The AIDC Technology that can Revolutionize Plastic Sorting Techniques

AIM & Rain Engage Again, May 6, 2021

Larry Logan, Chief Evangelist

DIGIMARC

Digimarc – 25 Years of Innovation / USD $270M in R&D

1995

Adobe Photoshop

Drivers License Authentication

IP portfolio "One of the world's most valuable" #3 behind Microsoft and SAP

Digimarc Barcode for Audio

First retailer for Digimarc Barcode

"Visual Shazam"

Emmy Award

Opened offices In Germany & Japan

Microsoft adds Digimarc Barcode detection to Windows platform

Signed the Ellen MacArthur Foundation's New Plastics Economy Global Commitment

Recycling, sorting and consumer collections initiative

2020

Consortium of Central Banks

NASDAQ: DMRC

Forbes #1 Fastest Growing Company

Nielsen/ Arbitron Audience Engagement

Sale of ID Systems

Discover for Publishing

Guinness World Record fastest retail checkout

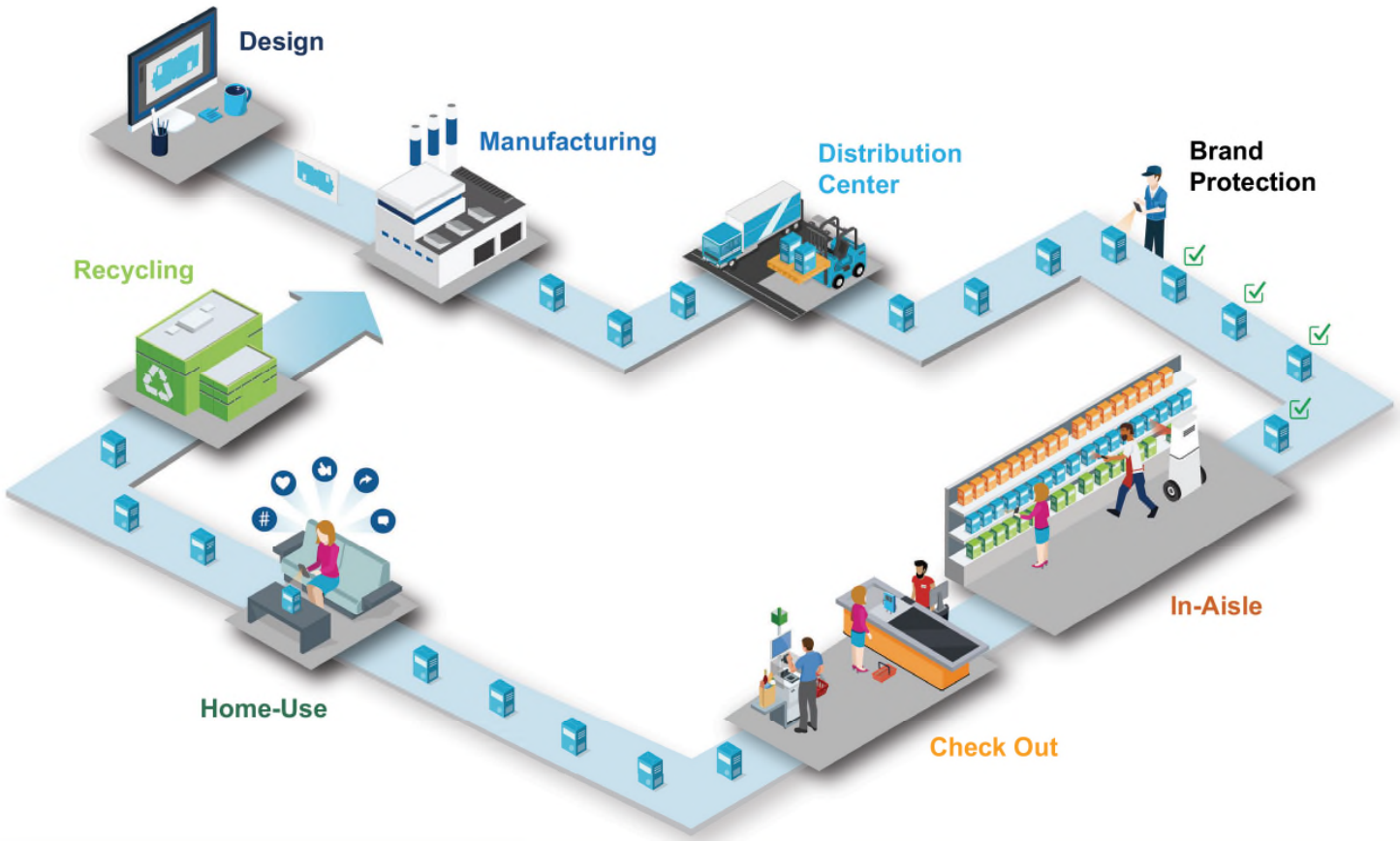
Barcode of Everything

GS1 US Launch

SmartLabel® Support

Approved as digital link for GMO disclosures by U.S. Congress

Digimarc Platform – Value Throughout the Package Journey



Design
- Incorporate barcode data into artwork
- Integrate codes and link to content

Manufacturing
- Improve in-line inspection

Distribution Center
- More reliable labels
- Print on corrugated packaging
- Scan readily from a distance
- Verify logistics and returns

Brand Protection
- Product authentication
- Identify counterfeits
- Product diversion

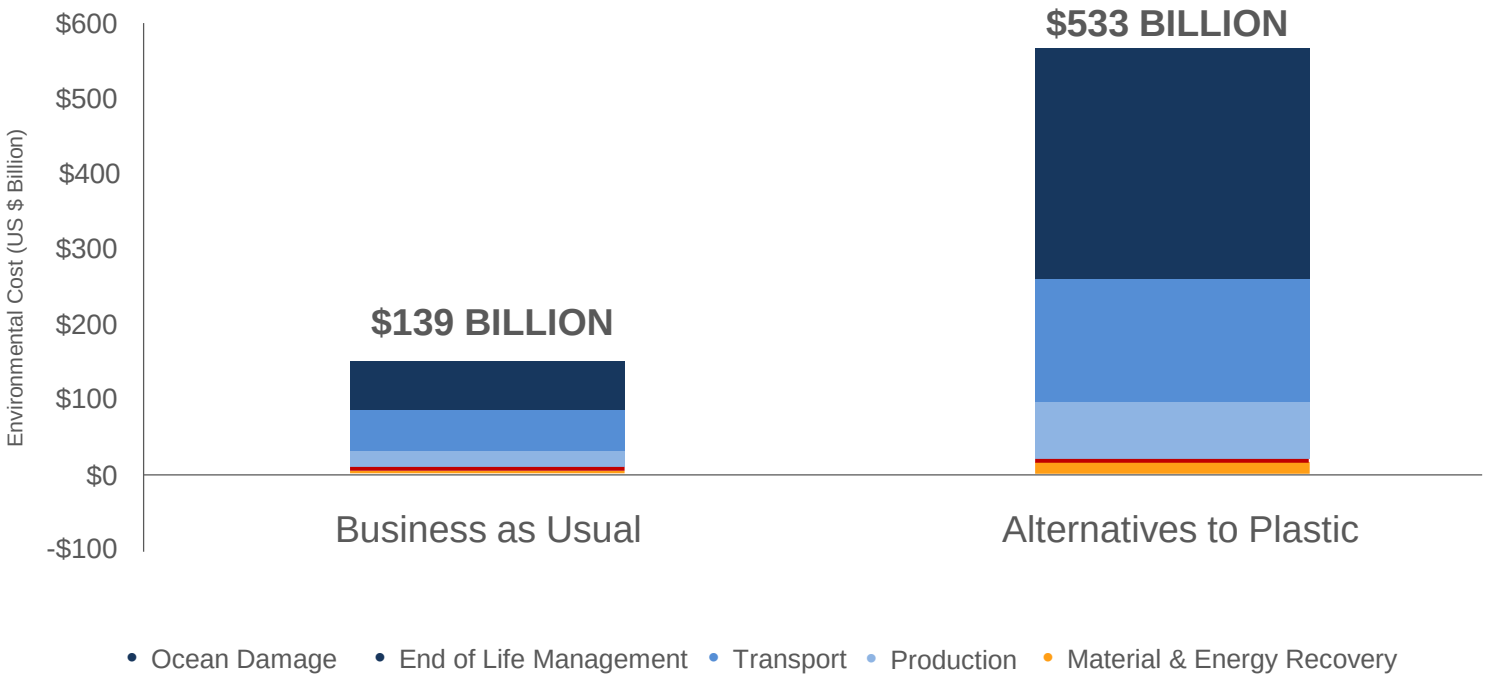
In-Aisle
- Price checks
- Manage planogram & availability (OSA)
- Data Analytics

Check Out
- Easily scan products & labels
- Improve first-pass read rate
- Reduce misreads and manual keying
- Improve customer experience

Home-Use
- Instructions for use
- Brand and social content
- Point and scan to buy now & reorder

Recycling
- Identify materials and substrates
- Improve sorting mechanisms

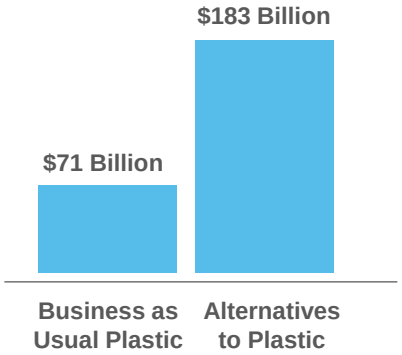
Environmental Cost of Plastic vs Alternative in the Consumer Goods Sector ($US Billion)



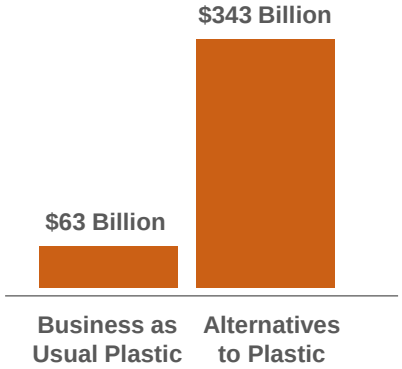
Source: Plastics & Sustainability: A Valuation of Environmental Benefits, Costs and Opportunities for Continuous Improvement, Trucost & American Chemistry Council 2016

The Cost to Society and the Economy

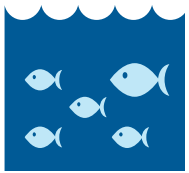
Climate change

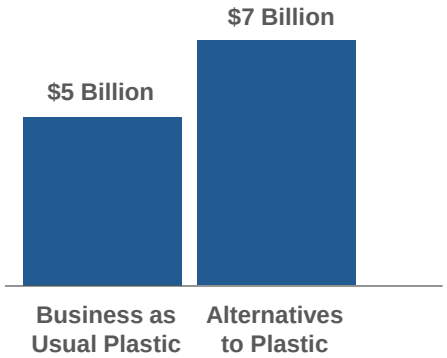


Damage to the health of humans & ecosystems



Damage to the oceans





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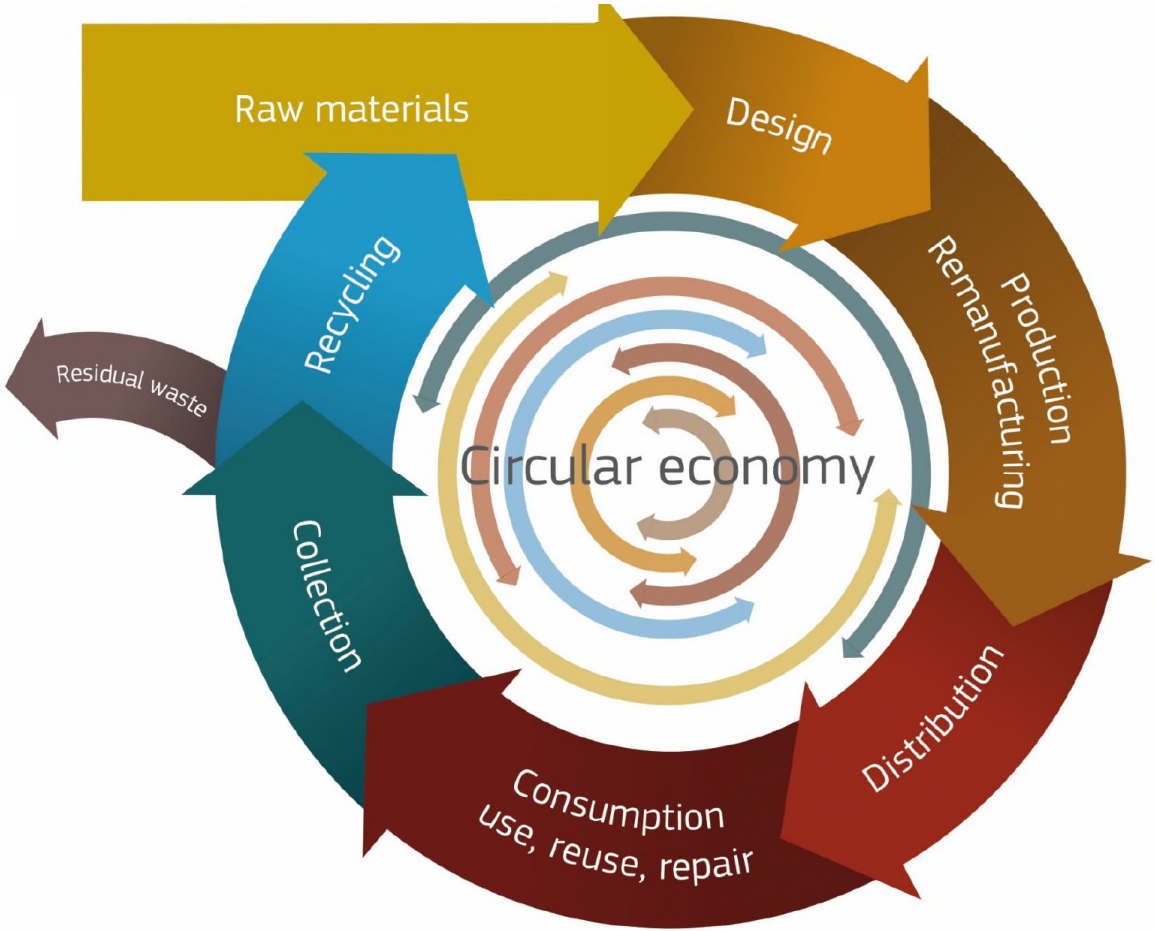

Raw materials
Design
Production
Remanufacturing
Distribution
Consumption
use, reuse, repair
Collection
Recycling
Residual waste
Circular economy

How Much Plastic is Recovered?

Only 9% is recycled

12% incinerated

79% discarded into landfills or natural environment

Estimated 12 billion metric tons will end up in landfills or environment by 2050

Governments, Brands, Retailers Respond to Problem

- Societal costs and consumer pressure to address plastic waste
- Regulations in Europe are mandating greater use of recyclable content in new products
  - Will require significantly higher yields in recyclate quality and quantity
  - Imposition of fees or blocked sales of products if goals not met
- 400+ manufacturers commit to 100% of their packaging will be reusable, recyclable or compostable by 2025
  - Represents 20+% of all plastic produced globally

But…You Can’t Get There From Here

Today’s recycling technologies cannot deliver what’s needed to meet these government mandates and public commitments

By 2025, industry needs 3.5X more recycled plastic content than available today[1]

> *The current plastics system is broken – system change is the only long-term solution”*
>
> ELLEN MACARTHUR FOUNDATION
>
> *“A business as usual approach will not enable the proposed challenging target of 55% plastic packaging ‘preparing for re-use and recycling’ by 2025”*
>
> PCEP POLYOLEFIN Circular Economy Platform

[1] American Chemistry Council

Recycling Today

Types of Single-Use Household Plastics

Polyethylene terephthalate (PET)
Water bottles, dispensing containers, biscuit trays

High—density polyethylene (HDPE)
Shampoo bottles, milk bottles, freezer bags, ice cream containers

Low—density polyethylene (LDPE)
Bags, trays, containers, food packaging film

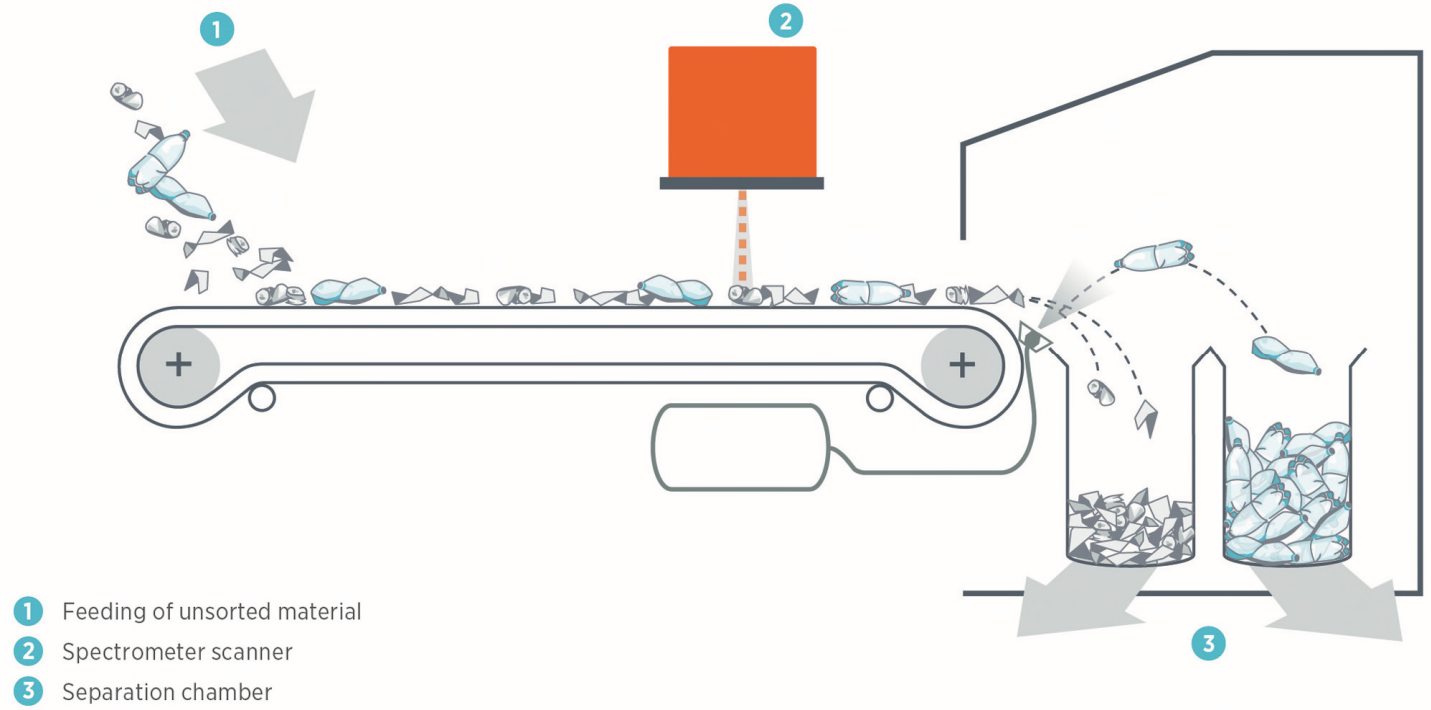
Polypropylene (PP)
Potato chip bags, microwave dishes, ice cream tubs, bottle caps

Polystyrene (PS)
Cutlery, plates, cups

Expanded polystyrene (EPS)
Protective packaging, hot drink cups

Source: "Banning single-use plastic: lessons and experiences from countries" UN Environment report (2018)

Schematic for Typical Sorting Line



Sorting – X,Y Blow-out Jets

Weaknesses in Current Near-Infrared (NIR) Recycling Sorting Systems

Difficult to identify and sort

- Food versus non-food containers
- Multi-layer plastics and percentages of composites
- Carbon-black, opaque, difficult-to-recycle objects
- Color/type of plastic hidden by shrink sleeve
- Manufacturer, product, origin/facility, specific contents of fill
- No data goes available to the manufacturer to show compliance to government regulations (important to offset new fees)

Technologies in Development

Chemical Tracers

- Non-rare earth based luminescent compounds, fluorescent lamps
- Applied to label or plastic
- Limited distinction of objects
- Concerns over contamination

Robotics/AI

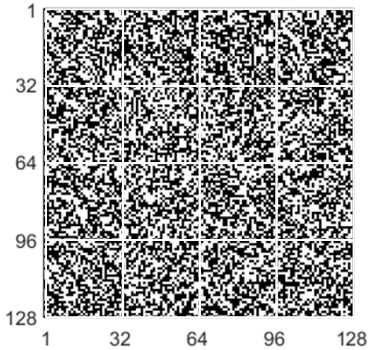
- Pick objects off conveyor
- Artificial intelligence
- Still slow on number of picks
- Key pitch is eliminating labor

Digital Watermarking

- Imperceptible IDs in labels or plastic
- Info on provenance
- Requires additional sorting module at facility

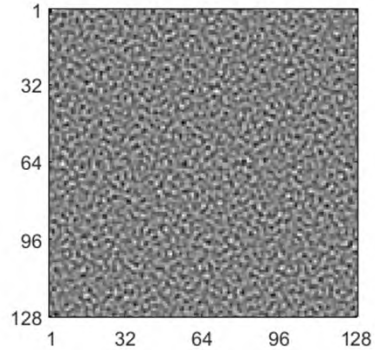
Digital Watermarking for Print and Plastics

Digimarc Barcode: Signal Construction



Message Signal

Structured data such as a product code, SKU, internal tracking data, or GS1 attributes



Synchronization Signal

Tells us the relationship between the viewing device and the object, such as distance, skew angle or rotation

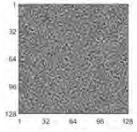
Signal Tile
2.2cm” X 2.2cm

Replicated throughout image by subtle modulation of existing pixels in the design, with no discernable structure to humans as with EAN

Exaggerated view for illustration purposes

Digimarc Barcode: Application in Printed Artwork

Repeated Tile



The encoder applies the tiles to graphics in a mosaic manner

Pieces of multiple tiles can be combined to recover a Barcode

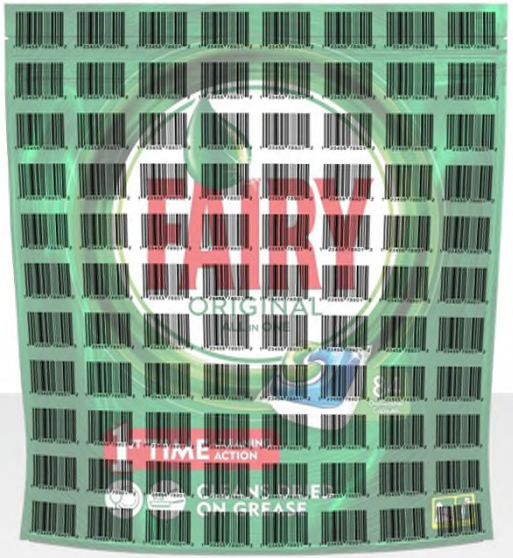
Uses existing pixels. No special inks. No special printing process

Exaggerated view for illustration purposes

Digimarc Barcode: Functional Benefit

Looks Like This

To consumers, the package looks as it did prior to enhancement

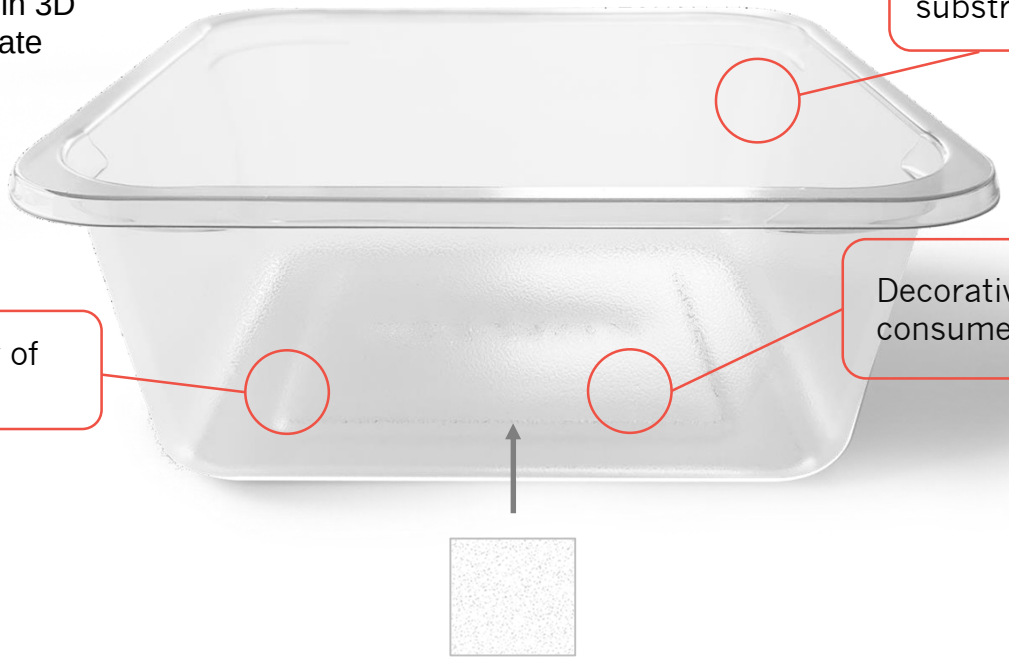


Performs Like This

This is how the package functions to computing devices with cameras

Digimarc Barcode: Applications in Plastic

The concept of enhancement is the same as with print, only the Barcode is created in 3D using the plastic substrate



Imperceptible Digimarc Barcode in PACCOR Thermoform Food Tray

Giving Packaging a ‘Digital Recycling Pasport’

Virtually unlimited Digimarc Barcodes available

- Identifies manufacturer and product (for reduced Extended Producer Responsibility Fees paid by brands)
- Food vs. non-food packaging
- Recyclable vs. compostable packaging
- Component layers of multi-layer packaging
- Carbon-black, opaque, difficult-to-recycle
- New material introductions

Compatible with Circular Economy – no environmental impact or additives

Current Near-infrared detection ‘observes’ plastic and attempts to identify object based on color or spectral analysis

We invert this model. Digimarc puts intelligence into the plastic, which then ‘tells’ sortation equipment its precise identity

THE CODE REVEALS
...EVERYTHING

Everything you need to know for good recycling

PACCOR
PACKAGING SOLUTIONS

I AM A TRANSPARENT PACKAGING

My digital identity tells you a lot about me.
I have saved following information in my code

Colour. Transparent
FOOD OR NONFOOD. Food,
I have packed food
MATERIAL. 88% recyclate / 12% virgin
WEIGHT. 34,34 g

ECOLOGICAL BALANCE. 3,92E-06 / packaging*
RECYCLABLE. Yes
REUSE. Yes, for any type of food, without any risk
PRODUCER. PACCOR Finland OY, Hämeenlinna

STATUS QUO. Would be recyclable today, but not as food packaging

* Internal cradle-to-grave life cycle assessment study carried out in accordance with ISO 14040/14044 standards using the PEF (Product Environmental Footprint) method (Environmental Footprint 2.0) characterization factors. End of life: recycling. The GaBi 9.2 Professional software and the Ecoinvent 3.5 datasets were used in performing the LCA. The PEF single score is dimensionless.

PACCOR

I AM A BLACK PACKAGING

My digital identity tells you a lot about me.
I have saved following information in my code

Colour. Black
FOOD OR NONFOOD. Food,
I have packed food
MATERIAL. 100% recyclate / 0% virgin
WEIGHT. 32,29 g

ECOLOGICAL BALANCE. 2,51E-06 / packaging*
RECYCLABLE. Yes
REUSE. Yes, for any type of food, without any risk
PRODUCER. PACCOR Finland OY, Hämeenlinna

STATUS QUO. With today's technology, black is considered non-recyclable

* Internal cradle-to-grave life cycle assessment study carried out in accordance with ISO 14040/14044 standards using the PEF (Product Environmental Footprint) method (Environmental Footprint 2.0) characterization factors. End of life: recycling. The GaBi 9.2 Professional software and the Ecoinvent 3.5 datasets were used in performing the LCA. The PEF single score is dimensionless.

PACCOR
PACKAGING SOLUTIONS

Drive Consumer Waste Collections and Brand Engagement

New applications and benefits are being added to smartphone scanning

Consumer scanning package is directed on how to *dispose*

- Confirmation of recyclability
- Proper disposal instructions tailored to user's location or waste provider
- Information about brand's sustainability practices

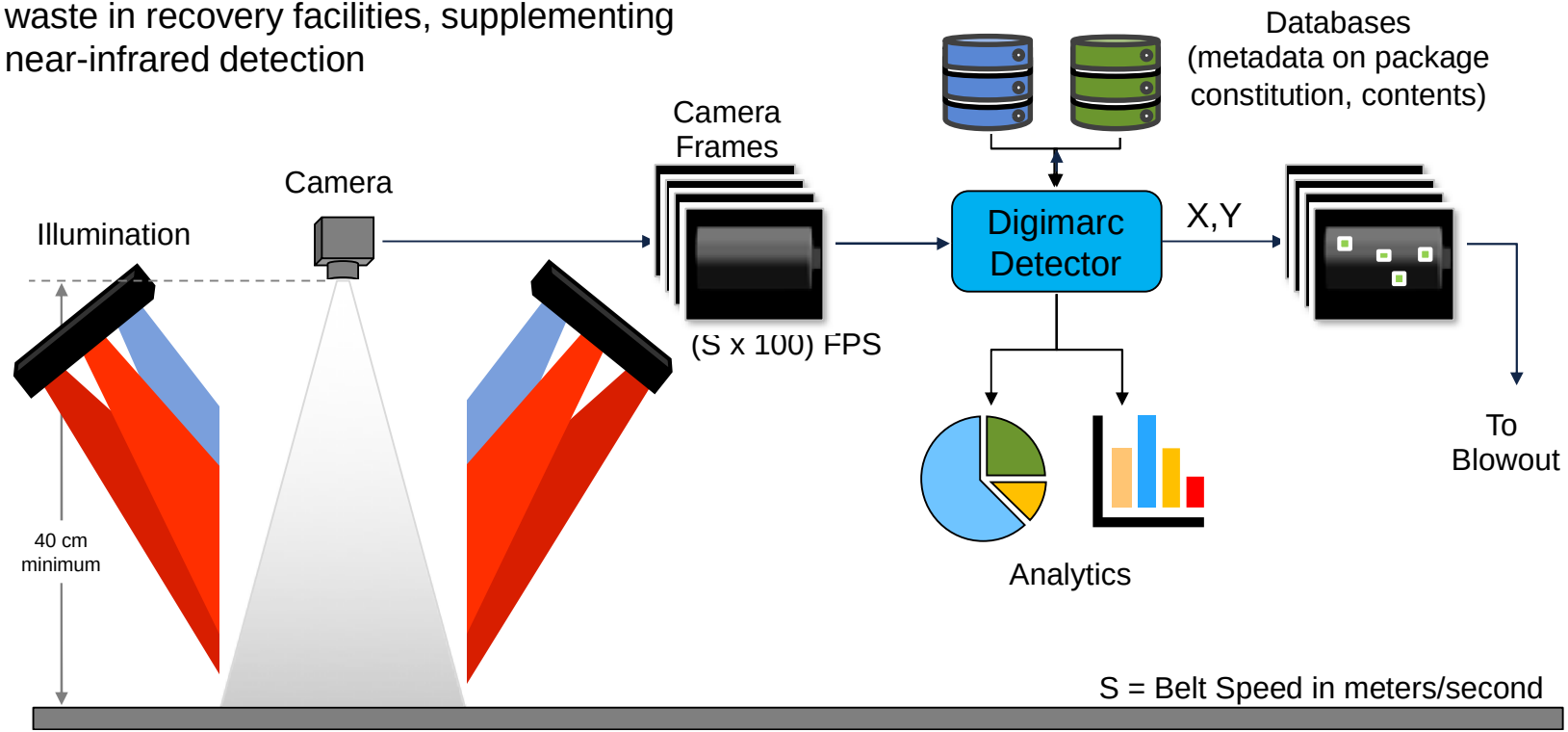
Brands can use interactivity for *additional engagement*

- Information on provenance of food or growing practices
- How to better use or 'enjoy' the product (e.g., recipes)
- Additional offers & promotions

Demo Video: https://vimeo.com/406558069/c4de813a3a

Operation of Digimarc Detector

Digimarc-specified components can scan waste in recovery facilities, supplementing near-infrared detection



TOMRA ‘Module Housing’ with Detection Components

Databases – Conceptual Illustration (Specifics TBD)

Virtually unlimited data on the object can be stored in the cloud

Database for Digimarc Barcode for Print Packaging

GTIN	Producer	Composition	Food	Sort
1234043212	ABC	PET	Y	Y
3456112343	XYZ	HDPE	N	Y
1234011112	ABC	PET Thermoform	Y	Y
9405240084	DEF	PP	Y	N

Additional Data Fields

Database for Digimarc Barcode for Plastics

Plastic ID	Producer	Composition	Food	Sort
891298	ABC	PET	Y	Y
123131	XYZ	HDPE	N	Y
131031	ABC	PET Thermoform	Y	Y
234568	DEF	PP	Y	N

Additional Data Fields

AIM®
EUROPEAN
BRANDS
ASSOCIATION

PIONEERING DIGITAL WATERMARKS FOR SMART PACKAGING RECYCLING IN THE EU

Digital Watermarks Initiative HolyGrail 2.0

HOLY GRAIL 2.0

MEMBERSHIP

AIM® EUROPEAN BRANDS ASSOCIATION

Holy Grail 2.0 Intelligent Sorting

HolyGrail 2.0 Work Packages

- WP1 – Intelligent Sorting
- WP2 – Digital Watermark for Printing
- WP3 – Digital Watermark for Molds/Plastics
- WP4 – Business Development
- WP5 – Data Management
- WP6 – Consumer Engagement
- WP7 – Legal Framework
- WP8 – Promotion
- WP9 – Project & Funding

Support of European Parliament & Commission

European Commission, *"Effectiveness of the Essential Requirements for Packaging and Packaging Waste and Proposals for Reinforcement"* 2020

- European Commission to carry out a review in 2025 to assess the feasibility of digital watermarking technology with a view to adopt a legal requirement for its use"
- "Proposed: Digital watermarking of all packaging by 2030 to facilitate sorting"

"European Parliament New Circular Economy Action Plan" 2020 (Amendment)

- "Urges the Commission and Member States to support the development of new innovative technologies…such as digital watermarking that can support the development of the circular economy through the tracking, tracing and mapping of resources."

"Commission Guidelines on the general minimum requirements for extended producer responsibility schemes (leaked draft version 18 September 2020)"

- "With the objective of harmonising the fee modulation [reduction]…such as the watermarking technology, a possible shift to using the recycling rate as the ultimate criteria for fee modulation"

Support of European Parliament & Commission – 2

EU Sustainable Products Policy Legislative Initiative (September 2020)

- Measures to be considered: *"establishing EU rules for setting requirements on mandatory sustainability labelling and/or disclosure of information to market actors along value chains in the form of a digital product passport"*

EU Sustainable Products Policy Initiative – Inception Impact Assessment (September 2020)

- *"this will require improved information flows through, inter alia, mobilising the potential of digitalisation of product information, including solutions such as digital passports and tagging."*
- Measures to be considered include *"establishing EU rules for setting requirements on mandatory sustainability labelling and/or disclosure of information to market actors along value chains in the form of a digital product passport"*
- *"The impact assessment will quantify the possible administrative burden linked to the policy measures to the extent possible and identify, where appropriate, the possibilities for minimising it, for example with digital solutions."*

EU Sustainable Products Policy Initiative – Public Consultation (closes June 9th 2021)

- *"The Commission committed to consider…..where appropriate, complementary legislative proposals…digitalisation of product information"*
- *"….*establish a digital product passport *that gathers data on a product along its value chain"*

For more information

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