

PROSPECTS 5.0 Industry 5.0 Wiki

September 2026 Patent Analysis

Robotics and Automation in Food and Beverage Manufacturing

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1. EXECUTIVE SUMMARY

This report presents a patent landscape analysis of robotics and automation technologies applied to food and beverage manufacturing. The analysis is based exclusively on a structured search of the European Patent Office (EPO) Espacenet database, which returned 85,089 patent families matching the combined criteria: a technology dimension covering robotics, machine learning, industrial control and automation, and an application dimension covering food and beverage production. Every figure, trend and interpretation reported here is derived solely from that dataset.

The field is large, long-established and expanding rapidly. Although food-processing machinery has been patented since the nineteenth century, annual volumes accelerated sharply from the mid-2010s, rising from around 1,500 families per year in 2012 to a peak of 7,042 in 2021. This reflects the accelerating penetration of robotics, automation and, increasingly, artificial intelligence into food and beverage production lines.

Geographically, China dominates the jurisdictions of protection with 59,712 families, far ahead of the United States (11,320), international PCT filings (WO, 7,602), Japan (6,914), the Republic of Korea (6,507) and the European Patent Office (EP, 6,235). Europe occupies a strategically strong position: the EPO is the second-largest CPC-assigning office in the entire dataset, ahead of the United States and only behind China, underlining Europe's central role both as a market and as a classification and examination hub for this technology.

On the origin-of-innovation side, the EU-27 collectively forms one of the world's leading knowledge bases for food and beverage automation, led by Germany, Italy, France, Spain and the Netherlands. European applicants combine world-class food-processing engineering, including globally recognised equipment manufacturers, with strong robotics and industrial-automation capabilities, positioning the Union to lead in the high-value, quality- and safety-driven segments of the sector that align with Industry 5.0.

The technology mix spans food-processing and shaping machinery, cooking and kitchen equipment, produce and beverage handling, and a growing digital layer of machine learning, industrial control and food-service ICT. Dedicated robotics classifications for food handling appear prominently, and sustainability-oriented classifications feature strongly, reflecting the sector's dual drive towards automation and resource efficiency.

Notably, activity continued to grow strongly through the COVID-19 period rather than pausing: publications rose from 6,213 in 2020 to a record 7,042 in 2021, and priority filings peaked at 6,705 in 2020. This is consistent with the pandemic accelerating demand for automation in food production, where labour availability, hygiene and supply-chain resilience became especially critical.

2. INTRODUCTION

2.1. Scope and Objectives

Robotics and automation are transforming food and beverage manufacturing, addressing long-standing challenges around labour, hygiene, consistency, throughput and traceability. From robotic handling and packaging to automated processing, quality inspection and AI-driven process control, these technologies are central to the resilient, sustainable and human-centric vision of Industry 5.0. This report maps the intellectual-property landscape of the field to help the PROSPECTS 5.0 consortium understand where innovation is concentrated, who the principal actors are, how the field is evolving, and where Europe stands.

2.2. Data Source and Search Strategy

The analysis draws on a single authoritative source: the EPO Espacenet worldwide patent collection. The search combined a technology dimension with an application dimension. The technology dimension captured robotics and manipulators (CPC B25J), machine learning (G06N20/00), industrial control and programmable automation (G05B19/00), operations/logistics management (G06Q10/00) and the free-text concepts of robotics and automation. The application dimension restricted results to food and beverage contexts through the food classification (A23) and the free-text terms food and beverage, further narrowed to a manufacturing setting via terms such as manufacturing, production and conveyor.

The combined query returned 85,089 patent families. Counting is performed at the patent-family level, so each distinct invention is counted once regardless of how many national filings it generates, which gives a robust basis for cross-country comparison. Every statistic in this report is taken directly from the Espacenet result set and its associated filter breakdowns; no external data has been introduced.

2.3. Methodological Notes

Two dating conventions are used. The earliest priority date approximates when an invention was first filed and is the best proxy for the timing of inventive activity; the earliest publication date records when a family first became public. Because applications are typically published around 18 months after filing, and because recent priority years are still being published, the most recent one to two years are necessarily incomplete and should be read as provisional rather than as evidence of decline. Jurisdiction counts describe where protection is sought; applicant- and inventor-country counts describe where innovation originates. Throughout this report, references to Europe and the EU-27 denote the twenty-seven member states of the European Union.

3. TEMPORAL EVOLUTION OF THE FIELD

The dataset reaches back to the mid-nineteenth century, reflecting the long industrial history of food-processing machinery, but the overwhelming majority of activity is recent. Annual publications grew steadily through the 2000s and then expanded rapidly from the mid-2010s onwards (Figure 1).

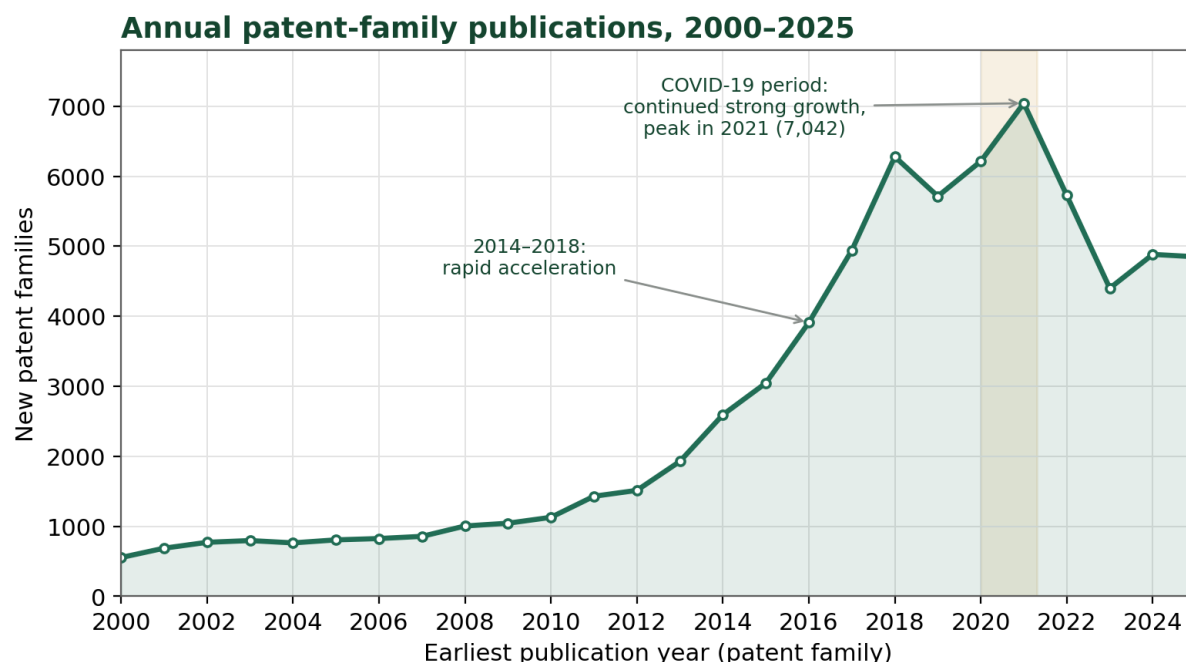


Figure 1 Annual patent-family publications by earliest publication year (2000–2025).

Three phases are visible. A steady-growth phase through to about 2013 saw annual volumes rise from roughly 550 to around 1,900 families. A rapid-acceleration phase then took hold: publications climbed from 1,927 in 2013 to 3,046 in 2015 and 4,942 in 2017, before reaching 6,278 in 2018. A high-plateau phase followed, with volumes fluctuating between roughly 4,400 and 7,000 families per year and a peak of 7,042 in 2021, the strongest year on record. The apparent softening in the most recent years reflects publication lag rather than a genuine decline, as discussed in the methodology.

This trajectory signals a field that has moved decisively from incremental mechanisation into an era of robotics-, automation- and AI-driven innovation. The acceleration coincides with the broad industrial adoption of collaborative robots, machine vision and data-driven process control across manufacturing, all of which are strongly represented in the technology breakdown later in this report.

3.1. Priority Activity and the Leading Edge of Invention

Earliest-priority data, which track first filings, confirm the same momentum and locate the leading edge of inventive activity. Priority filings rose from 1,367 in 2011 to 6,050 in 2017 and peaked at 6,705 in 2020 (Figure 2).

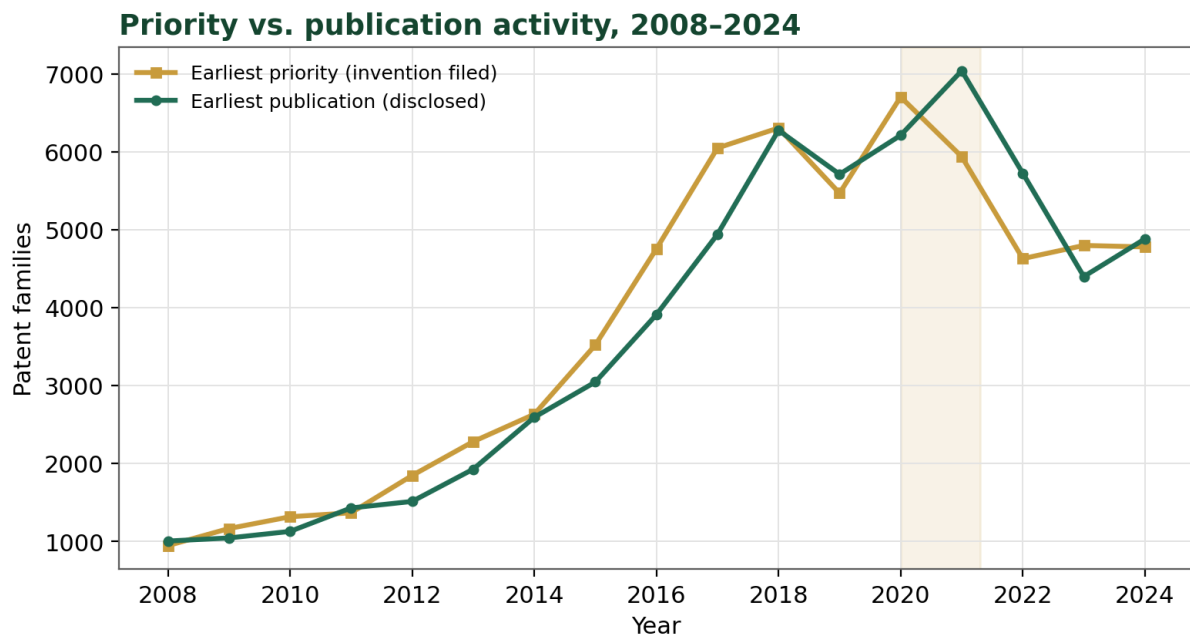


Figure 2. Earliest-priority versus earliest-publication activity (2008–2024).

The priority and publication curves track one another closely, with the priority series running slightly ahead as expected given the publication delay inherent in the patent system. The decline in the final priority years reflects families that have not yet been published and entered the counts, rather than any genuine slowdown. Read together, the two series describe a field sustaining historically high levels of inventive output.

3.2. The COVID-19 Period

In contrast to many technology fields, food and beverage automation grew strongly through the pandemic. Publications rose from 6,213 in 2020 to a record 7,042 in 2021, and priority filings reached their single-year peak of 6,705 in 2020. Rather than a pause, the COVID-19 period coincides with the most intense phase of activity in the dataset (Figure 3). This pattern is consistent with the pandemic acting as an accelerant for automation in food production. Disruptions to labour availability, heightened hygiene and safety requirements, and pressure on food supply chains all strengthened the case for robotics and automated processing. The data suggest that the sector responded to these pressures by intensifying rather than deferring innovation, reinforcing the strategic importance of automation to food-system resilience.

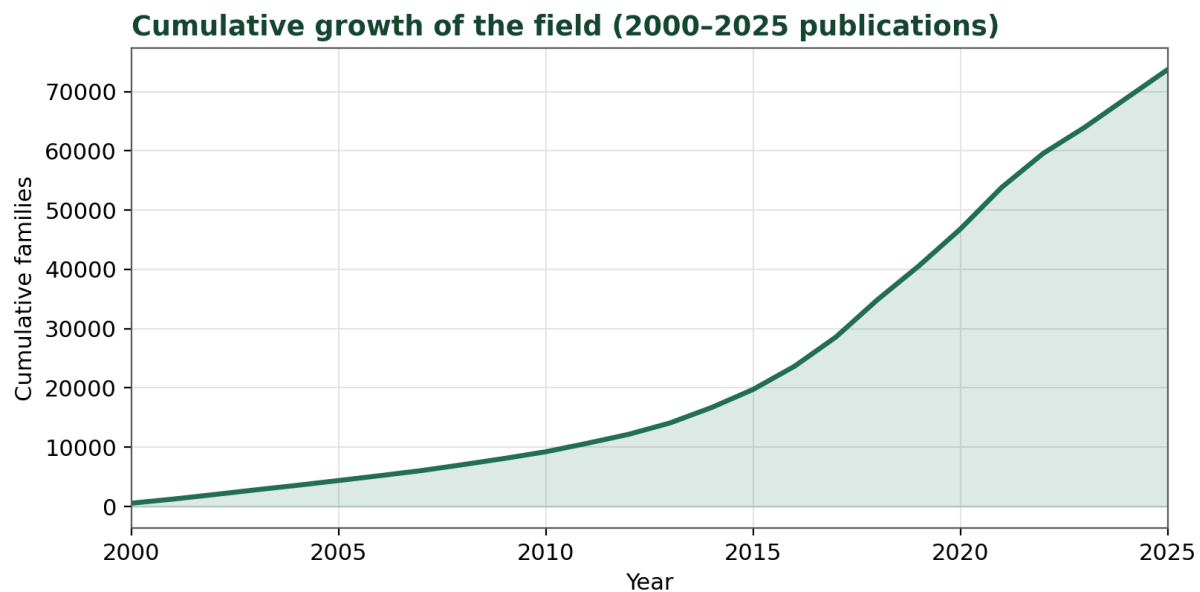


Figure 3 Cumulative growth of published patent families (2000–2025).

Viewed cumulatively, the field has compounded steeply, with the large majority of all families in the dataset published since 2015. The steepening slope underlines that this is an expanding, actively developing domain rather than a mature or saturated one.

4. GEOGRAPHIC DISTRIBUTION

4.1. Jurisdictions of Protection

The countries in which protection is sought reveal which markets applicants consider commercially important. China stands far ahead of all other jurisdictions, followed by the United States, a large volume of international PCT filings, Japan, the Republic of Korea and the European Patent Office (Figure 4).

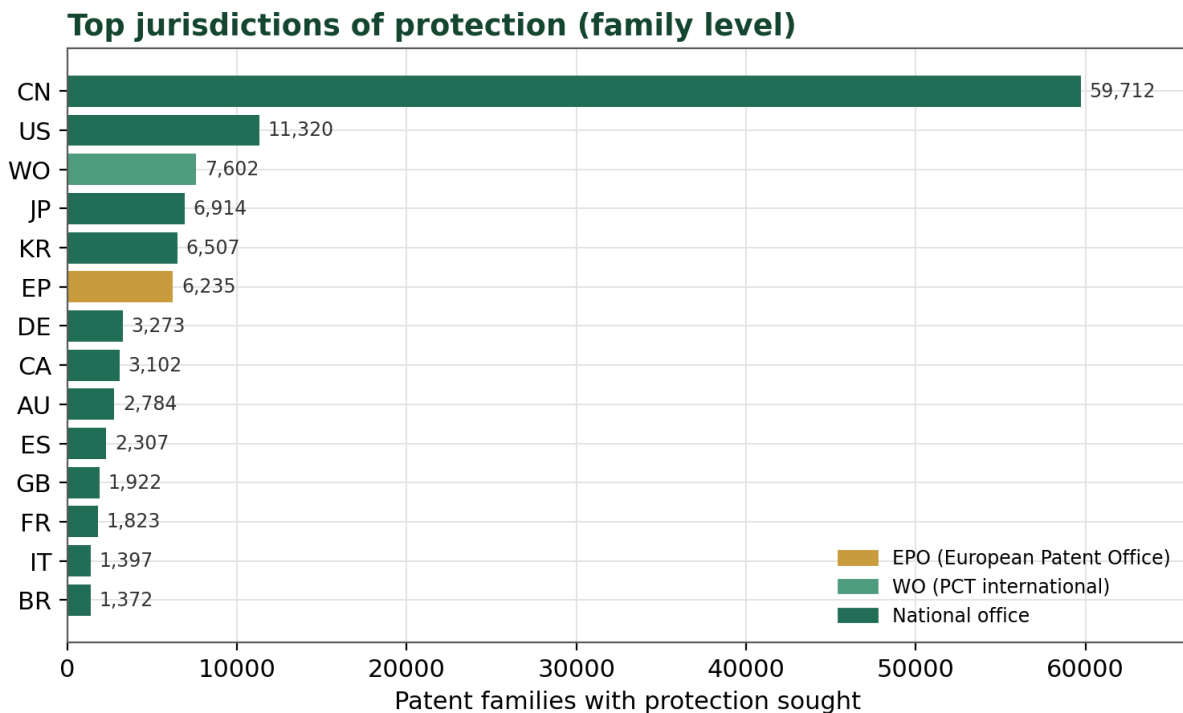


Figure 4 Top jurisdictions of protection at family level.

Table 1 Leading jurisdictions where protection is sought (family level).

Jurisdiction	Families	Interpretation
CN – China	59,712	By far the largest market for protection
US – United States	11,320	Major second market
WO – PCT (international)	7,602	Strong use of the international route
JP – Japan	6,914	Established automation and machinery base
KR – Republic of Korea	6,507	Major electronics and robotics hub
EP – European Patent Office	6,235	Europe a priority multi-country market
DE – Germany	3,273	Leading European machinery market
CA – Canada	3,102	Significant secondary market

China's dominance in filing volume is striking and reflects the scale of its food-manufacturing sector and domestic patenting activity. Europe's position, while smaller in raw jurisdiction volume, is strategically strong: the 6,235 EP filings represent applicants choosing to secure protection across multiple European states through a single centralised route, a clear signal of the commercial value placed on European markets. The large volume

of PCT (WO) filings further indicates that many applicants keep European entry open through the international phase (Table 1).

4.2. Origin of Innovation: Applicant Countries

Applicant-country data show where the innovation is generated, and here the picture is more balanced than the jurisdiction view. The United States leads (12,786 families), followed by the Republic of Korea (6,549), China (4,206) and Germany (3,369), with several European countries prominent in the upper ranks (Figure 5).

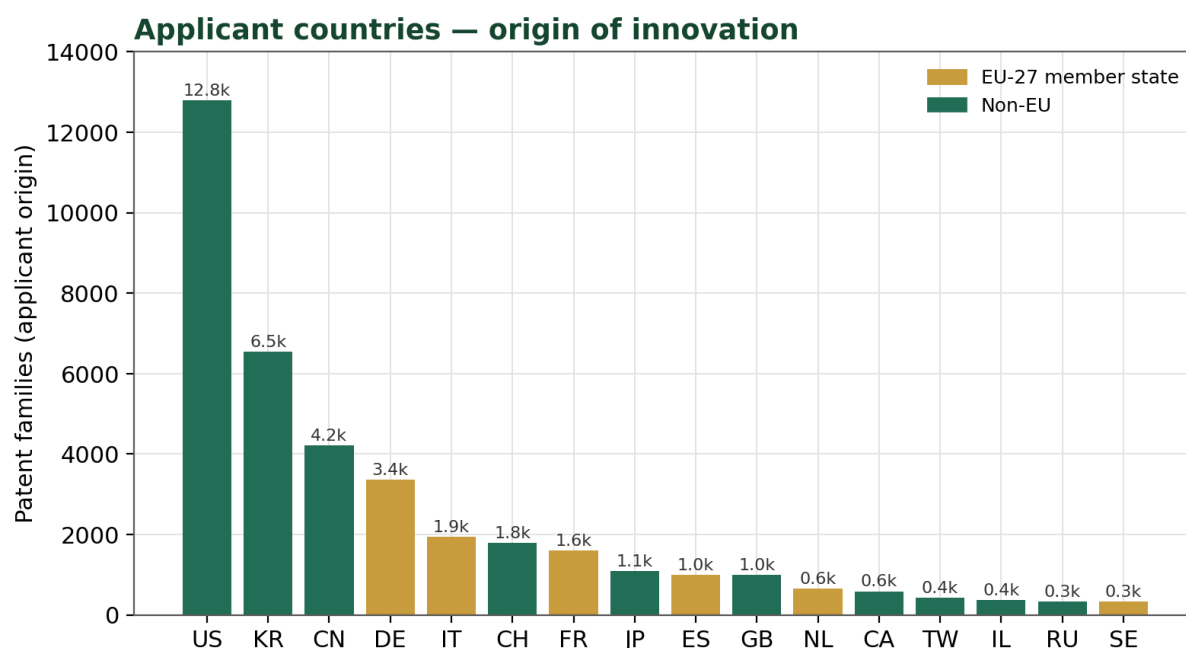


Figure 5 Applicant countries by origin of innovation, with EU-27 members highlighted.

Notably, when applicant origin rather than filing jurisdiction is considered, China's share falls substantially, while European countries, Germany, Italy, France, Spain and the Netherlands among them, feature strongly. Switzerland also appears prominently, reflecting the presence of major food and equipment companies. It is more informative to view the EU-27 as a single innovation bloc, which is the subject of the next section.

5. EUROPE IN FOCUS: THE EU-27 INNOVATION BASE

Consistent with a European-strategic reading of the landscape, this section aggregates the EU-27 member states into a single view. Taken together, the EU-27 constitutes one of the world's leading centres of invention for food and beverage automation, combining deep food-engineering heritage with strong robotics and industrial-automation capabilities (Figure 6).

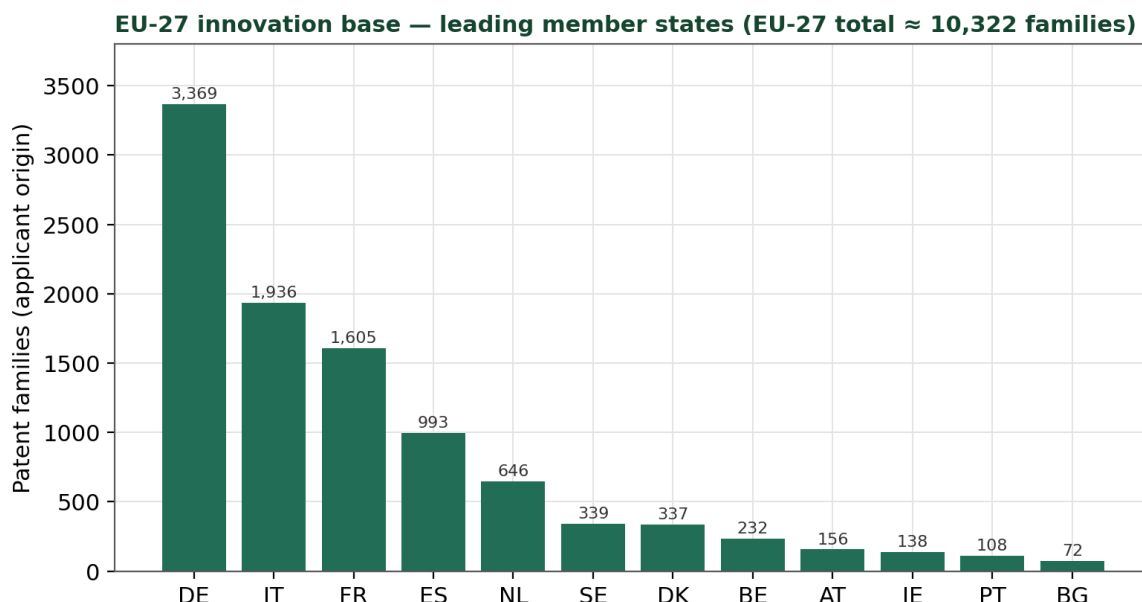


Figure 6 Leading EU-27 member states by origin of innovation (applicant country).

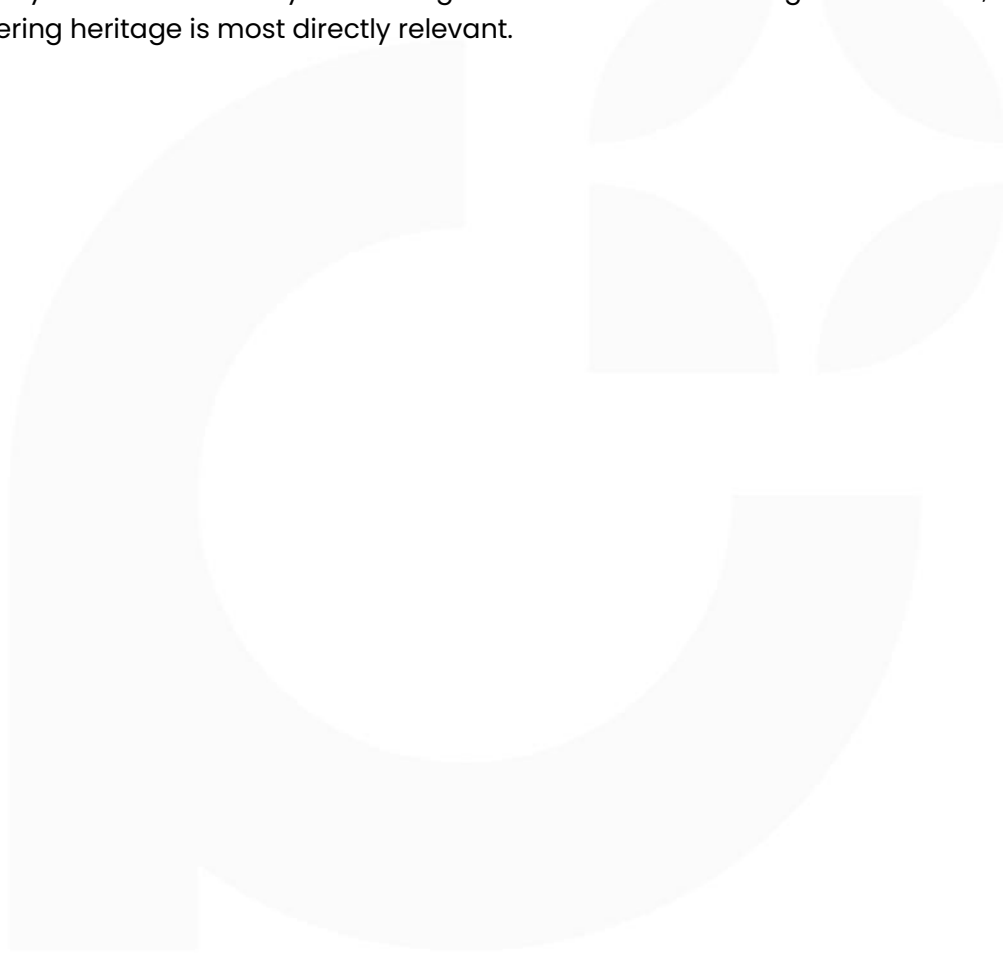
Within the Union, Germany provides the largest contribution, anchored by its world-leading food-processing and packaging machinery industry and its broader automation and robotics base. Italy follows closely, reflecting its globally recognised food-machinery sector, ahead of France, Spain and the Netherlands. This distribution mirrors Europe's traditional industrial strengths in food equipment and precision engineering, now increasingly augmented by robotics and digital control (Table 2).

Table 2 Principal EU-27 member states contributing to the field (applicant origin).

EU-27 Member State	Families (applicant)	European strength
Germany	3,369	Food-processing and packaging machinery, automation
Italy	1,936	Globally recognised food-machinery sector
France	1,605	Food industry, robotics and control
Spain	993	Food processing and equipment
Netherlands	646	Agri-food technology and automation
Sweden	339	Packaging and processing technology
Denmark	337	Food technology and processing equipment
Belgium	232	Food engineering and research
Austria	156	Machinery and mechatronics

This distributed strength is a European asset. No single member state dominates; instead, complementary national specialisms, German and Italian food-machinery leadership, French food-industry and control expertise, Spanish processing capability, and Dutch and Nordic agri-food technology, combine into a broad and resilient innovation base. This diversity is well matched to Industry 5.0's emphasis on human-centric, sustainable manufacturing, and it positions Europe to lead in the high-value segments of the sector where quality, food safety, sustainability and precision are decisive.

The protection side reinforces the point. With the EPO the second-largest CPC-assigning office in the dataset, ahead of the United States and behind only China, Europe is both a significant source of invention and one of the most sought-after and technically influential markets in which to secure it. Europe is therefore positioned not to catch up but to lead in the quality- and sustainability-driven segment of food and beverage automation, where its engineering heritage is most directly relevant.



6. TECHNOLOGY CLASSIFICATION

Classifying the dataset by Cooperative Patent Classification (CPC) subgroup reveals the technical composition of the field. Two broad strands stand out: food-processing and handling machinery, and a growing digital layer of automation, control and artificial intelligence (Figure 7).

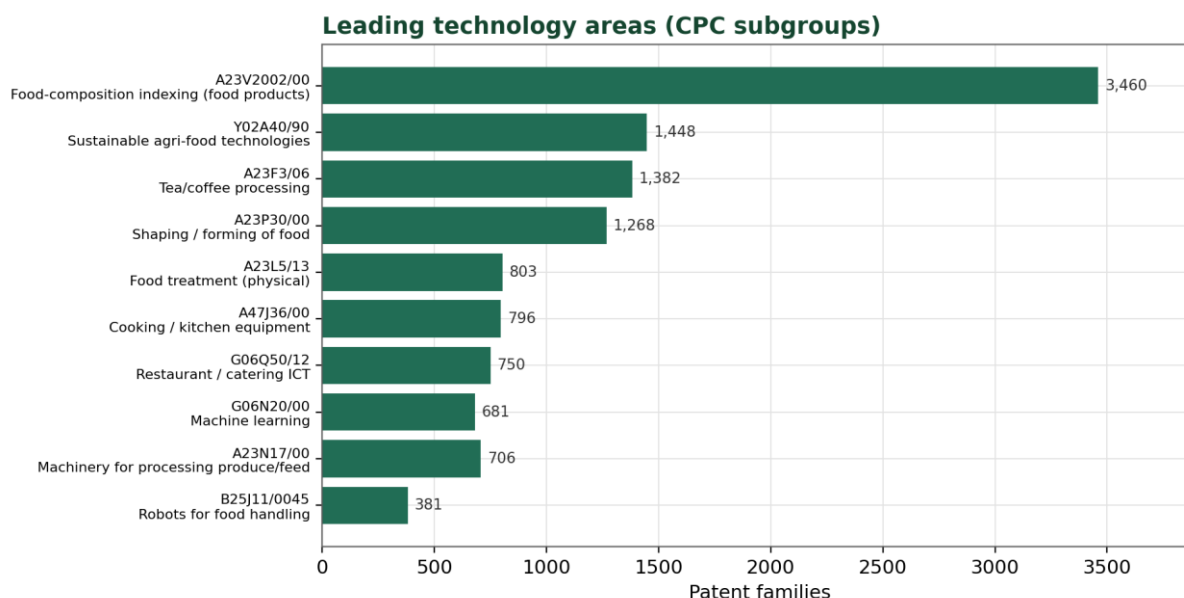


Figure 7 Leading technology areas by CPC subgroup.

Table 3 Leading CPC subgroups and their technology areas.

CPC subgroup	Technology area	Families
A23V2002/00	Food-composition indexing (food products)	3,460
Y02A40/90	Sustainable agri-food technologies	1,448
A23F3/06	Tea and coffee processing	1,382
A23P30/00	Shaping and forming of food	1,268
A23L5/13	Physical treatment of food	803
A47J36/00	Cooking and kitchen equipment	796
G06Q50/12	Restaurant and catering ICT	750
G06N20/00	Machine learning	681
A23N17/00	Machinery for processing produce/feed	706
B25J11/0045	Robots for food handling	381

The largest areas concern food products and processing directly, food-composition classifications, tea and coffee processing, food shaping and forming, and physical food treatment, confirming that a substantial part of the field remains rooted in the specifics of food manufacturing. Cooking and kitchen equipment and produce-processing machinery add further weight to this processing strand (Table 3).

Alongside this sits a clear and growing digital and robotics layer. Machine learning (G06N20/00, 681 families), restaurant and catering ICT (G06Q50/12, 750), industrial control (G05B19 families) and dedicated robots for food handling (B25J11/0045, 381) show that automation, data-driven control and artificial intelligence are being actively integrated into food and beverage production. The strong presence of sustainability-oriented classifications (the Y02A and Y02P families) is also notable, reflecting the sector's parallel drive towards resource efficiency and lower environmental impact, a priority closely aligned with European policy and with Industry 5.0.

The co-occurrence of these strands is the defining feature of the landscape: food-specific processing expertise is increasingly combined with general-purpose robotics, automation and AI. Innovation is concentrating at their intersection.



7. COMPETITIVE LANDSCAPE

7.1. Leading Applicants

The applicant landscape is notably fragmented and diverse, spanning appliance manufacturers, food and beverage multinationals, specialist equipment makers and a large number of universities. No single company dominates; the leading applicants each account for only a small share of the 85,089 families (Figure 8).

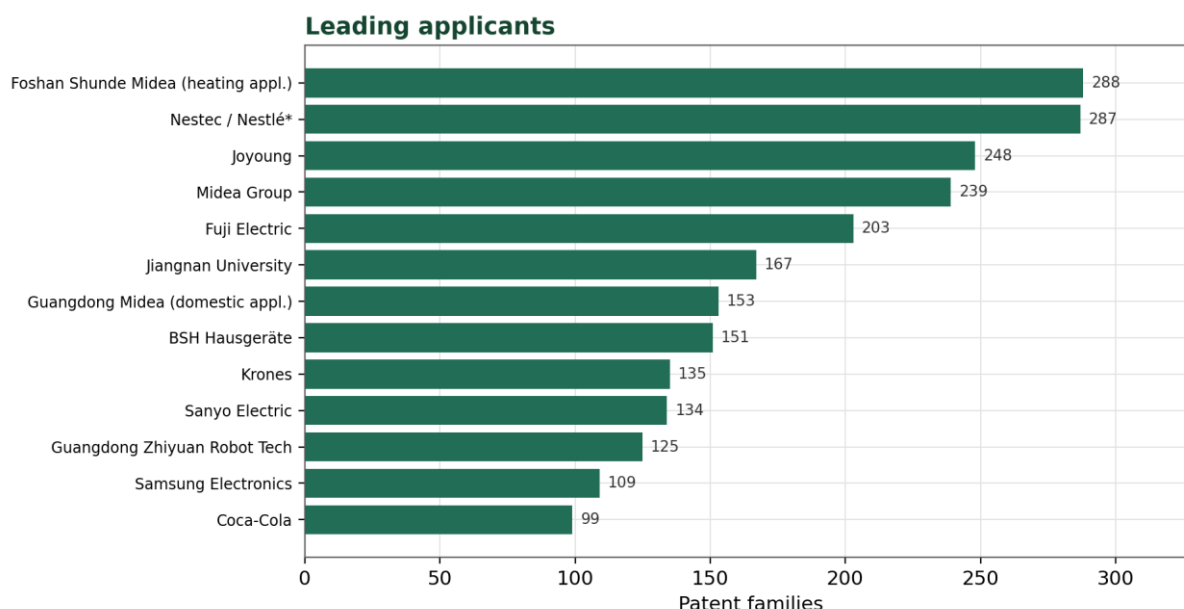


Figure 8 Leading applicants by number of patent families.

Table 4 Leading applicants and their principal focus (*Nestec and Nestlé SA entries combined).

Applicant	Families	Type
Nestlé (Nestec / Nestlé SA)*	287	Food and beverage multinational
Foshan Shunde Midea (heating appliances)	288	Appliance manufacturer
Joyoung	248	Food-appliance manufacturer
Midea Group	239	Appliance manufacturer
Fuji Electric	203	Industrial automation
Jiangnan University	167	Academic (food science)
BSH Hausgeräte	151	European appliance manufacturer
Krones	135	European beverage-line equipment
Guangdong Zhiyuan Robot Tech	125	Robotics
Coca-Cola	99	Beverage multinational

Several observations stand out. First, food and beverage multinationals are prominent, Nestlé (combining its Nestec and Nestlé SA entries) leads, with Coca-Cola, Tetra Laval, Procter & Gamble and others also present, reflecting substantial in-house innovation by the sector's largest players. Second, European specialist equipment makers appear strongly, including BSH Hausgeräte, Krones, Weber Maschinenbau, SEB, Miele and Vorwerk,

underlining Europe's depth in food and beverage machinery. Third, a very large number of Chinese appliance manufacturers and universities populate the ranking, consistent with the high domestic filing volumes seen in the jurisdiction data (Table 4).

The strong academic presence, including Jiangnan University, several Chinese agricultural universities and others, is characteristic of a field still generating substantial fundamental invention, and it signals clear opportunities for the kind of research–industry collaboration that European consortia are well placed to lead. The fragmented competitive structure, with no dominant incumbent, leaves considerable room for specialised European entrants, particularly in the high-value, quality- and sustainability-driven segments where European equipment makers and food companies are already strong.



8. METHODOLOGY AND LIMITATIONS

This landscape is built entirely from the Espacenet search result set and its filter breakdowns. The following considerations should be kept in mind when interpreting the findings.

- Family-level counting. All counts are at the patent-family level, so each invention is counted once. This is the appropriate basis for comparing jurisdictions and applicants without double-counting national filings.
- Recent-year incompleteness. Because publication typically follows filing by around 18 months, and because the most recent priority years are still being published, the last one to two years understate true activity and should be read as provisional.
- Search-definition sensitivity. Results depend on the chosen CPC classes and free-text terms. The query combines a broad robotics/automation technology dimension with a food and beverage application dimension; a different term set would shift the totals, though the broad structure of the landscape is robust.
- Applicant-name fragmentation. Large organisations may appear under several name variants (for example Nestec and Nestlé SA, or multiple Midea entities), so individual applicant counts can understate a group's true portfolio.
- Jurisdiction versus origin. Jurisdiction counts show where protection is sought; applicant- and inventor-country counts show where innovation originates. The two answer different questions and are reported separately.

Within these bounds, the dataset of 85,089 families provides a large and reliable basis for characterising the scale, timing, geography, technology mix and competitive structure of the field.

9. CONCLUSIONS

Robotics and automation in food and beverage manufacturing have matured into a very large, fast-growing and internationally active field of innovation. The Espacenet dataset of 85,089 patent families shows steady historical activity giving way to rapid acceleration from the mid-2010s, with annual publications peaking at 7,042 in 2021 and the great majority of all families published since 2015.

Distinctively, the field grew strongly through the COVID-19 period rather than pausing, with record activity in 2020–2021. This is consistent with the pandemic accelerating demand for automation in food production, where labour, hygiene and supply-chain resilience became critical – underscoring the strategic durability of the field.

Europe is strongly positioned. China leads in raw filing volume, but on the origin-of-innovation side the EU-27 forms one of the world's leading knowledge bases, led by Germany, Italy, France, Spain and the Netherlands, with complementary national specialisms and globally recognised food-machinery leadership. The EPO is the second-largest CPC-assigning office in the dataset, confirming Europe as both a priority market and a technically influential hub. The technology mix, combining food-specific processing expertise with robotics, automation, AI and a strong sustainability orientation, plays directly to European strengths and aligns closely with the human-centric, sustainable ambitions of Industry 5.0.

The fragmented competitive structure, the significant academic presence, and Europe's dual strength as both a source and a destination for this technology together suggest that Europe is well placed to lead the high-value, quality- and sustainability-driven segment of food and beverage automation. For PROSPECTS 5.0, the landscape points to clear opportunities to build on Europe's food-engineering and automation base, to foster research–industry collaboration, and to translate a strong innovation position into resilient, sustainable and human-centred food-manufacturing solutions.

10. REFERENCES

[1] European Patent Office, Espacenet patent search, result set of 85,089 patent families (search reference Espacenet_search_result_20260713_1224), retrieved 13 July 2026. This report relies exclusively on this Espacenet result set and its associated filter breakdowns (jurisdictions, priority and publication years, CPC/IPC classifications, applicants and applicant/inventor countries).

[2] European Patent Office, Cooperative Patent Classification (CPC) scheme – definitions of subgroups referenced in this report (e.g. B25J, B25J11/0045, G06N20/00, G05B19/00, G06Q50/12, A23 food classes, A23V2002/00, A23F3/06, A23P30/00, and the Y02A/Y02P sustainability tags).



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