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5 Ways Generative AI Will Transform Packaging by 2030

PACKAGING

Contents

Who are Smithers?

Smithers is an industry leader in providing market intelligence to the packaging, paper and print industries. Our market reports and strategic consultancy services are renowned worldwide for their authoritative market forecasts and analyses. With a network of global industry experts and extensive knowledge gained over a 100-year history, we provide businesses with the credible and robust data they need to support their business strategies and planning.

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Executive Summary
5 Ways Generative AI will Transform Packaging by 2030

1. **Brand Design** – Faster graphic design as well as practical design such as size, shape, and materials. Faster products to market (e.g. personalization or promotions). Driven by mix of human creativity supported by technology to reduce the risk of plagiarism. More targeted consumer research supported by richer and deeper data will see an increase in the number of products - number of SKUs increase, driving down run lengths (driving the adoption of digital print). Potential for digital print and AI combined to enable fast failure and rapid scale up.

2. **Analyzing Performance and Usage** – Unlocking innovation by reducing "friction" in the commercialization of innovations. By mining large volumes of unstructured data (images and text) to discover insights - for example real time data of products damaged in transit (e.g. impact damage), companies can understand performance beyond more simple metrics like NPS (net promoter score), and opportunity to provide many new services.

3. **Supply Chain Optimization** – Managing the stock holding at key locations to ensure the delivery products within 24 hours (micro fulfilment centres) and using less material in the packaging for shipment. Packaging technologies to monitor the condition of the product through the supply chain, and capturing and sharing data (condition-based monitoring). While packaging is already highly automated, increased use of robots and cobots (collaborative robots) to optimize palletization and stacking. Demand forecasting and monitoring risk to mitigate disruptions.

4. **Conversational engines** – Dynamic negotiations with suppliers (e.g. Walmart using chatbots to negotiate with many 100s of suppliers). Development of partnerships and alliances (e.g. two brands sharing the same truck for shipments), fast confirmation/approval with regulatory bodies.

5. **Enhanced R&D** – Researching and commercializing innovative new materials with enhanced properties – e.g. biodegradable materials with other desirable attributes. Examples are IBM's RXN and Google's Med-PaLM 2. Disruption in the typical "Make, test and decide" cycle with faster R&D pipeline, discovery of new materials, development time reduction, and prescribed ingredients.

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Generative AI – What is the hype all about?
Transformation impact on most industries – including packaging and printing

→ Artificial Intelligence (AI) took a huge leap forward in 2016 when AlphaGo – Google DeepMind's program – defeated the world's number one Go player. But after an initial buzz, public interest waned. It wasn't until 2022 that AI really captured the public's imagination with the emergence of ChatGPT, allowing anyone to experiment and create realistic new content quickly – often with incredible results.

Generative AI uses foundation models that are trained on a huge volumes of data. These models – based upon text, images, video, audio and computer code - can be used to execute many tasks including answering questions, creating new content, and summarizing huge amount of data and text.

The big leap forward is that – unlike with previous deep learning models – the latest Generative AI applications can process extremely large and varied sets of unstructured data and can perform more than one task. Companies are only just beginning to explore the potential – everything from personalized customer responses and identifying market trends using unstructured data sources through to generating fast designs and saving time on physical tests.

There will be many challenges along the road. Privacy concerns have led to proposed legislation by the EU, while the computational power required to train generative AI is threatening to become a bottleneck. Generative AI will have a huge impact across all industries, including packaging. A further pace of change in the workplace will lead to many disruptions (albeit with extra investments to support employees as they take advantage of Generative AI).

Computers can create better than ever, and it's never been easier for people to interact with them

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Generative AI – a primer

In simple terms, Generative AI uses machine learning, volumes of data and a language interface to make new content based on pattern recognition

What is Generative AI?

Generative AI (Gen-AI) is a specific type of AI focused on generating new content, such as text, images, or music. These systems are trained on large datasets and use machine learning algorithms to generate new content that is similar to the training data. This can be useful in a variety of applications, such as creating art, videos, music, or generating text for chatbots.

"We leverage AI across all dimensions of our business to predict outcomes and increasingly to prescribe actions through automation"
Vittorio Cretella, CIO of P&G

How does Generative AI work?

Gen-AI training models work by learning from a large dataset of examples and using that knowledge to generate new data that is similar to the examples in the training dataset. This is typically done using a type of machine learning algorithm known as a generative model. There are many different types of generative models, each of which uses a different approach to generating new data. For instance, a generative model trained on a dataset of images of faces might learn the general structure and appearance of faces, then use that knowledge to generate new, previously unseen faces that look realistic and plausible. Generative models are used in many applications, including image generation, natural language processing, and music generation. They are particularly useful for tasks where it is difficult or expensive to generate new data manually, for example creating new designs for products.

How are language models created?

The most common method of creating a language model involves using a machine learning algorithm on a large dataset of existing text. This process typically involves collecting a large dataset of existing text that is representative of the style of text that you want your model to be able to generate. Next, preprocess the text data to clean and prepare it for training. This will typically involve tokenizing the text into individual words or phrases, and converting all of the words to lower case. Then, the next step is training a machine learning algorithm on the preprocessed text data. Fine-tuning the trained model by adjusting the model's parameters, and by using additional training data if necessary. Test the model by generating sample text using the trained model and evaluating the results. Final step is to refine the model until the generated text is of high quality and matches the desired language or style.

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Dynamic design getting customized products to market faster

More design work needed for regional point of sale, promotional material and social media inspired products

Speed to market is increasing, driven by more personalization and promotions, shorter runs, regional/smaller brands, more channels to market, consumer convenience and the ability to quickly follow trends from the social media world. This is putting huge pressure on brands, retailers and suppliers across the packaging value chain – including graphic and packaging designers. Today, generative AI can struggle with basic packaging terms (in contrast it is excellent at replicating cartoons or celebrities as there is a lot of available data). This will change as massive improvements in performance will lead to AI becoming a powerful tool for getting customized products to market faster. Lot of development work going into design, prepress, and workflow tools. Human creativity will still be needed to reduce risks of plagiarism.

Brands and their packaging/graphic designers will have many more additional inputs to work with, including deeper and richer consumer research, live data on product performance and insights on regional or micro preferences. For example, a new product could be created off the back of social media trends. A social media influencer develops an idea and publishes a "fake version" to create a buzz (helped by generative AI) and if it goes viral, the brand chooses to get on-board and develop the "real" thing. Another trend is a local brand popular in one country going viral and desired by consumers in another country, as seen with Waken toothpaste, a UK brand, getting a big launch in Australia. There is huge potential for AI combining with digital print to enable fast failure and rapid scale up. All digital print equipment suppliers are using AI (or at least talking about it) for autonomous production on print and converting equipment.

Brands are seeking two designs: a retail shelf version and the e-commerce version. This need is driven by communication requirements. The retail shelf version needs to provide quick and clear information, the e-commerce version brings a rewarding opening experience and makes the consumer feel good that they made the right decision. Supporting the packaging is the design work for the display units, which varies for different promotions or shows regional differences. Previously the supporting POS or point of purchase material might have been generic, but will now become much more visible on the shelf.

Pringles limited edition packaging with NCAA players

UK toothpaste brand goes viral in Australia

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Analyzing performance and usage will unlock more innovation

Mining huge volumes of unstructured data (including images) to provide real time data on product performance, leading to more "frictionless" innovation and the creation of new profitable services

➤ Companies understand that data is essential, driving the consolidation of data across departments and sources, and the development of guardrails around data quality + governance. Huge volumes of data is being generated – from the making of the product, to sales, to usage and end of life. As this data is collected and organized, companies will figure out how best to manage this data flow to innovate and be more commercially successful. The pace of development is huge, with Sequoia predicting the wide scale use of images by 2025 and video by 2030 (see chart below).

Real time data of products moving through the supply chain up to and including interaction with consumers will provide a level of insight that goes far beyond traditional Net Promoter Scores. As well as seeing which products were damaged in transit, companies will be able to gather insight on the actual profitability of each product and understand which products give the best positive sentiment. The combination of text and images – for example photos of products damaged in transit (e.g. rain damage) – will provide insights that can be fed back into manufacturing on the fly.

Generative AI progression to 2030

	PRE-2020	2020	2022	2023?	2025?	2030?
TEXT	Spam detection Translation Basic Q&A	Basic copy writing First drafts	Longer form Second drafts	Vertical fine tuning gets good (scientific papers, etc)	Final drafts better than the human average	Final drafts better than professional writers
CODE	1-line auto-complete	Multi-line generation	Longer form Better accuracy	More languages More verticals	Text to product (draft)	Text to product (final), better than full-time developers
IMAGES			Art Logos Photography	Mock-ups (product design, architecture, etc.)	Final drafts (product design, architecture, etc.)	Final drafts better than professional artists, designers, photographers)
VIDEO / 3D / GAMING			First attempts at 3D/video models	Basic / first draft videos and 3D files	Second drafts	AI Roblox Video games and movies are personalized dreams

Large model availability: 🔴 First attempts 🟠 Almost there 🟢 Ready for prime time

Source: Sequoia

Packaging companies often come up with great ideas, but which meet resistance or "friction" in the market. It can be very difficult to launch a genuinely innovative product. For example, a new coating to replace a plastic alternative but which is either limited in supply or difficult to make. These are sources of friction that make it hard for companies downstream to adopt them. The innovative product may be harder to run initially on existing equipment or produces more off spec product, which causes a big drag on commercialization. The breakthrough in AI will make it easier to get the product into the hands of customer without so much storage, handling, tracking, scheduling shipments and loads etc.

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Supply chain optimization for faster speeds and greater complexity

Smarter systems will better manage the stock at key locations to allow for delivery within 24 hours, and use less material in the packaging for shipment

Drivers

The packaging market is driven by the consumption of products, which is hugely seasonal/variable. Brands are responding to changing consumer behaviours and external pressures with a product strategy for the number of SKUs, factoring in manufacturing process, shelf life, packaging requirements, market dynamics, value. Overall impact is an **increase in the number of SKUs** and **decrease in run lengths.**

Packaging in already highly automated, with continuing high use of robots and growth in cobots (collaborative robots) to optimize palletisation and stacking. AI will provide better forecasting and monitoring risks to mitigate disruptions, as well as allowing pricing optimization.

Challenges

Usage - a core area for development is "right sizing" the packaging, particularly for e-commerce, but also to package more in the same item and at lower cost. Suppliers will be able to get more on the same truck, while robotic lines will be doing more than one task (e.g. identifying the best box, designing, cutting and folding in line)

Location – Growth in Micro Fulfilment Centres. Amazon is optimizing on location and using micro fulfilment centres so consumers can get products in 24 hours. Companies will use live data to spot a significant divergence between the plan and market demand caused by special promotions, storms/weather etc.

Condition – companies will track the condition of the product through transit. Investment in packaging that helps monitor and detect conditions.

Future outlook

Supply chains will further evolve through the development of e-commerce and the omni-channel experience for consumers.
Even though the power of AI is growing at a rapid rate, it will continue to be a challenge to understand individual supply chains over the short to mid-term as the complexity is so intricate and specific to each company.
Pricing optimization.
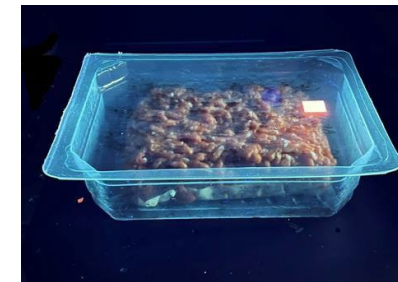
Packaging with sensors to monitor the condition of packaging products using printed food-safe inks

	Today	5 years' time
Robots	84%	93%
Cobots	27%	57%

PMMI Business Intelligence report 2022 Robots and Cobots: An Automated Future

WHITE PAPER - 5 WAYS GENERATIVE AI WILL TRANSFORM PACKAGING

Conversational Engines will be an early transformational change

A huge range of applications – some happening now, some on the horizon – will speed up marketing, sales, administrative functions, legal, HR, and vendor management

Application	Impact	Example
Chatbot technology to negotiate with suppliers	Dynamic negotiations with suppliers in lower risk categories such as equipment, transportation and office supplies. After setting budget and requirements, such as payment terms, it compares the demands of suppliers with trends and costs, and can speed up to days rather than weeks or months of conventional talks	Walmart and shipping company Maersk using Pactum's autonomous negotiations technology to negotiate with suppliers. The technology can proactively trigger new cost negotiations with suppliers based on data like competitive price fluctuations, negotiate cost increase requests with suppliers and renegotiate commercial payment terms and allowance
Digital humans as brand ambassadors	Greater control over the customer experience, with live agents teamed up with AI. The digital human will look more like the demographic or culture it is serving	Website customers are four and a half times more likely to complete an entire transaction and make a purchase than they were before digital human sales assistants were used (source: Soul Machines, a software company)
Development of partnerships and alliances across the value chain	Brands can quickly collaborate and share the same truck for shipments, including share on costs. Opportunities to lower transport costs per SKU, and lower carbon footprint as logistics are optimized	Unilever and Arzeda, a protein design company, have partnered to use AI to develop new enzymes for cleaning and laundry products developed five times faster than previously possible
Fast confirmation on regulatory matters / sustainability	Data combined with regulatory insight to determine the sustainability / suitability of a material for a particular application. Fast decision making on material selection	In banks, regular risk management decisions can result in tens of thousands of calls to internal policy experts every year – HSBC uses AI to reduce employee time on calls with policy experts and improve the consistency of response
Expansion of AI into the everyday, replacing time consuming and repetitive tasks	Humans teamed up with tools like Microsoft Co-Pilot to manage job scheduling, order entry, quotes, RFPs, etc	P&G initiative to encourage supply chain "citizen developers" to extend their digital transformation by using their own skills to create tools, rather than relying on IT

GPT-4 is a 5x improvement on earlier models and is available to ChatGPT Plus subscribers

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Enhanced R&D will see industry-wide collaborations forming

Disruption in the typical "make, test and decide" cycle with faster R&D pipeline, discovery of new materials, development time reduction, and prescribed ingredients

Drivers

Speed - AI can accelerate the discovery process by quickly analyzing large volumes of data and identifying potential new compounds and materials

Efficiency – Through automation, AI can streamline the process and reduce the need for manual labour, save time and resources, and reduce the risk of human error

Cost – faster and more efficient discovery process, with less need for manual labour, will reduce the overall cost of packaging R&D

Innovation – more data with high accuracy will identify patterns and relationships that might be missed by human researchers, leading to the discovery of novel compounds and materials

Sustainability – predicting the environmental impact of new chemicals and materials will allow researchers to identify compounds that are more sustainable and have a lower environmental footprint.

Challenges

Knowledge management is a key challenge in digitizing the R&D process – this includes connecting information sources from across the business such as manufacturing. AI enabled document searching can then automatically extract data, find novel connections between data points, and provide intuitive tools for researchers to easily find what they're looking for.

Tools powered by AI already exist, such as IBM's RXN and Google's Med-PaLM 2. There will need to be further developments in tools and processes aimed specifically at the packaging industry.

Work will be needed beyond the development of new packaging materials, such as Gen AI being used to significantly enhance waste sorting. This will make recycling more efficient and effective by recognizing different materials and suggesting best practices for reusing resources.

Outlook to 2030

Higher degree of collaboration, and alliances and partnerships across the packaging value chain to tackle some of the biggest R&D challenges. Big breakthroughs in researching and commercializing innovative new materials with enhanced properties – e.g. biodegradable materials with other desirable attributes. The industry is already seeing some of the world's biggest brands invest heavily in AI R&D (see PepsiCo example below).

PepsiCo is collaborating with the Stanford Institute for Human-Centered Artificial Intelligence to research four key areas:

- Supply Chains, Forecasting and Smart Manufacturing
- Direct-to-Consumer Impact and Personalization
- AI and Organizational Design
- AI and Sustainability

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What happens next?

Excitement in generative AI exploded in 2023, with huge investment in the underlying technologies, and businesses scrambling to make use of specific tools for specific applications.

Generative AI will **significantly lower the barriers for creativity for packaging design and its contents**. A brand could be disrupted by packaging through explosively growing personalized content, including text, image, video & other virtual content, and versatile packaging format generated through generative AI. Brands will move faster and launch new products based on a better interpretation and understanding of consumers' needs. Generative AI will help to **formalize packaging design based on consumer preference**. It reduces the time of experimental trials and improves the success rate. This will have an impact on printing for packaging, with **a further integration with digital printing, digital finishing and automatic forming machines**.

As well as the packaging itself, the **entire packaging supply chain will be further disrupted** as companies take advantage of the wealth of data to optimize and improve performance. This is sparking further interest in **packaging that is truly active and intelligent**. While active and intelligent packaging is not a new concept, combined with generative AI it could help with supply chain management and customer communication.

"Generative AI, in my mind, is a once in a lifetime kind of disruption that's going to happen" Navneet Kapoor, chief technology and information officer, Maersk

As well as working on data quality and running smaller experiments, many packaging companies are exploring potential partnerships and alliances to take advantage of Gen AI at scale. **These partnerships and alliances will be just as disruptive to the packaging industry as the technology itself**. To navigate this changing landscape, companies need to examine the potential impact of Gen AI within their own niche, identify the specific opportunities for growth, and assess potential partners to help with this transformation

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UNMISSABLE MARKET INTELLIGENCE

Smithers produces cutting-edge market reports that focus on various sectors and topics, including sustainability, within the packaging industry. The reports provide market forecasts, major drivers and trends, critical analysis of technological developments, and more.

Just some of our industry-leading reports include; The Future of Fibre-Based Packaging, The Future of Sustainable Packaging, The Future of PCR Packaging, The Future of Reusable & Refillable Packaging & more.

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Our expert teams are based in Europe, the USA and China.

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Smithers are the worldwide authority on the packaging, paper and print industries.

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SMITHERS PACKAGING EVENTS

Sustainability in Packaging

Held in Asia, Europe, North America and Latin America, these industry-leading events offer a 360 perspective on the key challenges and solutions the worldwide supply chain is facing in the move towards a circular economy. With 500+ attendees each year, these events are a must-attend.

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E-PACK

Held in Asia, Europe and North America, these unique cross-industry events cover the full landscape of the fast-growing e-commerce packaging market. Just some of the topics covered includes functional design & protection, regulations, cost-effective packaging solutions, case studies from brands & more.

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Digital Print for Packaging

Representing the industry as a whole, from designers and brand owners, through to equipment providers and converters, this event – held in Europe, Asia and North America – is the place to be for anyone working in the digital print for packaging industry.

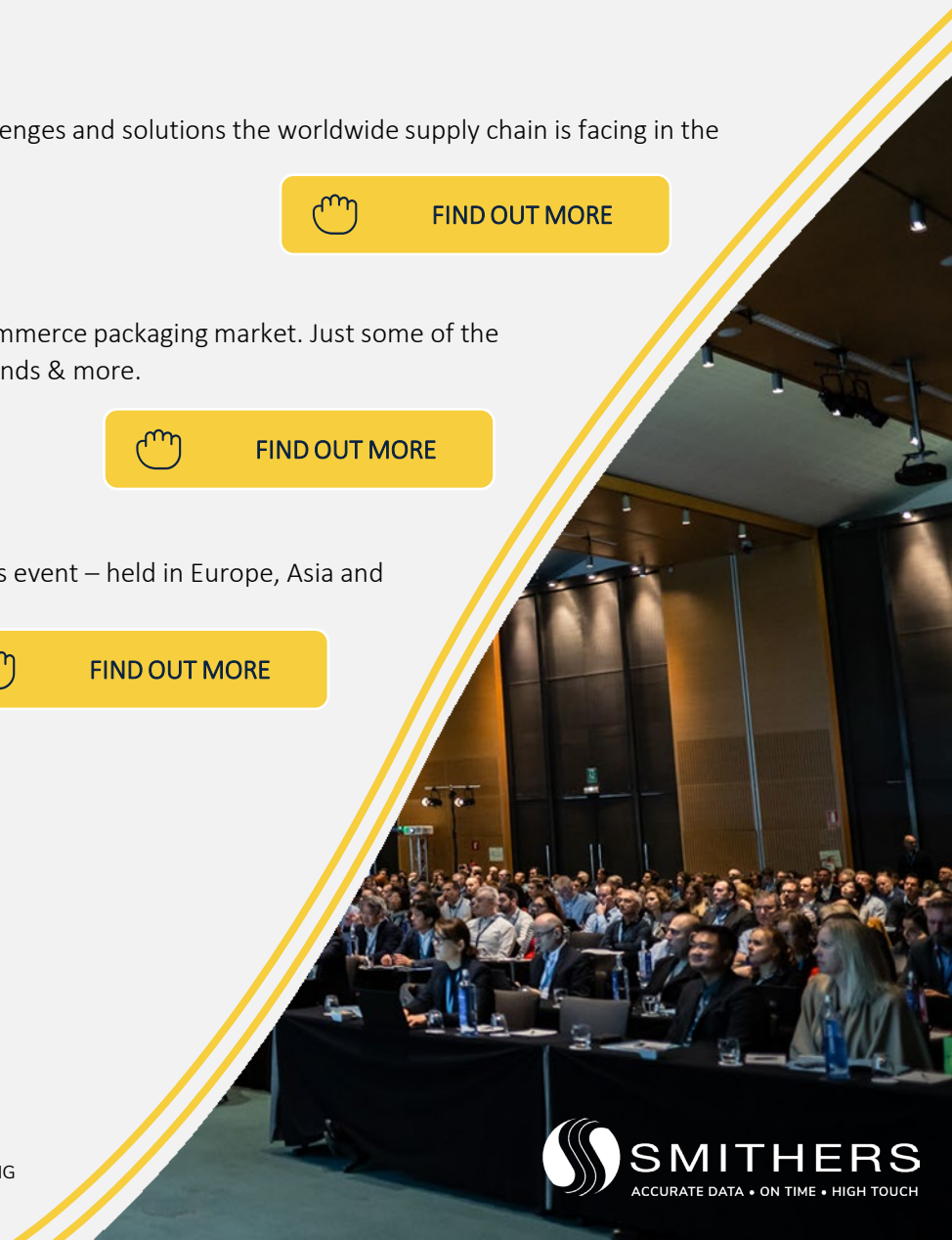FIND OUT MORE

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Meet our packaging experts

Tom Hallam

Project Director, Packaging Consultancy

Tom Hallam has 23 years of professional experience, initially working in the consumer products sector with Reckitt and for the last 15 years in forest products. Originally he was focused on market and consumer insight but he has been firmly working on sustainability and innovation ever since. He has worked for four multi-national companies and has since been delivering freelance projects via Brand Ethics consulting before joining Smithers as Project Director, Packaging Consultancy.

Felix Lu

Project Director, Asia Consulting

Felix Lu has 15+ years' sales & marketing experience in the packaging industry, in a variety of roles for multi-national companies for the Asia Pacific market. He specialises in the value chain of label and packaging materials, Internet-of-Things, and AIDC industry, with expertise in creating business strategy, directing new market development, strategic business planning and partnership development.

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