



Reinventing packaging

Companies can use packaging – a new contributor to the digital thread – to better engineer and manufacture products.

accenture



Foreword from the AIPIA



Eef de Ferrante

Managing Director, Active & Intelligent Packaging Industry Association (AIPIA).

Evolving market dynamics, such as COVID-19, regulations, customer expectations and the growing sustainability agenda, have elevated the push for product digitization higher than ever on C-suite agendas. Packaging can make even passive products become smart and connected products, enabling brands to weave a 'digital thread' for multi-directional interactions throughout the product lifecycle. This can ensure a route to the creation of a virtuous loop of downstream and upstream value generation and data sharing.

As Managing Director of the global Active & Intelligent Packaging Industry Association (AIPIA), I see significant growth potential for this industry and many new and interesting business cases coming up. AIPIA's original mission to decimate supply chain costs, reduce waste and increase its members' profitability through the implementation of smart

packaging technologies is still relevant. But new market dynamics are creating both a push and a pull for more smart packaging solutions.

Over the last 10 years, our industry was very much driven by the smart technology solution providers, which is typical for a relatively new industry. Today, brands are taking much more notice of how smart connected packaging relates to these shifting market dynamics.

But knowing how to utilize this understanding and effectively implement these technologies may not be immediately apparent.

The basic technologies used for much smart packaging such as RFID, NFC and QR codes are already long-established in the market. Sadly, myths about smart connected packaging have created misconceptions about their capabilities and cost effectiveness. These myths are

now being dispelled and brands are beginning to see real value creation potential. They have fewer and weaker reasons for not digitizing their product experiences though packaging innovation. Indeed, many are now seeing this as an imperative.

In this report, Accenture has collated the evidence showing that brands initiating smart connected packaging are achieving much better results than those who aren't – across a range of outcomes and business functions. Readers will be left in no doubt that CxOs should be shifting their perceptions of packaging from merely functional to truly transformational – reinventing how packaging is perceived and how it is utilized – just as the title of this report suggests.

I hope you enjoy reading!

Eef de Ferrante

Foreword from Accenture



Sef Tuma

Industry X Lead, Engineering &
Manufacturing at Accenture

Data is the heartbeat of every thriving modern product company. The most advanced companies are persistently using data to reinvent their products. They also use data to reinvent their operations by weaving digital threads which allow information to flow between products, processes, and plants. And the more they excel at processing this data and putting it to use, the better they do.

But being data-driven requires, of course, data. In my role, I see firsthand how the more varied and reliable the data companies possess, the more likely they are to weave valuable data threads and be successful.

Our team set out to understand how some product businesses are weaving digital value threads by leveraging one particular unconventional data source – product packaging. With the

exception of the barcode which emerged in the 1970s and some sector-specific adoption of practices like serialization, packaging innovation has been relatively anemic in spite of great advances in technology. But, aided in part by the stewardship of the AIPIA, compelling use cases are now emerging, and pockets of success are leading to growing interest in smart connected packaging and the data-driven-value it can deliver.

We investigated attitudes and actions of product business leaders to packaging innovation by conducting dozens of interviews and fielding a survey to 1000 company leaders. The answers to the survey were then processed by Accenture Research's AI-driven data clustering techniques to understand which combinations of management actions enable companies to excel.

Our findings? Simple. Companies that use packaging to drive data downstream to customers to enrich their product experience and also pull data back upstream to be shared across business functions such as product development and manufacturing are already achieving outsized gains across business imperatives.

This all means that product business leaders must understand that packaging is now, more than ever, inherently an extension of the product. So, if your purpose is to build an organization that truly believes in the reinvention of the product, the reinvention of your engineering and manufacturing operations, and the overall reinvention of the entire industrial sectors, then I urge you to read the report and take heed of our findings.

Best,

Sef Tuma



It's time we took a closer look at packaging...

Packaging has existed for as long as products have been traded. That's literally thousands of years.

From clay-pots and leather pouches to cardboard box and plastic bottles, the role of packaging to protect, preserve, promote and support the transportation of the product has remained fairly constant. So, why should product organizations be refocusing attention on it now?

Because a groundswell of tech-innovation is dramatically changing packaging.

While advances in material science are making new types of containers possible, new combinations of technologies are further enriching the functionality of packaging to deliver 360° value.*

*Accenture defines "360° value" as delivering the financial business case and unique value a client may be seeking, along with striving to partner with its clients to achieve greater progress across these dimensions: Client, Talent, Inclusion & Diversity, Experience, Sustainability and Financial.

... because next-gen packaging is helping drive 360° value.



Experience

University of Glasgow researchers have developed a solution for traders to authenticate bottles of rare whisky (of which 40% are not what they claim to be) by using their smartphone to tap an anti-tamper NFC bottle closure.¹



Financial

Annual sale volumes grew dramatically when **Treasury Wine Estates** launched an augmented reality-enabled 'living label' for its 19 Crimes brand – which 'disrupted the world of wine.'⁴



Talent

Pepsi developed an innovative platform which gamified the company's recruitment process to attract more diverse and creative thinkers. The scannable barcodes encouraged graduates to play interactive quizzes. The recruitment team then accessed the results back-end to shortlist probable candidates.²



Sustainability

Sheep Inc. launched garments which feature a biodegradable NFC tag providing each wearer with the ability to trace the supply chain of its knitwear; empowering them with the ability to carry out a self-service carbon audit.⁵



Inclusion

Kellogg's created a special Coco Pops box to mark World Sight Day helping partially sighted people access packaging info by scanning a code.³



Just ask
Heineken.

Finding out the environmental footprint of your beer bottle by simply scanning the label? It's not unrealistic.

Recent [research from Accenture](#) shows that 60% of consumers are buying sustainable or ethical products. Heineken recognizes that the key to increasing consumer trust around the issue of sustainability is to be as transparent as possible. The company believes that the environmental footprint of a bottle of beer should be accessible to consumers.

Heineken collaborated with Accenture, TNO and KrypC to pilot a smart label solution.

For the pilot, a batch of hops used in one of Heineken's regional Dutch brands, Brand Blond beer, was traced using a blockchain. This enabled the project team to model the supply chain on the blockchain – and thereby capture environmental data including water and fuel consumption.

Thanks to the pilot, scanning the QR code on the bottle showed the exact location and year in which the hops were cultivated, as well as their carbon and water footprint – an enormous step forward into developing full transparency.

The primary focus of this project was to test the technology for capturing provenance and the environmental footprint of agriculture, with data coming from different actors in the supply chain. However, the output also showed true potential for delivering detailed and reliable information to consumers.^{6,7}

But more than that, packaging can now be integrated within the digital thread.

Recently Accenture collaborated with a European luxury brand to develop a virtual retail showcase.

There has been a lot of discussion recently about the radical concept of 'the metaverse' which involves interconnected collaborative virtual spaces. Now, the Product Design & Engineering and R&D functions have the ability to put a digital design of a not yet produced product or digital twin of one produced in the metaverse. By engaging customers virtually, the Product Design & Engineering and R&D functions can seek direct feedback from customers.

In our prototype, customers enter the metaverse by scanning or activating smart packaging.

They can then start playing with the digital design or the digital twin of the product and experience its functionalities. The information collated from customer interactions can be effortlessly integrated with enterprise and industrial software systems such as ERP, CRM and PLM.

Packaging therefore becomes a part of the digital thread, capable of relaying valuable customer data to key functions such as engineering and manufacturing.



Play Video



To understand more, we surveyed and interviewed senior executives.

Between October and December 2021, we surveyed 1000 senior executives spanning eight industries and spread across 12 countries. Each of these executives represented a company with annual sales exceeding \$1 billion.

In the survey, we asked executives to detail their investments in digital transformation, and their usage, practices and perspectives concerning packaging innovation. We also collected data on the impact their investments are making, or are expected to make, on selected performance metrics.

This insight report leveraged extensive qualitative primary research to arrive at key findings.

Over 30 executives, including representatives from leading brands, packaging solutions suppliers, disruptors and other ecosystem players identified by AIPIA and Accenture were interviewed to understand their views on smart connected packaging innovation.



Survey fieldwork:

Oct – Dec 2021

1000 Respondents:

Dominantly, C-Level Executives

- Chief Executive Officers (18%)
- Chief Packaging Officers (17%)
- Chief Supply Chain Officers (9%)
- Chief Marketing Officers (8%)
- Chief Operating Officers (7%)
- Chief Strategy Officers (6%)
- Chief Technology Officers (4%)
- Chief Information Officers (3%)

>US\$1b Revenue

- \$1 - \$9.9b (71%)
- \$10 - \$29.9b (24%)
- \$30 - \$49.9b (4%)
- \$50b+ (1%)

12 Countries:

Australia (8%)

China (10%)

India (5%)

Spain (5%)

Brazil (7%)

France (7%)

Italy (7%)

United Kingdom (10%)

Canada (5%)

Germany (8%)

Japan (8%)

United States (20%)

7 Industries:

Automotive (10%)

Consumer Packaged Goods (20%)

Industrial Equipment (10%)

Retail (20%)*

Chemicals (10%)

High Tech (10%)

Life Sciences (20%)

*Excluding retail businesses where own-label accounts for <50% of sales volume

Executives see the humble package as the harbinger of massive data potential...

Smart connected packaging brings together an ecosystem of complementary technologies that enable new modes of product interactivity, giving packaging the ability to deliver a wide range of outcomes.

Smart connected packaging is not a single technology. It's an ecosystem of complementary technologies. These include physical sensors, flexible electronics, cameras, QR codes, NFC tags, RFID tags (among many others) as well as the software and systems used to organize and control smart connected packaging systems or to analyze the data for business purposes. **Indeed, our survey revealed that the type of technologies business leaders associate with the future of packaging are hyper-concentrated around data capture, data processing and data management.**

Key technologies being deployed towards smart and connected packaging

Percentage of executive responses



...able to
unlock
meaningful
value...

Top 10 use cases for smart packaging

Survey participants were asked: Which of the following smart connected packaging use cases can most benefit your business? Select all that apply.

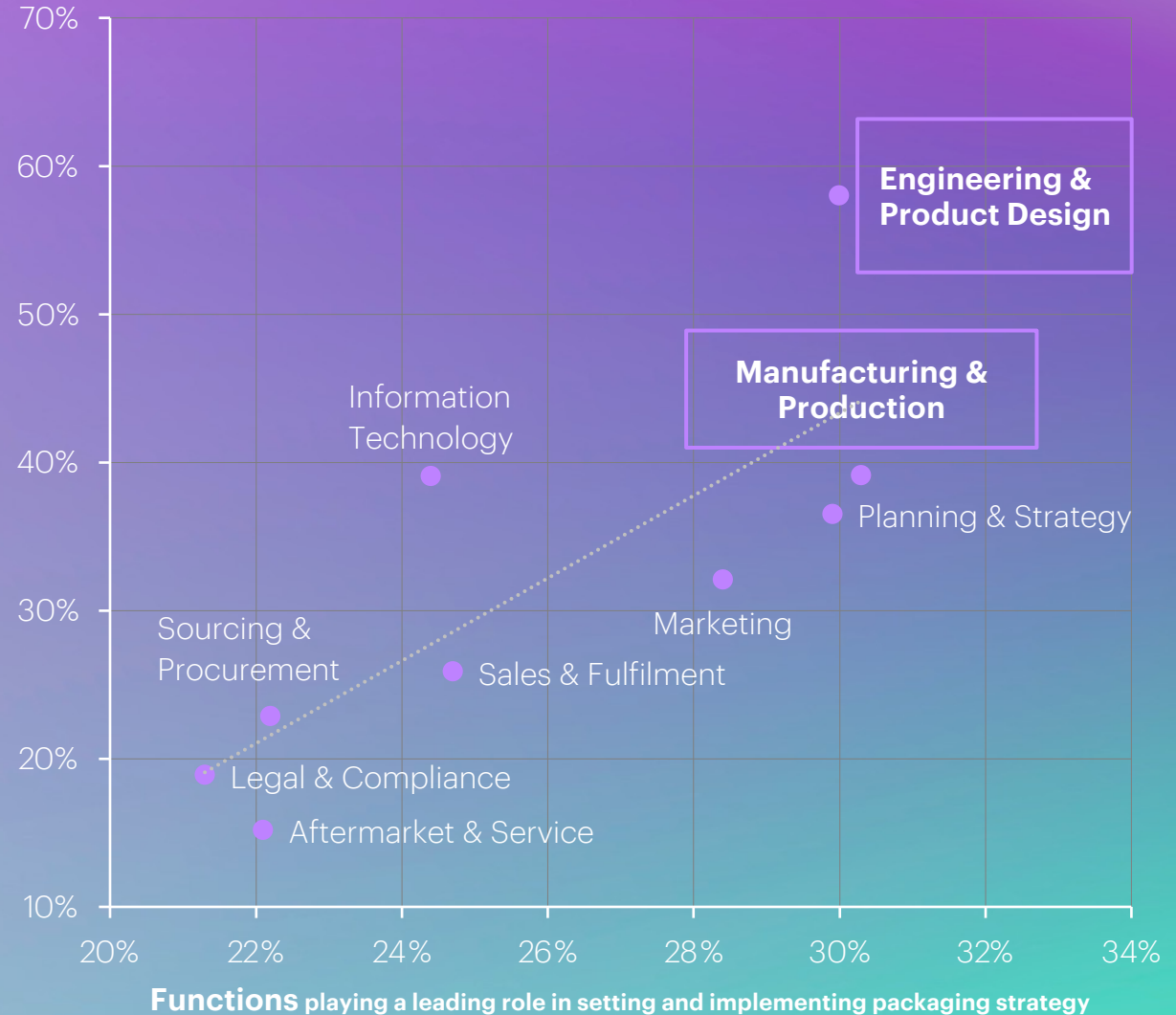


...with engineering and product design as well as manufacturing positioned to lead the innovation charge.

Surveyed executives reveal that engineering and manufacturing have a relatively higher influence on packaging development as well as much higher means to invest in and scale packaging innovation in comparison with other functions.

These functions, specifically, must see packaging as an extension of the product and a part of the larger digital thread capable of sharing critical data on product acceptance, use and sustainability upstream.

Functions with the largest budgets for innovation and digital transformation



Product development and engineering teams can design better products in the future with the help of packaging data.

Case study

Smart connected packaging innovation

A major multinational food, snack and beverage corporation began using smart connected packaging as a consumer transparency tool. The impetus was compliance with a new consumer ingredient transparency law in California. However, the brand saw this as an opportunity to also provide richer product information to consumers on details like ingredients, allergy advice and other attributes of interest.

First order impact?

When customers scan the product with their smart device, the company can now see, for example, if consumers are concerned about or interested in certain ingredients or flavors. They use this information to explain why they formulate a product a certain way.

Second order impact?

The company is also feeding this same data back to the **product development** and **manufacturing** functions in order to reformulate their products according to the latest consumer taste signals. They can achieve a new level of consumer intimacy which keeps their customers coming back for more.



Brands might pay market research companies six or seven figures to run a focus group of 20 people. Whereas with connected packaging, **your focus group is your customers** who are buying and interacting with your product. That's where there is so much opportunity for better data to come into play."

Packaging Executive
F500 Company



Manufacturing and production teams can roll out responsive and reliable production initiatives with the help of packaging data.

Case study

Smart connected packaging innovation

Masitek is a packaging tech start-up which produces in-line sensors in exact replicas of its clients' containers, which are then deployed on production lines to accurately measure the containers' experiences during processing.

First order impact

Poor handling of containers (such as glass jars) can result in difficulties running the line at the optimum speed and reduced efficiencies, as well as causing breakages which results in downtime for cleaning. The smart container replicas report back real-time data to data scientists and plant floor operators, helping manufacturers get to the root cause of damage on the packaging line.

Second order impact

The packaging itself can be redesigned by the product engineering team to better resist production line shocks, breakages, scuffing, load absorption, compacting and other issues that can manifest on the production line.⁸



We continually monitor to make sure the packaging lines are running smoothly to avoid any downtime. But often when we switch the line for different products, different weights, different velocities then things can go wrong. **Having the packaging itself generate data to quickly recalibrate would be very satisfying.**

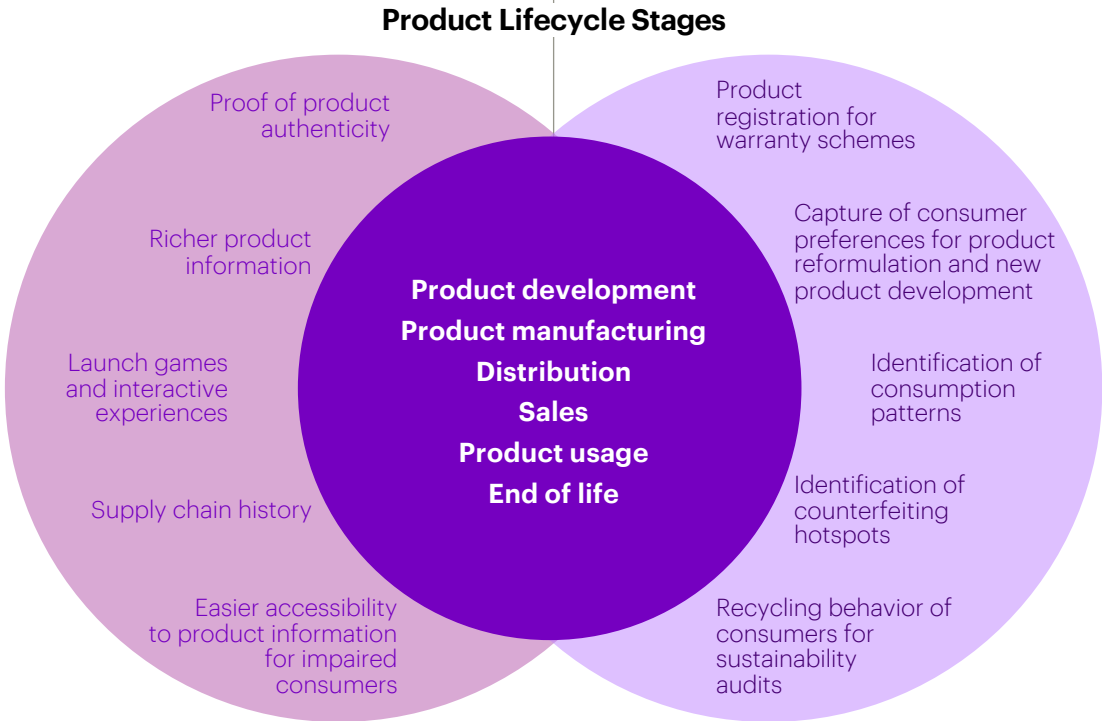
**Packaging Executive
F500 Company**



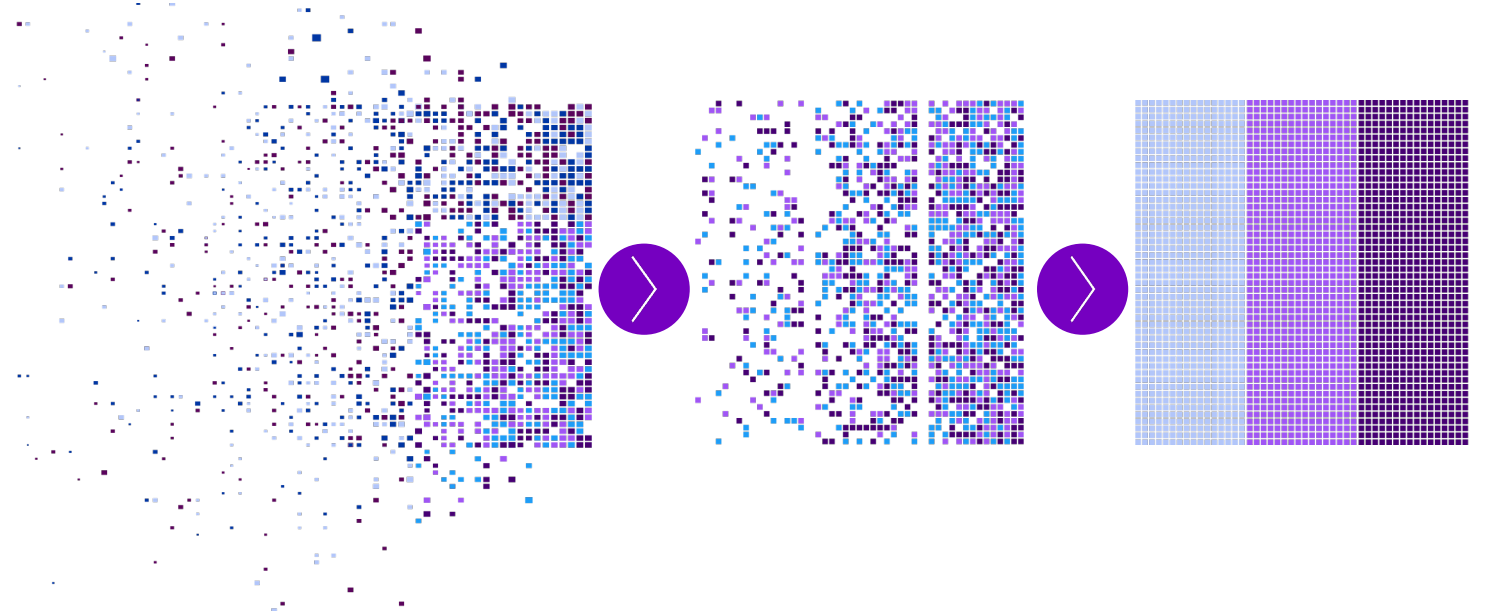


So, we decided to further analyze the sample data to investigate if there were companies using packaging as a part of the larger digital thread to push **data downstream to consumers as well as **upstream** with different functions.**

Indicative downstream data-driven experiences for the customer delivered through digital packaging | Indicative upstream data that can be captured by businesses from consumers through digital packaging



To find out,
we applied a
machine-
learning
clustering
technique.



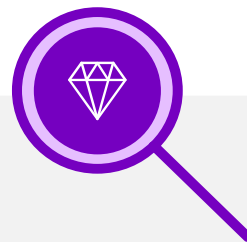
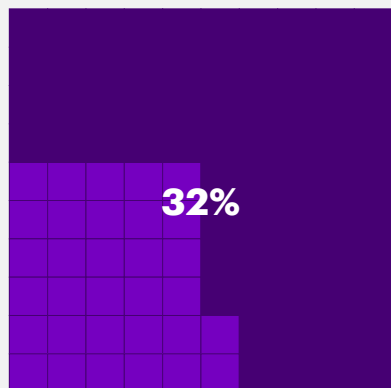
Using the extensive data points available from our executive survey, we identified a set of attributes which our machine learning techniques could use to begin understanding commonalities between clusters of companies. Our starting point was understanding their attitudes to the ability to **use smart connected packaging to push and pull data downstream and upstream.**

See appendix for detailed notes on methodology

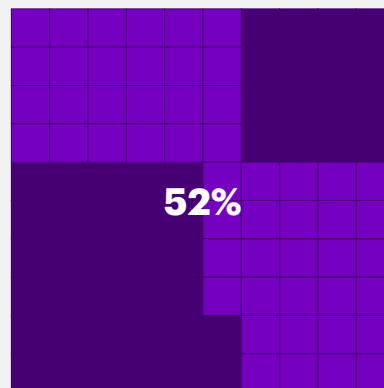
We discovered that only **16%** of businesses have such a comprehensive, data-driven approach to smart packaging.



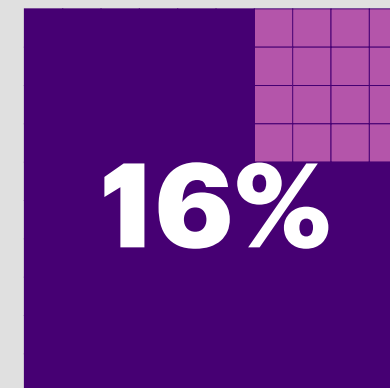
Value Evaders



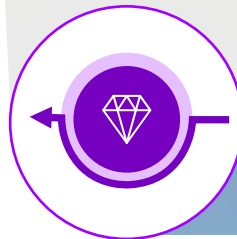
Value Seekers



Value Threaders



These 16% of businesses that are committed to harnessing the upstream and downstream data capabilities of smart packaging emerge as true leaders, significantly outperforming their counterparts in the areas of customer relevance, operational resilience and environmental and social responsibility.



Value Threaders

They outperform Value Seekers on various macro business objectives:

- Environmental and social responsibility by **1.4 pp**
- Customer relevance by **2.4 pp**
- Operational resilience by **4.4 pp**

Value Seekers

They outperform Value Evaders on various macro business objectives:

- Environmental and social responsibility by **1.4 pp***
- Customer relevance by **1.5 pp**
- Operational resilience by **2.9 pp**

Value Evaders

These companies struggle to make inroads towards becoming more operationally resilient, more responsible and more relevant to their customer and value chain partners.

*pp – percentage points

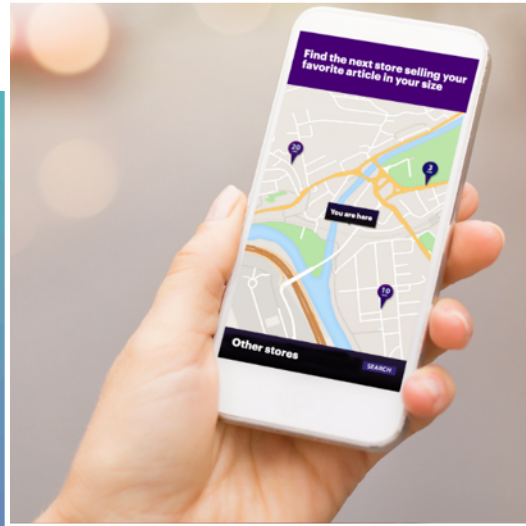


More specifically, Value Threaders in comparison to the Value Evaders...



Environmental and social responsibility

- Lower material intensity by **1.2 pp**
- Raise recycling rates by **1.1 pp**
- Lower expired inventory by **2.0 pp**



Customer relevance

- Reduce levels of inventory by **1.7 pp**
- Reduce trade in counterfeit products by **2.3 pp**
- Lower product recall rates by **3.3 pp**



Operational resilience

- Increase level of repeat purchases by **3.6 pp**
- Improve customer retention by **4.1 pp**
- Lower customer acquisition costs by **5.5 pp**



If the Value Evaders were to become Value Threaders, then they would have an average increase in revenue of 3.6%. This means that, on average, each Value Evader would have earned (over the last three years) an additional USD 300 million.*

+\$300m



If the Value Seekers were to become Value Threaders, then they would have an average increase in Revenues of 2.3%. This means that, on average, each Value Seeker would have earned (over the last three years) an additional USD 230 million.**

+\$230m

* We applied the 3.6% increase to the average company size of 8.2bn in the Value Evaders cluster.

** We applied the 2.3% increase to the average size of 9.7bn in the Value Seekers cluster.

So, how are these **16%**
of companies threading
data-driven-value
upstream and
downstream?

They execute 3 vital steps



01. They build data-driven feedback loops across the product lifecycle

Business leaders generally acknowledge the transformational potential of new data flows enabled by smart connected packaging, leading to enthusiastic discussions around new concepts such as 'packaging as a platform' and 'the internet of packaging.'

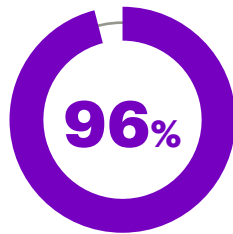
Reflecting on the feedback loop capability, one packaging executive we spoke to described next-gen packaging as opening up a new 'internet of packaging,' with each product becoming an 'edge device,' referring to any asset that contributes a valuable data flow from the boundary of a network.

This is a compelling perspective. Data scientists, business analysts and research engineers at electro-mechanical product companies like Peloton, Tesla and iRobot proactively analyze automated customer experience and product performance data from smart products. This feedback is used to make improvements across multiple domains – from future product iterations, optimized production methods and marketing campaigns.

But until now, this type of data feedback from the field has eluded many packaged goods brands. As products and their packaging are symbiotic – neither exists without the other – digitizing packaging means products are also being digitized by proxy.

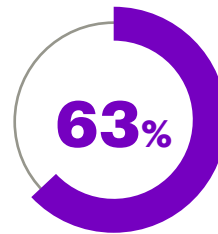
Now, smart connected packaging can also make passive and bulk products experiential, interactive and sustainable. For example, companies that specialize in analogue or organic products can use smart connected packaging to enable their passive products (from jars of coffee to cans of paint) to become alive.

In other words, it enables product companies to weave digital threads throughout smart product lifecycles and create new feedback loops.



of product businesses we surveyed have already **begun exploring** smart connected packaging use cases.

And...



of executives consider the data push or data pull capabilities of smart connected packaging to have 'Transformational' impact on at least one milestone in the product lifecycle.



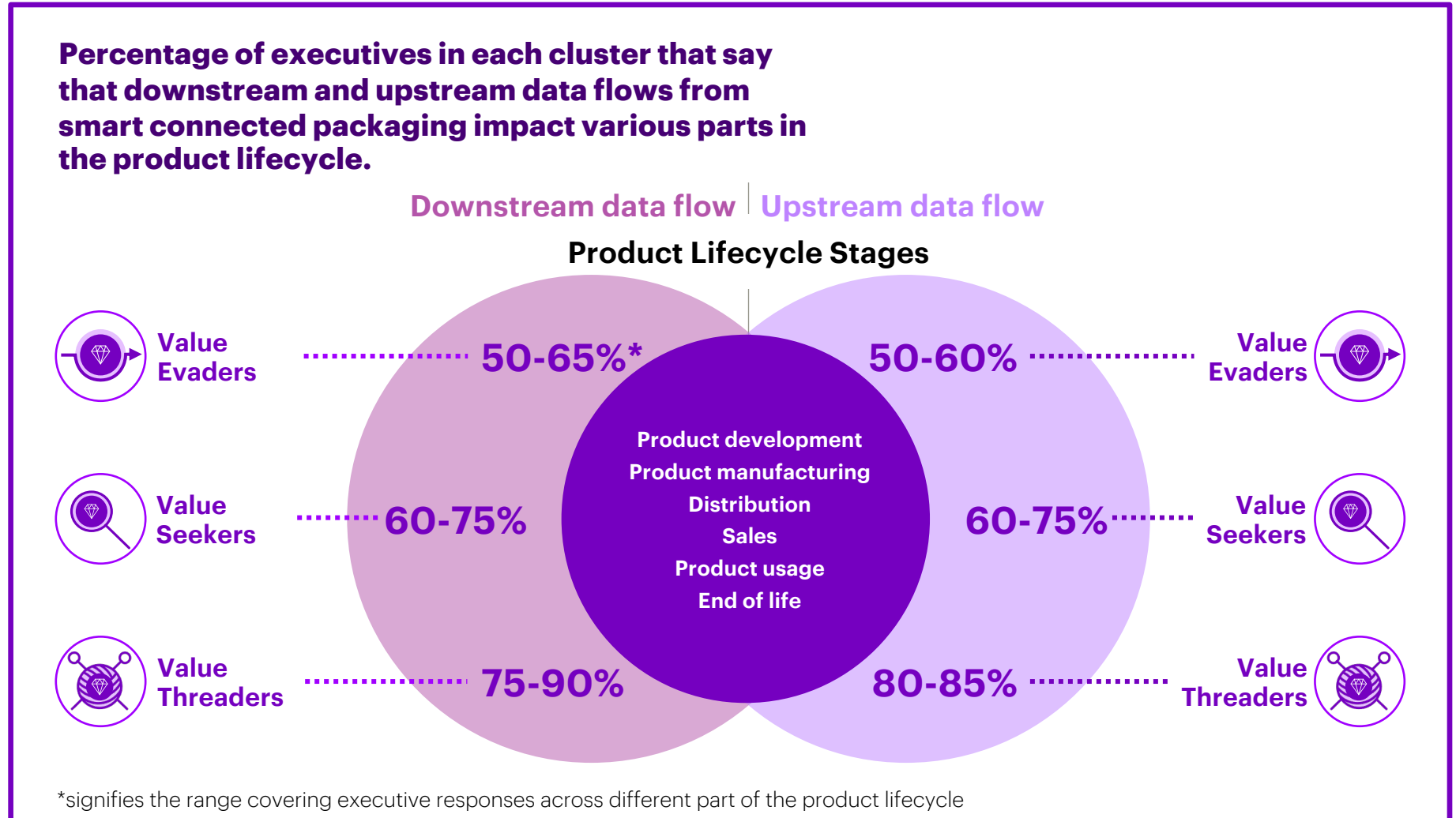
This idea of smart connected packaging has the potential to be a digital gamechanger for virtually every brand because every package is now potentially **an edge device.**"

**Packaging Executive
F500 Company**



01. They build data-driven feedback loops across the product lifecycle

It's not surprising then that businesses across all three clusters appreciate the opportunity of smart connected packaging to enable digital touchpoints capable of driving 360° value by threading data downstream and upstream. But a consistently higher percentage of Value Threaders are seen to build a feedback loop with this data across the value network.



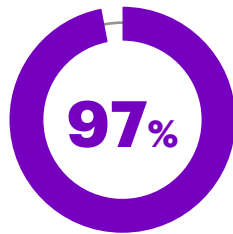
02. They excel at capturing, analyzing and governing data

Preparing for this future, where every package is an edge device, will require a shake-up of data operations for many businesses, to prevent packaging data becoming 'dark data.'

Indeed, 98% of execs believe it is important for their business to have a well thought-out and executed approach to smart connected packaging data.

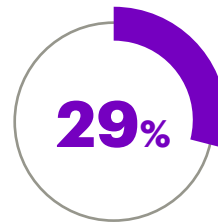
But data can only create value for an organization when it is managed with a defined business value-driven strategy through its lifecycle, from creation to retirement. This is called data governance. Proper data governance ultimately enables a data-driven and analytics-led culture. But 56% of businesses we surveyed admit that smart connected packaging introduces data governance overhead that their organization is ill-equipped to deal with.

The danger is that smart connected packaging data could become another fountain of 'dark data.' Dark data is the data an organization has but can't make use of, and it is still a common challenge for many businesses. Indeed, our survey shows that only 29% of businesses are 'extensively' applying data analytics to data currently being captured by smart connected packaging.



of executives agree that data from smart connected packaging can **improve the evidence-based culture** in their organization.

But...



of businesses are applying **data analytics** extensively to data captured by smart connected packaging.



Good decisions around solution architecture and data governance made early in an implementation can ensure digital continuity, meaning timely, accurate, and efficient information sharing across the business. Then the data generated by packaging can flourish internally and can perhaps even be made useful to external stakeholders.”

**Packaging Executive
F500 Company**



02. They excel at capturing, analyzing and governing data

Value Threaders are far ahead in terms of elevated values for capturing and analyzing smart connected packaging data and being able to unlock the business value of smart connected packaging data by having suitable data governance protocols in place.

Value Threaders



72% of companies extensively capture packaging data

64% of companies apply data analytics to packaging data intensively

84% of companies have a fully deployed governance structure in place for packaging data used for analytics and decision making

Value Seekers



29% of companies extensively capture packaging data (compared to 27% for Value Evaders)

24% of companies apply data analytics to packaging data intensively (compared to 16% for Value Evaders)

33% of companies have a partially deployed governance structure in place for packaging data used for analytics and decision making (compared to 0% for Value Evaders)

Value Evaders



Compared to the other clusters, businesses in this group can be recognized as demonstrating weak organizational readiness for a data-driven culture in the context of the smart connected packaging opportunity.

Indicative range across all product lifecycle touchpoints.



03. And, they dissolve data-silos

Many things can get in the way of successful technology-led innovation, but our research tells us that “cross-function” competition is one of the biggest obstacles. And it’s no different with packaging.

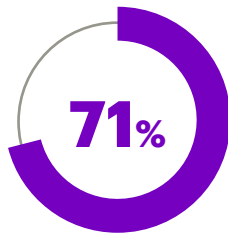
We found that almost all business functions are involved in packaging decision making to a greater or moderate extent. This can lead to confusion and miscoordination. In fact, in the two dozen interviews with senior executives that we conducted for this research, many admitted that they don’t actually know where packaging ‘lives’ in the organization.

Indeed, 71% of executives agree that succeeding with smart connected packaging requires much more internal coordination and cross-functional collaboration than is typical in their company.

This coordination challenge is compounded by the fact that different systems will need to be integrated to enable smart connected packaging use cases and this is only possible when there is close

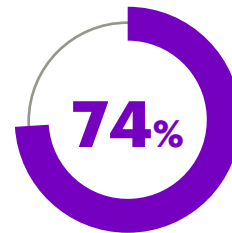
cooperation between business functions. Complexity of integrating technology systems is one of the top three challenges faced by businesses while executing smart packaging initiatives (38% of respondents), along with ‘transforming the culture and ways of working.’

If functions don’t collaborate effectively, the potential of packaging to underpin digital thread innovation will never be unlocked; and 74% of the companies we surveyed are struggling with this very issue.



Of executives agree that succeeding with smart connected packaging requires much more internal coordination and cross-functional collaboration than is typical in their company. (91% of CEOs).

But...



of executives believe that their organizations are not excelling at driving collaboration across different functions towards packaging innovation). (87% of CEOs).



A major barrier to adoption of smart connected packaging solutions is the complexity of the overall system, and the infrastructure behind it. Different systems need to be connected and that works best when there is cooperation within departments.”

**Packaging Executive
F500 Company**



03. And, they dissolve data-silos

Again, Value Threaders are far ahead in terms of cross-functional collaboration with regards to packaging innovation, while others have considerable room for improvement.

Value Threaders



Only **14%** report that their business functions are competing against each other instead of collaborating on innovation efforts

Nearly all (**93%**) have fully developed capabilities deployed to share packaging data between different functions

Value Seekers



52% report that their business functions are competing against each other instead of collaborating on innovation efforts

Only **28%** have fully developed capabilities deployed to share packaging data between different functions

Value Evaders



These companies are more likely to report that they struggle with cross-functional collaboration when it comes to driving packaging innovation.

88% report that their business functions are competing against each other instead of collaborating on innovation efforts

Almost no company in this cluster (**1%**) shares packaging data between business functions

Indicative range across all product lifecycle touchpoints.



So, what can businesses start doing right now?

Enormous opportunities are opening for companies that are ready to elevate the role packaging plays for their organizations. Here are some guiding principles that can help them to begin this journey.

Empower the right functions

Provide your **Product Design & Engineering and Manufacturing functions with an innovation mandate** to build digital packaging solutions that not only provide data to customers about the product but also pull relevant data from them to improve quality of product experience across its lifecycle.

Be ready to thread incoming data

Weave a Digital Thread across functions so that they are ready to share data collated by smart connected packaging. Establish **appropriate governance and collaboration mechanisms** to ensure friction-free and responsible distribution of data amongst functions.

Build a technology architecture to start breaking silos

Invest in a **flexible and intelligent technology architecture** to break data and functional silos. The Value Threaders are already using **cloud, AI and advanced analytics** to help functions collaborate and build value with packaging data.

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Here's how we did it

Primary qualitative research

Over 30 senior executives and experts across the globe, including leading brands, packaging solutions suppliers, disruptors and other ecosystem players were interviewed to understand their views on smart connected packaging innovation or returned written statements. These interviewees represented members and non-members of the AIPIA. These insights provided the foundation for this report, and we would like to thank those participants who spoke candidly and at length about their perspectives on packaging innovation.

Primary quantitative research (Survey)

Between October and December 2021, we surveyed 1000 senior executives spanning eight industries and spread across 12 countries. Each of these executives represented a company with annual sales exceeding \$1 billion. In the survey, we asked executives to detail the investments they had made towards digitally transforming, and their usage, practices and perspectives concerning packaging innovation. We also collected data on the impact their investments are making, or are expected to make, on selected performance metrics.

Primary quantitative research (Data Science and Economic Value Modelling)

We applied an unsupervised machine-learning technique known as Hierarchical Clustering towards arriving at three clusters—Value Evaders, Value Seekers and Value Threaders. A regression and scenario analysis was then performed to understand the extent of opportunity missed by 'Value Evaders' and 'Value Seekers' in comparison to 'Value Threaders.' Below, we discuss the steps taken to perform such analysis:

- 1. Variable selection:** The responses shared by surveyed companies on their use of upstream and downstream data was used as the primary filter to start clustering companies.
- 2. Analyzing respondent similarity:** A distance matrix was calculated to determine the distance of similarity of every individual in the sample. While many techniques are available to do so, we used the 'Grower distance' method to perform our analysis. It is a commonly used technique for data sets including categorical variables, which account for most of the variables chosen for our study.
- 3. Building the dendrogram:** A dendrogram shows the hierarchical relationship between objects. Again, many techniques are possible. In this exercise the commonly used 'Ward D2' method was chosen. This technique fulfils our objective of forming segments where individuals within a segment are the most similar possible (high intra-class homogeneity) and the segments are the most distinct possible (low inter-class homogeneity).
- 4. Defining the clusters:** Once the dendrogram was drawn, we then proceeded to define the number of clusters. Too many or too few clusters are difficult to interpret. Various techniques can provide guidance on the optimal number of clusters (e.g., the elbow test and silhouette test – both of which were performed in this exercise). The results were then combined with the business interpretation of the clusters. In this case, three clusters – Value Evaders, Value Seekers and Value Threaders – demonstrated adequacy.
- 5. Interpreting clusters:** Following the definition of clusters, it then became possible to perform an analysis of the distinguishing variables for each node and draw out the latent business story.
- 6. Calculating opportunity missed:** We then applied a linear regression model to predict the performance of firms (defined in the survey as the ability to improve over the past 3 years) with respect of each cluster calculated by the Hierarchical algorithm. Performance (in terms of percentage growth) was computed for the three key drivers that are the focus of this research: environmental and social responsibility, operational resilience and customer relevance. We used the regression results to calculate the percentage differences in growth logged by each cluster. To estimate the economic impact of the opportunity missed by 'Value Evaders' and 'Value Seekers,' we built a scenario model in which 'Value Evaders' and 'Value Seekers' would implement the same strategic choices of the 'Value Threaders.' The additional potential gains for them were estimated by multiplying the average revenue size of the firms in the clusters by the percentage point differences with respect to the 'Value Threaders.'



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