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# No ordinary disruption

Winning with new models in packaging 2030

## Executive summary

Five major trends will “change the game” in the packaging industry and raise the bar for performance in the next five to ten years. Much higher levels of innovation and agility will be required to deal with the pressure and potential disruptions emanating from these trends:

- **E-commerce everywhere.** Intense focus on increased packaging requirements, including for new products, along with last-mile delivery innovations
- **Changing consumer preferences.** Demand for much more personalization, convenience, health, and affordability, driving SKU proliferation to new heights
- **FMCG and retail margin compression.** Further margin compression for fast-moving consumer goods (FMCG) manufacturers and retailers, with pressure passed back up the line to converters,<sup>1</sup> intensifying the threat of insolvency
- **Sustainability requirements increasing at every step of the value chain.** With rising activist scrutiny
- **Digitization/Internet of Things (IoT).** Both to drive down costs and, increasingly throughout the decade, gain a competitive edge with consumers; for example, by generating greater customer value and service through technology integration in packaging.

All five trends are approaching at varying strengths and speeds, with a special role for digital trends. The biggest increase in pressure is expected from e-commerce, which will move from early adoption to early majority diffusion. The second rush of new pressure will likely come from digitization. Initially, digital's role will mainly be as a cost-efficiency booster via automation, and then increasingly as a source of customer-facing interactive tools, both to convey information and emotion and to collect data. The other three trends – changing consumer preferences, margin compression, and sustainability – are already moderate to strong in terms of their impact, and they will increase in strength.

Preparing for these changes requires packaging companies to think in new ways about their focus and market approach (“intuition resets”). While growth in China is cooling, together with other markets in Asia it will remain the industry's top growth engine alongside North America, which China has displaced as the global leader in packaging. Notably, while the use of plastic has soared, the ecological burden is provoking heavier restrictions as demand rises for more sustainable solutions across the board.

The overriding implications of these packaging trends differ according to substrate and will demand substrate- and channel-specific strategies. Despite the surge of sustainability pressure, the combined power of plastics' attractive attributes in terms of cost, automation, and quality will likely buoy rigid and flexible plastic substrates, if converters can increase recyclability and recycled content. Paper and board will continue to benefit from e-commerce growth and are ideal for integrating digital and IoT solutions (using QR codes, radio frequency ID tags, near-field communication protocols, and so on). Paperboard will likely see more of the convergence of primary and secondary packaging, a shift in focus or buzz around the last mile (as will plastics), as well as more local or even captive converting operations to increase FMCG customers' agility. Glass and metal have an uphill battle in this more omnichannel world, but their traditional strengths and sustainability profiles (recyclability and using recycled content) still offer ways to fend off substitution by other substrates.

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<sup>1</sup> A “converter” is a packaging producer that takes raw material such as plastic resins and paper and transforms it into a packaging product

Even with deep substrate expertise, most converters need to think through an array of moves and revamp their approaches accordingly, giving attention to five priorities:

- Investing in R&D and innovation to secure a portfolio of competitive options
- Handling SKU proliferation driven by consumer preferences; for example, more flexible and agile processes to manage shorter manufacturing runs, and faster new product development and time to market
- Reallocating resources and assets and pursuing M&A to, for instance, achieve a global-local presence
- Strengthening collaboration with FMCG manufacturers and input suppliers, including technology
- Shifting the product mix (and processes) toward greater sustainability.

All of the improvement levers that these five focal points imply offer some opportunities – the question is how to line them up or combine them effectively. While plans will have to be adapted as the journey proceeds, attention to these five elements now will provide the platform for building a winning formula. Controlled urgency is essential in all five areas. Overall, “urgency” is most needed in reviewing and revamping R&D and innovation programs within the next 18 to 24 months in order to have a portfolio of projects with horizons of a few months to two to four years. At the same time, “controlled” refers to using sufficient quality gates and milestones, with financial and market reality checks, and adapting projects as needed or exiting. Moreover, this is not only about how to make the most of a company’s current strengths and relationships to secure growth and profits, but also about developing an outlook on where the pockets of growth are located (even if currently unserved), where they will appear, and when to pivot and tap them.

## Introduction – welcome to the “pressure-verse”

Over the past decade, the global packaging industry has enjoyed steady growth, driven by shifts in choice of substrates, expansion of new markets, and changing ownership dynamics. Headline changes include increased use of plastics to replace other substrates and accommodate consumers' demand for convenience, the economic boom in China and other emerging regions, and greater industry consolidation and growing private equity ownership.

Growth will continue in the decade ahead, but with more pressure and disruptive changes likely. Although growth in China is slowing, together with other markets in Asia it will remain the industry's top growth engine alongside North America. Meanwhile, the use of plastic has soared, but the burden on the environment is prompting increasing restrictions. And, while e-commerce has been a boon to many converters, its spread has created new demands and sharply compressed margins for converters' customers, namely fast-moving consumer goods (FMCG) companies and retailers.

So, what is in store for converters up to 2030? To find answers, McKinsey's Basic Materials Practice conducted extensive interviews with retailers, FMCG companies, and packaging industry executives in major end-user markets and across the main substrates, and also carried out deep-dive primary research and analyses from September 2018 to March 2019.

Our analysis has identified five major trends that will transform the packaging industry over the next ten or more years. If companies can capitalize on them, these changing consumer behaviors, technology disruptors, and sustainability trends will also present opportunities for high growth and improved profit margins in some packaging segments in mature markets. However, to succeed, packaging companies need to put strategy back on their agenda – simply doing what everyone else is doing (like in the previous period) is no longer going to cut it. Instead, packaging companies need to embark on a change journey with controlled urgency: it will be essential for them to revise their approach from one based predominately on continuous improvement-type actions with reliance on market growth; rather, they should increase their strategic focus on innovation and agility in order to preserve value and capture growth. All the while, the forces at work are shaping up to form a new higher-pressure universe, what we might term a “pressure-verse.”

This white paper discusses what it will take to win under increasing pressure on multiple fronts. In chapter 1, we offer a snapshot of where the industry and its major segments stand today, with a focus on North America. We then devote chapter 2 to unpacking the five top trends that we believe will reshape the industry. These trends have certainly been present during the past few years, but mostly in nascent form; however, in the decade up to 2030, their pace is expected to pick up strongly and potentially become disruptive, as accelerated adoption will also hasten and compound innovation.

In chapter 3, we turn briefly to the overriding implications for substrates in particular, and the focal points for action more generally. While plans will have to be adapted along the way, attention to these areas now will provide the foundation on which to build. Success going forward will not only be about how to make the most of a company's current strengths and relationships to secure growth and profits, but also about developing an outlook on where the pockets of growth are located – even if currently unserved – where they will crop up, and when to pivot and tap them. For packaging players that find a winning formula and continue to enhance the products they carry, present, and protect, the coming decade could be a bonanza.

# 1 Context – the need to reset intuition in a rapidly changing packaging world

*There are opportunities for profitable growth in North America; the fastest-growing segments are among the smallest.*

China has surpassed North America and is now the world's largest packaging market. By 2022f,<sup>2</sup> China's faster growth will make it the "king of the hill" in packaging, with a global market share of roughly 28 percent. While this shift is notable, North America's relevance at 22 percent of the global market remains substantial due to its size and rate of innovation.<sup>3</sup> In such mature markets as North America (and also Western Europe with 17 percent of the global market), converters that reset their sights to a more granular view will more readily find pockets of growth and make successful decisions on how, where, and when to compete. For example, at USD 2 trillion in spend, the US "food ecosystem" – by which we mean the value chains from farm to table – represents roughly 10 percent of GDP and is larger than both the nonfood retail market and the market for construction. Over the next five years, the overall food market is expected to grow at a modest 1 percent annually, but there are still pockets of high growth. In particular, grocery delivery and ready-to-eat meals are expected to generate double-digit growth rates. Furthermore, organic-labeled foods, restaurant delivery, and new niche brands are expected to grow at close to around 10 percent per annum.<sup>4</sup>

Overall, with packaging's ability to boost a product's value and cost competitiveness, the industry can look forward to continued growth, roughly in line with world GDP. At the same time, however, given its midstream positioning, the industry is inevitably under pressure from multiple directions in the value chain. The industry is also still fragmented, and this, too, makes converters vulnerable to increased pressure – both upstream to price hikes and shortages of raw materials, and downstream to demands from industrial, FMCG, and retail customers as well as consumers – for more economy and creativity. Therefore, in the rougher terrain ahead, many converters will likely have to work harder to secure their share of the industry's moderate growth.

Before turning to the trends in chapter 2, let's look briefly at the current context of the packaging landscape: geographic markets, end uses, and substrates, with a focus on the mature North American market.

## **North America – mature, but some fast-growing segments**

Globally, packaging is a diversified USD 850 billion plus (2018) industry with healthy growth prospects of some 3 percent per annum.<sup>5</sup> Geographically, most of this growth will be fueled by emerging markets, which can expect to see packaging consumption increase by USD 107 billion in the period 2017 to 2022f (Exhibit 1). In the same period, markets in Western Europe and North America are projected to grow at approximately 1 percent per annum but from a large base, with packaging consumption in developed markets (also including Japan and Oceania) set to increase by about USD 22 billion by 2022f.<sup>6</sup>

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<sup>2</sup> In dates, "f" refers to following years

<sup>3</sup> Derived from Smithers Pira: The Future of Global Packaging to 2022 (December 2017)

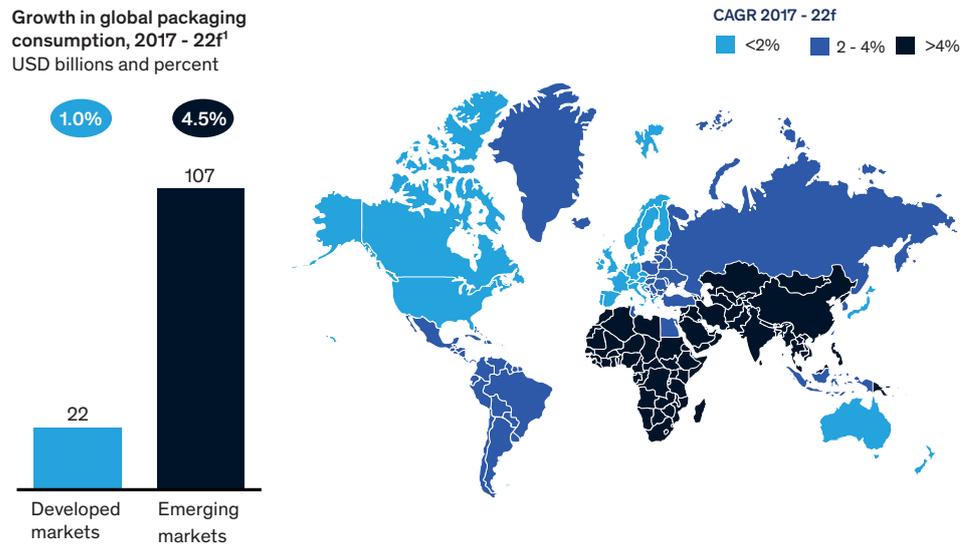
<sup>4</sup> Euromonitor

<sup>5</sup> All forecasts constant (2016) for prices and exchange rates

<sup>6</sup> Ibid.

## Geographically, most of the global growth will be fueled by emerging markets

Growth in global packaging consumption, 2017 - 22f<sup>1</sup>  
USD billions and percent



<sup>1</sup> At constant 2017 prices

SOURCE: Smithers Pira (Dec 2017); McKinsey

The main intuition reset to highlight is that North America is now the second-largest market after China. As of 2017, apparent packaging consumption in China was an estimated USD 214 billion, while North America stood at some USD 203 billion. By 2022f, China's lead is projected to widen to USD 276 billion, making North America about three-quarters (approximately 78 percent) the size of China's market by value.<sup>7</sup>

Although developed regions such as North America and Europe have lower growth rates, their large absolute size maintains their importance, and granular opportunities for growth still exist. To illustrate the relative sizes, in the industrial/transit packaging sector, North America and Western Europe are expected to see apparent consumption rise by 2022f to about USD 78 billion and USD 62 billion respectively, together exceeding the forecast for total packaging demand in other Asian markets (excluding China and Japan) at about USD 129 billion. In food, the biggest consumer packaging segment, other Asia (excluding China and Japan) is again the largest emerging market, with a projected consumption by 2022 of some USD 35 billion. However, it is still far smaller than the combined total for North America and Western Europe of approximately USD 120 billion (USD 69 and USD 51 billion, respectively).<sup>8</sup>

### North American snapshot across end uses and substrates

The second main intuition reset to note is that even those markets growing slower than overall GDP offer hot spots – pockets of fast growth – that converters can capitalize on. Although the North American market is expected to grow by only around 1.2 percent up to 2022f, its overall size ensures some attractive opportunities for granular growth. Of the end uses, consumer segments represent around 65 percent of total North American packaging, with a projected value in 2022f of some USD 136 billion. The largest end-use segment is food, while

<sup>7</sup> Ibid.

<sup>8</sup> Ibid.

the fastest growth is projected to come from healthcare and cosmetics, essentially the same as the global packaging growth trends.

- **Largest end use.** Food accounts for approximately 50 percent of consumer packaging and is growing thanks to increased demand for convenience. It is projected to have a CAGR of some 1.2 percent, which will expand this end use to USD 70 billion and a North American packaging market share of 32 percent by 2022f.
- **Slowest growth.** Within the drinks segment, the largest category, bottled water, continues to be the key driver of drinks packaging, supporting demand for PET<sup>9</sup> bottles. Niche categories also continue to outperform the overall mass market favoring metal cans. However, drinks packaging overall is shrinking, which is mainly due to the downturn in carbonated soft drinks in response to health concerns. With a growth rate of -0.2 percent, consumption is expected to stay flat in the 2017 to 2022f period at USD 22 billion, with a North American market share of around 10 percent.
- **Fastest growth.** At approximately 3.5 percent, healthcare is the fastest-growing end use, boosted by increased demand for healthcare products for an aging population. The forecast for consumption in North America is an increase from USD 9 billion to some USD 10 billion, representing a North American market share of approximately 5 percent.

Given that the fastest-growing end-use segments are small, converters may want to consider a diversification strategy, comprising a portfolio of segments that have some affinities; for example, some combination of health, wellness, and/or cosmetics packaging related to existing food packaging or functional food related to existing healthcare packaging.

Turning to substrates in North America in the 2017 to 2022f period, plastics are still expected to see growth despite mounting pressures for more sustainability. Perhaps optimistically given the surge in restrictions, industry forecasts still show the highest growth rates for flexible plastics at some 2.3 percent, rigid plastics at around 1.9 percent, flexible papers at approximately 1.9 percent, followed by paperboard at around 1.1 percent.<sup>10</sup> The main contributors to plastics growth, taking tailwinds into account, are the lightweight trend and technological improvements. For example, stand-up pouches continue to be favored for new product launches because they offer both lightweight and high consumer appeal. The growth in board is positively driven by online retail (e-commerce).

Despite slower growth rates across end uses, opportunities do exist for high growth and margins. They will be driven by changing demographics and shopping behaviors that make new demands on packaged foods and other goods, creating new requirements for packaging. However, the opportunities to earn higher margins through differentiation will be accompanied by higher “churn” and other challenges discussed in chapter 2.

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<sup>9</sup> PET: polyethylene terephthalate

<sup>10</sup> All forecasts constant (2016) for prices and exchange rates

## 2 No ordinary disruption – five trends changing the industry’s game

*All trends in packaging offer some opportunities; they also differ in that they are approaching at various different strengths and speeds, with a special role for digital trends.*

Our interviews and analysis have identified five major trends that will “change the game” in the packaging industry and raise the performance bar over the next five to ten years (Exhibit 2):

- **E-commerce everywhere.** Intense focus on increased packaging requirements, including for new products, along with last-mile delivery innovations
- **Changing consumer preferences.** Demand for much more personalization, convenience, health, and affordability, driving SKU proliferation to new heights
- **FMCG and retail margin compression.** Further margin compression for fast-moving consumer goods (FMCG) manufacturers and retailers, with pressure passed back up the line to converters,<sup>11</sup> intensifying the threat of insolvency
- **Sustainability requirements increasing at every step of the value chain.** With rising activist scrutiny
- **Digitization/Internet of Things (IoT).** Both to drive down costs and, increasingly throughout the decade, gain a competitive edge with consumers; for example, by generating greater customer value and service through technology integration in packaging.

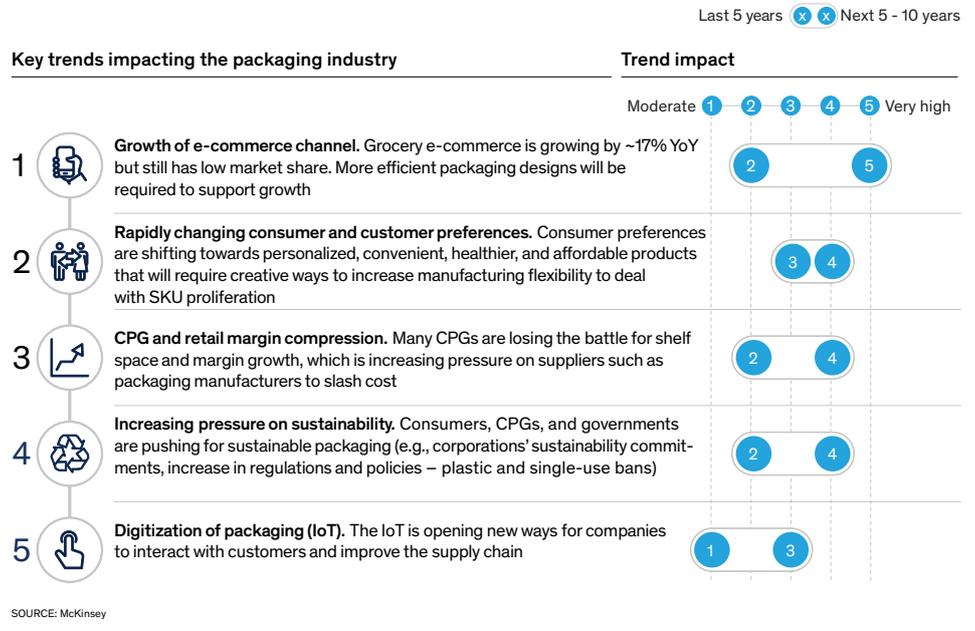
While none of the trends are new, most are now leaving infancy and coming at converters head on with increasing pressure and speed that could prove disruptive. Sudden turbulence could blindside an individual company or segment of the supply chain.

As before, converters will need to meet rising e-commerce and sustainability requirements, particularly last-mile customizing and concerns about plastics. Also, as always, converters must satisfy consumer preferences – this will drive the proliferation of SKUs to meet demand for personalized, healthier, more convenient, and more affordable packaging. All the while, packaging companies will also be dealing with a severe margin squeeze passed back up the line by FMCG manufacturers and retailers. Finally, even with challenges, increasing adoption of digital solutions and IoT will provide all-important options for improving cost efficiency and (later) faster customization.

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<sup>11</sup> A “converter” is a packaging producer that takes raw material such as plastic resins and paper and transforms it into a packaging product

## 5 major trends will change the packaging industry's game over the next 10+ years



### 1. Growth of the e-commerce channel – trend impact shift from two (moderate) to five (very high)

Can any packaging company win without fully integrating e-commerce as a key component of the business? Retail business is shifting from the traditional bricks-and-mortar channel to online and mobile shopping, with the global e-commerce market set to double by 2022.<sup>12</sup> More and more traditional businesses, such as grocery, are embracing e-commerce.

#### Is the online glass half empty for packaging ...

The move to online retail in general will continue to have a significant impact on packaging needs and the traditional converting value-chain constellation. E-commerce packaging must meet new and different needs, with increased requirements for strength and less investment necessary in “on-the-shelf” printing. Instead, there is a much greater need to optimize the overall packaging for last-mile shipments, improve the consumer’s unboxing experience, and facilitate easy, efficient returns.

The pessimistic view is that e-commerce will radically diminish the traditional role of primary packaging designed to attract consumer interest in retail stores as part of the purchase decision. Has this role already peaked, and could it continue to decline until, at some point after 2030, it will become a quaint relic of the past? Customers are becoming increasingly digitally savvy, so the argument goes: they seamlessly roam between the best of both online and offline channels, and they have already made up their minds before ordering or buying an item. This may well imply a large-scale shift to utilitarian protective packaging only. Moreover, consumer tools are being developed for easy replenishment and reordering, and such tools will tend to reduce impulse purchases by consumers in stores.

<sup>12</sup> Forrester

### ... or half full, with new avenues for growth?

More optimistically, however, e-commerce also brings with it new and different opportunities for packaging. In the short term, this is especially true for the next generation of transportation packaging; for example:

- **New volume.** At the most basic level, the strong growth trajectory in parcel delivery implies that the demand for individual packaging will increase, driven by the underlying growth in e-commerce activity (purchases and returns). This is already benefiting converters that make flexible packaging (pouches), corrugated boxes, and other protective packaging used in the last-mile delivery to consumers. In fact, e-commerce will, through its sheer growth rate, drive half the growth of the European fiber-based transportation packaging.
- **New types of packaging.** Different types of packaging will emerge with new features and characteristics to fit the omnichannel environment; for example, easy-to-pack, customer-focused unboxing, simple returns, and robust handling in the supply chain – that is, individual packages able to withstand at least some of the rough handling of shipping outdoors and crates. E-commerce requirements for robustness are currently roughly three to four times higher than traditional standards for package units; for example, packaging is typically drop-tested from 5 angles for store deliveries but from 18 angles for e-commerce shipping by some e-retailers.

Additionally, we also expect further disruption in packaging because e-commerce will require significant supplementary investment in product development and R&D to develop even more competitively efficient solutions to support this channel's expansion.

- **Next generation of e-commerce transportation packaging.** Basic requirements for e-commerce parcel packaging have so far been quite simple – prevent product damage and optimize productivity – but the bar is rising quickly. The pressure is especially noticeable given that e-commerce is highly competitive with very slim margins and demands packaging that can act as an enabler to improve profitability. Cost pressure has so far been especially prominent in fostering the use of pouches. They are cheaper and also faster to fill on production lines, take brand imaging well, and, in many cases, include design elements for easy returns.
- **Convergence of primary and secondary packaging.** We expect to see a tipping point emerge when purchasing volume via e-channels reaches over 20 to 30 percent. As volume increases, many more product manufacturers will be looking to e-channel-enabled packaging – in other words, the merging of primary and secondary packaging. We expect large e-commerce players to lead the way in removing the outer box by demanding primary packaging designed to allow direct shipment to consumers without a secondary protective outer layer. For example, the recent US launch of a new laundry detergent presented a product specifically for online orders. The detergent was reformulated to be more concentrated, and its packaging innovated to reduce its overall weight in transit. Handling has been improved with a plastic container fit snugly into a rectangular board shoe or raft. The hybrid mix of substrates adds another sustainability benefit by using less plastic and being even lighter than the original version.
- **Design for high automation.** With the expansion of e-commerce, demand is increasing for packaging designs that also efficiently meet the needs of advanced/AI-enabled or fully automated warehousing and filling technologies.

Finally, as e-retailers tackle the challenges of increased shipments of individual parcels and repackaging, we expect to see changes to the traditional packaging conversion value chain.

For one thing, business models requiring quicker turnaround and flexible conversion will encourage increasing use of automation. For another, it is likely that conversion will need to be more localized – that is, will be increasingly done close to or even in-house at brand owners – where converters need to be nimble to offer rapid prototyping, fast turnaround, and new technologies such as digital print.

## 2. Consumer preference shifts – trend impact shift from three to four

How can packaging help satisfy future demand from consumers in addition to just convenience?

We see consumer preferences shifting along five main dimensions, demanding more of each. These are convenience, personalization, “local hero” products, health, and affordability:

- **Increase in convenience.** The need for convenience in packaging is certainly not something new; it has been driving innovation and multiple substrate shifts over the past decade (and earlier). Going forward, we expect consumers to continue to demand an increasingly effortless and less time-consuming consumption experience.  
  
New product launches around the world specifically target consumer demand for convenience. The result is relentlessly high and rising requirements for packaging (easy-open and resealable closures, freshness retention, ready-to-eat/convenient foods/portability, one-hand use, and single-portion/smaller packs) where consumers are often unwilling to accept a trade-off for other advantages, such as sustainability. The strong preference for convenience points to the necessity for stronger packaging innovation to combine convenience with requirements related to recyclability.
- **Increase in variety and personalization.** Consumers want more package options and are increasingly opting for personalization on packaging. Accordingly, to satisfy this demand, the range of SKUs and number of pack sizes offered have increased exponentially from traditional channels to today’s online-with-marketplace format. While a store may have a dozen different SKUs for a category such as “air freshener,” the online-with-marketplace format often offers literally tens of thousands, augmenting its own selection with third-party products. Linked to this, FMCG manufacturers are increasingly testing digital printing for mass customization and increased personalization.
- **Less loyal, more local.** Consumers appreciate locally manufactured products (“local heroes”), as it gives them a sense of greater product safety along with additional positive attributes (for instance, “good for the local economy”). Millennial consumers are especially likely to seek out the new, different, and authentic, which is not a good fit with the core consumer goods marketing model. Compared with boomers, millennials are:<sup>13</sup>
  - 2.8 times more likely to believe newer brands are usually better or more innovative
  - 2.5 times more likely to prefer shopping at independent and specialty stores over traditional grocery chains
  - 3.7 times more likely to try to avoid buying products from “the big food companies.”

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<sup>13</sup> McKinsey Millennial Survey, US only

- **Focus on health and wellness.** US consumers are migrating to value/private label and premium segments, putting pressure on the traditional mainstream segment. As part of this larger shift in the consumer journey, consumers are increasingly becoming highly aware of their health and wellness; for example, concern for obesity – particularly child obesity, desire to stay healthy despite aging, and heightened sensitivity to food safety. Overall, fresh produce and health-oriented packaged goods are growing far faster than other categories.

As consumers spend more on related products, such as functional foods and organic products, health and wellness no longer represent a strategic differentiator; they are a requirement, hygiene factor, or table stakes for major food FMCG manufacturers. New product launches around health and wellness require packaging that fits and communicates the value proposition.

- **Increased price awareness.** Price pressure is a constant of business life, but with a new twist: disposable income is decreasing for the majority of the population in advanced economies. Millennials are poorer than their parents. Consumers are increasingly focusing on price, and their need to economize is fueling market share growth of private-label products. McKinsey's Global Consumer Sentiment Survey (2017) shows that 42 percent of the US consumers surveyed are looking for ways to save money. To cope with increased price pressure, FMCG manufacturers typically target packaging as a focus for cost savings. Cost has historically been king, serving as the single most important purchasing factor for packaging, especially as converters have had less negotiating power given their smaller size relative to their FMCG customers.

These changing consumer preferences will result in SKU proliferation and product-mix changes, requiring converters to have more flexible and agile processes to manage shorter manufacturing runs and faster new product development and time to market.

### **3. FMCG and retail margin compression – trend impact shift from two to four**

It will not get any easier, but just how severely will margin pressure increase for packaging?

Cost pressure in the packaging value chain will almost certainly accelerate even further. Consumers' increased price awareness thanks to the transparency provided by digital shopping channels is already exerting enormous downward pressure on retail prices. At the same time, input and resource prices (commodities, labor rates) are expected to rise, increasing the cost of goods sold. The increasing complexity of products, materials, and suppliers plus the requirements for higher-skilled labor are also expected to increase the cost base. Furthermore, the trend toward the automation and digitization of interlinked FMCG manufacturers and retailers requires not only additional investment, but also write-offs of physical real estate assets, intensifying cost pressure from yet another direction.

The combined effect of these shifts will put intense, relentless pressure on the income statements of FMCG manufacturers as well as retailers. For example, if not actively managed, these pressures could erode the FMCG manufacturers' margins almost entirely, with net profits declining from around 15 percent to 0 to 5 percent, with corresponding pressure passed back upstream to converters. Margin compression will require strong collaboration between converters and packaging customers to develop creative solutions to reduce costs without compromising convenience features and, increasingly, sustainability. Leading FMCG manufacturers also increasingly expect to have global partners for the majority of their packaging volume, which will require further consolidation efforts and the formation of a global presence.

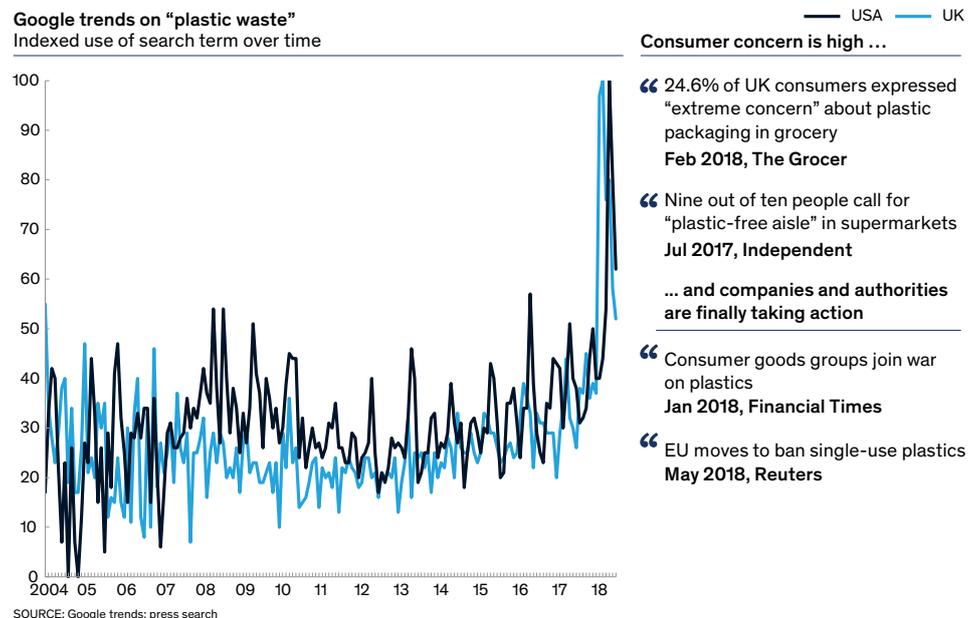
#### 4. Increasing pressure on sustainable packaging – trend impact shift from two to four

Pressure to reduce packaging waste has risen sharply, and so have actions by FMCG manufacturers, retailers, and legislators. How should packaging companies manage this challenge? FMCG manufacturers and retailers are experiencing severe pressure regarding their plastic packaging choices. Visceral images of ocean plastics have stirred up consumer sentiment around the world, and regulators are responding:

- Public awareness of plastic leaking into the environment has increased significantly over the past 12 to 15 months to an all-time high (Exhibit 3).

Exhibit 3

#### Public awareness of plastics leakage into environment has increased significantly over the past 12 - 15 months to an all-time high



- Most consumers claim to be highly concerned about the environment, with the highest rates registered in emerging economies.
- Governments have started responding to public outcry and are acting to increase recycling and put in place selective regulations to reduce plastic use. In the US, 16 states so far have enacted statewide plastic bag legislation.<sup>14</sup> As a result, there are currently about 52 approved bills in the US compared to 30 in 2015, which mostly revolve around banning single-use plastics, replacing plastics, and increasing recycling targets.<sup>15</sup> In addition, 90 plus similar bills are pending to be approved over the next 3 years.<sup>16</sup> Europe and India are also pushing toward bans on single-use plastics, as announced in 2018. For example, the EU is targeting plastic beverage bottle recycling at 90 percent by 2029 across member states.<sup>17</sup>

<sup>14</sup> National Conference of State Legislatures and press search

<sup>15</sup> Ibid.

<sup>16</sup> Ibid.

<sup>17</sup> European Commission

This increasing pressure from the public, regulators, and the industry itself encourages companies to move toward more sustainable packaging solutions. Consequently, both top retailers and FMCG manufacturers have made bold sustainability declarations<sup>18</sup> and commitments for the years to come; for example:

- Reduction of packaging material in terms of size, weight, and thickness – varying from 20 to 33 percent in terms of weight
- Increased recyclability, reusability, or compostability of packaging material – with most targets aiming at 100 percent
- Increased use of recycled plastic in packaging material – ranging from 9 to 100 percent depending on material properties
- Further commitments on designing for recyclability and educating customers on proper waste management.

However, while FMCG manufacturers and retailers may have pursued a rigorous packaging sustainability agenda with a focus mainly on “lightweighting,” new challenges around waste management and recyclability are posing challenges that exceed the capabilities of the usual tools and strategies. The largest and most troubling mismatch is arguably between stated desires for sustainability and consumers’ willingness to pay. Most evidence indicates that, so far, consumers’ willingness extends only to a low premium.

For packaging companies, pressure for sustainable packaging will require investment and a large scale-up of innovation capacity to reduce the environmental impact of packaging, comply with regulations, and satisfy consumer preferences. One implication, for example, is that more converters will supply fully recyclable packaging with little compromise on material barrier properties; another is that more packaging will have high recycled content. Efforts are already underway, and several packaging products are now being introduced as part of fully sustainable systems. Going forward, packaging companies will need to focus more than ever on cost-effective sustainability solutions. As the optimal combination of economics and environmental protection might, in many cases, lead back to substituting plastics for other substrates, the industry may need to consider conducting more extensive public education programs.

## **5. Digitization of packaging – trend impact shift from one to three**

Will there be any room left for “dumb” packaging in the future? Over the coming decade, intelligence and digitization in packaging – meaning technology integration and use of new technologies – will increasingly be aimed at enhancing customer value and pursuing new business areas.

In general, intelligence and digital in packaging offer a broad range of growth opportunities. Over the next 10 to 15 years, solutions that integrate digital technology into packaging substrates will likely also change the way consumers interact with packaging. Here, digital devices can add value for consumers by boosting packaging’s power as a platform for information and brand messaging. Multiple technologies are available to facilitate such interaction (for example, QR codes, RFID, and NFC). Over the next decade, we expect to see their increasing adoption for use in packaging to interact with consumers. Such interaction helps differentiate brands and makes them more consumer-centric, thereby uncovering unmet needs by segment, assessing willingness to pay, gaining early signals on new packaging trends, and so on.

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<sup>18</sup> Derived from company public sustainability reports

In the shorter term, we see more potential for packaging digitization to create value directly for FMCGs and retailers; for example:

- Developing track-and-trace solutions at the packaging-unit level to enable complete supply chain traceability (for instance, for product recalls, food safety, quality tracking)
- Conducting continuous, integrated demand planning (for example, to optimize production runs and inventory using customer and third-party data)
- Digitizing customer interactions to deliver a better customer journey, increase sales, and improve service, particularly for small-scale customers
- Increasing customer collaboration (for instance, co-development/co-design with customers)
- Pursuing new areas of business with opportunities to serve a broader range of smaller customers directly and efficiently (for example, developing an e-platform where smaller customers can order their packaging directly from the converter and not go through the traditional distributor channel).

Converters' adoption of such digital solutions with business partners will be accelerated by the effect of increased margin compression on FMCG manufacturers and retailers, and by the development of the e-commerce channel with growing automation and use of AI, which will, in turn, require more intelligent packaging. Application of digitization in packaging is, however, still in its infancy and will require further economies of scale to make costs competitive for unit-level implementation.

# 3 The change journey to preserve value and capture growth

*All main improvement levers offer some opportunities – the question here is how to line them up or combine them effectively.*

The breakthroughs achieved by packaging industry winners as they navigate the change journey over the coming decade will be many and various. Some that seem audacious or nearly impossible will result in great rewards and much acclaim, followed by widespread imitation. Others may be achieved with the help of intuition, conferring a strong competitive edge that is hard for rivals to unlock. Still others will be the result of close study of the substrate's physical properties and how they can be used to good advantage, including production and supply chain features that may be hiding in plain sight. In turn, all this packaging-specific knowledge will need to be harnessed to the machinery of a new business model that builds on five elements – innovation, agility, asset and resource reallocations (including M&A), collaboration, and sustainability – to meet the demand for lower cost and greater value for the customer and consumer.

These five game-changing trends will create different tailwinds and headwinds depending on a company's substrate focus. Most favor continued plastics substitution but only if the makers of plastic packaging can create more sustainable circular or recyclable offers. For example, innovation that results in a cost-efficient, easily recyclable flexible pouch with appropriate barrier and aesthetic properties will likely win big. Similarly, improving recyclability of polyethylene-coated paper (such as coffee-to-go cups), which today has very low recyclability properties, will be another area requiring collaboration across the value chain. Efforts are already underway, as illustrated by a recent contest sponsored by major coffee-to-go retailers that received more than 400 entries and yielded a dozen finalists, who are obtaining funding to develop their solutions, ideally to commercial viability.

Converters that harness knowledge of the trends, substrates, and processes along the value chain to a new business model will have the best chances of preserving value and capturing growth. As resources and attention are scarce, we suggest focusing on the five elements described above to develop a winning formula for lower cost and/or greater value for the customer and consumer.

Devising a winning formula for the change journey will involve both deep insights into substrate features (Exhibit 4) as well as answers to questions about how a company can revamp its approach and strategic focus to best exploit these features for a given end use and geography, and thus follow these trends to success.

Exhibit 4

**Mega trends will affect packaging substrates in different ways**

ILLUSTRATIVE EXAMPLES

	<b>Trend aspect examples</b>	<b>Paper and board</b>	<b>Plastics<sup>1</sup></b>	<b>Metal</b>	<b>Glass</b>	<b>Examples</b>
Growth of e-commerce	Packaging optimized for omnichannel	+	+	-	-	Need for robust packaging benefits for flexible plastics
	Convergence of primary and secondary packaging	+	+	-	-	Overall less material used but upside for flexible plastics/board
	Strong increase in parcel shipments	+	+			Corrugated and flexible pouches gaining
	Small and close converting	-	-	-	-	Challenge for overall packaging asset footprint
Rapidly changing consumer and customer preferences	Mass personalization		+			Plastic highly customizable for differentiation
	Preference for local products/growth of small businesses	+	-		+	Natural/organic trend in favor of glass and fiber
	Health and wellness trend	+	-		+	
	Increase in convenience	-	+	-	-	Plastic highly customizable for differentiation
	Increased price awareness	-	+	+	-	Plastics/metal low-cost options
CPG and retail margin compression	Transportation and handling costs	+	+	-	-	Retail-ready packaging needs benefit for paper board
	General shift to cheaper materials	-	+	+	-	Increased use of low-cost packaging
Increasing pressure on sustainable packaging	Increased policy pressure for sustainability	-	-	+	+	
	Design for recycling/reusability		-	+	+	Metal and glass highly recycled materials
	Increased recycled content	+		+	+	Metal, glass, and board already large users
	Food contamination concerns (e.g., BPA, mineral oils)	-	-	-	+	
	Recycling systems in place	+	-	+	+	
	Compostability	+				Paper with no barrier coatings and PLA plastics
Digitization of packaging (IoT)	Digital printing	+		+		Large billboard surface in favor of board and metal
	AR- and AI-enabled packaging	+				
	RFID/NFC integration into material	+				Integration possible as early as the paper-making stage

<sup>1</sup> Includes both rigid and flexible plastic packaging (and multimaterial plastic laminates)

SOURCE: McKinsey

## Substrate groups and how they could grow

Even with disruption, all the main consumer packaging trends continue to favor plastics over other substrates in most dimensions – apart from sustainability. In the context of this increasingly influential trend, paper and board, metal, and glass have stronger recyclability and renewability profiles. Glass, as in the past, has some premium association, and even kraft paper has gained a newly found status as a signal for health and wellness with its eco/natural look.

### **Rigid and flexible plastic packaging – sustainability’s surprise winners?**

How can plastics regain customer and consumer trust and acceptance?

While consumer trends and the need for convenience have historically favored plastics, society has long had a love-hate relationship with the substrate that is synonymous with “artificial.” Plastics now face headwinds from much stronger trends toward sustainability, with a noticeable surge over the past 15 to 18 months to an all-time high in negative response. And yet, finding the right focus could still help plastics emerge as the surprise winners of the sustainability trend.

The mounting pressure to reduce or avoid plastic waste has unleashed action on multiple fronts: programs and policy changes have been announced and are being implemented by FMCG manufacturers, retailers, and policymakers. To navigate through the challenges, converters should consider four main levers:

- **Reduce plastic material.** Reduce weight and excessive packaging further by using next-generation lightweight materials and simplifying material formulas and packaging designs.
- **Improve loops in the value chain.** Increase recyclability/reusability, boost recycling, and raise the share of recycled materials used in packaging.
- **Look for truly biodegradable plastic materials** (to reduce the impact of any leaked plastic packaging) but also so as not to disrupt, contaminate, or undermine other recycling streams of plastics.
- **Innovate to create products and technology road maps that address current sustainability shortfalls** – for example, a flexible pouch that is fully recyclable but still has high barrier properties compared with multilayer solutions.

Plastic packaging will likely continue to enjoy an advantage into the next decade because the obstacles to switching to alternative materials are still significant. These hurdles include cost position, weight, barrier/material properties, and currently installed filling lines at customers.

With the right collaboration and focus, there will also be tailwinds for monomaterial plastics (PET/HDPE<sup>19</sup> bottles and high-barrier monomaterial plastic films). Such plastic packaging is already highly recyclable and can incorporate more recycled content, especially for rigid packaging formats in nonfood applications. With current customer sustainability commitments, such packaging could be favored by FMCG manufacturers and retailers that are giving priority to recyclability. Additionally, other substrates such as plastic-paper laminates will struggle to meet some of the shelf life and barrier requirements. Thus, assuming closed loops (a circular economy approach with partnerships across the value chain), higher recyclability, and high use of recycled content, plastic could become a winner – the objective of initiatives to create and market “better plastics.” Moreover, with plastic packaging overall being a low-cost, lightweight, and highly formable substrate with strong barrier properties, it could also benefit from other trends, such as the demand for e-commerce-ready packaging

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<sup>19</sup> HDPE: high-density polyethylene

or particularly easy-return pouches. However, to succeed on this path, converters will need both significant collaboration with customers and other stakeholders (recycling system firms) and successful innovation – particularly of material formulas and package design – likely backed with public outreach to educate consumers about the relative sustainability benefits of new formulations and how to recycle.

### **Paper and board packaging – innovation hat tricks may deliver the winning edge**

What is the next big thing in paper and board: the convergence of primary and secondary packaging or captive converters – or both?

Paper and board packaging materials are already benefiting from developments in e-commerce, which have increased demand for secondary protective packaging. Changing consumer perception has also boosted paper and board for primary packs; for example, the health and wellness trend has adopted “brown as the new black” or rather “the new white,” associating purity and authenticity with brown paper/eco-looking packaging.

Along with continued growth, there will also be challenges. As the volume of products supplied through the e-commerce channel grows, it will increase pressure to develop e-commerce-ready packaging that can be filled and shipped directly on its own. Such solutions would basically merge primary and secondary packaging, potentially reducing the need for protective fiber-based packaging (corrugated, protective packaging and wrapping). In addition, large e-retailers are testing new formats for converting their transport packaging in-house or nearby to minimize void fill and improve efficiency. If these experiments develop to a large scale, the result will be a significant relocation of converter assets. From a sustainability standpoint, plastic-coated paper is difficult to recycle; hence, given FMCG commitments, we expect to see more demand for paper solutions that offer both strong barrier properties and high recyclability and, in some cases, even high recycled content. For example, enabling and scaling up use of paper cups with a natural barrier coating that is fully recyclable in the fiber waste stream is a great opportunity to improve sustainability within single-use packaging.

The trends also offer new potential upsides for paper and board. With the right innovations, paper and board packaging could help customers off-load some of the effects of margin compression. New comprehensive solutions are needed; for example, shelf-ready packaging for the “future retail store” that works both in automated restocking and fits future store setup and layout. If innovation can perform a hat trick – improve barrier properties, keep or even increase running speeds on customers’ filling lines, and do so at a competitive price – it would likely increase demand for fiber across end-use segments. Similarly, demand for large billboard surfaces could favor paper and board as a substrate able to integrate new IoT technology (NFC, RFID, and QR codes) to enhance consumer interactions regarding consumer communication and food safety, for example. With innovation, it should be feasible to integrate such IoT technology into the material as early as during the paper- or board-making process.

## Metal and glass – leaving no stone unturned

Will store shelves see a revival of glass and metal?

Metal and glass packaging have historically suffered from the growth of plastics, driven by cost and consumer convenience. New growth opportunities could emerge – but not without concerted action and innovation by these two industries. With the emergence of new trends, there are opportunities to reposition glass and metal packaging by highlighting their strongest features: robust barrier properties, high recyclability, potential for reusability, and a large share of recycled content. These growth opportunities can be spotted by taking a closer look at ways to match these features with applications that demand or need them:

- **Superior recyclability, reusability, and high amount of recycled content.** These attributes will offer by far the biggest opportunity for both glass and metal substrates. Consumers and other stakeholders are pushing FMCG manufacturers and retailers to offer alternatives to plastics and packaging materials. In addition, tighter “reuse” loops could further benefit glass and metal packaging as refillable containers.
- **Small containers with superior consumer perception and shelf life.** “Good things come in small packages,” as the saying goes. With the right focus, cans, decorative tins, and glass can be positioned as the premium alternative to shelf-stable foods and other goods to build on the health and wellness trend. A related avenue for growth is smaller-sized containers, where glass and metal have barrier advantages over plastics, and metal offers similar printability.
- **Lowest-cost metal packaging options.** Metal cans in particular typically remain a low-cost option for customers. The next generation of packaging down-gauging could fuel stronger competition that will boost metal relative to plastics.

Without innovation to capture opportunities created by these trends, metal and glass are likely to continue losing share to the other substrates. However, with focused actions, customer collaboration, and strong innovation momentum, converters can harness aspects of all the trends to recharge demand for metal and glass.

To come up with a winning formula, converters are challenged to think creatively: how can substrate properties, from composition to “look and feel,” and their production and logistics processes, locally and globally, best address the trends to give their packaging a competitive edge? They also need to act with controlled urgency: how can a converter quickly align or realign plans for packaging with people and financial resources and vice versa, to advance swiftly on the journey in areas that will lay the foundation for success?

## Getting started on the change journey

Packaging companies have a window of opportunity to revamp their approach and strategic focus in order to preserve value and growth. Through our research, we believe future winners in packaging will be those converters that develop a new business model based on the five key elements described above: innovation, agility, asset and resource reallocations (including M&A), collaboration, and sustainability. These will be integral parts of the arc or bridging mechanism needed to achieve success.

### **Building readiness for ordinary and extraordinary disruptions**

In the following, we will take a look at each element in turn.

**Significantly increase investment in R&D and innovation through organic efforts and partnerships to change the product mix and keep it competitive.** What can converters and their partners come up with to address ever-more demanding consumer preferences, sustainability requirements, and e-commerce needs? Over the past five years, top flexible-packaging companies have been spending most on R&D (approximately 1.5 percent as a share of revenue), while other substrates such as rigid plastics, metal, and glass have been trending at around 0.5 to 0.8 percent, and paper and board significantly lower at 0.25 to 0.3 percent.<sup>20</sup> Going forward, we would expect that packaging companies at least need to match the spend of flexible plastics and likely more will be required to excel in new areas around technology integration, recyclability, and recycled content. Hence, it will not be enough just to innovate based on cost and convenience; in addition, step change innovations in material, design, and digital will be needed. Rising pressure in sustainability and e-commerce will also change the product mix; staying ahead or even just keeping up will require strong partnerships across the value chain with key customers, upstream suppliers, and third-party research institutions.

**More agile processes to address SKU proliferation driven by e-commerce requirements and consumer preferences.** Demand for personalization, in particular, both on the store shelf and in unboxing online purchases, will require more agile supply chain and operations processes to respond to increasing pressure from consumers, FMCG manufacturers, and retailers for more novelty and delight at less or no extra cost.

**M&A and asset reallocation as a response to e-commerce growth, consumer preferences, and FMCG requirements.** As in the past but with higher intensity, converters will continue to pursue strategies such as expansion, vertical integration, and reallocation of assets to stay relevant. In paper and board, in particular, converters should keep an eye on the trend to captive converters downstream at retailers' sites and potential ownership shifts. Thorough preparation for any M&A and asset decision will be crucial in other segments as well. In North America, for example, the fastest-growing segments, such as healthcare and cosmetics packaging, are among the smallest, suggesting a roll-up strategy and diversification via mergers and acquisitions. In plastics, vertical integration should be considered to secure long-term access to recycled feedstock.

**Stronger collaboration with FMCG manufacturers, retailers, and suppliers to preserve long-term relationships.** Collaboration has always been essential given converters' midfield position in the value chain and typically much smaller business size. Going forward, the struggle with margin compression practically demands that existing relationships will need to be strengthened and new long-term partnerships established with suppliers and customers. These moves are critical to reduce frictional losses across organizational interfaces and to develop other creative ways to maintain long-lasting revenue and profitability streams. For

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<sup>20</sup> Capital IQ

example, we already see plastic packaging companies partnering with customers, recycling facilities, and research institutes to enable both quality and quantity of recycled plastic feedstock in their packaging.

**Understanding the future of sustainability and its impact on the current and future product mix.** This implies actions to prepare for shifts in the product mix to address trends in regulation, initiatives by FMCG manufacturers and retailers, and activism that alters consumer preferences. To succeed in the sustainability pressure front, converters will need partnerships to create more circular value chains to eliminate waste and to be assured of improving packaging product experience through improved materials and design.

Simultaneously, packaging companies will need to think through the impact of technology and partnering with technology companies to win in the IoT space.

We recommend asking five key questions:

- Are my investments in innovation in line with shifting consumer trends and e-commerce requirements going forward?
- Are my supply chain and manufacturing processes agile enough to address increasing SKU proliferation and consumer personalization preferences?
- What do I think of M&A and asset decisions driven by a potential change in the future product mix? What are my options as an acquirer and/or target?
- How can I better partner with FMCG manufacturers, retailers, and suppliers to create stronger and longer-term value-based relationships that will foster revenue and profitability growth (ideally for all of us)?
- What product and technology level sustainability investments am I or should I be making to deal with increased demand with regard to packaging as part of product sustainability? What partnering opportunities are there for circular recycling, including renewable materials?

### **Looking outside of the packaging box**

While searching for answers to these and related questions, companies will benefit from studying market and competitor analyses as well as looking outside the packaging box. This is due to the fact that converters and packaging designers generally apply the Osborne or SCAMPER design checklists<sup>21</sup> – as in, for example, plastic detergent bottles combined with cardboard shoebox “feet,” a new design hit because the hybrid reduces material used overall while becoming e-commerce friendlier. Most companies also have at least loose relationships with relevant university departments and start-up centers.

Tried-and-tested design approaches – substitute, combine, minimize, maximize – will continue to deliver valuable sparks for substrate innovation and process optimization. However, ideas should also be gathered by looking at product and process innovation in other industries and activities – not only among FMCG manufacturers and retailers, who will certainly have ideas and wish lists for packaging, but also beyond. As a thought starter, in a classic heavy industry such as steel, the postindustrialization era has brought forth the electric arc furnace minimill, a radically local and recycling-friendly change in the technology and business model that depends almost exclusively on scrap steel. Are there analogies here with fully recycled packaging? Or in a different vein, with captive converters embedded within leading retailers’ distribution centers, or for the stepping stones toward setting up a distributed local-global presence?

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<sup>21</sup> On Alex Osborne’s list, see, for example: [https://www.mycoted.com/Osborn%27s\\_Checklist](https://www.mycoted.com/Osborn%27s_Checklist); SCAMPER is a 1971 adaptation of Osborne’s 1942 list (Substitute, Combine; Adjust; Modify, magnify, minify; Eliminate; Reverse, re-arrange), see: Eberle, Bob (1996). Scamper: Games for Imagination Development. Prufrock Press Inc.

It is also critical to look at your company from a private equity investor's perspective, whether publicly listed or a closely held family operation. Investors can see that the packaging industry was growing moderately in the past decade and is likely to do so again, with some hot spots driven by the society's shift to e-commerce. While investors differ in assessing challenges such as shrinking disposable income, new consumer preferences, or environmental regulation, they all look at a company's position relative to competitors in the segment. How well can your company capture slivers and chunks of the packaging market profitably? Relative to your top competitors? What plans do you have for innovation and for capital allocation to expand organically and with partners or acquisitions? Investors assess the answers compared to past financial performance as well as current strengths and the outlook (for publicly listed companies) for returns to shareholders.

□ □ □

In the words of Alfred Marshall, whose 1890 book *Principles of Economics* continues to influence value creation in business today, it is useful to have both a language to describe the parts of the problem of finding a winning formula as well as the machinery for handling these elements. That said, it is essential for managers to study the particular problems and their actual conditions in the "pressure-verse." Otherwise, knowing the language of the trends and the machinery of coping with their effects will be little better than having built "a derrick for sinking oil wells [...] where there are no oil-bearing strata." In the decade up to 2030, packaging companies that assess the strategy cube of market segments, end uses, and substrates in light of the trends and the key elements of a winning formula, and revamp their approach and strategic focus accordingly, will increase their chances of landing their packaging in profitable growth-bearing markets.

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## Sources

Charles Duhigg: The Power of Habit. Why We Do What We Do in Life and Business, Random House, 2012

EAF minimills: McKinsey report (China)

Euromonitor

European Commission

Forrester Data: Online retail forecast, 2018 TO 2023 (US, Western Europe, and Asia-Pacific)

McKinsey Millennial Survey (2016), US only

McKinsey Consumer Survey (2018): Sustainable Packaging – attitudes and behaviors; n = 1,000 per country

National Conference of State Legislatures

On Osborne's list, see, for example: [https://www.mycoted.com/Osborn%27s\\_Checklist](https://www.mycoted.com/Osborn%27s_Checklist); on SCAMPER, a 1971 extension of Osborne's 1942 list (Substitute; Combine; Adjust; Modify, magnify, minify; Eliminate; Reverse, re-arrange), see, for example: Eberle, Bob (1 January 1996). Scamper: Games for Imagination Development. Prufrock Press Inc. ISBN 978-1-882664-24-5.

Richard Dobbs, James Manyika, and Jonathan Woetzel: No ordinary disruption, PublicAffairs (May 12, 2015)

Smithers Pira: The Future of Global Packaging to 2022 (December 2017)

Source of Marshall quote is Principles of Economics.

Full quote: I admit that these terms and the diagrams connected with them repel some readers, and fill others with the vain imagination that they have mastered difficult economics problems, when really they have done little more than learn the language in which parts of those problems can be expressed, and the machinery by which they can be handled. When the actual conditions of particular problems have not been studied, such knowledge is little better than a derrick for sinking oil wells erected where there are no oil-bearing strata.

– Alfred Marshall (in the public domain)

