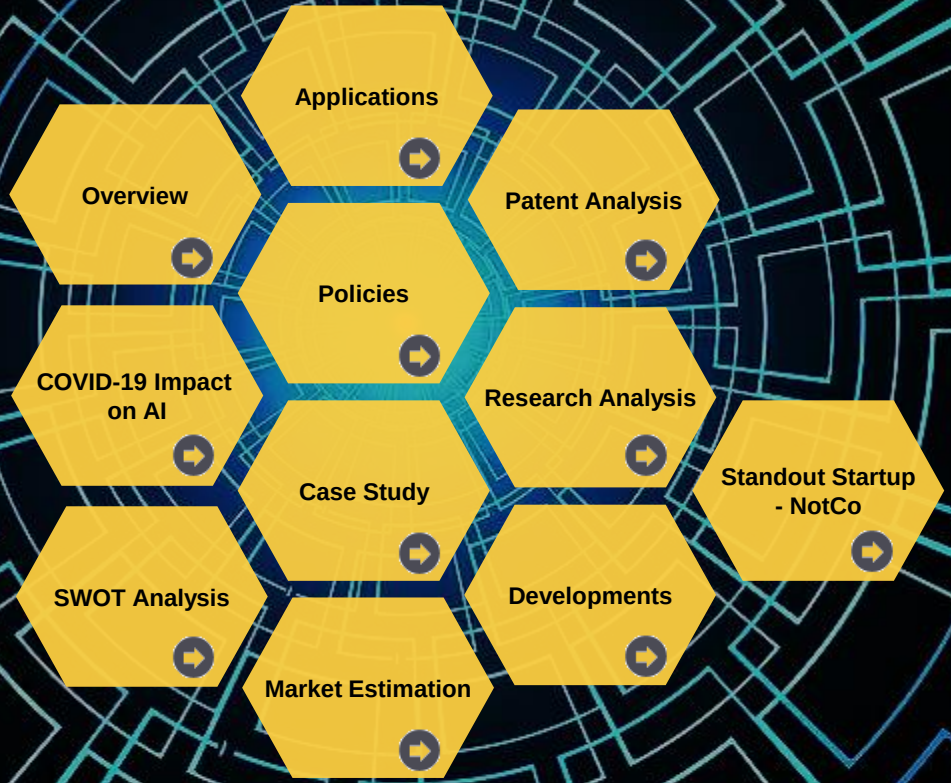
Industrial Innovations in Food Manufacturing

Artificial Intelligence Focus

Q1 | 2020

INDUSTRY PULSE

Contents: Q1 Pulse – Artificial Intelligence

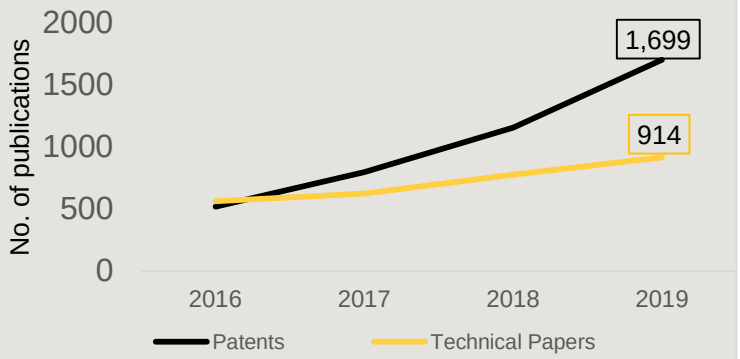


Overview: Q1 Pulse – Artificial Intelligence

Artificial Intelligence (AI) Learnings

- The global AI market is expected to grow to **USD 6 trillion** in **2025** with a CAGR of **30%**
- The AI technologies **predictive** and **analytical** capabilities are being explored to **create consumer acceptable products** and **efficient processes**
- The segment is expected to **rapidly rise** with **increased push** towards **digitalization** due to the **COVID-19 pandemic**
- **North America**, **Asia-Pacific**, and **Europe** are regions with the **highest developments** in the segment

Overview of AI developments (Global, 2016-2019)



Technology & Solutions

- Artificial Intelligence has found **use in every aspect** of **food supply chain** such as **increasing processing**, **lowering errors**, **predicting supply chain shortfalls** as well as **assessing workers** in the industry
- Standout startup **NotCo** (Chile) utilizes **AI technology** to create plant-based products that can **mimic animal protein**

Policies

- Countries in the **Asia-Pacific** and **European** region are increasingly framing **policy roadmaps** for the AI technology
- **UAE** has created a **Ministry of AI** to **regulate** the industry with a viewpoint of being a front-runner in the technological revolution

Technical Papers

- Research in the **AI segment peaked in 2019** with **914** research paper focused on **applications** of AI in **predicting consumer acceptability** and **efficiency of equipment**
- **North America** and **Asia** are the regions with the **highest papers** published. **US**, **China**, **Japan**, **UK**, and **India** being the top 5 countries with research published

Patents

- AI **patents** witnessed steady increase with **1966 published patents** in **2019**
- Established companies such as **IBM** (US), **LG Electronics** (South Korea), **Microsoft** (US), and **Kraft Foods Group Brands** (US) are highly active in AI-based patent segment

Player Strategy

- **Startups Worximity Technology** (Canada), **Covariant** (US), and **LeanDNA** (US) are receiving higher funding to **expand their technologies** and their **geographical reach**
- Established players such as **Sony** (Japan) and **Kerry Group** (Ireland) are expected to **increase competitiveness** in the segment with their **technological expertise**

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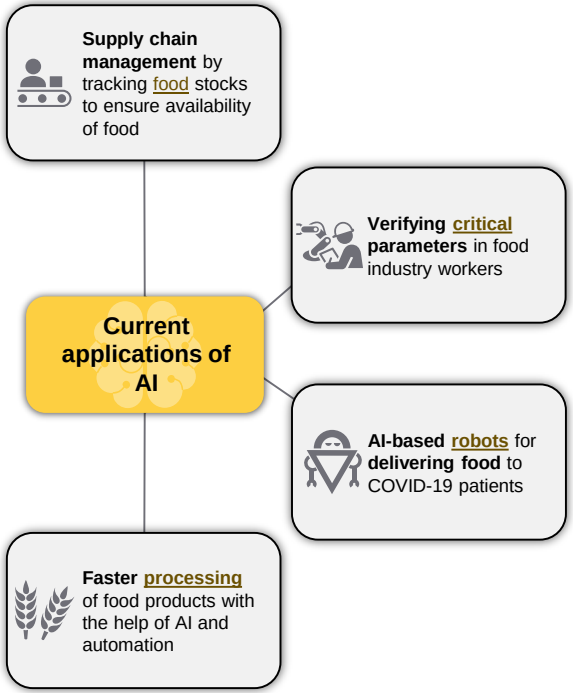
- The **COVID-19** pandemic is expected to push **AI** faster in the global market with **increasing investments** observed in the segment.
- AI is finding use in **increasing processing**, **lowering errors**, **predicting supply chain shortfalls** as well as **assessing workers** in the industry.

Fun Fact

AI-based model **HealthMap** and AI-based application **BlueDot**, were one of the first to sound an alarm on the coronavirus epidemic

COVID-19 is expected to highlight the applicability of AI in various segments to achieve faster and low-error production

Artificial Intelligence (AI): Impact of COVID-19



Long term effects of COVID-19 for AI

- **AI** will be increasingly utilized in **forecasting food demands** and **ensuring efficient delivery**
- Increase in AI-based healthcare and **nutrition applications** that **monitor users in real-time**
- The increased use of AI in **predictions of products and materials** that will be **successful in the market**
- Increased **investment in AI technology** will help in **increasing** the **technologies adoption**
- The **coronavirus pandemic** is expected to accelerate uptake of **digitalization technology** across segments. Developing countries are expected to build on their **digitalization capabilities**

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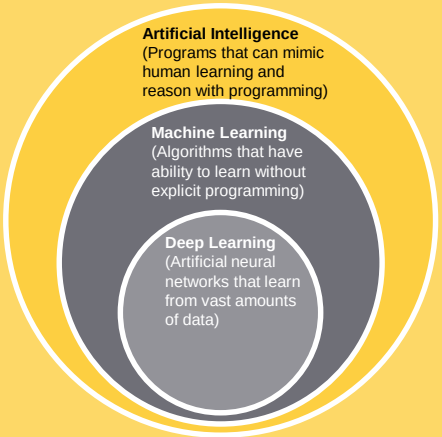
- The AI technology is a **relatively new** to be **adopted in the food and beverage industry**.
- The technology is capable of **analyzing large data** and **producing patterns** that can also be **predicted**.



Definitions

AI brings unique capabilities of analyzing large data to find patterns that can be utilized in the food and beverage industry

Artificial Intelligence (AI): SWOT Analysis

STRENGTHS

- Capability to **analyze large** amounts of **data** and find **patterns**
- **Reduces time** of **processing**
- Futuristic **risk analysis**

WEAKNESSES

- **Increased cost** of development
- **Slow** software **development**
- Requirement of **human intervention** to ensure validation of results
- The algorithm may **focus** only at **one particular** task

OPPORTUNITIES

- **Predicting food supply** and **demand**
- Combining **AI** with technologies such as **Internet of Things** increase its effectiveness in **resolving issues**
- Startups are receiving increasing amount of **investments** to scale-up its technologies
- Increasing the **precision** and **efficiency** of the software to obtain **better results**

THREATS

- **Ethical issues** regarding AI use of user information
- Potential **risk of data breach**

Artificial Intelligence (AI): Applications

Key Takeaways
- Artificial Intelligence has found **use in every aspect** of **food supply chain**.
- While traditionally more focus was observed in the food processing segment the focus has now **increased** on **personalized food products**, **predictive technologies** and **agriculture segment**.

Webinar Alert
AI is **FutureBridge's Top 5 Technology Trend in 2020**. Watch Now via this link.

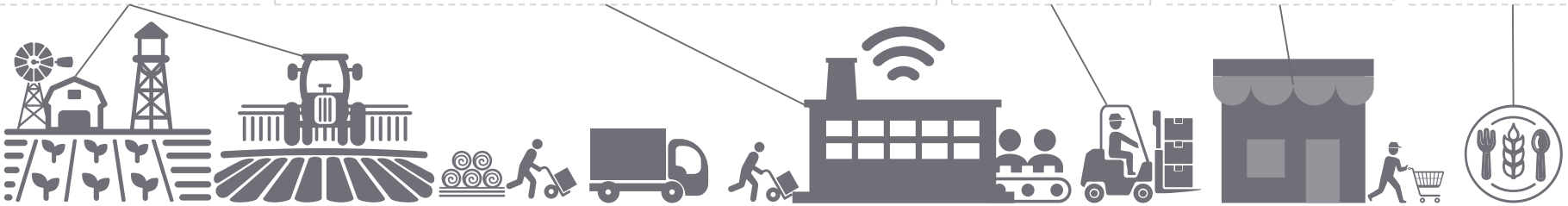
Agriculture
- **Weather prediction**
  - Google's Nowcast technology is expected to provide weather predictions accurately with the help of AI.
- **Raw Material assessment**
  - Precision Agriculture utilizes AI to predict crop pests or diseases. Microsoft and Danone have partnered to fund European startups that provide AI-based solutions for sustainable food and regenerative agriculture.
- **Robots for harvesting**
  - Panasonic's AI-equipped tomato harvesting robots increases efficiency of picking.

Processing at factories
- **Sorting Solutions**
  - TOMRA utilizes spectroscopy, LASER, and machine learning algorithms to sort food, vegetables, and waste stream objects.
- **Predictive maintenance**
  - Tetra Pak will launch its "factory of the future", machines will be able to communicate with each other as well as with the digital systems of the entire operation, automatically taking on tasks such as diagnosing problems, ordering and delivering parts, and looking for an engineer who is most suitable for the service needed.
- **Predictive products**
  - Kerry Group (Ireland) collaborated with IBM (US) to launch an artificial intelligence (AI) predictive tool- Kerry Trendspotter. Kerry Trendspotter would allow companies to utilize large unstructured data to interpret consumer behavior and predict consumer needs.
- **Faster Processing**
  - AI and automation solution provider Esker (US) and Angulas Aguinaga (Spain) collaborated to process food products faster. Esker utilizes Oracle JD Edwards Enterprise Resource Planning system for three times faster order processing.
- **Workers assessment**
  - Platinum CCTV verifies critical parameters in food industry workers.
- **Managing inventory**
  - Companies are utilizing AI for managing inventory and ensuring profitability. LeanDNA (US) raised USD15 Mn for AI driven factory management platform in Series B funding round.

Delivery routes
- Companies such as Dragontail systems are utilizing AI technology for scheduling deliveries with better time management.

Supermarkets/Grocery Stores
- **Food wastage management**
  - Canadian Produce Marketing Association's (CPMA) food waste management tool AI track data about fresh produce specific to the Canadian market.
- **Digital market**
  - Trigo Vision amalgamates computer vision and Artificial Intelligence technology for a camera-based technology that detects when a product is moved from the shelf into a basket.

Consumers
- **Personalization**
  - Kellogg's Company launched Bear Naked Custom, which lets people make their own customized granola from over 50 ingredients. The AI makes suggestions about what ingredients to add to your granola and lets you know if your ingredients are likely to taste good together or not.



Global Policies for Artificial Intelligence (AI)

Norway issued National Strategy for AI — Norway

"Towards an AI Strategy in Mexico: Harnessing the AI Revolution', for building an AI strategy — Mexico

AINED published a roadmap for developing a full national strategy — Netherlands

Building a network of eight research facilities focused on AI — Brazil

Spanish Ministry of Science, Innovation, and Universities launched the RDI Strategy in AI — Spain

Royal decree to establish an AI center, to align with the Kingdom's Vision 2030 program — Saudi Arabia

An AI expert group has published its recommendations for a Swiss AI strategy — Switzerland

AI Action Plan announced and a national AI strategy, expected in 2020 — Hungary

AI Master program launched, which is industry driven — Ireland

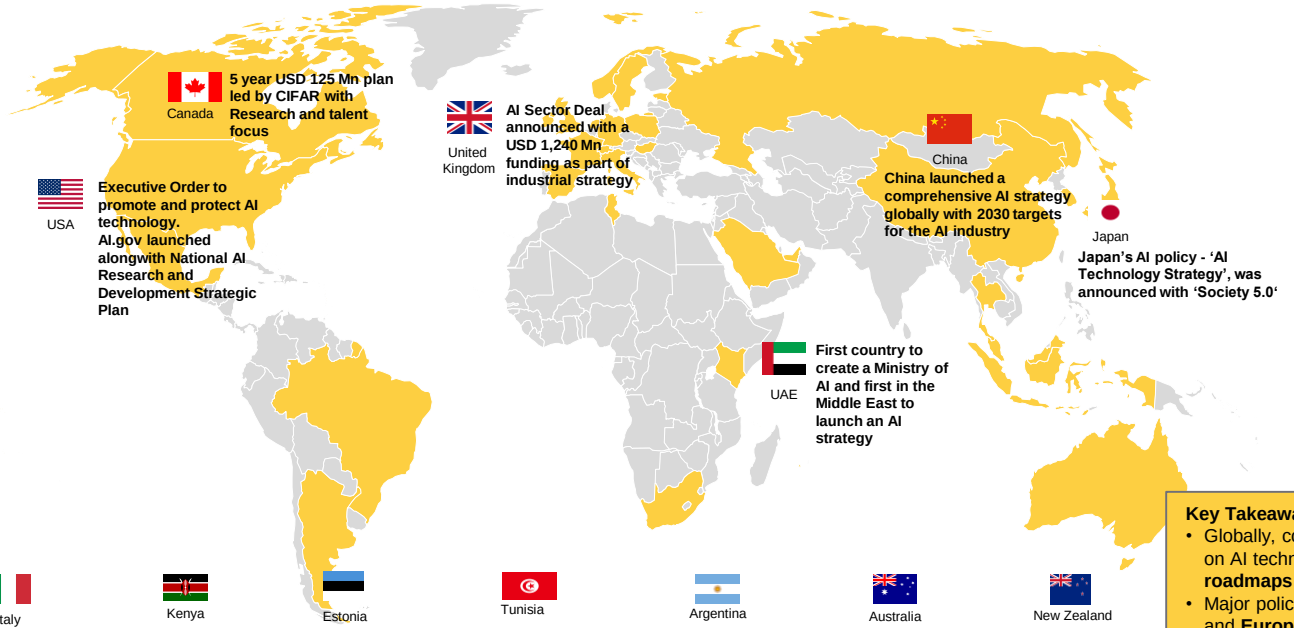
Action plan towards developing an AI strategy — Poland

USD 3,240 Mn plan announced to transform France into a global leader in AI — France

USD 3,000 Mn plan announced with a dedicated AI strategy to make Germany & Europe a global leader in AI — Germany

National Approach for AI launched — Sweden

Publishing its National Strategy for the Development of AI by 2030 — Russia



Thailand — Thailand's Digital Economy and Society (DES) Ministry has drafted the country's first AI ethics guidelines

South Korea — 5-year AI development plan launched with USD 1,950 Mn budget

Malaysia — Malaysia has a National AI Framework expanding the National Big Data Analytics Framework

Singapore — AI Singapore is a 5-year, USD 1,050 Mn national program to enhance AI capabilities

Indonesia — Indonesia AI Society (IAIS) inaugurated under Smart Indonesia. National Strategy expected in 2020

Qatar — National AI Strategy produced by Qatar Computing Research Institute (QCRI)

South Africa — Intsimbi Future Production Technologies Initiative aimed at advancing manufacturing sector

Italy — AGID published a paper called "AI at the service of citizens," which was edited by the AI Task Force

Kenya — A task force created a 5-year strategy for use of emerging technologies

Estonia — AI experts, led by government CIO produced the Estonian National AI Strategy

Tunisia — AI Task Force and Steering Committee to develop a national AI strategy

Argentina — Drafted the "National Plan of AI" under the Innovative Argentina 2030 Plan and the 2030 Digital Agenda

Australia — AI Roadmap focused on specialization in health, infrastructure, and natural resources

New Zealand — AI Forum of New Zealand, released "AI: Shaping a Future New Zealand"

Key Takeaways

- Globally, countries are **framing policies** on AI technology pertaining **to future roadmaps**
- Major policies are observed in **Asia-Pacific** and **European** region due to the expected rapid rise in the regions
- **UAE** has created a **Ministry of AI** as the technology is seen as capable of bringing **economic development**

Note: Currency converted to USD Millions by OANDA; Regions are not exhaustive

Source: OECD, Developments

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- AI is capable of **analyzing large amount** of both numeric and abstract data to **predict products** with **characteristics** that are desirable by consumers.
- The analysis of **big data** allows **prediction** of ingredients and conditions to **predict a possible best-seller product**.
- Although, **human intervention** is **necessary** to validate the results of AI analysis.
- **Mackmyra**, **Fourkind**, and **Microsoft** had partnered to produce **Intelligens whiskey**. The AI software generated over **70 Mn recipes** and a **discriminatory algorithm** allowed filtering of recipes, which is a process that could have taken several months.

AI's predictive technology is expected to increase probability of product success

Artificial Intelligence (AI): Case Study

MACKMYRA SWEDISH SINGLE MALT WHISKY

FOURKIND

Microsoft

Mackmyras Inteligens whiskey

Swedish whiskey distillery **Mackmyra** released a whiskey generated utilizing an **AI** (AI) programme called **Intelligens**

Players involved

- The **Mackmyra** whiskey was prepared by utilizing **Microsoft Azure Cloud Computing platform** and **Microsoft's Machine Learning Studio**, which is a powerful browser-based tool as a platform

Procedure

- Mackmyra distillery provided **Fourkind** with its own **existing 75 recipes** (including award-winning blends), **sales data**, **customer preferences**, **ratings**, and **brand ambassador evaluations**
- The raw data also includes **malting**, **fermentation**, **distillation**, and **maturation data**
- The AI technology is capable of **utilizing the raw data set** with a combination of **explorative algorithms generating** more than **70 Mn different recipes**
- The technology also utilizes another set of **algorithm** to discriminate between, which **recipes may work** from the already fed in data
- The algorithm highlights those whiskey recipes it predicts will be most **well-liked by consumers** and of the **highest quality**, based on the cask types that are currently on hand
- The **suggested whiskey recipes** are **curated by master blenders** (by Master blender Angela D'Orazio in this scenario)

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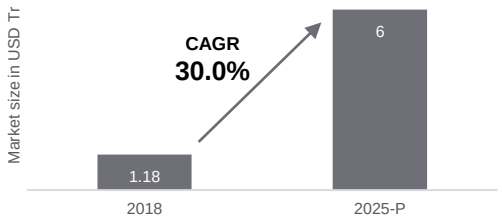
- **AI** is a rapidly growing industry with a **CAGR** of **30.0%** and an expected market size of **USD 6 trillion** in **2025**.
- The recent **COVID-19 pandemic** may cause a **higher adoption** of the technology.
- The **North American** AI market is estimated to be **USD 3.3 trillion** by **2025**, owning to the region being the hub of **technological advancement**.
- **Asia** and **Rest of World** are expected to **rapidly grow** due to the presence of **AI talent** amongst the population.
- The highest funded AI startup in 2019 is **NotCo** (Chile), which utilizes capability of AI to **predict ingredient combination** to develop plant-based options that **mimic animal protein**.

AI market is expected to be a USD 6,000 Bn industry by 2025

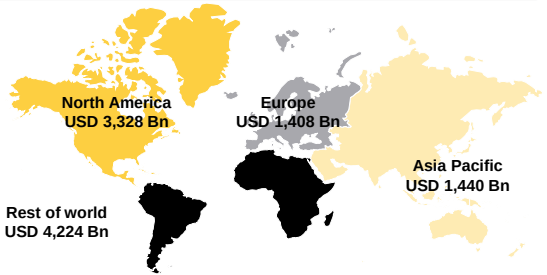
Artificial Intelligence (AI): Market Estimation

Global AI market by value

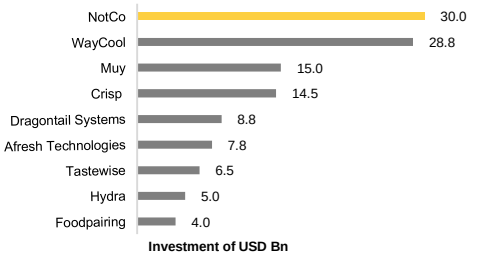


Source: Deloitte, FutureBridge Analysis

Projected regional market analysis in 2025

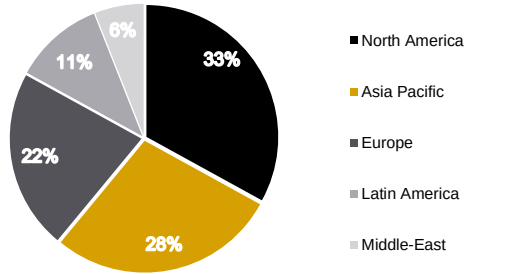


Total Funding of active AI startups in food segment (2019)



Source: FutureBridge Analysis

Percentage of active AI startups, by region (2019)



For more information check our 2H-2019 TDD >>>

FutureBridge Insights

- The published patents in the AI segment are **steadily increasing** with the top regions in **North America**, **Europe**, and **Asia-Pacific regions**. The regions are highly **active in AI technology** and also have **increasing policies** for **regulating** the technology.
- Established companies such as **IBM** (US), **LG Electronics** (South Korea), **Microsoft** (US), and **Kraft Foods Group Brands** (US) in the segment are highly active to ensure higher efficiency.
- The patents in the AI domain are mainly **focused** on the **personalized food segment**.
- The **predictive** and **big data analysis** of AI is utilized for **personalized recommendation** of food to user.

Patents in the AI domain are focused on the predictive capabilities of the technology

Artificial Intelligence (AI): Patent Analysis

Patent: US20200042865A1

Title: Method and apparatus for recommending food and drink based on AI-based user status

Assignee: LG Electronics

Claim: The patent describes an apparatus that can **recommend food** based by utilizing **AI** technology. The apparatus is capable of recommending food, beverages, kitchen appliances to be utilized by **considering** the **emotional aspects** of the user.

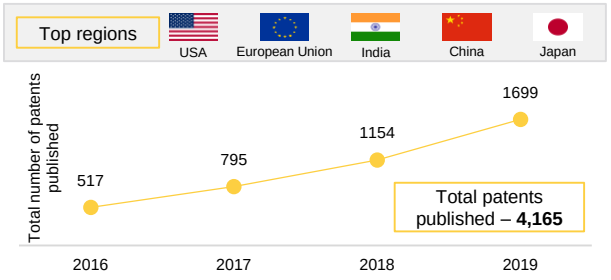
Patent: WO2019148033A1

Title: Method and system for preference-driven food personalization

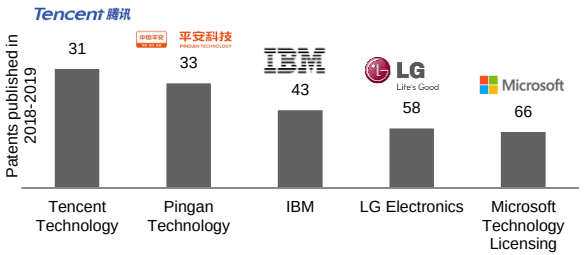
Assignee: Kraft Foods Group Brands

Claim: The patent describes a method for **improving personalization** of food for users. The database generates recipes by utilizing **dietary inputs** from a **subject matter expert interface**. The inputs **include food preferences**, **user characteristics**, and **meal rankings**.

Total patents published from 2016-2019



Top 5 companies with patents published in 2018-2019



Source: Questal Orbit

*Keywords: (*Artificial intelligence OR Machine Learning OR AI OR Intelligent agent*)) AND (Food* OR Beverage* OR Snack OR Puree* OR Juice* OR baker* OR Dair* OR Dessert* OR Breakfast* OR drink* OR confectionar* OR Cand* OR chocolate* OR Diet* OR Nutrition* OR Food processing); Patents restricted with relevant class codes

Technical papers in the AI domain is focused on increasing consumer acceptability of products and increasing efficiency of machines

FutureBridge Insights

- **North America** and **Asia Pacific** have the **highest papers** published as the technology is expected to rapidly evolve.
- The **artificial neural network model** utilizes **predictive capabilities** to assess the characteristics of beer that can **increase its acceptability** in consumers.
- Research involves methods to utilize **AI** to **increase efficiency** and optimizes working of **industrial equipment** such as **chillers**.
- The **Chinese Academy of Sciences**, **University of California System**, and **State University System of Florida** are the **top 3 institutes** involved in **publishing** technical papers.

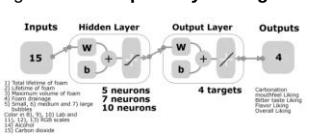
Artificial Intelligence (AI): Technical Papers Analysis (2015 – 2019)

Title: Development of Artificial Neural Network Models to Assess Beer Acceptability Based on Sensory Properties Using a Robotic Pourer: A Comparative Model Approach to Achieve an AI System

Researchers: Claudia Gonzalez Viejo, Damir D. Torrico, et.al.

Key takeaways:

- Robotic pourer **RoboBEER** was utilized to assess **carbonation**, **mouthfeel**, **bitterness**, **flavor**, **15 colors**, **foam-related** parameters and consumer liking descriptors
- The paper states the use of computer vision algorithms and artificial neural network algorithms to assess the **efficacy of beer** making and its **acceptability amongst consumers**



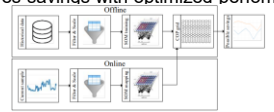
RoboBEER – Robotic pourer

Title: Data-driven operation performance evaluation of multi-chiller system using self-organizing maps

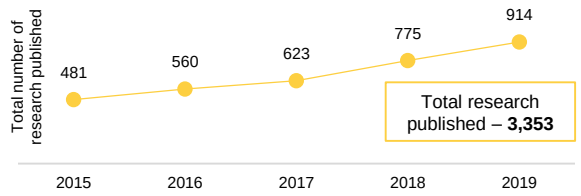
Researchers: Josep Cirera, Maria Quiles, et.al.

Key takeaways:

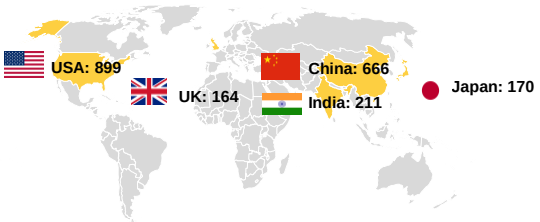
- The research describes a method to **detect deviations** in industrial **chiller systems**
- The methods used are **data-driven** that can describe a co-efficient of performance indicator (COP) in various chiller systems such as **cooler capacity** and **power consumption**
- The research prescribes a self-organizing map (SOM), which is based on neural networks that **evaluates performance** of various COP's and ensures savings with optimized performance of chillers



Total technical papers published



Top 5 countries with technical papers published



Source: Web of Science

Keywords: (Artificial intelligence OR Machine Learning OR AI OR Intelligent agent*) AND ((Food*) OR (Beverage*) OR (Snack*) OR (Puree*) OR (Juice*) OR (baker*) OR Dair*) OR (Dessert*) OR (Breakfast*) OR (drink*) OR (confectionar*) OR (Cand*) OR (chocolate*) OR (Diet*) OR (Nutrition*) OR (Food processing)); *Search results restricted by appropriate subjects*

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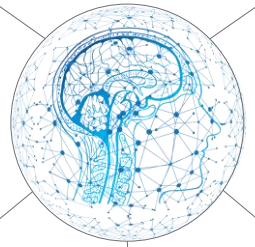
- AI is being utilized to **interpret large datasets** to provide an **increased personalization** in products, **predictive analytics** for factories, and **inter-connectivity** of food businesses.
- The trend for utilization of AI in the food and beverage segment includes **food flavor or combination prediction**, **reduction in food wastages** and **optimization of the food supply chain**.
- **Startups** are receiving higher funding to **expand their technologies** and their **geographical reach**.
- Established players such as **Sony** and **Kerry Group** are expected to **increase competitiveness** in the segment with their **technological expertise**.

Established players such as Sony and Kerry Group are increasing competiveness in the AI space

Artificial Intelligence (AI): Developments

Applications of AI



Faster processing

- AI and automation solution provider **Esker** (US) and **Angulas Aguinaga** (Spain) collaborated to **process food products faster**. Esker utilizes Oracle JD Edwards Enterprise Resource Planning system for three times faster order processing.
- **IIoT** and **AI-based** startup **Worximity Technology** (Canada) received **USD6.25 Mn** in **investment** series A, led by food processing giant **Marel** (Iceland).

Factory operations

- AI startup **Covariant** (US) raised USD 40 Mn. The company provides AI software for **warehouse robots** that pick objects with 95% accuracy.
- **LeanDNA** (US) raised **USD15 Mn** for **AI** driven **factory management platform** in Series B funding round.

Supply chain management

- **Scale AI** (Canada) announced an investment of **USD 3.4 Mn** for **AI (AI) solutions** to combat COVID-19 pandemic for developing **supply chain management**.
- **Canadian Produce Marketing Association's** (CPMA) (Canada) introduced new **food waste management tool** that uses AI data capture service to help the members to **track data about fresh produce**.

Predictive technology

- **Kerry Group** (Ireland) collaborated with **IBM** (US) to launch an AI predictive tool- **Kerry Trendspotter** to interpret consumer behavior and **predict consumer needs**.
- The **Not Company** (Chile) has partnered with **Papa John's pizza** (US) to produce vegan meat. The startup utilizes AI to **create a library** of ingredients for **recreating vegan options** of animal protein.

Centers or projects

- **ACG Group** (India) inaugurated a Switzerland-based **center of excellence** capable of exhibiting the company's **AI capabilities** and digitalization.
- **Sony** (Japan) launched an AI unit with three **flagship projects**, which include **gastronomy**, gaming, imaging & sensing.

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- NotCo utilizes **AI technology** to create plant-based products that can **mimic animal protein**.
- AI technology helps in **predicting combinations** of **ingredient** to created the **desired flavor** and **texture**.

The Not Company's products

NotCo utilizes AI technology to produce plant-based protein that mimic animal protein

Standout Startup

APPLICATION

The company uses AI to identify new protein sources as an alternative to animal products

PRODUCTS

NOT MAYO; NOT ICECREAM; NOT MILK; Vegan meat

INVESTORS

- Bezos Expeditions
- Kaszek Ventures
- MAYA Capital
- The Craftory
- IndieBio
- SOSV

TOTAL FUNDING

USD 30 Mn

NotCo

Trend: Artificial Intelligence

Chile

2015

TEAM

Karim Pichara Baksai (Co-Founder & CTO);
Matías Muchnick (Co-founder & CEO)

PARTNERS

Pão de Açúcar, Papa John's Pizza

RECENT NEWS

The **Not Company** (Chile) has partnered with **Papa John's pizza** (US) to produce vegan meat. The startup utilizes AI to **create a library** of ingredients for **recreating vegan options** of animal protein

COMPETITORS

Califia Farms, Good Mylk

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