IoT COMMUNITY
EDGE COMPUTING

EDGE COMPUTING IN
THE INTERSECTION OF
PREDICTIVE MAINTENANCE

COMPANY CLUSTER ANALYSIS:
FIELD SERVICE PREDICTIVE MAINTENANCE
INDUSTRIAL MAINTENANCE
AGRICULTURAL PREDICTIVE MAINTENANCE
HEALTH(CARE) PREDICTIVE MAINTENANCE
FLEET PREDICTIVE MAINTENANCE
SUPPLY CHAIN PREDICTIVE MAINTENANCE

POWERED BY

Valuer

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Foreword

This report aims to explore the innovation ecosystem in the area of edge computing for predictive maintenance by mapping trends, business models, and technologies.

To get familiar with both the "big picture" and specific solutions, the publication includes data analysis of clusters of companies that develop similar technologies, as well as five case studies of companies.

The magazine takes an in-depth look at six areas of innovation relevant to edge computing for predictive maintenance: Field service predictive maintenance, Industrial maintenance, Agricultural predictive maintenance, Health(care) predictive maintenance, Fleet predictive maintenance, and Supply chain predictive maintenance.

To identify the companies most suitable for inspiration or potential collaboration with the IoT Community, the selection favored those with already-existent practical solutions and proof of concept.

Clusters of Companies That Develop Edge Computing for Predictive Maintenance

Company clusters:

Field service predictive maintenance

Industrial maintenance

Agricultural predictive maintenance

Health(care) predictive maintenance

Fleet predictive maintenance

Supply chain predictive maintenance

Identifying companies relevant to edge computing for predictive maintenance

The process starts with Valuer processing its database of more than 600,000 companies to identify all potentially relevant to the topic "edge computing in the intersection of predictive maintenance."

The relevant company descriptions were then processed by Natural Language Processing (NLP), which finds patterns impossible to recognize with tags and regular search mechanisms. At this point, the number of organizations was narrowed down to around 1,000 most-relevant ones.

The platform then referenced the companies to six focus areas deducted from the IoT Community's request (listed below.) By choosing the ones nearest to a projected point, it selected roughly 200 most relevant to each of the six clusters.

Grouping companies from different focus areas

The illustration shows the clusters of companies (represented with dots) which are colored depending on their projection area. Their proximity to other companies depends on the commonalities of the products or solutions they provide.

Even though the platform processes the clusters in 1,024 dimensions, we've included a 2D interpretation for demonstration purposes (this is also why some dots may seem very distant from their projection areas). The rendered image lets us make several straightforward interpretations.

Observations and company trends

We can draw several insights from the company clustering image:

1. Overall, there is a considerable amount of overlap between these clusters, with the exception of the **"Agricultural predictive maintenance"** cluster, which may indicate similarities in market approach and technologies between the remaining five clusters.

2. The **"Field service predictive maintenance"**, **"Health(care) predictive maintenance"**, **"Fleet predictive maintenance"** and **"Supply chain predictive maintenance"** clusters are quite scattered around the map but also demonstrate heavy overlap with each other.

This might indicate a variety of innovations in these clusters. This could be due to the sector containing a large number of companies that use unique approaches and some that address similar challenges with the other sectors.

3. **"Industrial maintenance"** appears as a fragmented group that has candidates mainly concentrated within one area, suggesting a range of quite similar solutions provided within the field.
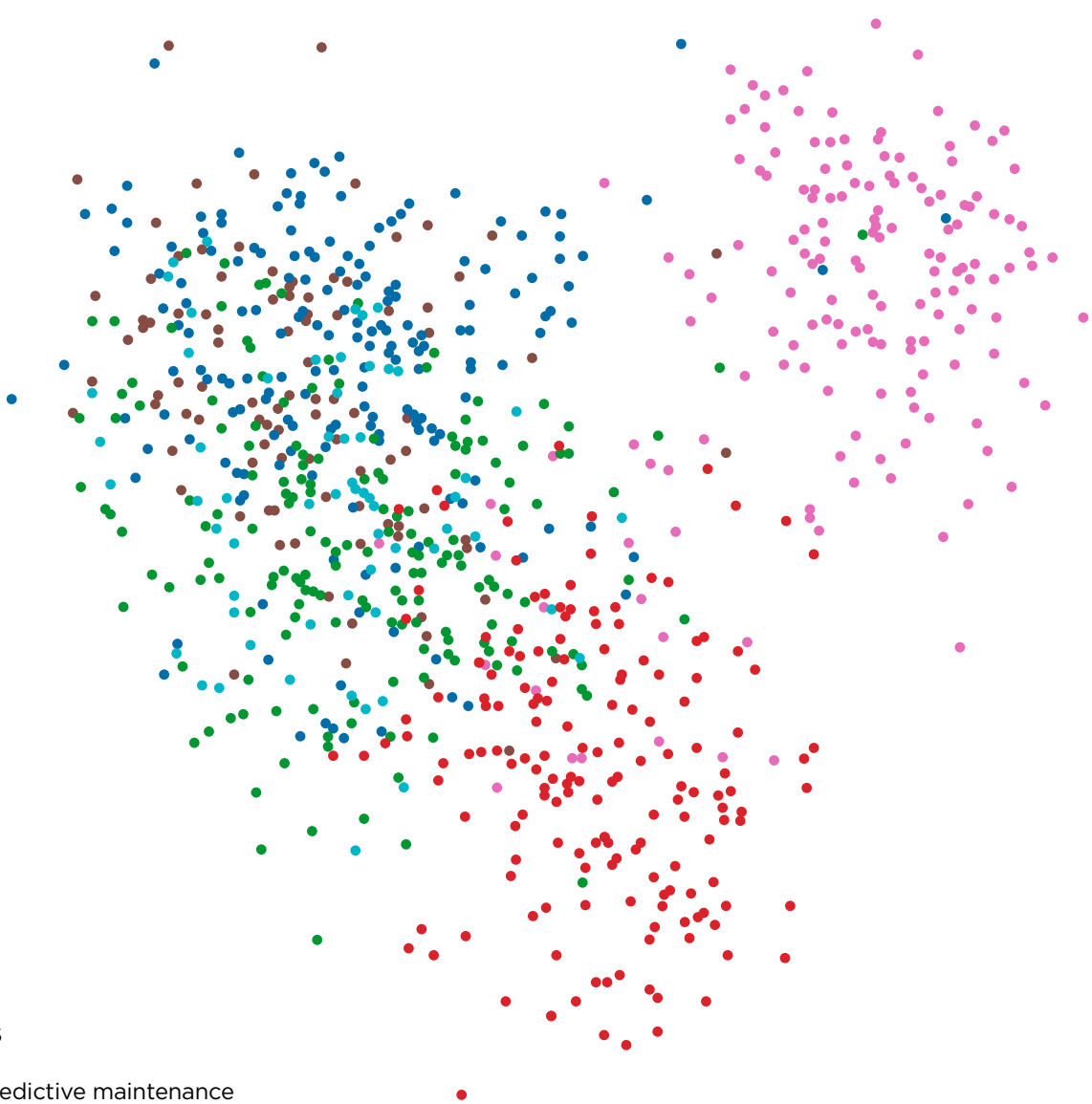
CLUSTER SECTORS

- Field service predictive maintenance
- Industrial maintenance
- Agricultural predictive maintenance
- Health(care) predictive maintenance
- Fleet predictive maintenance
- Supply chain predictive maintenance

Ranking the Clusters of Companies

The platform uses four parameters to assess the clusters' potential, market opportunity, degree of fit, and innovativeness:

1. **Success Potential:** The AI platform uses historical data from each company to evaluate the group's overall chance for future success.

2. **Market Maturity:** The AI platform analyzes companies' technologies to estimate the group's overall potential to generate profit. The algorithm analyzes the companies' financial history, the potential of attracting customers, and the maturity of their technology to compare it to the market's general development and trends.

3. **Degree of Fit:** The AI platform uses Natural Language Processing (NLP) to grade how well a cluster of companies aligns with the customer's challenges.

4. **Innovativeness:** The AI platform looks for original and previously unseen combinations of business models and technologies to grade how generally innovative a cluster is.
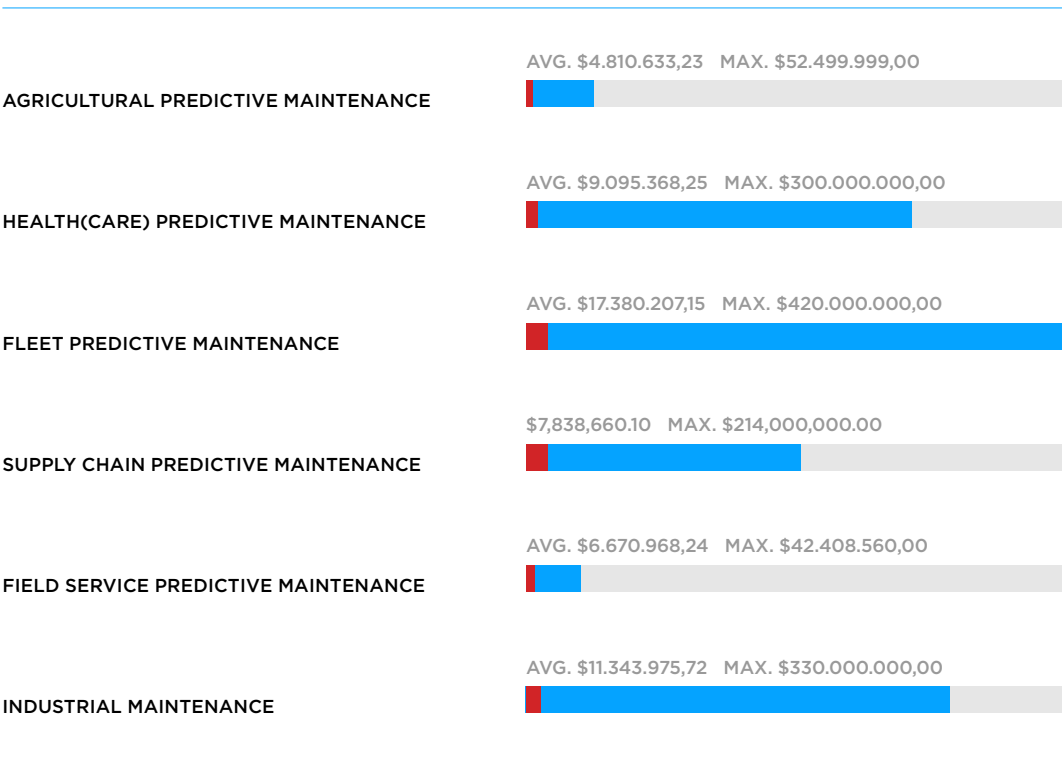
	Success Potential	Market Maturity	Degree of Fit	Innovativeness	**Total**
Agricultural predictive maintenance	55	42	69	80	**246**
Health(care) predictive maintenance	54	39	66	71	**230**
Fleet predictive maintenance	53	40	63	72	**228**
Supply chain predictive maintenance	54	41	67	66	**228**
Field service predictive maintenance	53	37	64	70	**224**
Industrial maintenance	52	41	61	67	**221**

Data Insights

Funding

● **Average funding** received by the companies in the cluster

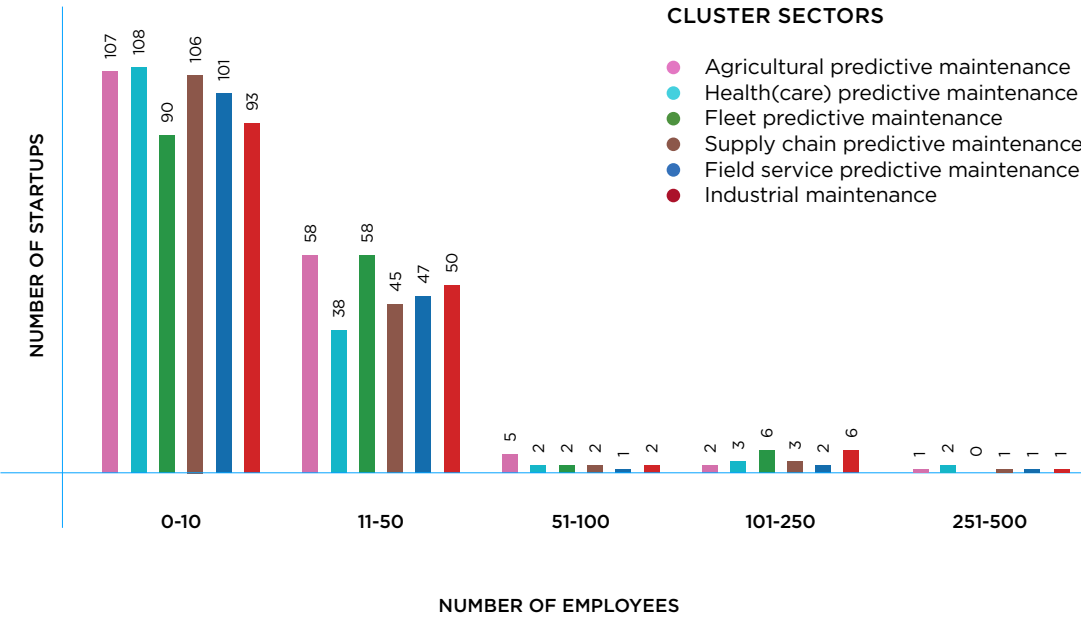● **Maximum funding** received by the companies in the cluster

For reference, all numbers are compared to the largest funding sum ($420.000.000 in "Fleet predictive maintenance")

AGRICULTURAL PREDICTIVE MAINTENANCE
AVG. $4.810.633,23   MAX. $52.499.999,00

HEALTH(CARE) PREDICTIVE MAINTENANCE
AVG. $9.095.368,25   MAX. $300.000.000,00

FLEET PREDICTIVE MAINTENANCE
AVG. $17.380.207,15   MAX. $420.000.000,00

SUPPLY CHAIN PREDICTIVE MAINTENANCE
$7,838,660.10   MAX. $214,000,000.00

FIELD SERVICE PREDICTIVE MAINTENANCE
AVG. $6.670.968,24   MAX. $42.408.560,00

INDUSTRIAL MAINTENANCE
AVG. $11.343.975,72   MAX. $330.000.000,00

Year of inception

	MINIMUM YEAR OF FOUNDING	AVERAGE YEAR OF FOUNDING	MAXIMUM YEAR OF FOUNDING
Agricultural predictive maintenance	2008	2017	2020
Health(care) predictive maintenance	2006	2017	2020
Fleet predictive maintenance	2004	2017	2020
Supply chain predictive maintenance	1990	2017	2020
Field service predictive maintenance	2003	2017	2020
Industrial maintenance	2003	2017	2020

Number of Employees

NUMBER OF STARTUPS

CLUSTER SECTORS

- Agricultural predictive maintenance
- Health(care) predictive maintenance
- Fleet predictive maintenance
- Supply chain predictive maintenance
- Field service predictive maintenance
- Industrial maintenance

Employees	Ag	Health	Fleet	Supply	Field	Industrial
0-10	107	108	90	106	101	93
11-50	58	38	58	45	47	50
51-100	5	2	2	2	1	2
101-250	2	3	6	3	2	6
251-500	1	2	0	1	1	1

NUMBER OF EMPLOYEES

Geographical Distribution

Area	Most Frequent	Number of companies	Second Most Frequent	Number of companies	Third Most Frequent	Number of companies
Agricultural predictive maintenance	United States	50	India	23	Israel	14
Health(care) predictive maintenance	United States	63	United Kingdom	14	India	12
Fleet predictive maintenance	United States	65	India	20	Israel	13
Supply chain predictive maintenance	United States	60	United Kingdom	15	India	14
Field service predictive maintenance	United States	62	United Kingdom	20	India	17
Industrial maintenance	United States	52	India	21	United Kingdom	10

Data Summary for All Company Clusters

FUNDING	YEAR OF FOUNDING	NUMBER OF EMPLOYEES	
$211,2 M MAXIMUM	**2020** MAXIMUM	0 - 10	**64%**
$9,86 M AVERAGE	**2017** AVERAGE	11 - 50	**31%**
$24,000 MINIMUM	**1990** MINIMUM	51 - 100	**1%**
		101 - 250	**2%**
		251 - 500	**1%**

Five case studies of innovative companies

FIELDEQUIP

YEAR OF INCEPTION: 2016

LOCATION: Houston, TX, United States

EMPLOYEES: 9

WEBSITE: fieldequip.com

SECTORS

Software

SUB SECTORS

Artificial Intelligence

Cloud Computing

Machine Learning

Predictive Analytics

SaaS

IDEA — PRODUCT/ PROTOTYPE — GO TO MARKET — **GROWTH & EXPANSION** — ESTABLISHED

Executive Team

Prat Gupta, PhD
Founder & CEO

Dr. Gupta is a machine learning, AI, and software specialist. In 2015 he founded Bursys, a software technology consulting and development company, and has since founded different companies under the Bursys Group portfolio. Gupta is also the CEO of ERP Experts, LLC. He holds a PhD in Civil Engineering with a focus on structures and computational mechanics and an MSc in Structural Engineering from the University of Kentucky.

Company Overview

FieldEquip is a Bursys' spinoff headed by the machine learning specialist Prat Gupta. Founded in 2016, the company focuses on developing software products for field service organizations to enhance their customer service operations. Its solutions utilize machine learning algorithms, edge computing, and cloud analytics. The company is located in Houston (TX), where it employs nine staff members.

Business Model

FieldEquip is a B2B company offering turn-key field service management and industrial automation software solutions. The company works with a SaaS-based revenue model, targeting clients in various industries, including energy and utilities, oil and gas, product manufacturers (OEMs), commercial HVAC and refrigeration, aviation and transportation, telecommunications, medical field service providers, heavy equipment dealers, etc. Via its solutions, FieldEquip aims to empower service providers to develop new revenue streams and business models and track service KPIs.

Value Proposition

FieldEquip's solutions allow organizations to increase operational efficiency by seamlessly connecting customers, field technicians, service providers, and equipment through a digital workflow via advanced cloud technology. The software enables real-time visibility into productivity, efficiency, inventory, and work order activity. Leveraging this, organizations can improve customer engagement, improve field technicians' operations, and maximize equipment uptime. FieldEquip's proactive and predictive maintenance capabilities take action before a severe defect occurs by analyzing the real-time data streaming through IoT-connected assets.

The software solutions easily integrate with other existing enterprise software solutions. These include OpenInvoice, SAP, QuickBooks, InforSyteline, and Microsoft Dynamics. Additionally, the FieldEquip IoT Edge Gateway is a manufacturer-agnostic device that can integrate with systems and equipment such as Emerson ROC800, SCADA systems, Allen & Bradley PLC, and packaging systems such as CMC Cartonwrap and CMC Smartmailer, among others.

Product Portfolio

FieldEquip offers a digital field service management platform that empowers field service providers (FSPs) and OEMs to improve their decision-making process, gain real-time visibility into service operations, and enhance customer engagement. The platform, built around the technician, enables service providers to provide outcome-centric services to clients. It offers various capabilities depending on the end-user, including field service management, field ticket management, intelligent asset management, and IoT services. The EquipConnect IoT module which can also be used as a standalone product, allows organizations to sustain maximum uptime by providing real-time equipment data that leads to proactive and predictive measures.

Technology Overview

FieldEquip's software platform provides remote diagnostic and analysis capabilities, working both online and offline. For example, the mobile field service feature enables field technicians to access tools through a mobile application that provides as-maintained drawings, manuals, and equipment history. Moreover, technicians can capture asset photos, videos, and barcodes to build comprehensive work order information. The platform provides a comprehensive work order management feature covering all work order briefing components from work order creation to execution. Organizations can automate tasks and integrate the work orders with the invoicing, thereby cutting down on review and approval times.

To ensure that the right technician is assigned to the right work order, FieldEquip provides customers with a scheduling and dispatch feature that allows them to increase first-time

fix rates. FieldEquip helps organizations choose a technician according to a pre-defined list of various parameters, including site vicinity, certifications, training, product, ratings, and technician schedule. The platform also allows organizations to centralize all necessary data and turn it into actionable insights. This is done with FieldEquip's data analytics and reporting tool, enabling organizations to generate niche or generalized reports for technicians, sites, teams, or spare parts.

In order to track real time equipment condition data and create up-to-date service maintenance predictions, FieldEquip offers their IoT edge gateway EquipConnect. The EquipConnect solution is based on FieldEquip's edge gateway technology to decipher complex data streams from traditional log files and IoT sensors. It can also directly access PLC data through local machine networks. This solution sends work-order notifications directly to FieldEquip and provides remote capabilities such as fault condition alarms, equipment settings control, and diagnostics. All these features are enabled by FieldEquip's edge gateway appliance—a manufacturer-agnostic device that can securely connect to any OEM equipment. This device saves bandwidth and enhances local response time since it allows the data to be analyzed at the source.

EquipConnect allows organizations to measure KPIs to assess the effectiveness of the internal field service organization or the external field service providers. The customizable KPIs and SLA (service level agreements) can be presented via graphs and push notifications on mobile applications and a web portal. Additionally, EquipConnect enables FSPs to have in-depth visibility into the equipment productivity and uptime. It allows FSPs to conduct remote services, create automatic service requests upon

faults and continuously deliver key metrics that support the service contracts.

The solution also creates a digital twin representation of the operational process and the equipment based on all the data gathered by the smart analytics engine. This helps organizations to identify problematic areas and bottlenecks. The real-time data analysis and actions can take place at the edge, with the option to send data selectively to the cloud, where deep learning enables intelligent field service workflows. By keeping track of equipment and their health, organizations can reduce downtime and take action before a critical fault has occurred. This is due to FieldEquip's software capability to track mean time before failure (MTBF) and mean time to repair (MTTR).

Market Opportunities

Aberdeen Research, an analyst firm, has reported that unplanned downtime can cost a company as much as $260,000 an hour. FSPs face increasing demand as businesses aim to decrease downtime to cut maintenance costs. To this end, FieldEquip provides FSPs and OEMs with software solutions for predictive maintenance utilizing edge computing and machine learning.

As such, the company targets the global predictive maintenance market, which, according to Markets and Markets, is expected to grow from $4 billion in 2020 to $12.3 billion by 2025. The market growth, set at a CAGR of 25.2% during the forecast period, will be driven by the increasing use of emerging technologies to gain valuable insights and the growing need to reduce maintenance costs and downtime.

Achievements and Future Plans

FieldEquip's solutions have been implemented in various companies operating in different industries. It digitized a fracking batch mixing plant for a company that provides automatic fracking batch mixing plants to large operators in the Permian and Delaware basins. The FiledEquip IoT edge gateway was connected to the existing Emerson ROC 800-series controller on the local network. The edge gateway uses advanced data mapping technology to convert the time series data into the MQTT-based messages for transmission to the FieldEquip cloud. Additionally, it uses standard IoT protocol MQTT to send various tags such as flow rate, tank levels for sand, water, and chemical additives.

Moreover, the company has worked with reBuy reCommerce, GmbH, the largest online reseller of new and refurbished electronic goods in Germany. The IoT edge gateway provides connectivity to the CMC Cartonwrap/SmartMailer machines, enabling real-time monitoring and visualization, notification, and data analytics. The solution helps the customer reduce equipment downtime, keep essential spare parts on hand, and monitor the productivity of the machines.

More recently, the company announced that via its German reseller XPROMA, it had added bol.com, a large Dutch online store, to its customer portfolio. The company leverages the IoT capabilities of EquipConnect to gather real-time production data from their CMC carton packaging systems in Amsterdam. Along with FieldEquip, these two solutions empower the company to monitor its operations remotely and take proactive measures to prevent machine downtime.

LITMUS AUTOMATION

YEAR OF INCEPTION: 2014

LOCATION: San Jose, CA, United States

EMPLOYEES: 55

FUNDING: 12,600,000 USD

WEBSITE: litmus.io

SECTORS

Software

Hardware

SUB SECTORS

Enterprise Software

Cloud Computing

IoT

IDEA — PRODUCT/ PROTOTYPE — GO TO MARKET — **GROWTH & EXPANSION** — ESTABLISHED

Executive Team

Vatsal Shah
Co-Founder & CEO

Vatsal Shah is an experienced leader with a technical background. Prior to Litmus, he held business-related positions at Metis Tech and MFL and industrial engineering positions at Rockwell Automation and Arvind Mills. Shah obtained a BTech in Instrumentation and Control from Nirma University and attended global entrepreneurship programs at several international institutions, including Purdue University, Zhejiang University, and EM Lyon.

Sacha Sawaya
Co-Founder & CFO

Sacha Sawaya brings experience in the finance industry, having held mainly investment analyst positions in the startup ecosystem. His previous workplaces include Imperial Capital Corporation, Meryll Lynch, Natcan, etc. Besides leading the financial matters at Litmus, Sawaya is also appointed the Head of the Canadian office. He also serves as an Advisor at Steadiwear and a Startup Mentor at the Canadian Technology Accelerators. Sawaya holds an MSc in Finance, Hedge Funds, and Private Equity from the International University of Monaco.

John Younes
Co-Founder & COO

Drawing from his experience working with startups and early-stage companies, John Younes manages Litmus Automation's operations and growth. He holds a Bachelor's in Management from the University of Western Ontario and a Master's in Management with specialization in Global Entrepreneurship from EM Lyon.

Company Overview

Litmus Automation is an IIoT company that aims to transform critical edge data into actionable intelligence. The company develops a flexible and scalable edge platform that provides the data connectivity needed to monitor, visualize, analyze, and integrate industrial data at scale. Founded in 2014 in Silicon Valley, and with offices in Toronto and Tokyo, Litmus has grown to a team of more than 60 employees.

Business Model

Litmus is a B2B company, mainly targeting the automotive, food and beverage, and agriculture industries. They have closed more than 10 Fortune 500 manufacturing and industrial companies as clients, with the automotive glazing leader Saint Gobain Sekurit being one of the most prominent examples. Litmus is promoting a no-hidden-costs plan, providing its industrial IoT platform with a site-based licensing package that covers all the drivers, data collection points, and features needed for a complete and successful deployment.

Value Proposition

Litmus prides itself on its flexible and scalable IIoT Edge platform, highlighting benefits such as fast deployment and intuitive user experience. Litmus brings IIoT values and benefits closer to companies by enabling them to connect to any asset and collect and analyze data, essentially leading toward improved asset and process uptime, performance, and quality. In doing so, Litmus connects to any type of industrial asset or system, such as PLC, SCADA, and MES, among others. The solution comes with more than 250 pre-loaded drivers, allowing for seamless asset connection without requiring programming from the client side. Combined with other benefits, such as integration with big data applications, Litmus is set on positioning its platform as an appealing choice for clients to process and act on asset data at scale.

Product Portfolio

The company developed Litmus Edge, a scalable IIoT platform that combines data collection, machine analytics, edge-to-cloud data integration, and edge applications. The end goal is to drive operational improvements at the enterprise by seamlessly connecting their devices to applications that derive business value from the collected data. Implementations of the Edge platform are controlled through Litmus Edge Manager, which is built specifically to give edge and enterprise teams visibility, access, and control over the orchestration of all edge devices, applications, and deployments.

Technology Overview

Built over a secure edge architecture, the Litmus platform enables rapid edge-to-cloud data flow over different scales to provide notable business value. With features such as flexible deployment options, no-coding implementation, and a large library of integration drivers, the company aims to accelerate customers' time-to-market.

The process begins with Litmus connecting to any machine or industrial system out-of-the-box using more than 250 pre-built drivers. The platform can be integrated with different commercial systems, such as PLC, SCADA, DSC, Historian, and ERP, among others, to get a complete picture of the industrial processes. Customers can control the connectivity and data collection with ease, using drag-and-drop flow editors to test device connectivity and

customize workflows. All data points collected from the devices can be normalized into one standard format, enabling simple processing by any application. The data is stored in scalable and secure time-series databases and uses an optimized version of influxdb. Here, Litmus Edge provides features such as data publishing to a local message broker, access to native data by SDKs and non-native REST APIs, and integration with any enterprise-grade cold storage.

The collected data is analyzed in real time by the platform using ready analytics, which reduces manual setup and configuration time. Clients get access to a plethora of features, including setup of alerts, configuration of KPIs such as uptime and downtime, and configuration of time series data analytics by various values. They can also perform statistical and analytical queries over live data, define workflows, and create visualizations and business intelligence dashboards.

Upon analyzing the data, the client can share it across the enterprise and the different services and applications it uses. The result is a complete edge-to-cloud data picture that can be utilized by the client's OT, IT, and data teams. Clients can feed the collected data into big data implementations with native Kafka and database interface, with the platform providing REST API integration for workflows. The platform also comes with a marketplace that hosts more than 45 container-based applications, which can be easily installed. Finally, the analyzed data can also be fed into machine learning models to optimize the asset's performance continuously. Through

the platform, customers can run and utilize available models, as well as run new ones that deliver corrective actions in real time.

Market Opportunities

The increasing computing power of IoT devices resulted in the generation of unprecedented volumes of data, with future projections showcasing no stop in this trend. According to Gartner, 75% of data will be processed outside the traditional data center or cloud by 2025. And as the world is becoming increasingly connected, enterprises and asset owners have started exploiting the benefits of IoT and edge computing to improve their performance.

With its edge-to-enterprise IIoT platform, Litmus Automation focuses on providing such benefits, mainly toward driving its clients' operational improvement. As such, they have been listed as one of the key players in a Markets and Markets report on the edge computing market. According to the analysts, the market that was valued at $3.6 billion in 2020 is expected to reach $15.7 billion by 2025. The growth of the market, which is set at 34.1% during the forecast period, is mostly credited to the growing adoption of IoT across multiple industries, as well as the rising demand for low-latency processing and real-time, automated decision-making solutions. The need for surmounting exponentially increasing data volumes and network traffic will boost the market demand further.

Achievements and Future Plans

Since its inception in 2014, Litmus Automation has focused on developing its platform and advancing its capabilities continuously. This has brought them industry recognition as well as an increasing number of deployments worldwide, which is currently set at more than 3,000. Nissan, Renault, and Mitsubishi are some of Litmus's clients, whereas their partner list includes Intel and HP, among others. One of the latest announcements in this regard is the expansion of the already established partnership with Google Cloud.

Litmus did not fall short on awards either. The company was named in the Gartner 2020 Magic Quadrant for Industrial IoT Platforms in addition to winning the Frost & Sullivan Edge-to-Cloud IIoT Enablement Platform for Manufacturing Award. The IoT Breakthrough Awards brought further recognition to the company, wherein Litmus's CEO Vatsal Shah was named "IoT CEO of the Year," and Litmus was named "Emerging Company of the Year".

The company has been successful on the investments' front as well, having completed a $7 million Series A led by Mitsubishi Corporation in 2019. The investment brought Litmus Automation's total funding since launching its platform to $12.6 million, allowing them to expand to meet the rising demand in the industry.

ONALYTICS

YEAR OF INCEPTION: 2019

LOCATION: Lisbon, Portugal

EMPLOYEES: 4

FUNDING: 100,000 EUR

WEBSITE: onalytics.tech

SECTORS

Software

Hardware

SUB SECTORS

SaaS

Artificial Intelligence

IoT

Cloud Infrastructure

IDEA — PRODUCT/ PROTOTYPE — **GO TO MARKET** — GROWTH & EXPANSION — ESTABLISHED

Executive Team

Joao Tacanho
Founder & CEO

Joao Tacanho brings extensive experience in information technology and business development, having held diverse roles across several companies. Notable positions before Onalytics include Managing Director of LOKA and Managing Director of InfoPortugal, among others. Besides Onalytics, he founded another company named Mobbit IoT Enabler, where he served as the COO. Tacanho holds an MSc in Informatics from the Autonomous University of Lisbon.

Luís Rosado, PhD
Co-Founder & Chief Hardware Officer

Dr. Luís Rosado is an experienced electronics engineer. He has been associated with the Instituto Superior Tecnico in Lisbon as Visiting Professor since 2017. His professional experience also includes positions such as Chief Hardware Officer in LOKA and CTO at Sedect SA. Dr. Rosado obtained a PhD from the Instituto Superior Tecnico in Lisbon for his dissertation on Eddy Currents Testing.

Cristina Raposo
Co-Founder, Chief Sales & Marketing Officer

Cristina Raposo brings experience in sales and marketing, having served as the Head of Sales and Marketing at LOKA before co-founding Onalytics. Her experience also includes positions such as Lead QA Consultant at InnoWave Technologies, Business Consultant at INFOS, HR Business Unit Manager at SQUAD, and most prominently, COO at Best for Business. She has also worked at Microsoft for three years in the business development sector. Raposo's academic background includes a Master's degree in Landscape Architecture from the University of Évora and an Executive Master's degree in Digital Marketing from IPAM Lisbon.

Company Overview

Onalytics is a Portuguese AI company founded in 2019. The company develops smart solutions for logistics management of industrial returnable packaging in supply chains. They introduced ONKEG, a smart keg management solution-as-a-service for breweries. The company leverages IoT, AI, and edge computing technologies to give customers total control and visibility over their industrial assets, helping them operate more efficiently and sustainably.

Business Model

Onalytics operates on a B2B model, targeting breweries, keg manufacturers, and rental companies. The company generates revenues on a SaaS basis with a pay-as-you-go product. The customer receives a ready-to-deploy product that requires simple installation with no technical expertise needed. Onalytics delivers the keg trackers and the IoT connectivity, providing access to the cloud platform and business insights. In addition, the subscription includes device maintenance, battery swap, and device replacements if need be.

Value Proposition

The ONKEG solution streamlines breweries' digital transformation, providing them with data-based insights and the necessary tools to improve logistics inefficiencies. By installing an IoT sensor on every keg, breweries can cost-effectively analyze large datasets from each keg and automate their processes.

The solution integrates with CRM or ERP systems, so customers can use Onalytics API to extract information from multiple business areas. With the solution, breweries can control the quality of their beverage and have full visibility over the temperature while the kegs are transported and stored. In addition, the company aims to ensure its customers design more targeted marketing offerings through automated detection of all venues in a brewery's distribution network, identifying and predicting sales patterns.

Moreover, ONKEG's device components are energy-efficient, with intelligent tracking algorithms enabling three AA batteries to last over three years. The long battery lifetime and the possibility to replace the device batteries ensure a quick ROI, and perpetuating the use of steel kegs helps Onalytics achieve its sustainability goals. Onalytics guarantees the cybersecurity of the devices and the collected customer data by deploying security measures to ensure that the IoT tracking devices are protected from unauthorized access.

Product Portfolio

The Onalytics IoT solution enables the optimization of sales and reverse logistics cycles for breweries. It uses edge computing to build intelligence into how the cloud analytics platform and the keg sensors communicate and interact.

The plug-and-play sensors monitor beverage temperature and keg movement throughout the distribution network. Also, they are mapping logistics premises and identifying outlier locations while registering abnormal movements. The sensors can adjust their configuration and behavior according to the situation, enabling energy savings that ultimately mean a longer operating life and lower maintenance costs. In addition, they are IP67 resistant and have a long battery life of four years, meaning they can sustain extreme weather conditions while requiring no maintenance.

Business KPIs are updated in the cloud based on movement data, such as real-time inventory, rotation rate, shelf life, and transit times. With AI, it delivers business intelligence and predictive analytics on sales and logistics, which customers can use to increase revenue and reduce operational costs.

Technology Overview

ONKEG consists of a tracking device and an IoT cloud platform connected with NB-IoT connectivity.

To track the kegs' movements, ONKEG uses a geo-server with Wi-Fi positioning capabilities. The advantage of Wi-Fi positioning over GPS is that it can correctly obtain indoor location information with very low power consumption. Nowadays, most industrial areas have Wi-Fi networks visible to any IoT device. The location accuracy delivered by Wi-Fi positioning varies according to the number of visible Wi-Fi

networks, the signal strength of each visible network, how many times those networks were seen before, as well as possible additional information.

The IoT connectivity is Narrow Band IoT, an LPWA technology that covers the most relevant aspects of the requirements, such as global availability supported by GSM carriers worldwide, power efficiency features designed for remote IoT devices communication, LTE-grade security mechanisms to protect the communication to and from the IoT device, increased indoor coverage, and no constraints on the amount of data that can be sent and received. The implementation of these features relies on both the sensor's edge computing capabilities and the analytics features of the cloud platform.

The tracking device scans for visible Wi-Fi networks to send to the cloud platform while also applying dynamic rules to the access points information. It needs to eliminate mobile hotspots and favor networks from known carriers and enterprise-grade manufacturers. In addition, it needs to identify check-in and check-out on the distribution network premises, creating a Points of Interest (PoI) list. The cloud platform sends each tracking device a customizable list of PoI containing the client's supply chain sites such as breweries, distribution centers, wholesalers, and consumption points. For each PoI, the list includes the known visible Wi-Fi networks at each site, enabling the device to recognize when it enters or leaves one of them and immediately connect to the cloud to relay that check-in or check-out information.

The ability to differentiate the locations through which the device moves enables various triggers to wake the device up and connect to the cloud platform. This logic allows for the increase of the battery lifetime. When in transit, the location and other monitoring information are saved onto the device's internal memory, and the tracking device

doesn't connect to the cloud if there's no urgency in receiving that information in real time. When the report timer expires, all the data saved by the device is sent to the ONKEG cloud platform. This behavior allows for more efficient power management.

By tracking the kegs movement between logistics sites, the ONKEG cloud platform can learn the location information and visible Wi-Fi networks on the most relevant business locations. It is also possible to directly provision those locations in the platform. The cloud platform applies a set of machine learning techniques to identify the keg status, which can be (1) moving through the sales logistics cycle (from brewery to the point of consumption), (2) going through the reverse logistics cycle (from the point of consumption to the brewery), (3) parked in the logistic premises, (4) parked in unregistered locations, (5) in transit between logistic premises, (6) anomalous transit time, (7) anomalous movements, and (8) full or empty.

Market Opportunities

While the overall beer consumption worldwide has not changed significantly, the trend that most shaped the global beer market in the last few years is premiumization. Consumers turn to craft beer and are willing to pay more for a more exclusive and enjoyable experience. Onalytics designed ONKEG to help breweries track their returnable containers as a key piece of their business to streamline operations and offer their customers a premium product.

"With an industry-average annual keg fleet shrinkage of 7.5%, the ability to track kegs is a priority for everyone in the business. Not only do breweries have to replace kegs that are lost, stolen, or damaged, but they also need to keep up with average annual volume growth of 10% in craft beer sales," stated Onalytics.

In the development of ONKEG, the company harnessed edge computing technologies. The global edge computing market was valued at $4.68 billion in 2020 and is expected to expand at a CAGR of 38.4% from 2021 to 2028. Key factors driving the market growth include the growing adoption of IoT across industry verticals and the increase in smart applications.

Achievements and Future Plans

Onalytics was among the first six companies selected for the business accelerator that Indico Capital Partners and Google for Startups launched in Lisbon in July 2020. The accelerator highlighted Onalytics as one of the three companies led or co-founded by female entrepreneurs. To further develop the ONKEG, their SaaS platform for logistical and quality management of beer kegs, the company received an initial investment of €100,000. They joined a six-month program of mentorship, training, and fundraising support, followed by an incubation period.

The company was recently selected to join the 5G Accelerator - Collaborative Innovation Program, an initiative to accelerate 5G transformation and innovation in Portugal. The program is promoted by NOS and Amazon Web Services with the support of Startup Lisboa. Onalytics was selected as one of the 15 startups out of more than 50 applications, due to its commitment to placing new solutions on the market based on 5G.

"Establishing a competitive advantage is one of the most important goals for any business. Without it, companies will find it difficult to withstand the test of time. A brewery can now reposition itself as a data-driven, forward-thinking digital organization that stays one step ahead of its competitors when it comes to innovation," says the team at Onalytics.

STERNKRAFT

YEAR OF INCEPTION: 2017

LOCATION: Dłutów, Poland

EMPLOYEES: 19

FUNDING: 2,000,000 USD

WEBSITE: sternkraft.com

SECTORS
Data & Analytics
Transportation

SUB SECTORS
Artificial Intelligence
Fleet Management

IDEA	PRODUCT/ PROTOTYPE	GO TO MARKET	GROWTH & EXPANSION	ESTABLISHED

Executive Team

Marcin Lewicki
Founder & CEO

Marcin Lewicki is the creator and main visionary of Sternkraft. His previous experience is primarily within the finance sector, serving shortly as a Deputy Finance Manager for Halcrow in 2010 and then joining Goldman Sachs as an Associate in the 2011-2014 period. He also co-founded Kantor77, a Polish company which he was a part of until 2017. Lewicki holds a BA in Finance and Accounting Management from the University of Sheffield, a Master's degree in Philosophy on the subject of Economics, and a Postgraduate degree in Mergers and Acquisitions from the Warsaw School of Economics.

Maciej Grabek
CTO

Maciej Grabek is an IT industry professional with 15 years of experience in software development, quality maintenance, and system stability. In addition to his current position at Sternkraft, Grabek is also the Head of Application Development and Head of Nordea Trading Technology Poland, where he has served since 2014. Another noteworthy career milestone is his MVP award from Microsoft.

Company Overview

Sternkraft is a Polish-German company established in 2017 by finance specialist Marcin Lewicki. Sternkraft maintains headquarters in Dłutów, Poland, as well as an additional office in Berlin, employing a team of 19 people. The company has developed the Safeway product, an IoT and edge computing-based computer vision technology aimed at solving safety and security problems in the logistics industry.

Business Model

Sternkraft's Safeway product is designed to improve the security of vehicles and cargo for logistics and transport companies. Initially designed for semi-trailer trucks, the Safeway system can be adapted and installed on any type of vehicle, including vans, pickup trucks, buses, trams, small commercial vehicles, and others. Sternkraft is a B2B company that generates revenue through a subscription-based model. They offer four subscription plans—Fundamental, Expanded, Complete, and Premium—which differ in pricing depending on the features they include. The Fundamental basic package includes five features: in-trailer sensors and cameras, trailer positioning data feed, event history, and telemetry data. With more advanced packages, customers gain access to additional features, such as sensors for fuel tank surroundings, an advanced loading control system, and a multitude of cabin and external cameras, to name a few.

Value Proposition

The edge computing-based Safeway solution was designed to provide customers with predictable and safe transportation. Sternkraft's product package is bolstered by AI algorithms and the latest camera and computer vision technology to ensure safe delivery and personnel and vehicle security. The Safeway alarm system does not rely on the imminent danger to react but rather analyzes the vehicle's area to react in a preventative manner. The online fleet management feature of Sternkraft's subscription service enables secure and encrypted access to an online portal where managers can monitor vehicle security and position status. Additionally, the Smart and Eco-Driving features of the Safeway FX2 system provide additional value through reduced fuel consumption and, consequently, reduced carbon footprint.

Product Portfolio

The Safeway FX2 product is a result of Sternkraft's multi-year research and development process in the field of intelligent video analysis systems. Sternkraft's solution covers cargo space monitoring, blind-spot monitoring (DVS), the AI FX2 shared platform, and an AI algorithm system. The main features of the Safeway AI algorithm system are divided into four modules: Driver, Security, Optimization, and Safety.

Technology Overview

The Safeway FX2 Cargo Space Monitoring solution implements cameras that monitor the tarpaulin and trailer cavity and utilizes a specialized computer vision system that recognizes objects and people detected within those areas. Sternkraft's demo materials show that the AI algorithms recognize and discern human operators, cargo, loading machinery such as forklifts, and deduce a trailer's cargo space utilization. The system provides fleet managers with access to a live video feed and alerts about irregularities, such as when the vehicle is overloaded or when expected cargo objects are missing.

A subset of the Safeway FX2 is the blind-spot monitoring system, dubbed the Dynamic Vision System (DVS). It handles the dangerous issue with blind spots, which are especially pronounced in the operation of large road vehicles such as semi-trucks. Sternkraft has tackled this problem by installing cameras that observe these blind spots, feeding live video to the driver, and notifying them when an object is detected in the areas mentioned above.

The DVS system is a part of Sternkraft's first AI algorithm module, the Driver module. In addition to blind-spot monitoring, this module also provides telemetry data monitoring, driving suggestions, and road condition notification. The AI module is directly connected to the vehicle through the CAN bus. It has access to the vehicle's Smart and Eco-Driving sensor data, which aids in the communication between the driver and the vehicle. The Safeway Driving module notifies the driver of speed limits and suggests optimal actions to maintain the most efficient and economical driving manner.

Safeway's Safety AI module provides warnings and prompts to help the driver operate the vehicle safely and smoothly when traversing foreign countries and unfamiliar roads, preventing mishaps and incidents. The system also notifies the driver of necessary precautions in certain situations, such as checking tire pressure, wearing a reflective vest and safety helmet, securing the seatbelt, etc. The 24/7 video security system is also part of this module. It monitors fleet parking, cargo space, and the driver's cabin optionally, offering peace of mind for the driver, the fleet manager, and the owner.

The Security module overlaps with the Safeway Safety module in that they share some of the video monitoring features. However, the Security module expands upon these features by implementing character and behavior recognition algorithms and is capable of early detection of fuel theft, cargo space or cabin intrusion, and goods theft. Safeway responds to such situations by notifying all concerned parties through the platform of the current ongoings and can even deploy a specialized smoke gas in the cargo area and activate loud alarm sirens.

Finally, the Optimization AI algorithm module analyzes loading methods and destination routes, offering optimized corrections when necessary.

Sternkraft's Shared AI FX2 Platform ties all of the data and smart analysis together, offering insight to drivers, transport company managers, as well as forwarding, shipping, and insurance companies.

Market Opportunities

Fleet management systems, as is the Safeway system by Sternkraft, typically cater to operations management, vehicle maintenance and diagnostics, performance management, and fleet analytics and reporting. Fleet management allows the removal or minimization of risks associated with vehicle investment, improving efficiency, productivity, reducing the overall transportation and staff costs, and providing compliance with government regulations. Sternkraft and their Safeway FX2 product fulfill these requirements through a novel and innovative approach by implementing IoT, edge computing, and AI into the fleet management sphere.

A report by Markets and Markets states that the fleet management system market valued at $20.6 billion in 2021 is expected to grow at a CAGR of 10.5% in the 2021-2026 period, reaching a projected value of $33.9 billion by the end of the forecast period. The analysts list the high growth rate of computer analysis implementation, declining hardware and IoT-connectivity costs, growing need for operational efficiency, and rapidly changing government mandates as the lead growth drivers for this market.

Achievements and Future Plans

In January 2021, Vestbee declared Sternkraft as one of the winners in AWS AI Challenge, organized in partnership with Amazon Web Services. The AWS AI Challenge is a business-oriented program that focuses on bringing publicity to innovative AI startups and helps them with the product and business development.

Most recently, in May 2021, Satus Starter made a press release in which they revealed that they would be investing PLN 4 million (circa $1 million) in Sternkraft to develop their Safeway FX2 product further. Satus Starter is a venture capital firm, and this is its second investment into Sternkraft, in addition to its previous contribution of PLN 2 million (circa $520,000).

Sternkraft's total funding amount equates to approximately $2 million. In the most recent Series A funding round the company raised PLN 938,000 (circa $244,000), closing the round in late July 2021.

SYNSENSE

YEAR OF INCEPTION: 2017

LOCATION: Zürich, Switzerland

EMPLOYEES: 35

FUNDING: 2,280,600 EUR

WEBSITE: synsense-neuromorphic.com

SECTORS
- Biotechnology
- Hardware

SUB SECTORS
- Bioinformatics
- Neuroscience
- Semiconductor
- Computer

IDEA — PRODUCT/ PROTOTYPE — **GO TO MARKET** — GROWTH & EXPANSION — ESTABLISHED

Company Overview

SynSense (formerly known as aiCTX) is a Chinese-backed Swiss startup that provides analog and mixed-signal neuromorphic processors. It leverages Dynamic Neurormorphic Asynchronous Processor (DYNAP) technology to develop AI-based edge-computing applications. The company was founded in 2017 by Dr. Ning Qiao, Kynan Eng, and Dr. Giacomo Indiveri, all of whom are well-established engineers from the field of neuroinformatics. Headquartered in Zürich, Switzerland, SynSense also has an office in Chengdu, China, employing a team of over 30 people across both locations.

Executive Team

Ning Qiao, PhD
Co-Founder & CEO

Dr. Ning Quai is an experienced professional in the field of microelectronics and solid-state electronics. Parallel to SynSense, he is also a Senior Researcher at the Institute of Neuroinformatics, UZH & ETHZ, leading ultra-low power neuromorphic VLSI development. Before SynSense, he founded the high-tech Swiss company aiCTX AG in early 2017, where he held the CEO position. Dr. Quai holds a PhD in Microelectronics from the Chinese Academy of Sciences.

Giacomo Indiveri, PhD
Co-Founder & Scientific Counsel

Dr. Giacomo Indiveri is the Director of the Institute of Neuroinformatics at the University of Zurich and ETH Zurich, where he also teaches several courses. Besides SynSense, he is a co-founder at GrAL Matter Labs, a Paris-based company that enables multi-modal sensor analytics and dynamic machine learning at low power levels. He has been directly engaged with SynSense since its foundation in 2017, currently serving as a Scientific Counsel. Dr. Indiveri obtained his PhD in Electrical Engineering and Computer Science from the University of Genoa.

Business Model

SynSense provides full-stack custom neuromorphic processors for AI-based edge-computing applications that require ultra-low-power and ultra-low-latency features. The company operates on a B2B model, targeting enterprises that develop autonomous robots, mobile and embedded devices, wearable healthcare systems, security, IoT applications, and computing at the network edge. With 18 other industry and research partners, SynSense has been awarded a grant of €20 million from industry and national institutions to develop the ultra-low-power neuromorphic computing technology further.

Value Proposition

The neuromorphic chip by SynSense is built with the human brain as the main inspiration for its design. It features massive parallelism and asynchronous logic, providing mixed-signal/fully digital neuromorphic processors to overcome the von Neuman limitations of conventional computer systems and reach an unprecedented combination of ultra-low power consumption and low-latency performance. Neuromorphic computing is also considered to be a key enabler of next-generation AI. Since it spinned off from the joint Institute of Neuroinformatics at the University of Zürich and ETH Zürich, SynSense is based on the vast know-how of the leading research institutions on this matter.
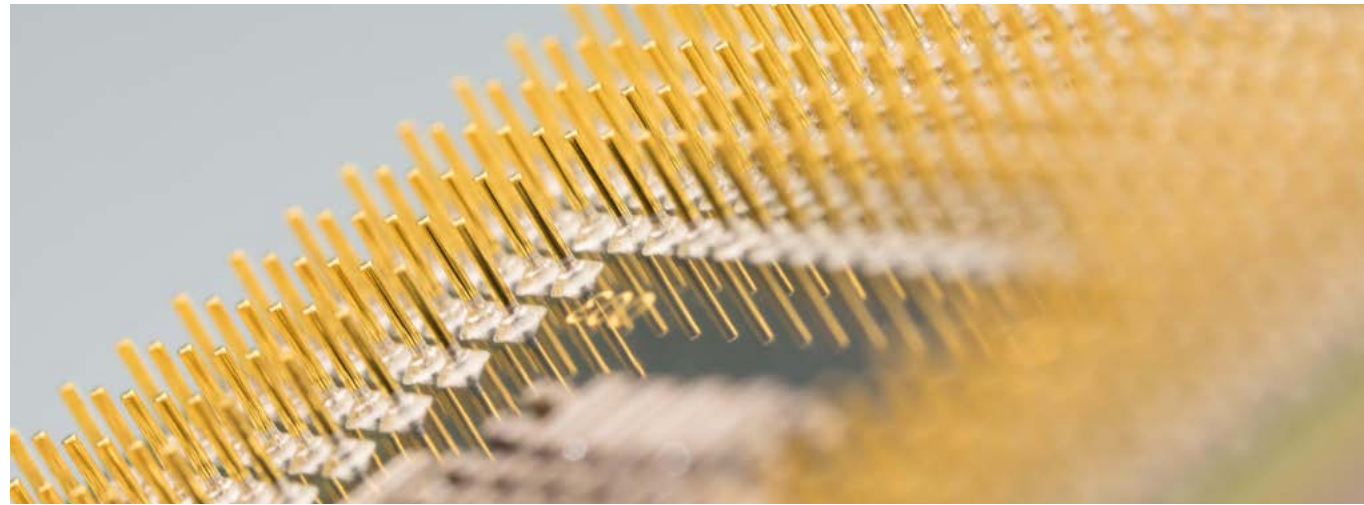
Product Portfolio

SynSense's product portfolio is divided into two categories: AI Processor Solutions and Software Solutions.

1. AI Processor Solutions include the (1) DYNAP-CNN, (2) DYNAP-SEL, and (3) DYNAP-SE2.

2. Software Solutions consist of (1) Samna, a developer interface to the SynSense toolchain and run-time environment for interacting with SynSense devices, (2) Sinabs, an open-source PyTorch-based library, and (3) Rockpool, a Python package for developing signal processing applications with spiking neural networks.

Technology Overview

All the chips SynSense developed rely on the Dynamic Neuromorphic Asynchronous Processor (DYNAP) technology, a patented event-routing technology that facilitates the implementation of reconfigurable, general-purpose, real-time neural networks based on spiking neurons. It enables the development of ultra-low-power, ultra-low-latency neuromorphic processors for a variety of AI edge-computing applications. This provides users with a newly-developed mix of ultra-low-power consumption low-latency, crucial for developing smart home and security solutions, autonomous driving, drones, or robots.

DYNAP-CNN relies on 1M ReLU spiking neurons per chip for implementing Spiking Convolutional Neural Networks (SCNN). Featuring an interface for dynamic-vision-sensors, it allows direct input of event streams from a wide range of advanced dynamic-vision-sensors, enabling seamless integration and rapid prototyping of models. It is fully configurable and supports various types of CNN layers (such as ReLU, Cropping, Padding,

and Pooling) and network models (such as LeNet, ResNet, and Inception) while providing total control over the models with extensive programmability of all its parameters. DYNAP-SEL is the next-generation solution, featuring 1,000 analog low-power spiking neurons and up to 80,000 configurable synaptic connections, including 8,000 synapses with integrated spike-based learning rules. Its capabilities are comparable to the connectivity architectures observed in the mammalian cerebral cortex and permit networks with biologically realistic connectivity to be emulated using DYNAP-SEL.

The latest in the developmental path of SynSense's line of processors is the DYNAP-SE2. It combines high levels of energy efficiency, a characteristic of the previous generations. It is merged with several new features that provide low latency, real-time end-to-end applications using general-purpose feed-forward, recurrent, and reservoir networks. It features 1,000 redesigned adaptive exponential integrate-and-fire analog ultra-low-power spiking neurons and 65,000 enhanced synapses with configurable delay, weight, and short-term plasticity. The innovative asynchronous low latency infrastructure enables each neuron to communicate with up to 230,000 surrounding neurons alongside the possibility for infinite scalability via relay neurons for truly large-scale networks. Due to its bio-signal amplifiers, DYNAP-SE2 has a wide applicative potential in mobile health and robotic applications.

The three software solutions are built to work in synergy, both interactively and with the hardware aspects of the SynSense offer. Samna, the SynSense developer interface, is written in C++ and made for users to manipulate and upload networks generated by Rockpool and Sinabs to Synsense neuromorphic chips. With the help of Rockpool, users can build networks, simulate, train, and test them, as well as deploy
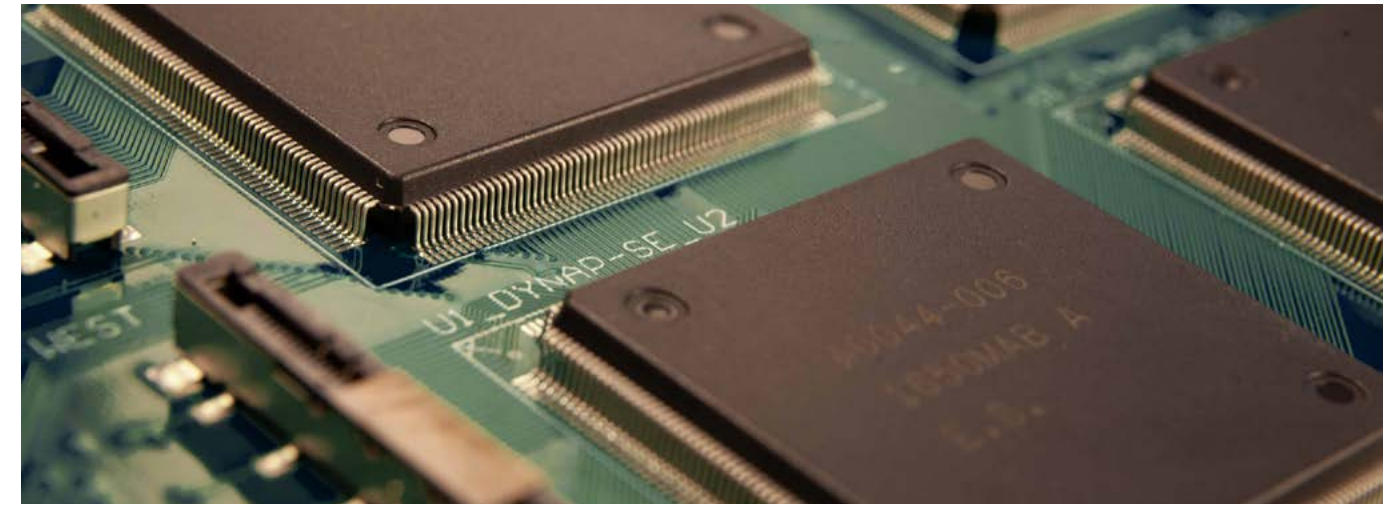
them either in simulation or on event-driven neuromorphic compute hardware. It provides layers with simulation backends, including Brain2, NEST, Torch, JAX, Numba, and raw NumPy. Sinabs is developed to design and implement Spiking Convolutional Neural Networks (SCNNs). It is an open-source PyTorch-based library, implementing several layers (spiking equivalents of CNN layers) and conveniently providing support to import CNN models implemented in Keras to test their spiking equivalent implementation.

Market Opportunities

Traditional computing technologies are expected to hit a digital wall by 2025, forcing a new paradigm in the perception of hardware. According to Emre Neftci, an Assistant Professor in Cognitive Science at the University of California, neuromorphic engineering won't replace general-purpose hardware. Still, it could be hugely important for solving special or specific technology challenges, such as effectively implementing AI at the edge. Power-hungry autonomous vehicles, robots, drones, and plenty of other self-reliant machines require large energy efficiency, one that the standard semiconductors cannot provide due to their natural limitations in miniaturization and capacity.

The global neuromorphic computing market size is expected to reach $6.48 billion by 2024, registering a 20.2% CAGR during the forecast period, as per Grand View Research. Industry-leading companies are making some large investments in R&D activities, recognizing the capacity of this new approach. The rising demand for cognitive and brain robotics, combined with the overall trend of AI development and implementation, are two of the factors that are expected to drive the market further.

Achievements and Future Plans

Since its foundation in 2017, large investors have closely followed SynSense, as one of the most promising startups to deliver the next generation of ultra-low-power computational architectures. In July 2019, the company was awarded a €20 million grant, with 18 other industry and research partners, securing funding from industry and national bodies. On this occasion, SynSense joined forces with IMEC, CEA-LETI, Fraunhofer, Philips, STMicroelectronics, and several other key players on the market. The investment came as part of the TEMPO Project, an initiative to build a European eco-system around developing, producing, and applying neuromorphic hardware through cross-fertilization between major foundries, chip design, system houses, application companies, and research partners.

In May 2021, SynSense became a part of the 42-month project "Memory technologies with multi-scale time constants for neuromorphic architectures" and signed a contract that secured them an additional €200,000. It started in January 2020 with a team that, besides SynSense's researchers, included experts from Leti, IMEC, and IBM Zurich. The project is fully funded by the European Union's Horizon 2020 program.

The company successfully performed its proof-of-concept demonstration, spanning prestigious European and Israeli universities, making deep links into the research community. They applied their technology to bi-directional brain implants, a project that had a goal to demonstrate that SynSense's neuromorphic hardware can act as a smart low-power bridge to the brain. Furthermore, the company publicly offered a development kit to applicants created using the open-source Python library SINABS, allowing enthusiasts to extend their research capabilities further.

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