities and Provinces since 2016, agreeing on the definition and inclusion of 80 data in its latest agreement, in 2024 (FEMP, 2024).
- Thirdly, and individually for each autonomous community responsible: address a comprehensive public strategy that incorporates the commitment to keep the datasets updated, which in the future would

avoid finding so much outdated information as has been encountered; improve search engines and downloads options, and oblige themselves to have a summary dataset with all the information contained in their portal.

- Finally, there should be a standardized approach to whether datasets should be assigned to a single category or multiple ones. As Curto-Rodríguez and Marcos-Sánchez (2024) point out, communities such as Aragon, Valencian Community, La Rioja and Community of Madrid make a single assignment (i.e., dataset belonging to only one category) while Galicia, Principality of Asturias, Basque Country, Foral Community of Navarra, Castilla-La Mancha, Murcia, Andalusia, Balearic Islands, Murcia and the Canary Islands the opposite phenomenon is observed. Finally, other communities as Castilla y León, Catalonia and Cantabria, datasets have been left unlabeled since the total number of datasets (which is worrying because when searching by category many datasets will no longer be displayed).

It is hoped that some of these contributions will be taken into consideration and contribute to value creation in the future, as intended. The study offers interesting insights for both those responsible for the initiatives, who can address the identified gaps, and for users, by summarizing existing information. The consolidation of an effective open data ecosystem in the Spanish industrial sector requires not only technical and regulatory improvements, but also a culture of inter-institutional collaboration and an ongoing commitment to data updating and quality. Only in this way can it be ensured that these resources truly contribute to innovation, competitiveness, and sustainability in the sector.

## 8. Limitations, conclusions, and future lines of research

The study encountered several limitations. One of these was due to the heterogeneity observed, which made it difficult to apply methodologies other than the comparative approach to the study of OGD. This aspect, pointed out by Criado et al. (2023), has necessitated that the main conclusions of this research be issued through descriptive techniques, which is undoubtedly a limitation of this study that could be justified, however, by the absence of preceding research.

Another limitation to highlight is related to the methodology used. Although, as Batini et al. (2009) point out, there is a wide variety of techniques and methodologies for evaluating and improving data quality (DQ), the relevance of the interesting proposal of the comprehensive DQM framework (Máchová et al., 2018) could have been chosen to evaluate the usability and suitability of portals or MELODA (Abella et al., 2014), a metric for evaluating the reuse of open government data (OGD) in Spain. However, given the lack of a unified framework that rigorously compares their approaches, we preferred to use our own ad hoc tool, assessing data provision in a multidimensional way.

In any case, we believe that the objectives of the research have been met. The overall objective of demonstrating how an OGD initiative works by presenting a summary idea of it, including its strengths and weaknesses, which would allow for comparison with other initiatives in neighboring countries or at similar administrative levels, has been achieved. It seems clear that there is still much room for improvement so that the potential of OGD can be fully exploited, without forgetting the important role of AI in this regard. As Nikiforova (2025) mentions, AI has great potential for enhancing OGD initiatives.

At the beginning of this research, it was indicated that OGD initiatives are relevant tools for identifying market niches or emerging business models, innovating, generating new digital services or applications, and using predictive analysis tools (among many other sources of value). To this end, the information disclosed must meet certain requirements: the existence of abundant quality information, homogenized or standardized, available in a wide range of well-documented and reusable formats and with the use of open licenses; unfortunately, only this last aspect can be considered as met.

With the exception of the predominant use of open creative commons licenses of recognition (by), which are the most favorable and least restrictive and will allow the exploitation of the work, including its commercial purpose or the creation of derivative works, without any restriction beyond recognizing the authorship of such information, the rest of the requirements cannot be considered to be met.

It cannot be said that there is an abundance of information concerning the industry. Forty per cent of the initially labeled datasets have had to be discarded, leaving the supply at 316 datasets (0.6% of the total supplied by the Spanish autonomous communities and a figure far from the expected average value of 2,100 datasets). Furthermore, the lack of homogeneous information will limit its interoperability and make comparative analysis difficult. Nor can it be considered that the offer is of high quality, as the information available is predominantly of a statistical nature and is available in a very segmented manner. For example, is it really necessary to offer the accounts by activity groupings, branches of activity, and subgroupings of activity instead of aggregating all this information into a single dataset? Two of the eight principles of OGD (Sunlight Foundation, 2007) mention that the information should be complete and primary, but, evidently, if this were done, the content of the portals would apparently be less. Is it necessary to remind (or recommend) the authorities of the autonomous communities that the goal should be to provide more meaningful information, not just more datasets? Is it possible that the disaggregated offer responds to the need for better performance?

With regard to formats, it should also be noted that, with a few exceptions, such as Catalonia, the Canary Islands, Cantabria, Foral Community of Navarra, and La Rioja, the predominant range is limited (one or two formats), and the proposed coding of the information is difficult to reuse (e.g., pdf and html files).

The investigation concludes by pointing out some lines of research. One line of research could be to compare the results achieved in this study with those of other levels of the Spanish government. Nikiforova (2020) indicates that it has not been empirically proven whether the OGD provided by national governments is of better quality than that of municipalities; in fact, it may be surpassed, so it would be advisable to compare these results with studies at the municipal or national level.

Likewise, future studies could carry out a comparison or autonomous communities ranking (this is a complex issue due to the heterogeneity of the initiatives), investigate the determinants of the values achieved (also difficult due to the differences in size, income or population of the Spanish autonomous communities) or contrast whether the inattention observed is related to the predominance of the tertiary sector in Spain as opposed to the industrial sector.

Obviously, another line of research would be to apply other indicators to see if the conclusions reached by this study hold true. It is hoped that some of these possibilities will eventually be put into practice in the future.

## Funding

The authors would like to thank SIGNUS Ecovalor, S.L. for the collaboration provided through the creation of the SIGNUS Classroom (reference number PAU2354090272) at the E.T.S. de Edificación de Madrid (Spain).

## CRediT authorship contribution statement

**Ricardo Curto-Rodríguez:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Rafael Marcos-Sánchez:** Writing – review & editing, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis. **Daniel Ferrández:** Writing – review & editing, Visualization, Validation, Supervision, Software, Resources, Project

administration, Methodology, Formal analysis.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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