EZASSi™
Technology to innovate *faster.*

Smart Connected Packaging

Technology Scouting Report

Proprietary & Confidential | 2022

Ezassi has the technologies and services to accelerate your innovation lifecycle and usher in your next generation of products and services.

Technology Scouting Reports identify emerging markets, technologies, competitive threats, and key players.

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Executive Summary

Background to the Problem

The pandemic has driven tremendous innovation in retail experiences, from click-and-collect to in-store ordering with home delivery, and connected packaging is helping brands enhance these offerings and manage their retail channel portfolio.

- The COVID-19 pandemic has driven the socially distancing population further into the online shopping space. As of May 2020, there was a 202% increase in online grocery delivery web searches in the wake of the initial outbreak. In fact, sales of grocery delivery and pickup in the U.S. surged from $1.2 billion in August 2019 to $7.2 billion in June 2020. These rapid e-commerce gains are expected to persist even after the pandemic wanes. As a result of this anticipated sustained shift, CPGs urgently need to develop packaging and overall strategy to do e-commerce right.

The global health crisis on retail has increased demand for transparency from consumers and regulators alike.

- Consumer awareness of and attention to food safety and sustainability in the supply chain, for example, have risen sharply. A recent survey of 14,000 consumers across 18 countries by taste and nutrition company Kerry Group found that more than 60% of consumers have increased their focus on food safety in the wake of the pandemic and that 49% now consider sustainability when purchasing food and beverages.

- The US FDA has recently announced that it is working to “create a safer and more digital, traceable food system,” with the end goal of reducing foodborne illnesses. It requires US consumers to have direct access to trusted information about the origins of food products.

With consumer e-commerce and QR code engagement boosted by the pandemic, ***connected packaging*** is emerging as a key pillar for ***consumer engagement*** and first-party data generation. Interactive packaging is enabling brands not only to provide consumers with access to information and enable them to authenticate items directly themselves, but also to gather ***traceability data*** as items move through the supply chain and to facilitate transactional experiences at the point of sale and post-purchase.

Problem Definition : What is Smart Connected Packaging?

Smart Connected or Intelligent Packaging is a form of intelligent packaging that opens a **digital channel** for products to capture and share information and interact with other devices.

- Connected packaging innovations are transforming basic packaging into an **interactive and immersive consumer experience.**
- This allows brands to create two of the most critical contributors to purchases: **loyalty and advocacy** through increased touch-points and direct interactions.

In its ability to connect brands directly with consumers, **smart packaging is transforming CPG** marketing practices in five distinct ways:

1. CPG Trends allow for Digital Direct-to-Customer Relationships
2. With smart packaging, consumers get real-time access to products/services/information when they want and wherever they want. This combination of physical products with digital information will change how consumers perceive brands and, ultimately, how they engage with them.
3. With smart packaging, content delivery can be personalized for each audience – maximizing its relevance – for higher levels of engagement and more memorable experiences.
4. Digitized products can provide granular data on consumer spending patterns, behavior, and the most influential touch-points. Gaining such detailed insight in real-time has powerful applications. Campaigns can be fine-tuned for better results, content tailored for maximum impact, or consumers targeted with relevant promotions to increase conversion rates.
5. Delivering Trust & Transparency by Digitizing Products: Smart packaging is among the group of technologies that can help with the governance of supply chains and provide consumers with the timely information they need to trust the brands they are buying from.

Value Proposition

- Beyond reducing food waste or helping to ensure food safety, smart connected packaging also can track the location and condition of food, thereby facilitating transfers of food to those in need, linking nutrition to consumers' health needs, mimicking the growth kinetics of pathogens like *Escherichia coli*, and reducing food fraud.

- **Personalized experiences & increased brand loyalty**

  - Gathering data helps companies understand how their products are being used, which can help them develop customer-tempting variations on those products. It can make consumers happy. It can make them more loyal.

  - In a recent survey conducted by Jabil, 74% of participants agreed that it's very convenient when the products they need are automatically sent to them. Companies can use auto-replenishment to increase profitability in two ways: wallet share and overall consumption. Also, 90% of consumers acknowledged that companies can create better products by gathering user data. Furthermore, 58% of the survey participants say that they don't mind data collection as long as they're aware of how it is being used.

- **Improved Customer Insights and Power to the Brands**

  - Connected packaging sends an even more potent message about a company's values: one that is dedicated to crafting a personalized, convenient experience for its customers. It gives power back to the brands, allowing them to grow their product, service or experience and ultimately to form a long-lasting relationship with its customers.

Value Proposition

- **Many global brands are innovating**
  - For example, over the next few years, Reckitt plans to implement connected packaging across all of its global brands, enabling richer and more contextually driven digital experiences throughout the usage cycle of products. Ultimately, this is expected to create a platform for its brands to help more people, in more ways, with increasingly personalized experiences that go beyond product and into multi-touchpoint solutions to their everyday needs.

- **The Global Smart Packaging Hub** reported that 96% of 1,000 product company executives surveyed said they had begun exploring smart connected packaging. Heineken, for example, is piloting a smart label solution to increase transparency into the environmental footprint of beer bottle.

- **Consumer Readiness:** As uncovered in SharpEnd's Connected Experience Report 2021, consumer readiness and appetite for this technology has reached a tipping point. 79% of consumers have already interacted with a product via a QR code and 51% expect to do so again in the next 12 months.

Slide Sources:
https://www.packaginglaw.com/special-focus/regulation-active-and-intelligent-food-packaging-us-and-eu,
https://www.sharpend.com/what-is-connected-packaging,
https://www.jabil.com/blog/smart-packaging-vs-connected-packaging.html,
https://www.aipia.info/news-When-the-box-becomes-smarter-than-its-content-new-research-on-connected-packaging-1417.php

Recommended Actions – Identifying Solutions

Engage the following:

- **Avery Dennison: Smartrac and atma.io**
  - Leader in RFID and NFC packaging solutions: RFID/NFC tags combined with atma.io cloud platform enables track & trace, product authentication, enhanced consumer engagement
  - Expertise for customized solutions to technical problems – Using RFID on Dassai Sake bottles while using the existing production line. This necessitated a new RFID design: Designing RFID antennas for liquids and glass, Bonding the IC chip to the aluminum antenna, Converting into an RFID label and printing on the face material, Encoding a unique ID on the IC chip for each label, Printing a QR code with the same ID on the label

- **R.R. Donnelley and Sons**
  - In addition to traditional packaging and materials, RRD offers Smart Packaging technology
    - Tamper-evident cartons with solutions for brand security and counterfeit protection
    - RFID labels for asset tracking, security, and inventory management applications
    - Augmented Reality motion graphics and NFC to drive product engagement
  - AR packaging offers a dynamic, attention holding experience in-store to differentiate a product or brand

Recommended Actions – Identifying Solutions

Engage the following:

- **Blue Bite**
  - Blue Bite's simple platform works with NFC, QR-Codes and more for connected packaging, up and running in weeks rather than months, no coding or developers needed
  - Proven track record in Connected Packaging for high profile clients
    - Moët Hennessy, L'Oréal, Adidas, Samsung
    - Redken home hair products using RFID and NFC tags customized consumer experience:
      - Experience language was automatically set based on the user's phone settings
      - "Complete Your Hair Routine" directing consumers to related products in-store based on what package is scanned
      - Different Content for Pre-Sale and Post-Sale


Subject Matter Experts

Subject Matter Experts

Cameron Worth,
Founder & CEO | SharpEnd

A recognized figure within the innovation space and a regular speaker and writer on how technology innovation can be leveraged to build brands in a connected world.

In 2014, he launched SharpEnd, now a global leader of experience-led programs across connected packaging and retail.

Name	Cameron Worth
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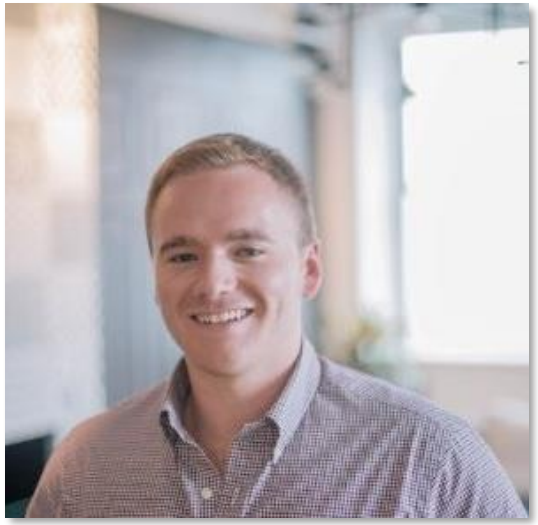
Email	NA
Phone	NA

Subject Matter Experts

Ian Clough,
Director of Growth | Blue Bite



Currently leading growth and sales initiatives at Blue Bite, where our mission is to change the way that people interact with the physical world around them. Spoiler: it's by making it digital, and through a simple scan or tap of their phone.

Name	Ian Clough
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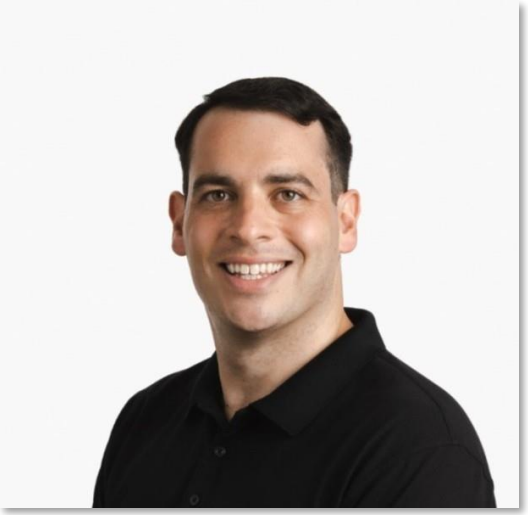
Subject Matter Experts

Max Winograd,
Vice President of Connected Products |Avery Dennison Smartrac, Co-founder| Atma.io



As Senior Director, Digital ID and Ventures, Max is responsible for leading our digital identification platform, enabling any everyday item to have a unique digital identity.

Before joining Avery Dennison in 2017, Max was co-founder and CEO of NuLabel Technologies, a new materials startup developing activatable materials and sustainable solutions for brands and the packaging industry.

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Solutions Ecosystem

Key Players in the Solutions Ecosystem

- Utilizing Ezassi's proprietary AI-powered Technology Landscaping software, we data mine more than 40 million data sources, capturing powerful information from data source records including global grants, patents, trademarks, scientific journal publications, news, web monitoring and conference data. Emerging technology data mining from 2010 to present.
- The Key Players were selected based on top ranking within the Technology Landscaping tool.

Key Players

	Amcor plc	Sealed Air	Avery Dennison	Ensurge Micropower (formerly Thin Film Electronics)	International Paper	R.R. Donnelley & Sons
Annual Revenue (all products)	$14.5 B	$4.9 B	$8.4 B	$440 k	$20.6 B	$5.1 B
Portfolio Strength	**Medium**	**Medium**	**High**	**High**	**Medium**	**High**
Market Sectors	B2B	B2B	B2B	B2B	B2B	B2B
Technology	Flexible packaging, specialty cartons, plastic bottles, jars, & capsules, closures. Active packaging and intelligent packaging	Packaging materials, equipment, services, and automation	Label & Graphic Materials, Retail Branding, Information Solutions, Industrial, Healthcare Materials	Printed tags, labels, and systems: memory, sensors, displays, and wireless communication	Production of fiber-based packaging, pulp and paper	Marketing, packaging, print, and supply chain solutions
Product Pipeline	QR code, data matrix, NFC/RFID tag and other customer preferred carriers	Prismiq: solutions for design services, digital printing, and smart packaging	Smartrac: RFID with a connected cloud platform (atma.io) for tracking, traceability, and consumer engagement	NFC mobile marketing and smart-packaging solutions using printed electronics technology	RFID technology for intelligent packaging, Ohmega conductive ink, Touchcode technology platform	RFID, Augmented Reality motion graphics and NFC
Website	https://www.amcor.com/maxq	https://www.sealedair.com/solutions/prismiq/smart-packaging	https://rfid.averydennison.com/en/home.html	https://ensurge.com/	https://www.internationalpaper.com/	https://www.rrd.com/a

Initiatives (Trends)

Yeo Valley

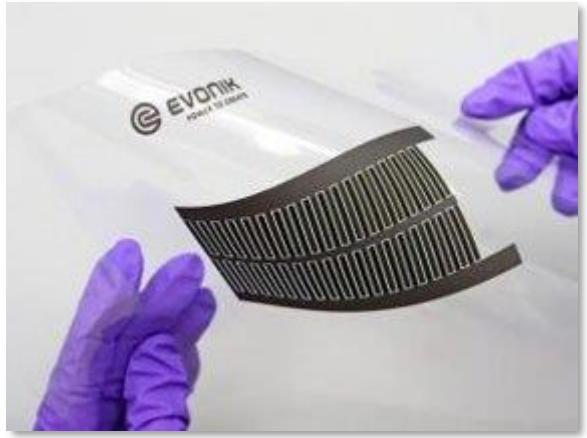
- Britain's largest organic brand, Yeo Valley Organic, has rolled out connected packaging across all products as part of their new 'Put Nature First' brand platform. The move comes as brands turn to mobile to make packaging a smart asset to drive messaging and sustainability credentials.
- **By scanning a SKU-specific QR code on any Yeo Valley product, consumers were taken through to a digital experience that allowed them to access a range of unique and useful content.**
- This included recipes along with eco-information on the brand and the specific product they had bought, with details on how to recycle it too.
- They also used this innovation to introduce a seamless way to redeem Yeo Valley **loyalty points** with the content offered to consumers changing over time, based on their loyalty.
- The dynamic digital experiences adjust based on the product, customer location, and the time of day.
- The campaign used SharpEnd's connected data and experience platform – io.tt – to issue, manage, and measure over 100 million identities and ensure each digital experience can be enhanced as Yeo Valley's campaign evolves. Through io.tt analytics Yeo Valley Organic can build consumer profiles and track engagement across the product portfolio.

Slide Source: https://internetretailing.net/mobile/yeo-valley-organic-launches-always-on-connected-packaging-as-mobile-makes-boxes-smart-22162/

Initiatives (Trends)

Evonik

- InnovationLab has announced it has acquired Evonik's TAeTTOOz printable battery technology. The companies have been close partners in this field for many years and have jointly driven the technological development of TAeTTOOz to the present threshold of industrial-scale production.
- It is the first technology of its kind that enables flexible, rechargeable solid-state batteries to be printed at industrial scale, they claim.
- Typical applications are set to include low-cost IoT sensor labels for packaging and stock management, wireless industrial sensor technologies, and self-powered signage solutions.
- It has a potential to be used in smart connected packaging applications.



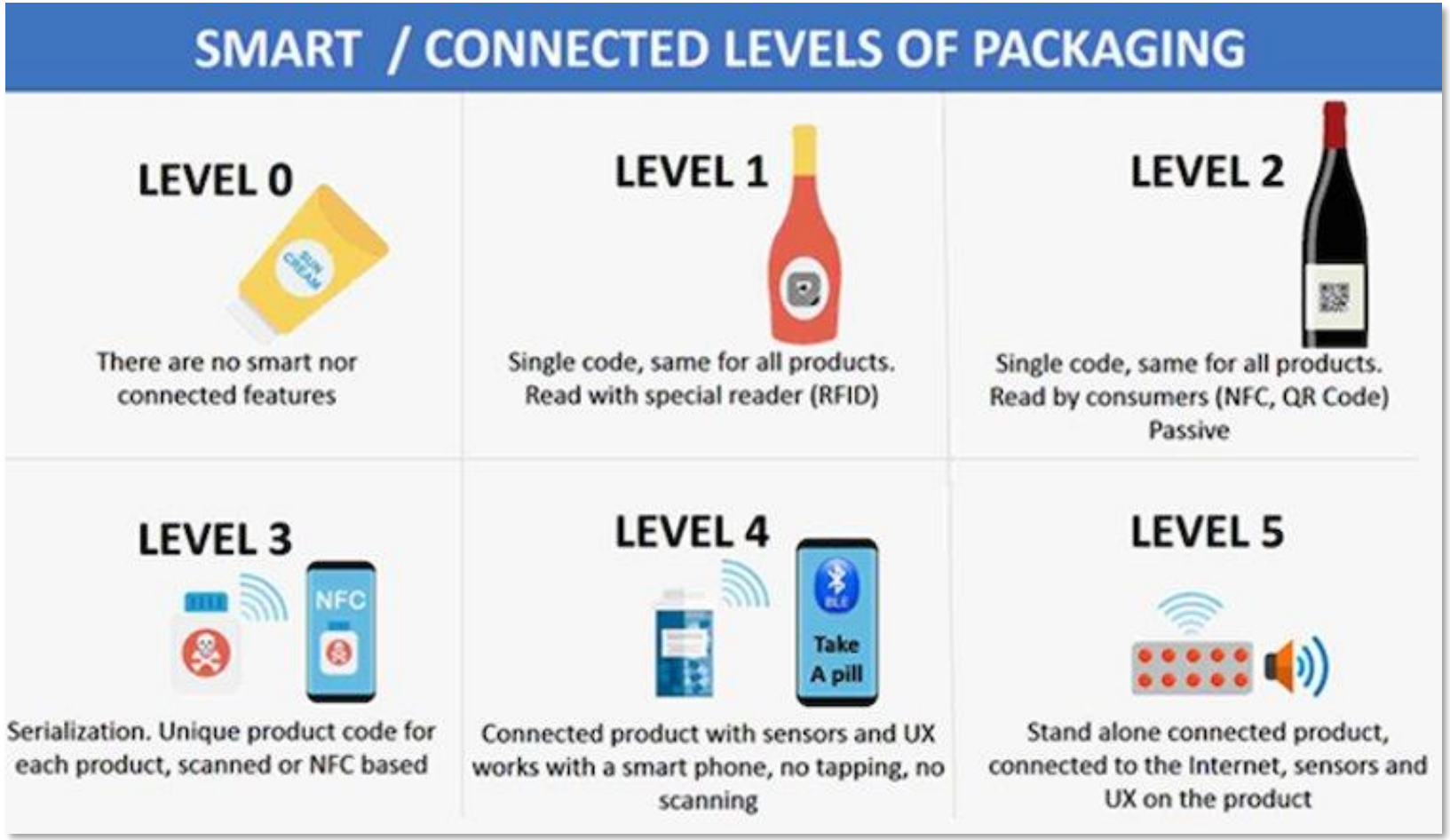
Slide Source: https://

Startup Ecosystem

Summary

- **Mostly using QR codes, connecting smart phones**
  - Point-of-sale consumer engagement
  - Product authentication
  - Freshness tracing
  - Automatic refilling products

Summary


SMART / CONNECTED LEVELS OF PACKAGING
LEVEL 0
There are no smart nor connected features
LEVEL 1
Single code, same for all products. Read with special reader (RFID)
LEVEL 2
Single code, same for all products. Read by consumers (NFC, QR Code) Passive
LEVEL 3
NFC
Serialization. Unique product code for each product, scanned or NFC based
LEVEL 4
Take A pill
Connected product with sensors and UX works with a smart phone, no tapping, no scanning
LEVEL 5
Stand alone connected product, connected to the Internet, sensors and UX on the product

Startup Profiles

Vestapack

What they offer: Connected Refill Containers

Vestapack is a UK-based startup that leverages the IoT to monitor, manage, and arrange the transportation and refill of supplies. The company's biodegradable containers set off alarms when the contents of the container are low. Vestapack's platform and app learn from user patterns and provide full tracking of the packages in use or transit.

Founded: 2017

Funding Stage: seed fund

Funding amount: undisclosed

Website: https://www.vestapack.com/

Slide source: https://www.vestapack.com/a-bold-pledge/

Startup Profiles

ColorSensing

What they offer: Connected Quick Response (QR) Sensors

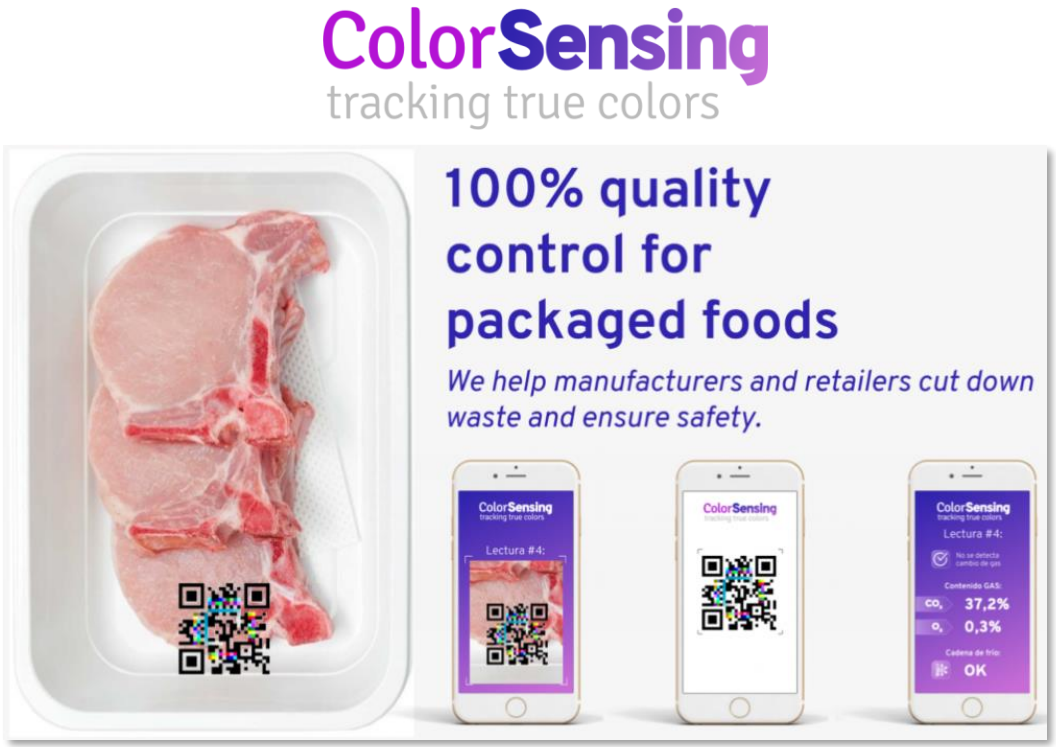
A spin off from the University of Barcelona, Spain. The startup ColorSensing utilizes QR technology to automatically and quantitatively measure food freshness. The startup employs colorimetry-based sensors to quantify the condition of the food inside the package while a color-corrected output indicates the freshness of the food.

Founded: 2018

Funding amount: $367 k

Funding stage: 3 rounds of grant funding

Website: https://www.color-sensing.com/en



Slide Source: https://porcinnova.es/color-sensing-participar-en-el-programa-de-aceleracion-de-porcinnova-supone-una-oportunidad-unica/

Startup Profiles

Thaddeus Medical Systems, Inc

What they offer: Temperature-Controlled Packaging

Thaddeus is a US-based startup that develops smart packaging solutions for temperature-sensitive products. Their patented platform, iQ-ler, offers a range of software and hardware features for temperature-controlled packaging. The platform has a built-in IoT system that enables real-time tracking, active temperature control, and lid security sensor for strengthened product safety. iQ-ler transports medical specimens, such as vaccines, drugs, blood, tissues, and organs.

Founded: 2015

Funding amount: $881 k

Funding stage: convertible note

Website: https://www.thaddeusmed.com/

THADDEUS

Startup Profiles

LivingPackets

What they offer: Smart Reusable Packaging

The French startup LivingPackets manufactures smart packaging boxes made up of recyclable expanded polypropylene. Using this solution, the startup covers shipping items from the size of a SIM-card or a book to the size of two shoeboxes. The smart box reduces carbon emissions and uses an electronic ink address data display, integrated holding mechanism, and smart locking system to securely protect packages.

- THE BOX can make up to 1,000 deliveries.
- The user receives an alert in case of intrusion, shock or anomaly on your phone and by e-mail
- THE BOX is available in two sizes (32 liters and 2 liters). It can be folded and unfolded in 5 seconds with an integrated wedging system.

Founded: 2016

Funding amount: $5 M

Website: https://livingpackets.com/

Startup Profiles

Algramo

What they offer: Provider of smart reusable packing and refills of staple goods

It's a vending machine that sells non-perishable staples such as rice, beans & detergent by the gram. The buyer can buy smart reusable packaging containing RFID tagged, and provider's information to the vendor to refill the package. Using the mobile application, the customers can find tricycles at multiple points.

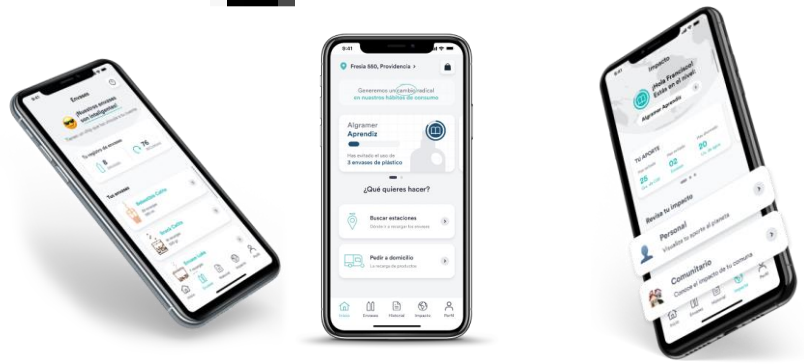
Founded: 2013, in Santiago Chile

Funding amount: $9 M

Investors: Dalus Capital, Century Oak Capital, Closed Loop Partners and 7 other investors

Website: https://algramo.com/en/

Algramo



Buy the last packaging of your life and stop generating waste

Examine and manage your packaging

Check the positive impact you are generating

Research Initiatives

University of Donja Gorica - Faculty of Information Systems and Technologies, Montenegro

- **TagItWine** - Pilot for Brand Protection and Anti-Counterfeiting in Wine Industry (H2020) got Horizon2020 research grant worth 7M Euros. Later formed a spin-out company.
- The team successfully developed a new app to provide consumers with the appropriate information necessary to make an informed alcoholic purchase, hopefully resulting in the consumer finding the perfect drink for their unique palette.
- To use the app, consumers can simply scan a bottle's bar code. The app will then offer the wine's origins, including the location and subregion of the vineyard, bottler and distributor. The data also helps the app gather data what's selling inside of stores, to help companies better understand their target markets. This app is currently working on developing a label that can be added to all bottles of wine.

Slide Source: https://www.researchgate.net/project/TagItWine-Pilot-for-Brand-Protection-and-Anti-Counterfeiting-in-Wine-Industry-H2020 and https://tagitwine.udg.edu.me/

Research Initiatives

Helmholtz Association

- HELMHOLTZ Association (Germany's largest scientific organization) & FZJ conducts research to provide comprehensive solutions to the grand challenges facing society in the fields of energy and environment.
- Project: **Smart Food: Is It Fresh?** Later formed a spin out **"Is it Fresh"**
- A printed ultra-low-cost sensor technology, makes food packaging smart by measuring the product freshness via temperature, pH, humidity and other parameters and predicting the expiration date of the product based on these freshness parameters. A freshtag is integrated into the package and communicates wirelessly so that consumers can monitor the product freshness in real time through their smartphone or smart fridges.
- Is It Fresh is now a provider of IoT-based packaging products. The product is a sensor-based supply chain tracking solution that allows customers to scan through the mobile phones, view product catalog, communicate, and measure the quality of the product. The product application is in industries such as packaging, inventory management, logistics, etc.
- Funding: EU funds (EFRE Mobilität und Logistik NRW/EU, and Horizon2020 programs) and investment on the spin out (Plug and Play Tech Center and 5 other VCs).

HELMHOLTZ ASSOCIATION

JÜLICH FORSCHUNGSZENTRUM

IS IT FRESH

Slide Source: https://www.earto.eu/rto-innovation/helmholtz-smart-food-is-it-fresh/, http://www.is-it-fresh.com and https://www.innovationnewsnetwork.com/is-it-fresh-tackling-food-waste/416/

Appendix

Appendix

- Regulations
- Technology Breakdown
- Market Analysis
- Methodology Overview
- Keyword Deconstruction
- Data Analytics
- Research Insights
- Highlighted Findings
- References & Addenda

Regulation

Appendix

Regulation

United States

- US FDA has recently announced that it is working to "**create a safer and more digital, traceable food system,"** with the end goal of reducing foodborne illnesses. The FDA's "New Era of Smarter Food Safety" blueprint for the next 10 years portends an environment where US consumers have direct access to trusted information about the origins of food products.

- In the US, active and intelligent (smart connected) packaging are regulated under the Food and Drug Administration's (FDA) regulatory framework and subject to the same requirements as all food contact substances. Materials used in food-contact applications are subject to premarket regulatory clearance in the US if deemed "food additives."

    - If materials in active and intelligent packaging systems do not migrate to the food or have a technical effect in the food, there are no special regulatory concerns.

Slide Source: https://www.forbes.com/sites/niallmurphy/2021/07/21/cpg-brands-are-looking-to-connected-packaging-to-connect-with-consumers/?sh=34d99cc12b9b and https://www.packaginglaw.com/special-focus/regulation-active-and-intelligent-food-packaging-us-and-eu

Appendix

Regulation

European Union

- European legislation for Active and Intelligent packaging materials, (EC) 450/2009. Suppliers of active and intelligent packaging materials on the European market need to make sure that their materials comply with the general European Framework (EC) 1935/2004, the 450/2009 (EC), and others where relevant. Active and intelligent materials and articles may be placed on the European market if they comply with the restrictions set out in Regulation (EC) 1935/2004, articles, 3, 4 and 15, and the European Regulation (EC) 450/2009. In regulation (EC) 450/2009 specific rules are laid down for active and intelligent materials and articles intended to come into contact with food. On 29 May 2009, the regulation (EC) 450/2009 was published in the Official Journey. The regulation has become active as of 18 June 2009.

- In the EU, active and intelligent packaging intended to contact food is regulated pursuant to Regulation (EC) No 450/2009.[6] This regulation establishes a premarket approval system in which active and intelligent materials may not be marketed unless the individual substances responsible for the active and/or intelligent function are included on the European Community list of eligible substances, with some limited exceptions. In addition, A&I materials, as well as their component substances, must be accompanied by a written declaration of compliance at every stage of marketing other than just the final sale.

France:

- In July 2020, France's parliament passed an anti-waste law with some drastic changes: to ban single use plastic containers. Restaurants have to switch to reusable food containers by January 2023.

Slide Source: https://www.intertek.com/assuris/food-contact/regulatory/active-and-intelligent-food-packaging-legislation/

Technology Breakdown and Taxonomy

Smart Packaging: Intelligent, Active, or Connected?

Slide Source: https://www.jabil.com/blog/smart-packaging-vs-connected-packaging.html

Abbreviations & Definitions

- **(Smart) Connected Packaging:** Connected packaging refers to product packaging that facilitates brand-to-consumer engagement via the internet and a smartphone, focusing on experience and creativity to deliver anything from product information to an immersive AR environment.
- **IoT (Internet of Things):** Concept aimed at providing a globally interconnected network infrastructure for connecting objects to the cyber-physical world. It allows for the tracking and control of devices equipped with sensors and actuators. For example, packaging objects equipped with RFID tags can easily be tracked along their journey from manufacturer to customer.
- **NFC (Near field Communications):** a set of standards for smartphones and similar devices to establish radio communication with each other by touching them together, or bringing them into close proximity, usually no more than a few centimeters apart. Communication is also possible between an NFC device and an unpowered NFC chip, called a "tag."
- **RFID (Radio Frequency Identification):** wireless or contactless transfer of a digital ID and additional data between an RFID tag and a reader by means of electromagnetic waves. RFID allows tags to be read without a line of sight at a distance of a few centimeters to more than 20 meters or 60 feet.
- **QR (Quick Response) Code:** a type of barcode that can be read easily by a digital device and which stores information as a series of pixels in a square-shaped grid. QR codes are frequently used to track information about products in a supply chain and because many smartphones have built-in QR readers they are often used in marketing and advertising campaigns. The data stored in a QR code can include website URLs, phone numbers, or up to 4,000 characters of text.

Slide Source: https://www.sciencedirect.com/science/article/pii/S2212827118304104

Technology Overview

- The way consumers access these always-on resources is simple. Connected packaging starts with a printed or embedded code in the brand artwork (NFC, QR codes and visual recognition apps are common applications). The consumer uses a smartphone or tablet to scan (or tap) this code, triggering a convenient, connected journey that's filled with content to enhance the experience of use — when brand/category users are the most engaged.

Slide Source: https://www.forbes.com/sites/niallmurphy/2021/07/21/cpg-brands-are-looking-to-connected-packaging-to-connect-with-consumers/?sh=392560f62b9b

Technologies Available

“Offering transparency in the food supply chain”

- Barilla has worked hard to create traceability in its supply chain. By scanning a QR code, consumers can view all stages of the production process, from farm to fork, via a linked website. Details are provided about the origin of the durum wheat varieties and background detail on the harvest, milling, and movement through the supply chain through to the point-of-sale.

“Notifying when time to refill/reorder”

- The introduction of the Internet of Things (IoT) in packaging enables smart devices to learn from human actions. Thanks to active chips and sensors that employ specific notification systems (e.g., alarms), users are notified about the need to refill supplies such as milk, water, or food. Startups across the world are developing connected packages that inform individuals on their emptiness levels and thereby reduce waste.

“Freshness indicators for food or medicine”

- Connected QR sensing technology usually finds applications in packages containing medicines and food, where lifetime and expiration dates are exceedingly important. In these cases, the technology assists consumers in recognizing the quality, freshness, or other parameters of a product. Moreover, automation brings more cost-effectiveness, and greater accuracy in terms of the package’s internal “health”.

“Medical cold chain Security System”

- Variability in temperatures across regions or during transport negatively influences the contents of packages (for example, vaccines). With the help of intelligent software, wireless communications, and climate-control, temperature-controlled packaging strives to protect them from the atmosphere. As a result, these enhance control over lead-time, reduce labor and material costs, while continuously providing connected temperature insights.

Smart Reusable Packaging

- It reduces packaging waste and creates a closed-loop recycling system. This helps to store food, paint, and chemicals for longer with the use of biomaterials that increase the lifetime of a product. These solutions use blockchain technology and sensors to enable continuous traceability at reduced costs.

What challenges does Smart Packaging face in the immediate future?

- **Eef de Ferrante, Director of AIPIA, the Active & Intelligent Packaging Industry Association says,**
  "I believe that we are currently in the second phase of the development of Smart Packaging. The question is no longer what Smart Packaging can do, but rather, what can it do for me? Brand owners and retailers are now convinced that there is value in these technologies and that they are an opportunity to add value to their products. *The challenge for the industry is to ensure that they can mass produce, whilst providing reliable performance and at a price that makes mass adoption affordable.* Much progress has been made in all these areas, but it is a journey that is not over yet."

- **From an Information and Communication Technology (ICT) point of view,**
  the actual integration of smart packaging into the growing number of horizontally and vertically integrated production networks as part of the Industrial Internet of Things and Internet of Services requires the manufacturing sector to overcome a number of challenges, including:
  - Seamless integration of their internal Information Technology (IT) and Operational Technology (OT). This so-called IT/OT convergence is a precursor for enabling the distributed and largely autonomous smart manufacturing networks of the future.
  - New ways of addressing cybersecurity and ensuring data security and IP protection along the entire lifecycle are yet to be resolved.

Slide Source: https://www.hispack.com/en/the-challenge-for-smart-packaging-is-to-ensure-mass-pro-duction-with-good-performance-at-an-affordable-price/ and https://www.sciencedirect.com/science/article/pii/S2212827118304104

Market / Data Analysis

Smart Connected Packaging Market Analysis

The Global Smart Packaging Market size is expected to reach over USD 33.00 Billion by 2028, exhibiting a Compound Annual Growth Rate (CAGR) of 12% during the forecast period from the year 2021 till 2028. The said market stood at a revenue of USD 13.88 Billion in the year 2021.

Smart Connected Packaging Market According to Mindshare, 64% of consumers say they are interested in the idea of internet-connected packaging. Findings of their research:

- Connected packaging that delivers extra consumer value is most appealing.
- 62% find the idea of a product which alerts you or reorders itself when about to run out appealing
- 58% find the idea of a product reminding you when it is about to reach its expiry date appealing
- Product packaging has the potential to become an adaptable digital touchpoint – over 50% of those surveyed are interested in scanning packaging to learn more about the provenance of fresh produce
- Consumers are willing to passively share purchase and usage data on everyday items – 62% agree that connected products can collect data if they get something of value in return
- Household products companies could move towards subscription relationships with consumers
- 39% agree that ‘I would consider a service contract with a brand where it automatically reorders and delivers products for me’
- But consumers are wary of ceding too much control to products capable of communicating to them directly or acting independently
- 76% agree that ‘If all household products are internet connected, I need to be in control of which can interact with me and in what circumstances’
- There will be a need for a central aggregator to manage all connected products in the home
- 35% agree that ‘I would like a virtual assistant to manage all of the interactions with products for me’

Technology Keyword Deconstruction

Targeted Discovery

Through a technology-driven process, we build extensively upon the core traits of the scouting project to discover and identify every type of target.

Deconstruction Engine

Utilizing a unique deconstruction technology-driven engine within our Technology Scouting tool, we break down and deconstruct the core traits of the scouting project, piece-by-piece.

We look at categories including trending terminology, topic trends, suggested terms, relevant keywords and adjacent terminology, to capture specific characteristics that will uncover, discover and lead to new, adjacent opportunities that are transformational for the project needs.

Data Analytics

Keyword Deconstruction

- Smart connected packaging
- Connected packaging
- IoT
- Sensor enabled packaging
- Active packaging
- Intelligent packaging
- RFID tagging
- NFC
- Consumer Engagement
- Interactive

Emerging Source Evolution

- 2010 to Present

Ezassi Market Landscape Indicator

The chart analytics displayed here shows an increase in market data from 2016 to Present with the majority being News and Web monitoring

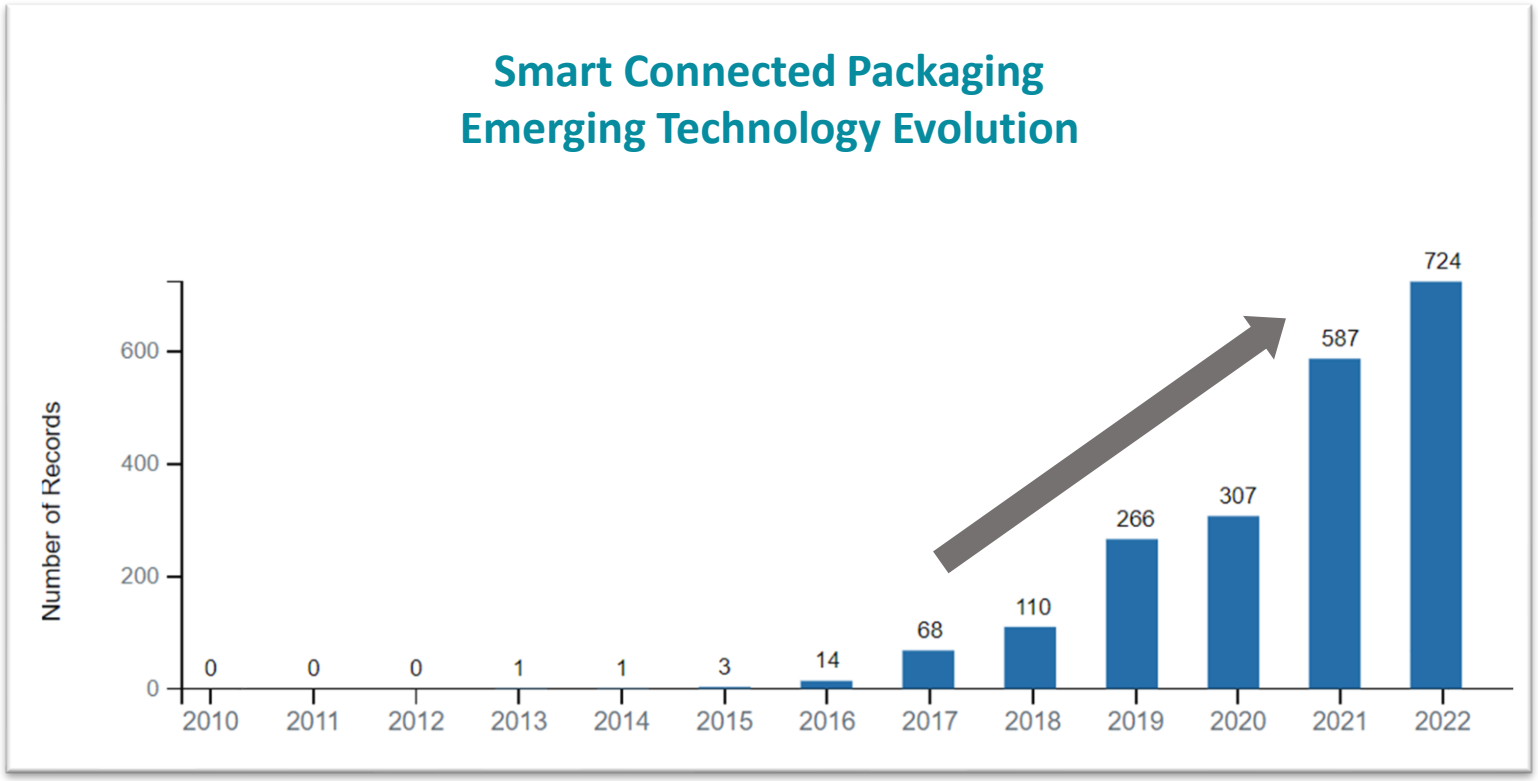


Chart Type Defined

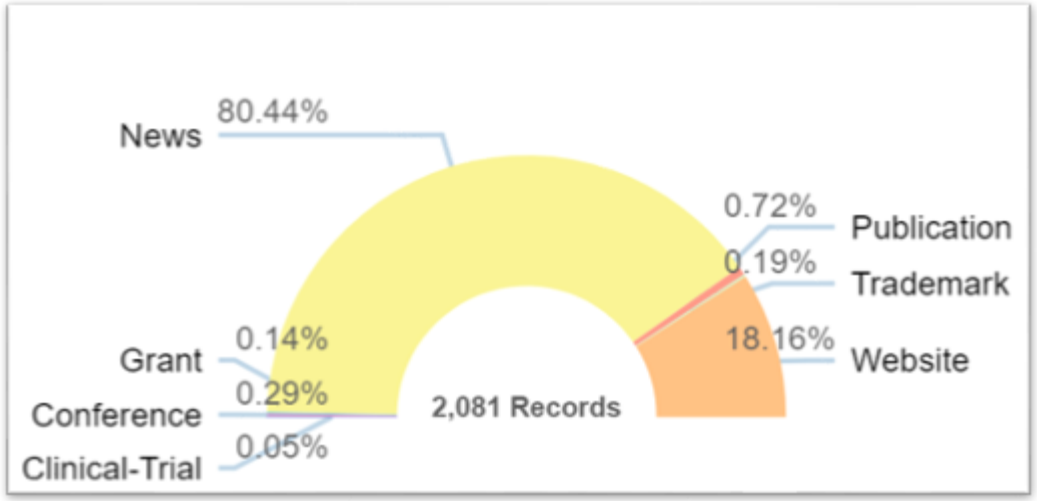
Utilizing Ezassi's proprietary AI-powered Technology Landscaping software, we data mine more than 40 million data sources, capturing powerful information from data source records including global grants, patents, trademarks, scientific journal publications, news, web monitoring and conference data. Emerging technology data mining from 2010 to present.

The graph represents:

- The evolution of a technology, product and/or topic over time
- How the emerging technology or topic has evolved year-over-year (for 10 years)
- How a topic is trending and can contribute to forecasting the market

Market Landscape Data Distribution

- 2010 to Present
  - News spiked in 2021 through 2022 and made up >60% of all news data produced in the last 12-year period
  - Signifies emergence of commercial activity around the topic due to increase pressure for product traceability
  - Data sits in the commercialized space
  - 2020 - Present has seen the most significant jump



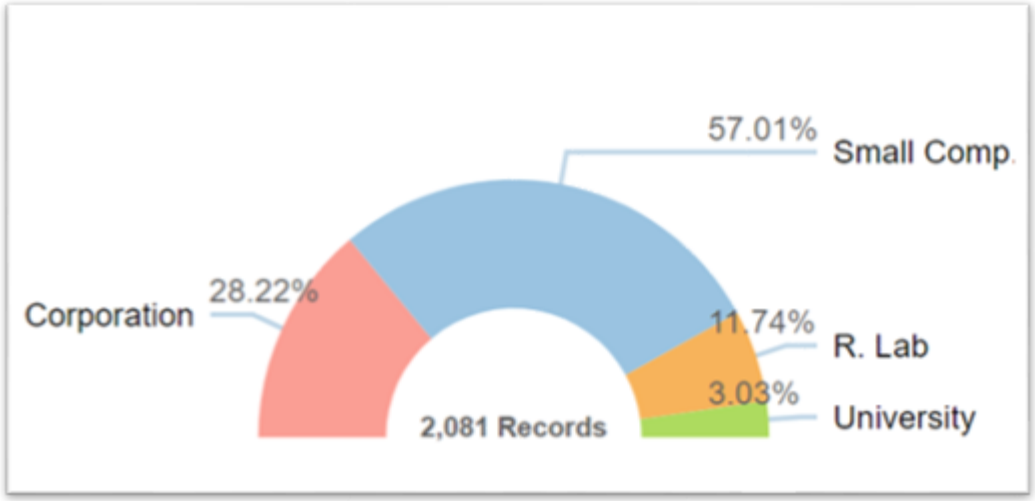


Chart A represents:

- Data source contribution
- Identifies the prominent sources to capture market positioning
- Identifies higher market concentration of startups, for example, if trademarks are greater than patents
- Helps in identifying a saturated market

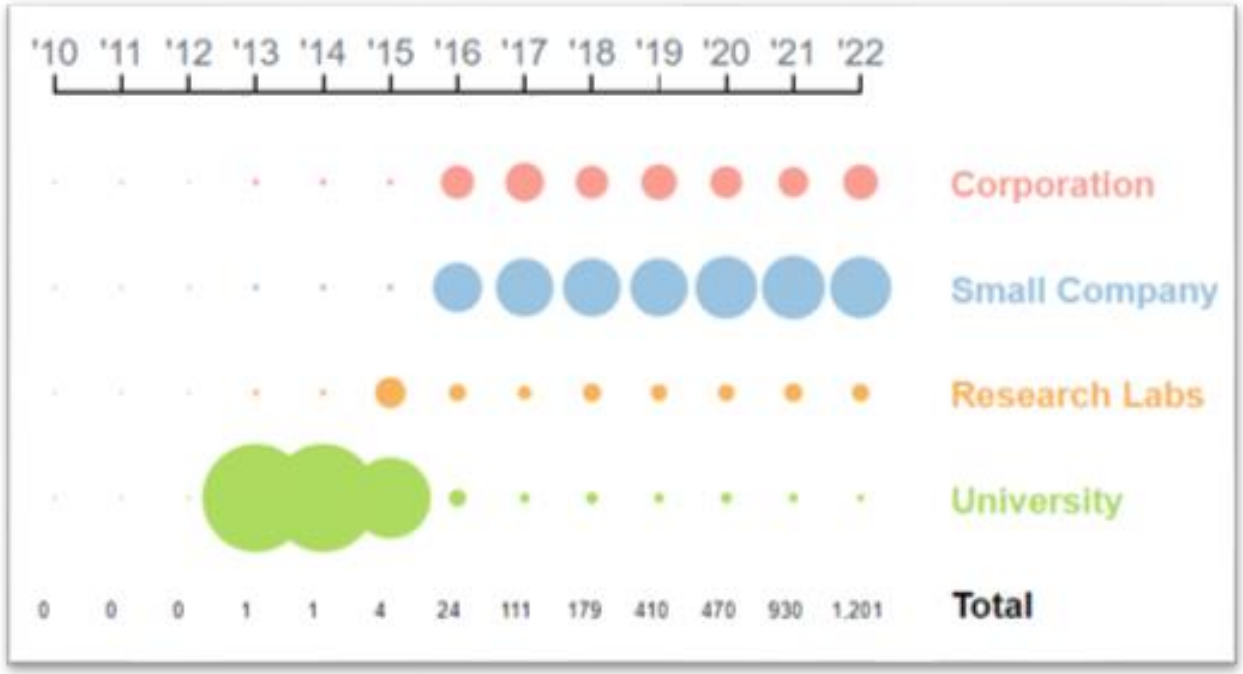
Chart B represents:

- Entity source activity of the technology, product and/or topic
- Closeness to market by identifying where the majority of the sources reside
- Market saturation identification

Market Landscape Organization Prevalence

- 2010 to Present
  - From 2015 to 2016, the prevalence of records switched from Universities and Research Labs to commercial entities. 2016 through the present shows a majority of smaller companies indicating the technology is still emerging with more news from startups than established companies.

Smart Connected Packaging: Organization Prevalence



The chart represents:

- Source records prevalence by organization type
- Where the product or technology is within the market pipeline
- When the product or technology transitioned from one organization type to the next
- Identification of closeness to market

Chart Description:
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References & Addenda

Articles of Interest

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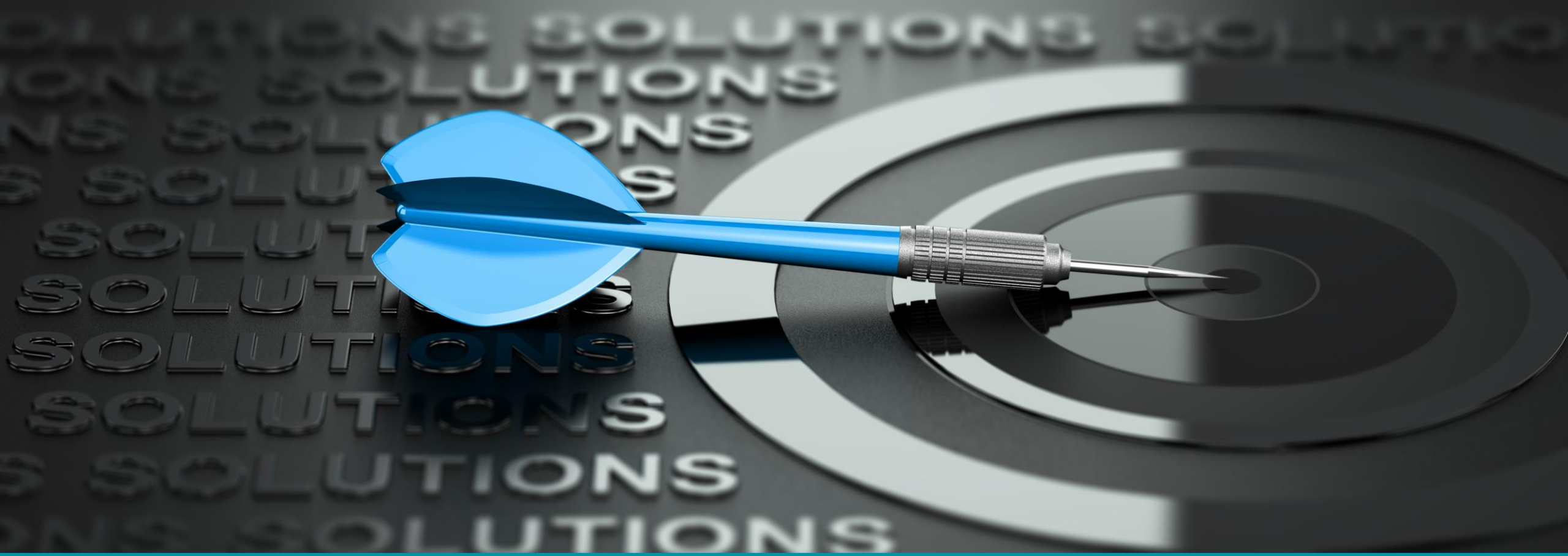

Ezassi's Technology Scouting team works with R&D and engineering departments across all industries to help them solve for their innovation pain points. We pride ourselves on the ability to operate in the rapidly moving global arena and have perfected the art of identifying disruptive and emerging technology, locating startups, and sourcing vendors.

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Technology to innovate *faster.*