

PACKAGING SECTOR POTENTIAL AND WAY FORWARD



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PACKAGING SECTOR: POTENTIAL AND WAY FORWARD

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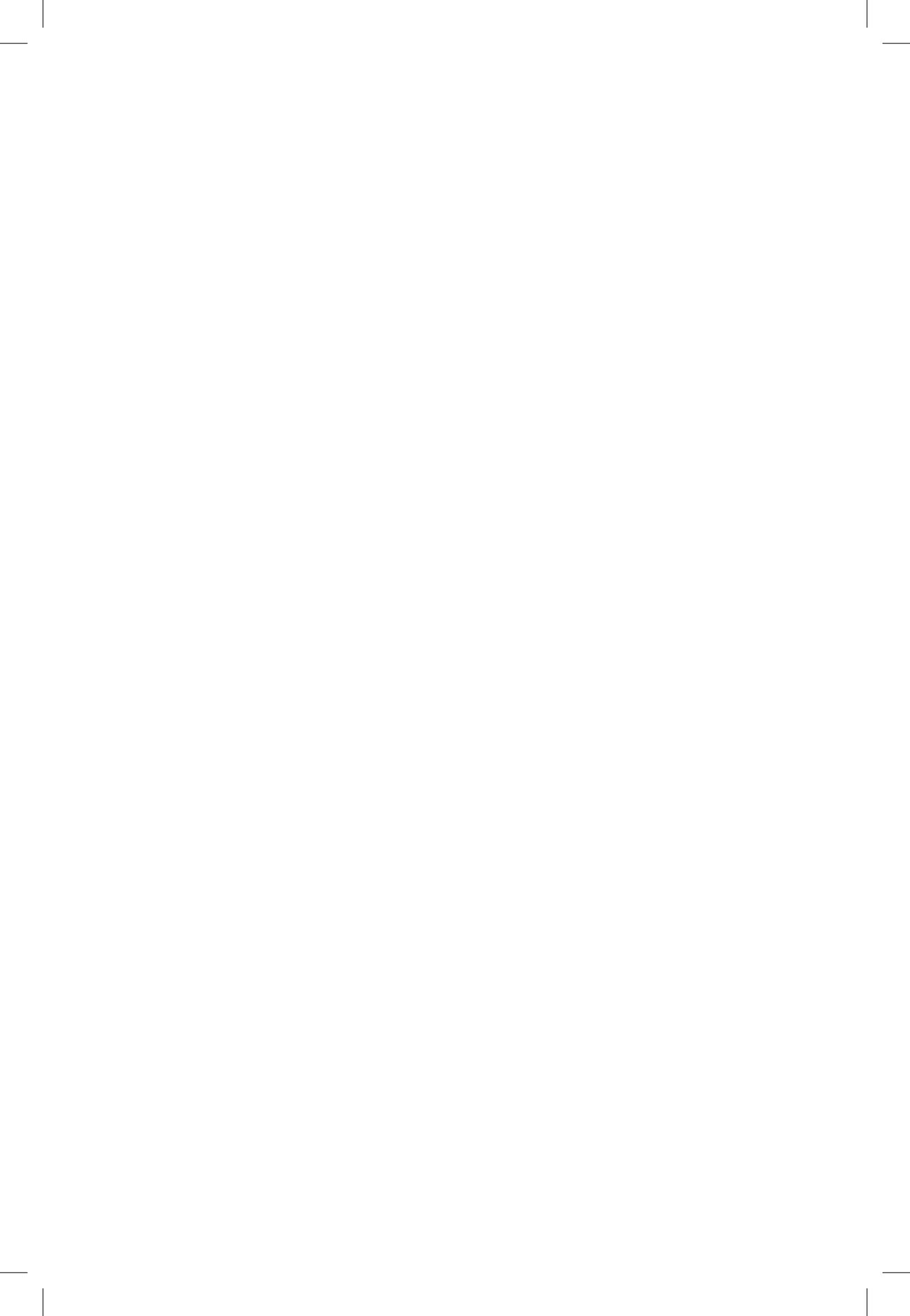
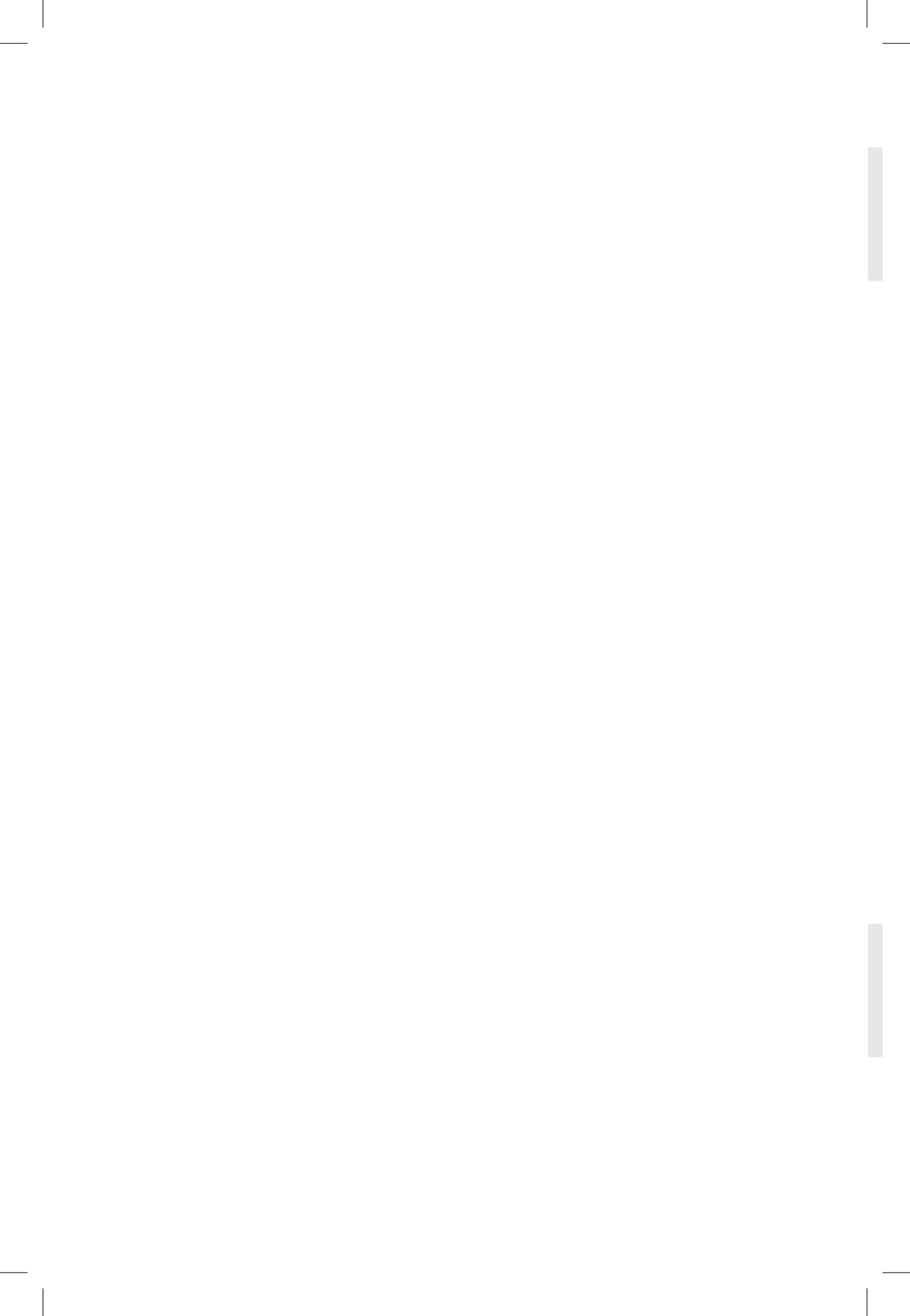


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EXECUTIVE SUMMARY

Overview

Packaging Industry is of paramount importance and plays a vital role in the international trade of goods. Packaging is used across sectors in a wide range of industries, viz., food and drink, healthcare, cosmetics, and other consumer goods. Packaging can be classified based on their type of use, which is primary packaging, secondary packaging, tertiary packaging and ancillary packaging. It is also segregated on the basis of types of materials used. A wide range of materials are used to manufacture packaging, which include flexible plastics, rigid plastic, flexible foil, glass, metal, paper and paperboard, wood and composite materials. Some of the common packaging products include boxes, cartons, cans, bottles, bags, envelopes, wrappers, and containers.

The packaging industry could be divided in two major components, viz., supply side - the providers of packaging products, and the demand side comprising of the end users. The supply side of packaging industry includes packaging manufacturing, packaging machinery and packaging services. On the demand side, the packaging industry may be categorized based on type of end users, which are individual consumers, institutional and industrial users.

The demand for packaging is guided by a wide range of factors. The size and condition of the economy plays a major role in determining the size and scope of the packaging market, and subsequently its growth. Besides, there are other factors impacting packaging demand, which include changing lifestyle, demographic changes, brand awareness, environmental awareness, and demand for smaller pack sizes among others.

Global Scenario

The global packaging market was estimated at US\$ 876 billion in 2018¹, registering a y-o-y growth of 2.9% over 2017 (US\$ 851 billion) at constant prices, including US\$ 61 billion for industrial packaging. Geographically, the emerging markets in the Asia-Pacific have been the driver of this growth, by virtue of

¹Smithers- PIRA Report

increased per capita income and increased demand for packaged goods. Emerging economies, such as India, Indonesia and China, in that order, has been the drivers of growth for industrial packaging in Asia-Pacific and globally². The emerging and developing economies are expected to contribute around 70% of the growth in global packaging consumption during 2017-2022. The developed economies are expected to grow at a rate of around 1 %, however, these economies are projected to grow from their high base value as compared to developing economies, adding big numbers in absolute value terms and volume.

In 2018, with 43%, Asia Pacific was the largest region in the world in packaging consumption, significantly ahead of Western Europe with 18.4% and North America with 14.2% in packaging consumption. The economies of Eastern Europe, Central and South America, the Middle East and Africa together represented 19.4% of this consumption. The high growth in packaging consumption in Asia is largely driven by growths in China and India.

According to the industry sources, the packaging industry is envisaged to cross the US\$ 1000 billion mark in the first half of 2022 attributed much to the steady growth in E-commerce. Nevertheless, the growth rate of packaging and that of consumption will continue to remain unequally distributed around the world, Overall the global per capita consumption of packaging stood at around US\$ 115 for 2018.

Growth in Global Market

The global packaging industry is projected to grow at a CAGR of 2.9% during the period 2018-22. With historic CAGR of 4.6%, the packaging industry in the Asian region is projected to register a CAGR of 5.2% over the period 2018-2023, which is the highest among all the regions, globally. The growth in terms of CAGR is forecast to be the lowest at 1.1% for the North American region, with historic CAGR recorded at 1%. Middle East and Africa is forecast to register a CAGR of 4.1% over the period 2018-2023, with historic CAGR registered for the region at 3.1%.

Trade

With respect to the materials used for packaging, such as glass, paper, plastic, and wood, there are wide variations among those used in the developing and developed economies. For these four items, the average annual import during 2014-2018 was estimated at US\$ 86.1 billion. During 2014-2018, the average

²Mordor intelligence industry-reports on industrial-packaging-market

annual global imports of plastic packaging material were estimated at US\$ 51.7 billion. The import of plastic packaging materials during 2018 was estimated at US\$ 57.1 billion³. Among importers of plastic material for packaging, the US was the largest importer with estimated imports of US\$ 8.3 billion in 2018⁴. Other countries among top five importers of plastic for packaging were Germany, France, Mexico and the United Kingdom.

Average exports of the dominant four packaging materials, during 2014-2018, was estimated at US\$ 88.8 billion. Plastic material was the largest exported packaging material among the dominant four types used and traded globally. Average global exports of plastic material for packaging during 2014-2018 was estimated at US\$ 52.3 billion. Export of plastic material, during 2018, was estimated at US\$ 57.6 billion. Among the exporters of plastic material for packaging, China was the largest exporter with estimated exports of US\$ 9.3 billion in 2018 followed by the US, Germany, France and Mexico.

Regulatory Framework

The trade policy and regulatory framework for the packaging industry differs among countries and the regulatory mechanism plays a crucial role in the trade and development of the packaging industry.

Food Packaging Regulations in the US

The food packaging regulations are enforced by the Food and Drug Administration (FDA) in the US. The FDA charged with monitoring of food safety requirements, carries out risk assessment as well as risk management regarding food safety and packaging. Food, Drug and Cosmetic Act 1958 enforced by the FDA is the basic regulation for Food Contact Materials (FCM).

Food Packaging Regulations in the European Union

There is a coexistence of national legislation and community level legislation in the European region for food packaging and FCM. The regulations are directly effective in the member states, the same need to be transposed by national parliaments for making it more effective. The EU Framework Regulation EC 1935/2004 is used for regulating the food contact materials at Union level.

Food Packaging Regulations in Middle East Region

The Gulf Cooperation Council (GCC), comprises of the UAE, Bahrain, Kuwait,

³Here HS code 3923 is taken for plastic materials used for packagin

⁴ITC Trade Map

Oman, Qatar, and Saudi Arabia as its member nations. The standards and technical regulation with respect to food packaging, for GCC nations, comes under the purview of GCC Standardization Organization (GSO). These standards and regulations are also followed by Yemen. There are various standards developed by GSO, which the GCC nations must implement voluntarily. The standards must be adopted into national law to have legal effect in the Member States and Yemen.

Regulations for Food Packaging in India

The food packaging and labelling requirements in India are notified by the Food Safety and Standards Authority of India (FSSAI). The regulations are stipulated in the Food Safety and Standards (Packaging) Regulations (2018) given by FSSAI also specify that food packaging materials must comply with the Indian Standards (IS), which are listed in Schedules I, II and III, for paper and paperboard materials, metal and metal alloys, and plastic materials, respectively. Schedule IV of the regulations is a list of suggested packaging materials for different food product categories.

The Food Safety and Standards Regulations 2018 (FSS) states the requirement for the products, which are used for the packaging of the food. The regulatory standards for these materials are as per the Indian Standards given by the Bureau of Indian Standard (BIS). Besides, general and specific requirement with respect to packaging materials, the regulations also prescribe overall migration and specific migration limits of contaminants for plastic packaging materials where migration limit is described as “the maximum permitted amount of non-volatile substances released from a material or article into food simulants”. As per the regulations, packaging and storing of food is deemed to be unfit for human consumption if the containers are rusty, and or have become chipped and rusty.

Indian Packaging Industry

The Indian packaging industry is expected to reach US\$ 72.6 billion by FY20, growing at a CAGR of 18% during 2016-21⁵. Indian packaging industry is becoming a preferred hub for global packaging industry and it is emerging as one of the largest sector in India’s economy⁶. With steady growth over the past years, the industry is showing firm potential for expansion, including in the export markets. Low cost of packaging, in some cases 40% lower than the costs in many parts of Europe, combined with India’s resources of skilled labour, make the Indian packaging industry a potential sector for investment.

⁵ASSOCHAM-EY Study

⁶Packaging Industry Association of India

The per capita consumption of packaging in India, however, is on a lower side as compared to other countries. This low consumption level indicates the untapped potential in the sector. The global per capita consumption of packaging in terms of value was estimated at US\$ 115 per person per year; for India, it is estimated at around US\$ 55 per person per year⁷. The per capita packaging consumption in India, in terms of volume, is significantly low at 10.5 kg, compared to countries, such as Germany and Taiwan with 42 kg and 19 kg, respectively. The per capita consumption of packaging in the US is 109 kg, followed by 65 kg in Europe, 45 kg in China and 32 kg in Brazil.

In India, packaging may be broadly divided into two categories viz, rigid packaging and flexible packaging. In the recent years, the demand for flexible packaging materials has been increasing faster than the demand for rigid packaging materials. The strong demand for flexible packaging material has been mostly arising from food & beverage industries, personal care, and pharmaceutical industries. According to an estimate, the value of flexible packaging market in India during 2018 was US\$ 16.3 billion, which, growing at a CAGR 3%, is forecast to reach US\$ 19.5 billion in 2024.

Trade

India is a net exporter of packaging materials⁸. The net export of packaging materials during 2018-19 was estimated at US\$ 504.1 million⁹, which increased by 15.8% from the previous year value of US\$ 435.1 million. The export of packaging materials from India was estimated at US\$ 843.8 million in 2018-19, witnessing a growth of 14.1% from the estimated value of US\$ 737.4 million the previous year. The export of packaging materials from India witnessed a CAGR of 13.4% over the period 2014-15 to 2018-19.

However, the share of India's exports in the global export of packaging materials remained low at 1.4% in 2018. Total global export of packaging material was estimated at US\$ 56.6 billion during 2018. The USA has been a major export destination for Indian packaging materials. In 2018, 19.2% of the total export of packaging materials from India was directed towards the USA. Other major export destinations for Indian packaging industry include the UK (8.3%), the UAE (5.2%), the Netherlands (3.8%) and Germany (3%). The US, Germany and the

⁷Exim Bank's estimate considering Indian packaging sector's value at US\$ 72.6 billion

⁸The packaging materials includes HS 392310, HS 392321, HS 392329, HS 392330, HS 392350, HS 392390 as per composition of packaging materials by DGCIS and further use of the word will be applicable for the mentioned HS codes

⁹DGCIS

UK are among the top 5 importers of packaging materials, having a combined share of 26.3% in total global imports; however, India is far from featuring among the top 10 suppliers to these countries.

Research and Development

Globally, food, beverage, and packaging companies have been recording the lowest spending on research and development, indicating little research-based innovation in these sectors compared to other industries. In India, the average spending on research and development as percentage of sales, by companies engaged in the packaging sector, is significantly low at 0.36%¹⁰.

Trademark and Design Applications

During 2017-18, 1.28% out of the total trademarks filed in India were pertaining to the packaging Industry¹¹. In all, 3503 trademarks were filed in 2017-18 and 4594 trademarks were registered in the packaging sector. During 2017-18, 8.8% out of the total design applications which were filed in India were pertaining to the packaging Industry¹². Total 1043 design applications were filed in 2017-18 and 954 were registered for packaging sector.

Role of Exim Bank

Exim Bank has been providing support to various industries and help enhance their export potential. The Bank, through its Eximius Centres for Learning has been organizing workshops and training programmes on export packaging, drawing expertise from various institutions, including the Indian Institute of Packaging. Exim Bank's exposure to the packaging industry as on 31 January 2020 is ₹188.24 crore (US\$ 26.2 million¹³), 0.25% of the total credit exposure to all industries.

Challenges

The packaging industry is constantly faced by various challenges in terms of cost, design, knowledge, regulations and environment. The changing economic conditions and taste and preferences of the consumer also possesses a challenge for the packaging industry to stay relevant in the dynamic environment.

¹⁰This is the average R&D spending by top 9 listed companies, MSME spending is not accounted for. If that is considered this figure will come out to be even lower.

¹¹Here Class 39 of the trademarks is taken which is for Transport, Packaging and storage of goods; travel arrangement

¹²Here Class 09 of the Designs is taken which is for Packages and Containers for the transport or handling of goods

¹³Conversion rate as of 31st January 2020

Technological Challenges

Rapid changes in technologies to keep pace with the changing dynamics of the markets and consumer preferences have emerged as a major challenge for the packaging industry. The technological challenges faced by the industry is spread across the entire packaging manufacturing line. Recent advances in technologies, such as smart packaging, non-destructive inspection methods, printing techniques, application of robotics and machineries, automation architecture, software systems and interfaces are increasingly posing challenges for the industry to automate and upgrade.

Packaging, being dominated mostly by the unorganized sector, for the small players in India, automation and technology upgradation, is often faced by the challenges, such as inadequate knowhow, skillset for adaptation and implementation, and investments. Technology challenges in Indian packaging industry are also predominant in use and adaptation of material in packaging. In the absence of adequate research, health safety of new packaging technologies also poses considerable challenge for the industry in its development and further implementation.

Innovation and Raw Materials

Various forms of packaging require various raw materials, viz., plastic, paper, cardboard and glass among others. Raw materials like Polyethylene (PE), Polyethylene Terephthalate (PET), Polypropylene (PP), and Polyvinyl Chloride (PVC) are used extensively in the plastic packaging. The cost of obtaining these raw materials has been increasing, with demand outstripping supply and reduced capacities in the refinery sector. Raw material cost though varies by types used, however, usually forms around 40% to 50% of the operating cost in the global packaging industry.

Cost of raw materials have been significantly impacting the Indian packaging industry across most segments and is putting profitability of the Indian packaging industry under pressure. The net margins in the packaging industry has been declining on account of the rising raw materials cost and depreciation cost. Increase in cost of packaging have a substantial impact on the cost of the end product, subsequently impacting the demand of the product.

Availability of Skilled Manpower

The packaging industry is labour intensive and requires skilled manpower for design development and innovation. Availability of skilled manpower has been

a continuous challenge for the industry. As per the industry sources, more than 35000 packaging experts are required currently for Indian packaging industry, while only 1.5% of it are produced each year in the country. The lack of skilled manpower are often also observed at the top management positions in the industry largely due to the dearth of skilled packaging professionals.

Lack of Credit Flow

One of the major challenges faced by the packaging sector is the shortfall in the regular flow of credit. Timely credit is required for meeting the working capital requirements as well as for innovation and technology up gradation. Timely and adequate credit availability is more crucial for the MSME sector, to maintain raw materials base and inventory. Availability of institutional finance has been a major challenge for the MSMEs engaged in packaging sector. The cost associated with employing skilled professionals and experts are higher due to the demand supply mismatch, which impacts the pricing strategy and profitability of the companies associated with the packaging industry.

Challenges Associated with the Packaging Machinery Sector

The major challenges in the packaging machinery sector include rapid changes in technology and the expenditure on human resources. Packaging manufacturers find it difficult to keep up with the changes mainly due to limited professional knowhow in the sector and costs involved in upgradation. In India, demand for packaging machinery and materials are predominantly in food processing and pharmaceutical sectors. Developing countries are largely dependent on the imports of packaging machinery to cope up with the rapidly changing technologies in packaging and commerce in the absence of an indigenous availability of such advanced machineries. This has often exposed them to imports of sub-standard and duplicate machineries resulting in challenges arising due to low performance and frequent breakdowns. Packaging industry as a user of machine tools in India has been much insignificant. Lack of advanced packaging machinery produced within India have emerged as a considerable challenge for small manufacturers in the industry. After sales services and maintenance have also emerged as limiting factors in the absence of adequate skill set.

Food Safety Regulations in Packaging

Safety regulations in food packaging worldwide is a complex system involving global authorities, country specific authorities and multiple laws governing the use of materials, technologies, designs, and labelling that are generic as well as product specific. The food packaging laws are often stringent and are subject

to frequent revisions, modifications and amendments with shifts in preferences, dynamism in food supply chain, implementation of new technologies, outbreaks of diseases and implications in trade. The multiplicity and stringency of the laws, frequent changes in specifications, and resultant compliance remains the single most dominant challenge for the food packaging manufacturers, particularly for the MSMEs.

Environmental Concerns

Packaging processes has a direct and indirect impact on the environment. The environmental impact of packaging like other industries can be quantified in terms of air, water, and ground emissions, as well as in terms of a final waste product that must be eliminated. According to the industry experts, the relative contribution from packaging to the overall environmental impact is usually small. While environmental impacts tend to be lower with recycled materials, not all materials are good candidates for recycling. Wastes from plastics packaging present a number of challenges in terms of recovery due to the composition and diversity of the plastics used and the fact that mixed wastes are often contaminated. There are several limits to plastic packaging recycling. Most restrictive are the technical limits. A complete elimination of plastic from packaging industry may impose considerable direct and indirect impact on the packaging sector, such as on employment. To quantify the environmental impacts associated with various packaging materials, life-cycle assessment (LCA) has been an effective tool. Alternatives to plastic packaging, such as recycling and biodegradables have been emerging as probable solutions to addressing plastic waste management. However, adequate and effective labelling of bioplastics for classified disposal has also been a challenge in replacement initiatives and waste management.

Packaging Design and Right Packaging

The designing aspect of packaging emphasizes on two aspects, viz., functional parameters and printing parameters. The functional parameters are concerned about the height, weight, type of material, aesthetics and structure of the packaging. The printing parameters are relevant for the printing and labelling of the packaging material. With rapid changes in commerce, demography, environmental concerns and consumer preferences, packaging design are also under constant pressure to consistently re-innovate to suit the requirements. Globally packaging designs are facing increased demand for addressing consumer convenience, such as small package size, smart packaging, reusable packaging, and tracking and traceability; and environmental concerns, such as compostable and sustainable packaging. In India, packaging design innovation,

in terms of intelligent and smart packaging, as a percentage of total packaging is considerably low and is mostly concentrated in export product packaging. Particularly for food, packaging innovations, even for exports, have been primarily focused on packaging of primary processed products.

Certification Multiplicity and Complexities

International certifications in packaging industry are extremely complex and varied. These certifications are to verify that manufacturers are adhering to the highest standards in various areas of manufacturing of packaging materials, from processes and practices to customer focus and supplier relationships. Besides being complex and tedious, multiple certification processes for packaging are also cost intensive. Different operations have different procedure of evaluation, hence there are no 'standard templates' or 'one fit all' process for the operators or manufacturers. Cost and compliance requirement have often been inhibitive for small operators for certifications. India's domestic packaging certification infrastructure is much nascent and restricted to mostly bulk cargo packaging for hazardous products for trade and scattered certification of packaging materials pre-packaging.

Research and Development

Globally, the packaging industry has never been a driving force in applied research. Instead it has been highly fragmented seldom recognising the interdependence among material, production, logistics and marketing. Packaging as a subject has never been into mainstream education and research, and had been mostly confined to industries having packaging as part of their operations, hence, leaving gaps and delays in solutions in the supply chain needs related to packaging. Indian packaging sector is challenged by limited indigenous R&D capability for design innovation, low research productivity, high capital investment requirement, and marketing and after sales service. Firm level innovation in India has been considerably low. The R&D spending by the industry has been low at around 0.36%¹⁴ of sales.

Policy Framework

India's policy of import-substitution helped India achieve self-reliance in technologies for domestic production and consumption; however, the country could not adequately build capacities to create internationally competitive technologies to produce for the international markets, and also efficiently

¹⁴R&D spending as percentage of sales of 9 listed companies

upgrade to advance technologies for the domestic market. As a result, there is a considerable lag and gap in acquiring export competitiveness across industries, including packaging industry. Although Indian organizations are served by a network of national laboratories and institutional infrastructure, the quality is relatively poor when compared to those in the industrialized countries – putting India at a comparative disadvantage.

Way Forward

Technological innovations, focusing on marketing, labelling and prolonging shelf life, as well as protecting the environment, are transforming the future of packaging. Some of the key technological developments in global packaging are:

Materials and advanced packaging methods

Sustainable Packaging: Global market is estimated to reach US\$ 255 billion by 2026. Renewed focus are on alternatives for plastic packaging, such as biodegradable and sustainable packaging. Materials under development are polylactide acid (PLA) plastics, sugar cane pulp, fiber composite, and starch-based films. Plant based fibres in the form of Microfibrillated cellulose (MFC) are the prominent research area for sustainable packaging.

Active and Intelligent/Smart Packaging: Active packaging is a method, where the packaging material itself interacts with the food to confer longer shelf-life, higher safety, and improved hygiene. Smart packaging is an advanced active packaging, relating to the use of sensors. Intelligent packaging, sometimes also referred as smart packaging, senses certain properties of the food it encloses or the environment in which it is kept and helps in monitoring the state of these properties and conditions during transport and storage. The global market for smart packaging is projected to reach US\$26.7 billion by 2024.

Nanotechnology in Packaging: This approach is concerned with molecular level material manipulation that can reduce spoilage or oxidation. Furthermore, there is secure hygienic production, processing and shipment. Nanotechnology-based sensors and coating materials can be used for pathogen and contaminant detection and tracing. The global nano-enabled packaging market is projected to reach US\$ 72.3 billion by 2024.

Antimicrobial Packaging: Antimicrobial packaging help control the growth of pathogenic and spoilage microorganisms on food surfaces. It includes incorporation of antimicrobial substances into a sachet, direct incorporation of antimicrobial agent into the packaging film and coating of packaging with a

matrix that acts as a carrier for the antimicrobial agent. The global antimicrobial packaging market is projected to reach US\$ 11.5 billion by the end of 2024.

Edible Coatings and Films: Edible polymeric packaging materials can be made from polysaccharides, proteins and lipids as wrapping materials, standalone films, or can be fabricated into pouches and bags for subsequent packaging use. Can also be applied directly to the food product in a liquid form and then allowed to dry on the substrate. Global edible packaging market size is projected to reach US\$1,097 million by 2023.

Retort Packaging: It is a form of semi-rigid flexible packaging made from heat-resistant laminated plastic. Food products, such as soups, pasta, rice, sauces, and cook-in-a-bag meals are sealed and sterilized in these pouches with a maximum temperature of 121°C. The retort packaging market is projected to reach US\$ 4.5 billion by 2025.

Aseptic Packaging: Aseptic packaging is a process in which food & beverages, pharmaceuticals, and others are sterilized separately from the packaging. These contents are further filled into the packaging container under aseptic conditions. Aseptic packaging is usually carried out at extremely high temperature to maintain the freshness of the products. The aseptic packaging market is expected to reach US\$ 66.5 billion by 2025.

Packaging machineries and automation

Robotics: Robots are transforming the packaging industry, particularly in the field of e-commerce. The ability of robotic arms to sort small items into boxes for delivery quickly and accurately has made them a most sought-after option with the manufacturers and retailers, particularly with medium and large scale operations. Global packaging robots market size is expected to reach US\$ 4.6 billion by 2023.

Automation: Implementation of advanced automation and control strategy in the food packaging domain plays a vital role. The modern architecture in food processing and packaging control system embeds a generic set of essential requirements with regard to timing, error diagnostics, coordination, periphery-control acknowledgement, and synchronization. Appropriate selection of technology standards can substantially improve the effectiveness of food processing and packaging.

Safety and Traceability: In food processing and packaging, traceability has been extremely important in order to maintain safety and authenticity of the products.

Currently, the barcoding and RFID (Radio Frequency Identification) methods are being used extensively in packaging development for exchanging information sophisticatedly.

Package Printing and Security : The use of printing inks in food packaging falls under the jurisdiction of the regulatory authorities and the regulations in effect require the ink materials to be manufactured under safe conditions and composed of organic compounds. Some of the current techniques used in this area include rubber plates with a raised image area that are printed with quick-drying inks directly on foil, plastic wrap, and other material, flexography printing, lithographic printing, and electron beam (EB) printing.

Key trends in packaging

Transit Packaging: The global transit packaging market by product type is segmented into corrugated boxes, crates (wooden and plastic crates), pallets (wooden, plastic and metal pallets), and other protective packaging, such as bubble wraps, air cushions, foam packaging, insulated shipping containers, tapes, and protective mailers. The key end-user segment in the global transit packaging market is divided into food and beverage, retail, electrical & electronic industry, and industrial goods. Global transit packaging market is projected to generate a revenue of around US\$148 billion by 2024. China, India, Japan, and South Korea have emerged as the largest revenue generators in the global transit packaging market, in the recent years.

Omni – Channel Packaging: Omni-channel refers to retailing with both a physical and digital presence. Packaging for the omni-channel, impacts the manner that a product packaging is designed right from the development process. The package development in the omni channel thus, offers a multi-sensory, 3D experience in an effective 2D. Packaging in omni channels aims to have presence of products on-the-shelf as well as the virtual store consistent, seamless and with integrated brand communication across channels. According to the industry reports, omni-channel influenced retail sales is projected to grow 58% by 2022.

Implications for Indian Packaging Sector

Indian packaging industry is at the crossroads. The inevitable shift from the traditional and unorganized sector is already evident in the gradual evolution of the Packaging Industry in India with emerging of some clear market leaders in the respective sub-segments. A large part of the growth in the industry can be attributed to the transformational shift. Despite the transitions in the last decade, unorganized players still form around 45 to 50 percent of the industry.

Consolidation and M&A

Most of the product packaging in India by the unorganized sector has little or no product differentiation; hence, there is an intense competition among these small players at the regional levels based on cost competitiveness and product pricing. Further, most customers of this segment have multiple suppliers for the same product category in order to mitigate and diversify supply side risk. As a result of this and coupled with the fast changing dynamics of the industry these small players have been witnessing competitive pressure and looking for growth avenues due to stagnancy in businesses. This provides a significant opportunity for the leading players in the organized segments to consolidate the market. There has been profound presence of global players largely in the flexible packaging segment, which has witnessed a certain degree of consolidation due to the acquisitions and mergers.

Key Potential Segments

Food Packaging

Urban regions account for 80% of the packaged food in India. The industry is expected to reach around US\$ 55 billion by 2020. The main categories of packaged food are bakery products, canned processed food, frozen processed food, meal replacement products and condiments. With rising urbanization, growing largest pool of young and middle to high income population, the industry is slated to undergo a transition from loose to packaged, processed food and beverage products in the next five years, and this is projected to aid growing consumption of packaged food and beverages in the country opening up new avenues for packaging development and trade. A consolidation of domestic manufacturers in the food packaging sector is anticipated to enhance investments and preparedness towards global standards of packaging.

Transit and Corrugated Packaging

Increasing organized retail and the boom in E-Commerce, in the recent years, have also emerged as major growth drivers for the Indian Packaging Industry. E-commerce in India is projected to grow rapidly at a CAGR of 27% from 2017-2026 to reach US\$ 200 billion by 2026. With the steep growth in E-commerce and E-retailing, demand for transit packaging in India is set to witness an unprecedented growth. This increase in volumes is projected to have strong structural implications on the transit packaging industry necessitating an operational transformation going forward. The multi-fold increase in the number of shipments is forecast to inevitably give rise to an ecosystem of organized

players of scale having ability to cater to large volume requirements of requisite quality.

Corrugated packaging comprises roughly 60% of the e-commerce transit packaging market globally. The Indian corrugated box industry is projected to grow to US\$ 8.9 billion in 2023 in terms of revenue. The industry is highly fragmented with over 18,000 players with 10% belonging to the organized sector and 90% comprising of unorganized sector. The organized sector caters to 45% of the corrugated production, while 55% of the production comes from the unorganized sector. By use of technology, the organized sector uses automatic and semi-automatic machineries, whereas the unorganized segment is mostly labour intensive with manual production.

Print Packaging

India is the fastest-growing print packaging market across all segments, growing on an average of 12.4% per year during the period 2016-2020. According to the industry sources, the fast-moving consumer goods and food products are the sectors that offer the best opportunities for print packaging.

Flexible Intermediate Bulk Container (FIBC)

FIBC (Flexible Intermediate Bulk Container) is an industrial container made of flexible fabric that is designed for storing and transporting dry, flow able products, such as grains, horticultural products, sand, fertilizer, and granules of plastic. In the last decade India has emerged as the second largest market leader in this segment after China. India's exports in FIBC has witnessed a CAGR of 15.6% during the period 2015-2019. The growth of the industry is largely driven by increase in exports of food and horticulture and chemicals. Additionally, the low-cost of shale gas, which is used as a major feedstock for the manufacturing chemicals, is driving enhanced production of chemicals, which is also driving the demand for FIBC bags. The worldwide market for FIBC is expected to reach to US\$ 9.2 billion in 2023.

Packaging Films

Films, one of the key raw materials for plastic packaging, is currently estimated as a US\$ 68 billion market accounting for about 23% of the packaging market. The largest application of thin BOPET (BOPET - biaxially-oriented polyethylene terephthalate) film is flexible packaging, which accounts for 72% of total thin film consumption. The high consumption is mostly led by the food and beverages sector and consumer staples, whose demand is non-discretionary and thereby,

steadily feeds the packaging demand. India is one of the significant players in this industry and the growth of the top Indian plastic films companies is projected to be driven by global competitiveness backed by scale, operational strength, onshoring models and better product portfolios.

Edible Film and Wrap

The global edible film packaging market size by plant based material is projected to grow from US\$ 527 million in 2019 to US\$ 679 million by 2025, growing at a CAGR of 4.3%. The growth in edible packaging solutions in India can be attributed to government initiatives, advancements in packaging technologies, and the development of new sources for edible packaging solutions. Edible packaging is steadily emerging as a sustainable alternative for container applications in foodservice and delivery applications. Seaweed and algae have emerged as popular raw material sources in the manufacturing of edible packaging products.

Global edible packaging wrap market by ingredient type protein, polysaccharides, lipids, composite films, and surfactants is projected to grow to US\$1,097 million by 2023.

Advances in Machinery and Equipment

There are about 600-700 packaging machinery manufacturers in India, of which 95% are in the small/medium, and unorganized sector. The Indian packaging machinery manufacturers in the small and medium and unorganised sector mostly fabricate general-purpose equipment to serve the basic needs of the industry. Majority of the updated machinery needs of the industry is met through imports. Due to intense competition in the end-user market the cost of equipment, the low running/processing cost and the ability to seamlessly incorporate the equipment in the facilities remain the primary factors influencing sales and purchase of machinery, followed by upgrading and after sales services.

Technology Needs

The technological advancements in packaging sector have been rapid with the advent of the space and the information technology, which gradually required and also facilitated the changes in consumer food habits and preferences across the world. While some of the large Indian manufacturers are making use of the new technologies to increase production, meet international quality standards and thereby increase profitability, the unorganized manufacturers are adopting technology in a sporadic manner. Thus, for India, where SMEs and unorganized players are integral part of processing and packaging manufacturing, technology

developments and advancements needs to take into account the applicability and appropriateness to the level of need and capacities of the would-be adopters.

Restructuring R&D

Globally, the national R&D services is driven much by industries' and trade requirements, while in India, national R&D services work much in silos. In order to keep pace with the global developments in the packaging sector, there is an urgency in relooking at the way national R&D set up has been operating in terms of degree of awareness on the industry needs and preparedness of the systems in providing appropriate solutions to the needs. This may also need a restructuring of the national R&D set up. Improving coordination among R&D programmes through mergers and consolidation of institutions that work in similar areas of packaging research and creating 'Centres of Excellence' may also aid in scaling up the public R&D infrastructure and industry connect.

Optimizing Packaging Cost

For cost sensitive market like India, packaging cost is of prime concern for the packaging manufacturers as well as the end users, to whom the cost of packaging development is eventually passed on. Packaging cost is a factor of length of the manufacturing chain and the cross sections involved. For forward looking packaging manufacturers, cost of import of technology has been a deterrent in adaptation of the technologies. For MSMEs, remaining cost competitive or increasing their competitive intensity has been a major factor in adapting operational changes and pricing products.

Going forward, competitiveness of the current packaging suppliers and manufacturers will be a key factor in determining the overall packaging supply chain costs. For optimizing the packaging cost various strategies are used which include reusable transport packaging, pre-packing and contract packing arrangements and Container standardization. As global aggregators and importers increasingly prefer packaging at source of production, these arrangements may help the SME packaging sector enhance their viability substantially.

Plastic Packaging

A complete elimination of plastic from packaging may not be a viable option. The impact it would have on economy, employment, environment and consumers will be multi-fold and far-fetched. More prudent solution is thus, required to address the concern. Creating a robust regulatory framework on sustainability in plastic packaging may include significantly revamping the existing plastic recycling

infrastructure in the country. To address the major concern of reusable and compostable waste collection, innovative technologies, such as optical sensors and floatation devices could be adopted on large scale with adequate investment, which will result in improved sorting process.

Government initiatives and policy interventions

Developing the traditional packaging manufacturing units in the MSMEs with appropriate policies on investments, R&D, technology influx and standardization may make the units viable, productive and export oriented. This may also curtail our import needs. With increasing penetration of e-commerce, e-retailing and aggregators and importers preferring packaging at source, packaging services for MSMEs may be encouraged by adequate policy interventions. The Government may consider developing goal oriented entrepreneurship development programs at engineering and R&D institutes along with promoting knowledge building and implementation of global standardizations to create export competitiveness.

Strategies and Recommendations

The Packaging industry is of high significance for the economy. It has potential to grow more rapidly and take India among the top markets for packaging solutions. However, there are a few challenges which are to be addressed, for unlocking the path of higher growth trajectory for the Indian packaging industry.

Addressing the Technological Changes

To address the challenge of rapid technological changes, it may be imperative to invest on developing, upgrading, channelizing and accurizing the indigenous packaging technologies and integrate them with marketing and advertising. This has been increasingly practiced in other developing countries, such as Thailand, Philippines, Malaysia, Indonesia and Egypt, where there is an established exportability of packaged food products. In the food sector, to maximise the benefits of packaging and profitability in food supply chain, the packaging technology solutions should focus on reducing food losses at every stage along the value chain, viz., production, post-harvest, distribution, processing, wholesale, retail, and consumption.

Reducing the Cost of Raw Materials and Innovation

According to various industry research, some of the most essential factors identified in reduction of packaging cost include redesigning, reducing multi-layering, recycling, storage space optimisation, process improvement, supply chain cost management, materials substitution and reusing. Working out a cost

index for packaging with appropriate weightage may be the way forward for the packaging industry in optimizing the cost.

Increasing the Availability of Skilled Manpower

Availability of skilled manpower not only helps the packaging industry in its day to day functioning, but also in undertaking the research and development activities. There is need to increase packaging training and R&D institutes where degrees and diploma are provided in the fields of packaging. Simultaneously, training could be provided to people already working in the field of packaging in emerging technologies. The skill development programs in the field of packaging will also help in increasing the number of trained and skilled personnel available to the manufacturing sector.

Strengthening the Packaging Machinery Sector

It is essential to strengthen the packaging machinery sector so that the packaging industry remains self-reliant. In order to make the Indian packaging machinery industry self-sufficient, as also to enhance mechanization and advancement across the packaging sector, the Indian capital goods industry needs to significantly scale up in terms of investments in R&D driven technology, skilled manpower, production capacities, speed and quality of production, and testing abilities, supported adequately by post sales and upgrading services.

Complying with Food Safety Regulations in Packaging

In order to comply with the food safety regulations that are associated with packaging, there is a need to create awareness among the producers, especially among the MSMEs, and other unorganised and informal sections. Increasing awareness about the required standards and regulations of packaging in the target markets could help in making the packaging as per the required standards. Traceability has been considered as an important parameter in order to maintain safety and authenticity of the products.

Compliance to Environmental Standards

There is a need to innovate in the field of flexible packaging as further norms restricting the use of plastic without finding any suitable alternative could be daunting the growth prospects of the industry. More prudent solution is thus, required to address the prime concern that has dented the plastic packaging

industry in the recent years; - the environmental concern with plastic waste disposal and management. An approach may be adopted to enhance the usability and utility of plastic waste through collaborative approach between the government and the industry.

Packaging Design and Innovation

Globally packaging designs are facing increased demand for addressing consumer convenience, such as small package size, smart packaging, reusable packaging, and tracking and traceability; and environmental concerns, such as compostable and sustainable packaging. There is a need to channelize the resources and encourage innovation in packaging design. Indian Institute of Packaging (IIP) and other national R&D institutes could help in improving the design capabilities of MSMEs and other firms in the informal sector.

Certification Multiplicity and Complexities

International certifications in packaging industry are extremely complex and varied. A collaborative approach may be adopted wherein the national R&D institutions seek accreditations from international certification agencies. In addition, through diplomatic channel, efforts should be made to seek effective technological extension services from global R&D majors with the objective of helping Indian packaging firms improve their manufacturing and design capabilities. A single certification program could help in saving time and in turn could help in timely completion of export orders. Increasing the certification institutes for packaging could also help in speeding up the time taken for certification.

Restructuring Research and Development

In India, while larger manufacturers in the packaging sector have their own R&D infrastructure, MSMEs and unorganized manufacturers largely depend on the national R&D infrastructure for their technology needs. Creating an effective connect between the industry and national R&D services is therefore, crucial for developing internationally competitive indigenous technologies and bringing the MSMEs in the packaging sector under the ambit of R&D driven technology advancements. Besides, building research capacity in the dedicated national institute of packaging, and effectively employing universities in research and development for the packaging industry may aid R&D up-scaling.

Policy Framework and Government Initiatives

Encouraging public private partnerships in establishing Packaging Parks at various manufacturing centers may help in scaling up the objectives of MSMEs and enhance productivity. The Government, through its institutions, like the IIP, may encourage firms, through the dissemination of relevant information, to acquire packaging technology that would best suit for India. In order to achieve this, the Government may establish Technology Trackers in leading countries, such as Germany, Taiwan, Japan and the USA, to track the development of technology in key packaging segments. The Government may also help promote technology based FDI partnerships among foreign and local enterprises especially in the medium-scale enterprises with the view to developing India as global outsourcing and subcontracting base. IIP could also be strengthened to serve as a one point source of classified information on Indian packaging industry for the MSME segment.

INTRODUCTION

Packaging industry is of paramount importance for international trade in goods. Packaging is used across sectors in a wide range of industries, viz., food and drink, healthcare, cosmetics, and other consumer goods. Packaging can be classified based on their type of use, which is primary packaging, secondary packaging, tertiary packaging and ancillary packaging. It is also segregated on the basis of types of materials used. Packaging is also used for handling a wide range of industrial goods and agricultural commodities. A wide range of materials are used to manufacture packaging, which include flexible plastics, rigid plastic, flexible foil, glass, metal, paper and paperboard, wood and composite materials. Some of the common packaging products include boxes, cartons, cans, bottles, bags, envelopes, wrappers, and containers.

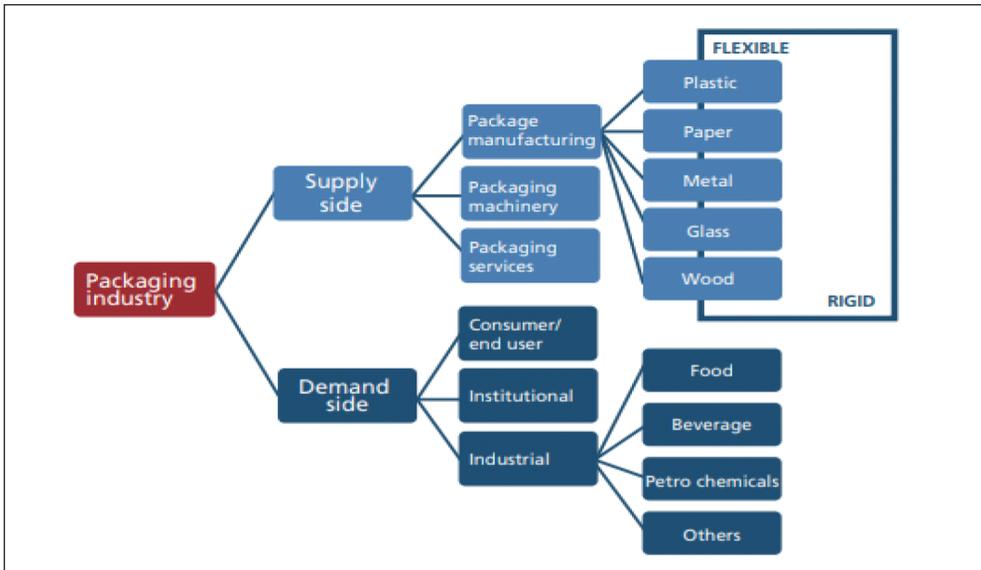
The global packaging industry is a dynamic industry and is under rapid expansion. The global packaging market is estimated at US\$ 876 billion in 2018¹⁵. This global growth is primarily driven by factors like growing pharmaceutical, food processing, manufacturing industry, FMCG, healthcare sector and ancillary industries in the emerging economies like China, India, Brazil, Russia and few other East European countries.

Industry Composition

The global packaging industry could be divided in two major components, which are supply side who are the providers of packaging products, and the demand side who are the end users. Both the categories have different characteristics and could be differentiated based on investment drawn and potential for growth in each sector.

¹⁵Smithers – Pira Report

The Packaging Industry

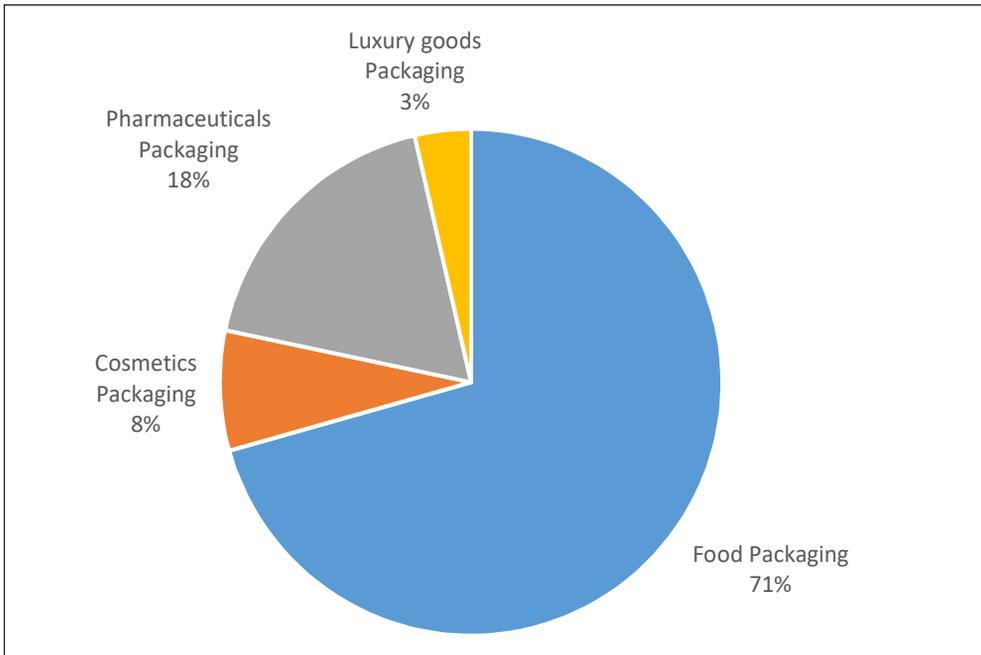


Source: FAO

The supply side of packaging industry includes packaging manufacturing, packaging machinery and packaging services. As for the type of end product, packaging manufacturing has globally the greatest share of the total industry (81%), followed by the packaging service (14%) then by packaging machinery (5%). Packaging manufacturing differs on the basis of forms of packaging. Packaging can be flexible or rigid, where flexible packaging includes materials like foil, paper sheet, film among others, while rigid packaging includes materials like wood, glass and metals. The flexible packaging has been growing steadily as compared to rigid packaging, and the market share for flexible packaging is also estimated to be larger than rigid packaging.

On the demand side, the packaging industry may be categorized based on type of end users, which are individual consumers, institutional and industrial users. The industrial users can be further categorized by the type of industry, namely, food, cosmetics, pharmaceuticals and luxury goods among others. These four categories constitute the major share in the packaging industry. Among these, food packaging registered a 71% share in global packaging in 2017, while the pharmaceuticals packaging had an 18% share, during the same year. The growing demand from food and beverage market has been a major contributor in stimulating the overall growth of packaging sector.

Exhibit 1.1: Market Share Among Top 4 User Markets in Packaging (2017)



Source: all 4pack and Exim Bank Research

Drivers and Trends

The demand for packaging is guided by a wide range of factors. The size and condition of the economy plays a major role in determining the size and scope of the packaging market, and subsequently its growth. Besides, irrespective of the condition of the economy, there are other factors, which plays significant role and have direct or indirect impact on the packaging market. They include:

- Increasing environmental awareness
- Development of new materials
- Increasing demand for convenience packaging and ready to eat food
- Shift towards smaller pack sizes
- Increasing awareness regarding health
- Changing lifestyle and brand awareness
- Changing family orientation

Health and environmental awareness, among the non-economic factors, are regarded as more important factors in deriving the changes in the global packaging industry.

Economic and Demographic Trends

The economic conditions play a vital role in deciding the level of packaging consumption. It has a direct impact on the demand for packaging, in particular, and an indirect impact on the levels of investment into research and development primarily related to packaging materials and technology. The world per capita income has increased from US\$ 8,820 in 2009 to US\$ 11,312 in 2018. With a rise in the purchasing power of customers across the globe, consumerism also tends to increase, which is reflected in the growth of the packaging market. Urbanization, and with it the quest for convenience, is also adding to the demand for packaging. The food packaging constitutes a major portion in the packaging industry, and the consumption expenditure on food increases as the economy progresses.

The demographic factors also play a significant role in effecting the demand trends in packaging. In the dynamic packaging industry, the taste and preferences of the customers are of utmost importance for the manufacturers. With rapidly changing lifestyle and family orientation, demand for convenience food and ready-to-eat food is witnessing a robust increase. Also, there is a shift towards smaller pack sizes, which cater to the changing individual demand. The global ready-to-eat food market is expected to reach US\$ 172 billion by the end of 2023 with a CAGR of 7.3% over the forecast period. The growing awareness about health-food is also influencing and leading to the expansion of food packaging.

Marketing Requirements and Retail Industry

Packaging is a key aspect of differentiating products, and sometimes the packaging gives a marketing benefit at the point of sale. There are various marketing requirements, which the packaging industry needs to adhere to, which includes branding and labelling concerns. This has been giving way to various improvements in the packaging industry.

The retail industry is the most dynamic industry globally, which has a direct impact on the packaging industry. The increasing number of hypermarkets, shopping centres, specialty stores, primarily in the larger cities, has paved the way for more technical advancements in packaging.

Environmental Concerns

The increasing environmental concerns have led the governments across the globe to take steps towards the by-products and waste generated by the packaging industry, especially the plastic packaging. The carbon footprint of plastic is usually very high. According to an estimate, emissions from plastics

production and incineration could account for 56 gigatons of carbon between 2020 and 2050. A constant increase in the use of flexible and layered packaging adds to challenges faced for collection, separation and recycling. It is reported that around 40% of plastic packaging ends up in landfills, while only around 14% of it is collected and recycled¹⁶.

The environmental legislations in recent years, has been focusing on reduction and optimization of weights of packaging materials and structures used. This has been done across materials like glass, plastic, metals and paper, with the help of technological improvements. The usage of lighter corrugated boxes can be seen as a significant trend in the paper and paper board market, particularly in developed economies. With increased environmental concerns and raising awareness, consumers are increasingly shifting towards environment friendly packaging. The packaging industry too is constantly upgrading itself to comply with the legislative needs and consumer preferences.

Developments in Packaging

Increasing consumerism has emerged as a significant driver for demand for ready-to-go and prolonged shelf-life packages to induce volume purchase. With increasing competition and technical advancements, there has been major developments in packaging based on material used, design and end use. With rise in nuclear structure of households and the advent of double income households, where women are engaged in activities outside of the home, ready-to-eat and convenience food with easy-to-open and resealable packaging is increasingly replacing conventional food preparation concepts, significantly adding to the demand of convenient packaging. High-performance packaging, active and intelligent packaging are emerging as the key segments in food packaging by virtue of their ability to adapt to varying pack contents and environment and extend the shelf life of the product.

The materials used in packaging are also witnessing a change overtime. Packaging encompasses a wide range of materials, which includes plastic, board, glass, wood and other materials. The technically advanced package type includes Lenzing's wood based cellulose fibres, paper foam, paptic paper, cocoform and leather paper among others. Changing adaptation in packaging materials are result of a continuous research and development in the field of packaging.

¹⁶Sustainability Times

Types of Packaging

Packaging can be classified on the basis of point of use, the materials used and by type of the product.

Use Basis

- Primary Packaging
- Secondary Packaging
- Tertiary Packaging

Method Basis

- Anti-Corrosive Packaging
- Pharma Packaging
- Plastic Packaging
- Flexible Packaging

Based on its use, packaging can be of three types which is primary packaging, secondary packaging and tertiary packaging.

Primary packaging – Under this type of packaging, the packaging product is in direct contact with the products, such as food products, accessories, and gadgets. The packaging products, which are included in retail packaging, food packaging and those that are seen and used by the end users of the products, falls under primary packaging. Various packaging products under this category are laminated pouches, plastic and tin containers, composite cans, paper bags, bubble wraps, and shrink wraps.

Secondary Packaging – This type of packaging includes packaging products used for securing the bulk quantity of primary packaging with the final products inside it. It holds together the individual units of primary packed goods. For instance, the plastic rings that hold a six-pack of cans together, or the cardboard box that holds a case of cans together are considered as secondary packaging products. Secondary packaging may be removed from the items without changing the qualities or attributes of the goods. Products like plastic crates, plastic trays, expanded polystyrene trays and wooden crates are included in this category of packaging.

Tertiary Packaging – Tertiary packaging include packaging products used for protection, shipping and transfer of secondary or primary packed products. Pallets are most commonly used in tertiary packaging for shipping followed by wooden and corrugated fiberboards. With developments in E-commerce this segment of packaging has witnessed a significant progress in the recent years.

Packaging can also be differentiated on the basis of methods used for packaging. The various types of packaging methods include anti-corrosive packaging, pharma packaging, plastics packaging and flexible packaging.

Anti-corrosive packaging – Anti-corrosion refers to protection of metal surface from corroding in high corroding risk environment. Anti-corrosive packaging is used for protecting the products from such corrosion. Materials such as oil, chips, bags, Vacuum Volatile Corrosion Inhibitor (VCI) bubble film beside some other materials are used for protecting products from corrosion, resulting due to exposure to different climate conditions. Moreover, this packaging is also for export of goods over long distances, long-term storage of metal goods, and metals that are sensitive to corrosion. The global VCI packaging market, which is an important segment of this category, was estimated at US\$ 600 million during 2018 and is expected to grow at a CAGR of 6% during 2019-29¹⁷.

Pharma Packaging – Pharma or drug packaging is used for pharmaceutical operations which involves taking the product through various distribution channels to the end consumer. The packaging process include containment, drug safety and identification of product for handling and delivery. The major role of pharmaceutical packaging is to market life-saving drugs, surgical devices, blood and blood products, powders, liquid and dosage forms of drug, solid and semisolid dosage forms, while maintaining the quality of the product for a longer duration. The pharmaceutical packaging market is estimated to be US\$ 83.6 billion in 2019, which is expected to increase at a CAGR of 6% over 2019-24¹⁸.

Plastic Packaging – This form of packaging is used for varied items ranging from fragile items to non-perishable items. The objective of plastic packaging is to enhance shelf life of a product by restricting exposure of the product to air, dust and moisture, which may cause malfunction or destruction of the products. Plastic packaging is used heavily due to its properties of durability, safety, hygiene, security and scope to design freedom. Packaging companies involved in this segment often recycle waste or scrap plastic for re-use in their own facilities. The global plastic packaging market was valued at US\$ 318.92 billion in 2017 and is expected to grow at a CAGR of 3.4% till 2023¹⁹.

Flexible Packaging – According to the Flexible Packaging Association, flexible package is a package or any part of a package whose shape can be readily changed. This non-rigid packaging structure uses plastics and other flexible materials for the base. Some of the most common examples of flexible packaging include bags, pouches, shrink films, tubes, sleeves and carded packaging. It is

¹⁷Future Market Insights

¹⁸Markets and Markets

¹⁹Plastic Packaging Market

among the highest growing segment in the packaging industry due to continuous innovations and cost-efficiency. The global flexible packaging market was valued at US\$ 250.75 billion in 2019, and it is expected to reach a value of US\$ 314.98 billion by 2025, at a CAGR of 3.87%, over the forecast period (2020-2025).

Scope of the Study

The study predominantly focuses on the developments and challenges in the food packaging sector. Food packaging has the major share, on the basis of end use, in the packaging industry. With increasing demand for on-the-go-food and changing lifestyle, this sector is expected to remain the highest contributor to the packaging industry.

Reducing wastage along the food value chain is the primary objective of packaging. With emphasis given on increasing the shelf life of a product, the various advancements in the food packing industry is envisaged to be an important tool in the reduction of food loss.

Table 1.1: Packaging Solutions for Reducing Food Waste Along the Value Chain

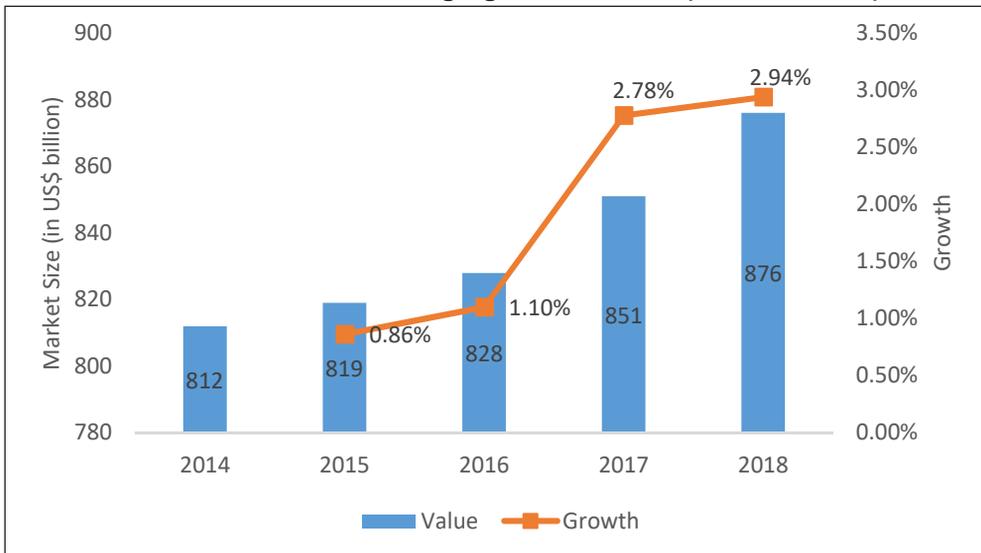
Loss situation and causes	Selected packaging solutions
At production stage	
Unnecessary variety of packaging types	- Universal packaging design
High amount of greenhouse gas (GHG) emissions per ton of production	- Modified atmosphere packaging - Integrated materials handling and warehouse management systems
Non-recyclable wax-coated boxes for delicate perishables	- Recyclable packages with excellent moisture barrier - reusable plastic containers
At post-harvest stage	
Inefficient product insulation	- Fibre reduction - Micro flute technology
Manual case forming and stretch wrapping	- Automated processes reducing labour and material costs
Product spoilage and toxicity	- Anti-microbial packaging
At distribution stage	
damage due to palletizing and strapping	- Slip sheets and stretch wrapping in lieu of pallets and strapping
Damage due to mixed products on pallets	- Cube utilization via 'pin-wheeled' position
At processing stage	
Damage during transport	- Leak-resistant packaging - Tough, tear-resistant packaging
Product spoilage	- Hermetic seals - Vacuum or modified atmosphere packaging
Loss of production	- Efficient equipment systems - System integration and automation
At wholesale stage	
Inappropriate shipping containers	- Optimizing secondary packaging for shipping and shelf impact/appeal
Damage due to high humidity, storage time and stacking height	- Use of new materials with enhanced stacking strength - Modified atmosphere packaging
At retail stage	
In-store preparation losses	- Centralized food preparation - In the bag merchandizing

Product spoilage	<ul style="list-style-type: none"> - Leak-resistant packaging - Vacuum or modified atmosphere packaging
Passed sale date	<ul style="list-style-type: none"> - Shelf-life extension - Freshness preservation
At consumption stage	
Too much preparation	<ul style="list-style-type: none"> - Portion control packs - Ready-to-eat entrees
Spoilage	<ul style="list-style-type: none"> - Re-sealable packaging - Vacuum or modified atmosphere packaging
Not consumed prior to expiration date	<ul style="list-style-type: none"> - Shelf-life extension - Freshness preservation

GLOBAL SCENARIO OF PACKAGING

The global packaging market was estimated at US\$ 876 billion in 2018²⁰, registering a y-o-y growth of 2.9% over 2017 (US\$ 851 billion) at constant prices, including US\$ 61.04 billion for industrial packaging. Geographically, the emerging markets in the Asia-Pacific have been the driver of this growth, by virtue of increased per capita income and increased demand for packaged goods. Emerging economies, such as India, Indonesia and China, in that order, has been the drivers of growth for industrial packaging in Asia-Pacific and globally²¹. The emerging and developing economies are expected to contribute around 70% of the growth in global packaging consumption during 2017 to 2022. The developed economies are expected to grow at a rate of around 1%, however, these economies are projected to grow from their high base value as compared to developing economies, adding big numbers in absolute value terms and volume.

Exhibit 2.1: Global Packaging Market Value (in US\$ Billion)



Note: The values are estimated

Source: Smithers Pira Report

²⁰Smithers- PIRA Report

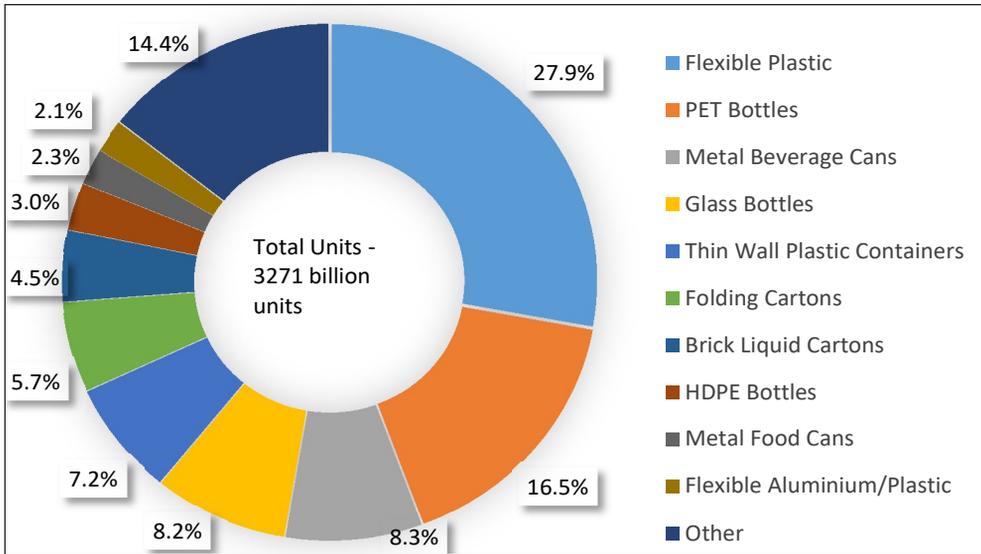
²¹Mordor intelligence industry-reports on industrial-packaging-market

According to the industry sources, the packaging industry is envisaged to cross the US\$ 1000 billion mark in the first half of 2022 attributed much to the steady growth in E-commerce. Nevertheless, the growth rate of packaging and that of consumption will continue to remain unequally distributed around the world, Overall the global per capita consumption of packaging stood at around US\$ 115 for 2018.

Lifestyle changes across the globe have fueled the growth of convenience-orientated packaging, such as flexible plastic and PET bottles. These two segments, in the recent years, have emerged as the most dominant pack types across multiple categories, especially in food and beverages, such as salty snacks, noodles, and confectionery. These pack types are characterized by their lighter weight, and convenience of use while on-the-go. They also have a high degree of customizability and are cost effective from manufacturing perspective.

Flexible plastic was the largest selling item in 2018 in the packaged articles segment, accounting for around 27.9% of total packaged units sold during 2018²². Other major articles include PET bottles, metal beverage cans, glass bottles, thin wall plastic container, and folding cartons.

Exhibit 2.2: Global Volume Share of Different Packaging Products



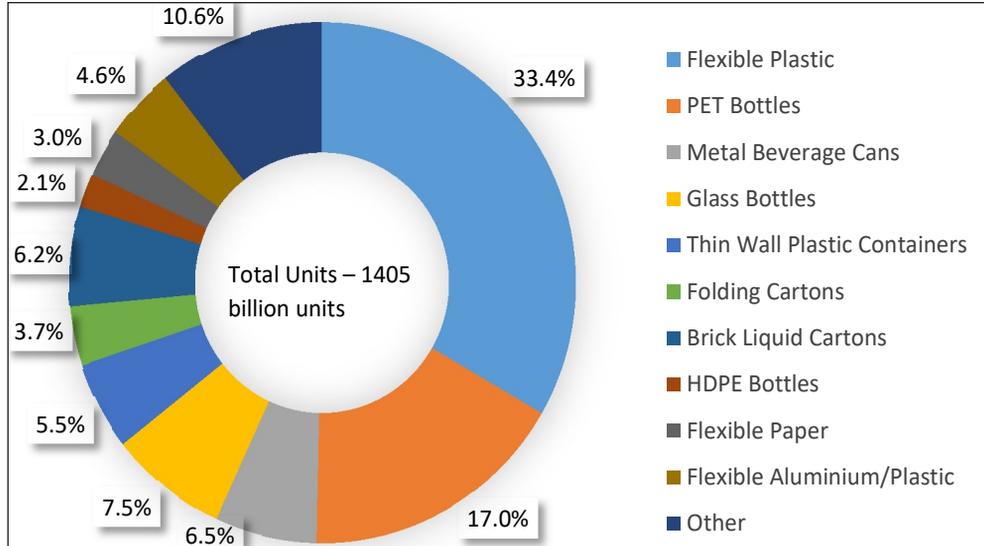
Source: EMI-PMMI Report

²²The total units includes retail unit volume in billions of units, unless otherwise noted, and includes online purchases.

In 2018, with 43%, Asia Pacific was the largest region in world packaging consumption, significantly ahead of Western Europe with 18.4% and North America with 14.2%. The economies of Eastern Europe, Central and South America, the Middle East and Africa together represented 19.4% of this consumption. Asia displays the highest growth rate, driven by China and India.

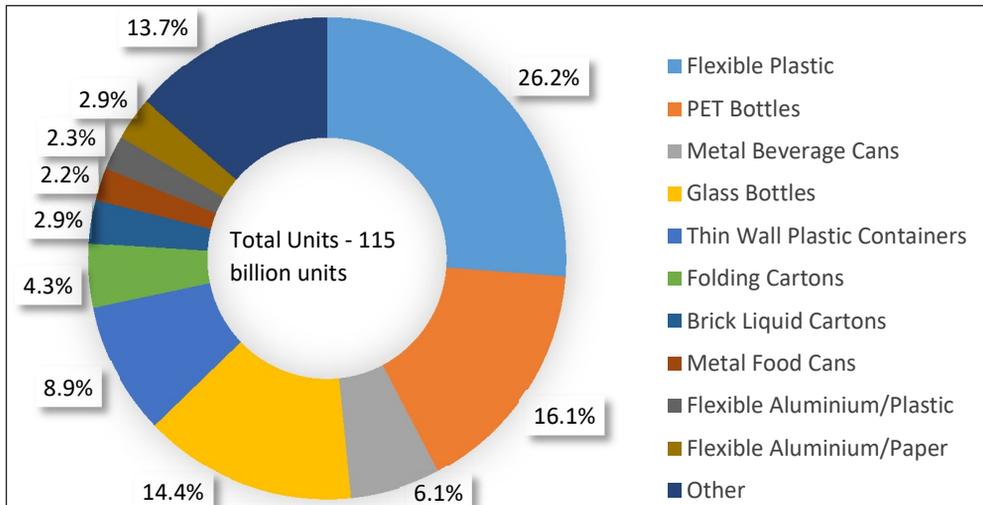
A study of consumer preferences in the high growth markets reveals a steady demand for convenient-to-carry package types largely due to dominance of time-strained lifestyle. In countries, such as Japan, India, and Indonesia, there is a growing demand for smaller-sized packaging. In Japan, aging population being predominant, preferences are more for easy to open, lighter, and smaller portioned packaging. During the period 2013 to 2018, in countries such as India, Singapore, and the Philippines there has been an increased focus on premium packaging across multiple categories, including beauty and personal care, and beverages. Apparent portion downsizing and choices of healthier beverages in smaller packaging continues to remain the popular trend in emerging Asian economies, in the recent years.

Exhibit 2.3: Volume Share of Top 10 Pack Types in Asia Pacific (2018)



Source: EMI-PMMI Report

Exhibit 2.4: Volume Share of Top 10 Pack Types in Eastern Europe (2018)

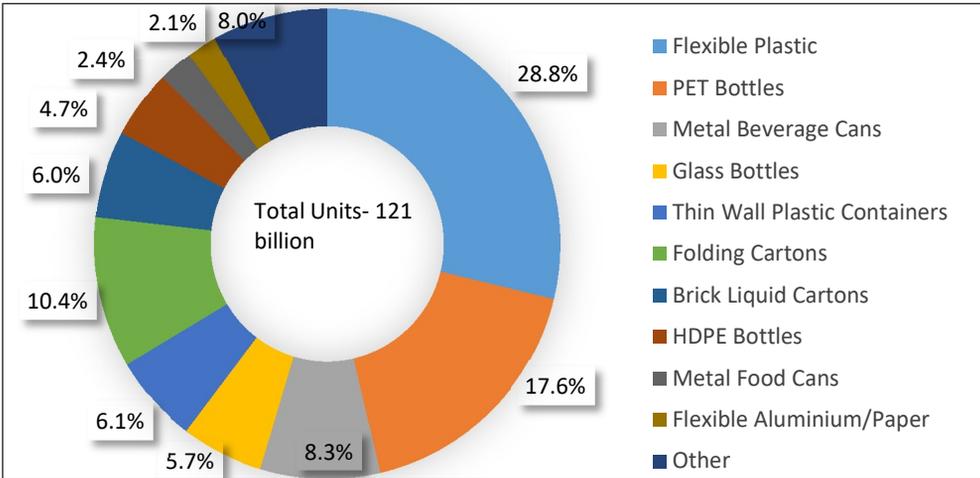


Source: EMI-PMMI Report

In Eastern Europe, sustainability and sizing are top trends in pack type distribution. Convenience and sustainability led by resource-efficiency, and versatile plastics have been driving the packaging trends in the region. Flexible plastic is the most used pack type in this region with 26.2% share among the top ten pack type used. Others include PET bottles, glass bottles and thin wall plastic containers. However, glass packaging has been re-emerging as consumers' preference in Eastern Europe much to avoid contributing to the global plastic pollution. Health is a key influencer of product and packaging development in the region, which is coupled with Eastern Europeans seeking to combine ethical and sustainable packaging with sizes catering to moderate consumption and maximize convenience.

In Middle East and Africa, flexible plastic has been the most dominant form in overall packaging in the region, driven by increased portability, which has emerged as a priority for food packaging. Food packaging, in 2018, had the majority share in packaging in the UAE, Egypt and Morocco, the largest markets in the region. Beverages packaging accounted for the majority share of packaging in Saudi Arabia in 2018. In Saudi Arabia, the new regulation banning plastic products in the food and beverage industry that do not have the approval of the Saudi Arabian Standards Organization (SASO) is expected to have an impact on the packaging industry in the region. As a result, manufacturers are expected to increase the share of recyclable plastic packaging, including HDPE and PET bottles.

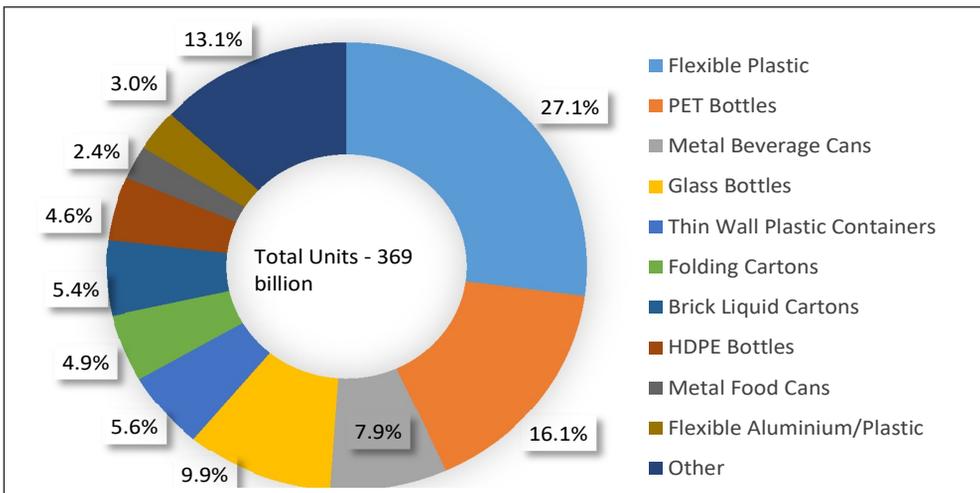
Exhibit 2.5: Volume Share of Top 10 Pack Types in Middle East and Africa (2018)



Source: EMI-PMMI Report

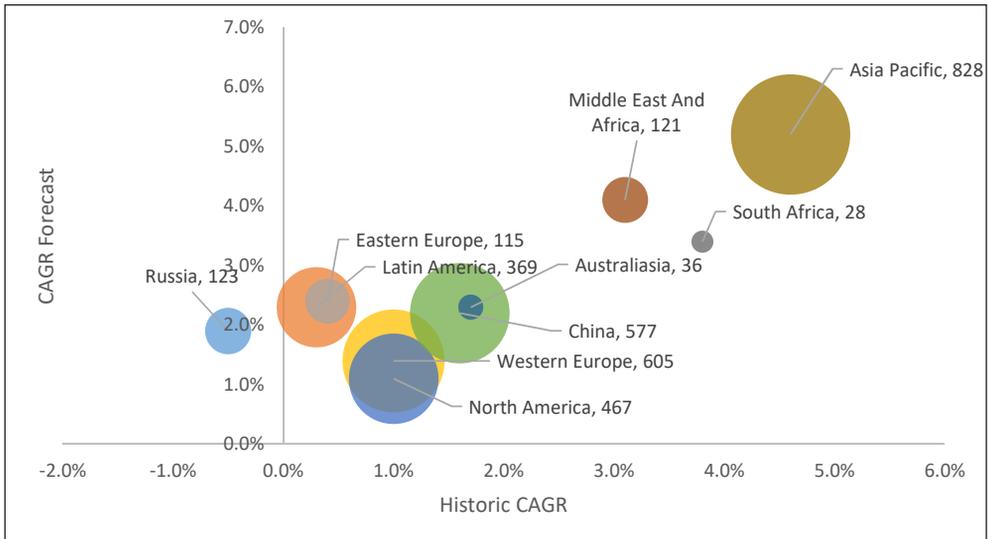
In Latin America, flexible plastic remains the most used type of packaging, due to easy usage. In 2018, food packaging had the majority share in packaging industries of Brazil, Argentina, Chile and Peru, which are the largest consumers of packaging in the region. Beverage packaging emerged as the major segment in Venezuela and Mexico. In the beverage segment, alcoholic beverage, particularly beer packaging was the leading category in Latin America, with glass bottles being the dominant packaging type. Increased sale of craft and other premium beers helped to drive growth in the use of glass bottles in the region.

Exhibit 2.6: Volume Share of top 10 Pack Types in Latin America (2018)



Source: EMI-PMMI Report

Exhibit 2.7: Historic and Forecast CAGR of Packaging Market and Market Value in 2018

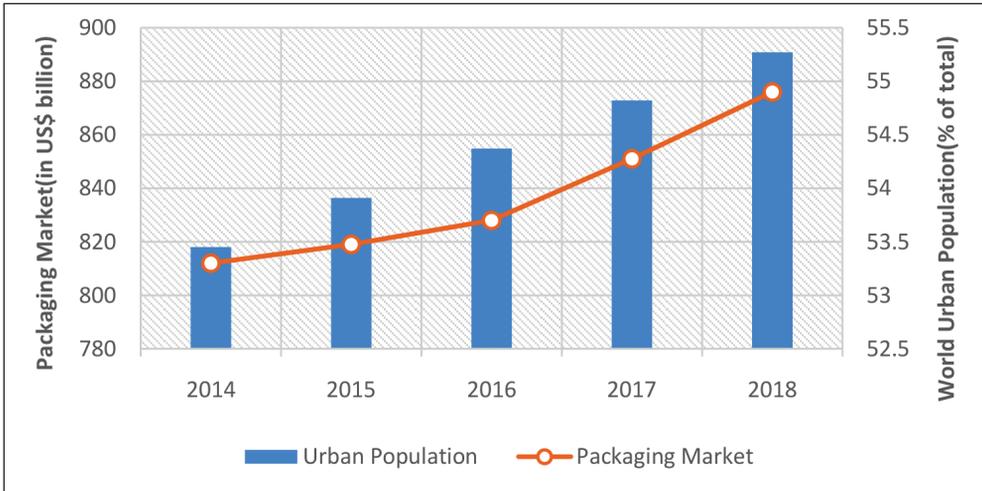


Note: The Number after region shows the market value of packaging (in billion units) in 2018
Source: EMI-PMMI Report, Exim Bank Research

The global packaging industry is projected to grow at a CAGR of 2.9% during the period 2018-22. With historic CAGR of 4.6%, the packaging industry in the Asian region is projected to register a CAGR of 5.2% over the period 2018 to 2023, which is the highest among all the regions, globally. The growth in terms of CAGR is forecast to be the lowest at 1.1% for the North American region, with historic CAGR recorded at 1%. Middle East and Africa is forecast to register a CAGR of 4.1% over the period 2018 to 2023, with historic CAGR registered for the region at 3.1%.

Urbanization has also been defining the trends in packaging and contributing considerably in the growth and development of the packaging industry. The demand of packaged goods is higher among urban population, globally, due to higher per capita income availability. With projections estimating 68% of the world population to be urbanized till 2050, the packaging market is also expected to grow considerably globally.

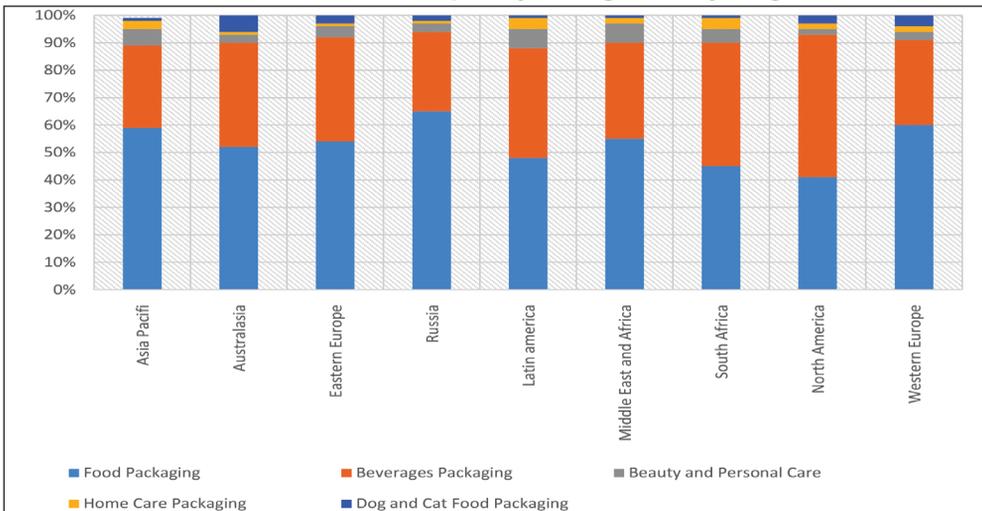
Exhibit 2.8: World Urban Population and Packaging Market Value



Source: Smithers Pira Report, World Bank, Exim Bank Research

Food packaging has the highest share in terms of volume in different uses of packaging. The share remained around 50% for most of the regions in 2018. In regions, such as Asia Pacific, Russia and Western Europe, food packaging constituted a share of around 60% in the packaging industry. Other segments too witnessed expansion within the product range, such as beauty and personal care, and home care, especially the demand for larger pack sizes, which provided value-for-money, and enabled the consumers to save on bulk purchases.

Exhibit 2.9: Volume Share Split by Categories by Region, 2018



Source: EMI-PMMI Report; Exim Bank Research

With respect to the materials used for packaging, such as glass, paper, plastic, and wood, there are wide variations among those used in the developing and developed economies. For these four items, the average annual import during 2014 to 2018 was estimated at US\$ 86.1 billion. During 2014 to 2018, the average annual global imports of plastic packaging material were estimated at US\$ 51.7 billion. The import of plastic packaging materials during 2018 was estimated at US\$ 57.1 billion²³. Among importers of plastic material for packaging, the US was the largest importer with estimated imports of US\$ 8.3 billion in 2018²⁴. Other countries among top five importers of plastic for packaging were Germany, France, Mexico and the United Kingdom.

The average import of paper packaging material during 2014-2018 was estimated at US\$ 21.8 billion. The US was the largest importer with estimated import of US\$ 2.9 billion in 2018.

Table 2.1: Average import of packaging materials by developed and developing market economies, 2014-2018 (billion US dollars).

Packaging	Import Region		Total
	Developed Economies	Developing Economies	
Glass	6.9	2.8	9.7
Paper	15.2	6.6	21.8
Plastic	35.3	16.1	51.4
Wood	2.7	0.5	3.2
Total	60.1	26.0	86.1

Source: ITC Trade Map, EXIM Bank Research

Average exports of the dominant four packaging materials, during 2014-2018, was estimated at US\$ 88.8 billion. Plastic material was the largest exported packaging material among the dominant four types used and traded globally. Average global exports of plastic material for packaging during 2014-2018 was estimated at US\$ 52.3 billion. Export of plastic material, during 2018, was estimated at US\$ 57.6 billion. Among the exporters of plastic material for packaging, China was the largest exporter with estimated exports of US\$ 9.3 billion in 2018 followed by the US, Germany, France and Mexico.

²³Here HS code 3923 is taken for plastic materials used for packaging

²⁴ITC Trade Map

Table 2.2: Average export of packaging materials by developing and developed market economies, 2014-2018 (billion US dollars).

Packaging	Export Region		Total
	Developed Economies	Developing Economies	
Glass	5.9	4.0	9.9
Paper	14.6	8.6	23.2
Plastic	29.5	22.8	52.3
Wood	2.8	0.6	3.4
Total	52.8	36.0	88.8

Source: ITC Trade Map, EXIM Bank Research

Average export of paper packaging material globally during 2014 to 2018 was estimated at US\$ 23.2 billion. Export of paper packaging material during 2018 was estimated at US\$ 25.4 billion. China was the largest exporter of paper packaging material with estimated export of US\$ 4.5 billion in 2018.

Food Packaging

The thriving food processing industry globally has been the key driver of the food packaging industry. The food processing sales market is estimated to reach US\$ 3.2 billion by 2023 with estimated CAGR of 3.3%²⁵ over 2018 to 2023.

The global food packaging market was estimated at US\$ 278 billion in 2017, registering a CAGR of 5.1% over the period 2017-2025. Changing preferences of the consumers and the changes in the eating habits coupled with the increased awareness among consumers about importance of food packaging are the major drivers of growth in the food packaging market. The food packaging helps in maintaining the shelf life of a product by preserving the food during the journey from factory to the end user in the distribution chain. The increased safety and shelf life have been driving reliance on packaged food materials in the recent years.

The increasing urban population in developing countries is also leading to the growth in the consumption of packaged food as well as rising popularity of single-serve packs. Growth in this industry is also supported by increasing recycling infrastructure for plastics, metals and glass. The food packaging market is among the highly regulated market, as health of the customers is directly affected by its use. Agencies, such as FDA and European Commission imposes stringent

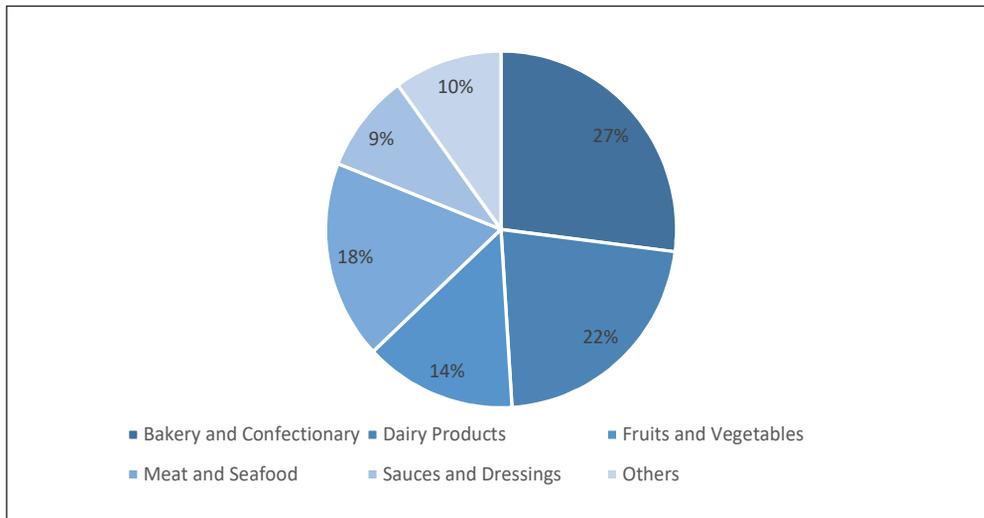
²⁵Marketsand Markets

regulations on use of types of food packaging as well as on the Food Contact Materials (FCM). With a shift towards more sustainable packaging solutions, such as bio-based plastics and thermoplastics, addressing environmental concerns, the prospects for the industry to grow is considerable.

Food packaging industry can be classified by its application or end use. Bakery and confectionary, dairy products, meat and sea food, and fruits and vegetables are the major segments of the industry by application or end use. The bakery and confectionary goods had a market share of 27% in the food packaging market in 2017 followed by dairy products (22%), meat and seafood (18%) and fruits and vegetables (14%).

Bakery and confectionary products are usually packed in high moisture barrier packaging for increasing the shelf life of the product. Flexible packaging is also widely used due to its advantages, such as lightweight, printability, and cost-effectiveness over paper cartons and tins. Aesthetics and consumer appeal also define this industry largely.

Exhibit 2.10: Global Food Packaging Market Share (by Application), 2017



Source: Grand View Research

Preferences towards smaller pack sizes for dairy products, as a result of nuclear and smaller households, are expected to drive growth and developments in dairy product packaging. Most widely used packaging technique in dairy is modified atmosphere packaging (MAP).

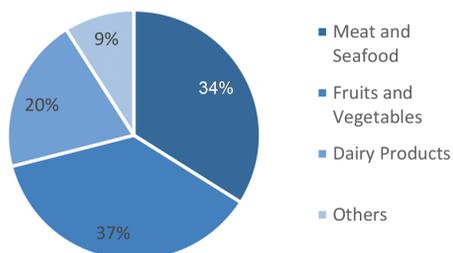
Rising health awareness and rise in income per capita are driving consumer preferences towards the fresh fruit industry. With increasing demand for fruits and vegetables, their packaging needs and techniques are also witnessing expansion.

The Asia-Pacific region is estimated to be the largest market for food packaging, accounting for around 35.9% of the total market revenue in 2017. Per capita consumption of packaging material in Asia is 3 kg/person/annum and major portions accounts for food packaging. Other major markets for packaged food are Europe and North America. Countries, such as China and India, with more than 35% of the global population, are the major markets of packaged food in the Asia Pacific region. Growing retail sector, expansion of e-commerce coupled with growing population and rising purchasing power in these two countries are steadily expanding the food packaging industry in the recent years.

The European and North American region benefits from the large manufacturer base. Despite high saturation level, food packaging continues to remain key constituent of the overall packaging industry.

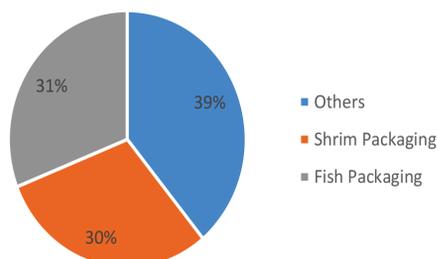
Box 1: Market Share of Various Packaging

Global Fresh Food Packaging Market Share (by application), 2018



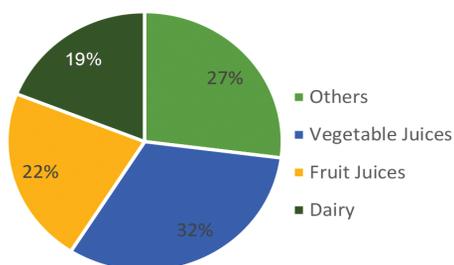
Source: Grand view research

Global Fresh Sea Food Packaging Market Share (by application), 2019



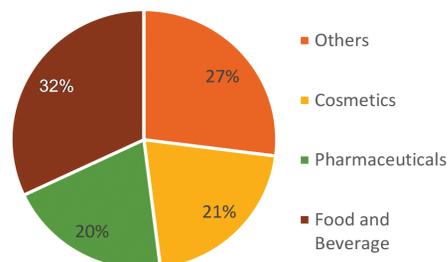
Source: Market Intellica

Global Liquid Food Packaging Market Share (by application), 2019



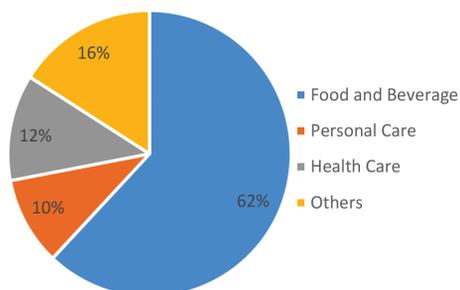
Source: Market Intellica

Global Active, Smart and Intelligent packaging market share (by application), 2019



Source: Market Intellica

Global Green Packaging Market Share (by application) 2016



Source: Grand view research

*Years reported as per latest available data

Table 2.3: Food Industry SWOT Analysis and Packaging Industry Implications, by Region

SWOT	ASIA	AFRICA	AMERICA
STRENGTHS			
Robust agricultural and food-processing sectors	Home to some of the largest exporters of various agricultural products	Diversified agriculture sectors (food & cash crops/ livestock). Highly vibrant food processing industry with increasing growth opportunities.	Food industry accounts for sizeable proportion of industrial output and GDP and attracts foreign investors
	Set to become world's biggest consumer of foods and beverages	Well-developed commercial agriculture in regions like South Africa	Significant exporter of agricultural products and dairy products
Geographic advantages	Foreign trade with the neighboring countries facilitating expansion of food industry		Access to markets within and global
Improving consumption and economic growth	Growing economies, rising per capita income and steady urbanisation is expected to give a push to consumption, specifically consumption in food sector		There is increase in the consumption of organic & socially aware food, which is expected to lead the food industry
WEAKNESSES			
Infrastructural Issues	Bottlenecks in transportation infrastructure leading to low realization of potential	High cost of transportation due to poor infrastructure makes business unviable for companies and inaccessible for rural consumers	Poor infrastructure (Latin America), and heavy reliance on imported goods
Limited facilities and raw materials	Higher cost of raw material reduces the profitability	Lack of cold storage restricts the market for perishables	Procurement of raw material remain a challenge
OPPORTUNITIES			
Changing consumer Preferences	Changing lifestyle, rise in nuclear family, and increasing number of working couples, health, environment and brand consciousness is driving demand towards processed and convenience food, demanding developments and expansion in packaging		

Investment opportunities	Dynamic domestic markets paving way for flow of investments	Opportunities for investment due to expected higher profitability	Investment opportunities in new product development catering to increasing consumer preferences for health and environment
THREATS			
High cost of raw materials	Increased cost of production may affect product pricing, which in turn will be affecting the demand	Higher dependence on import of raw materials for packaging might increase the cost of production leading to subsequent rise in product pricing	Affects consumer purchases due to higher cost of end-product
Political issues	Unfavorable regulatory environment and widespread corruption in some countries remain significant investment deterrents		Stringent regulatory frameworks, tariff and trade wars affect trade and investments
Environmental Concerns	Climate change jeopardizes many food-processing industries		

Source: FAO and Exim Bank Research

REGULATORY FRAMEWORK IN PACKAGING

The trade policy and regulatory framework for the packaging industry differs among countries. The regulatory mechanism plays a crucial role in the trade and development of the packaging industry. The US, the European Union (EU) and the Middle East are the largest markets for packaged food products globally. The regulatory environment for food packaging of these strategic markets and of India, are discussed briefly in this chapter. A more detail coverage of regulatory environment in select strategic countries for India's trade in food products are presented at Annexure 1.

Food Packaging Regulations in the US

The food packaging regulations are enforced by the Food and Drug Administration (FDA) in the US. The FDA charged with monitoring of food safety requirements, carries out risk assessment as well as risk management regarding food safety and packaging. Food, Drug and Cosmetic Act 1958 enforced by the FDA is the basic regulation for Food Contact Materials (FCM). Clearances are required for FCM, which are considered additives, also known as indirect additives, which can potentially migrate into the food products. The food additives are regulated under the Food Additive Directive (FAD). A substance may be authorized as a food additive if it is in accordance with an applicable Food Additive Directive. As per Food Additives Amendment, Section 201, an additive is “any substance the intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristics of any food (including any substance intended for use in packing, packaging, or holding food)”²⁶

Cases not pertaining to FAD are approved by the FDA by an indirect food additive petition. Both the processes require the FDA to notify the public in Federal Registry and allow for comments. Due to the time-consuming nature of this process, the process has limited usage. The most used process for packaging approval, currently is the Food Contact Notification (FCN) program. Under this program, an FDA committee reviews the notification and issues a no objection certificate upon adherence within 120 days, after which the notified substance is

²⁶Food Additives Amendment, Section 201

permissible for application. However, the notifier can make use of the substance if no response is received from FDA within the stipulated 120 days. Further, no public review takes place before the notice promulgated as a rule in the Code of Federal Regulations (C.F.R.). Notably, “no objection certificate’ issued by the FDA is restricted only to the notifier, and does not permit other manufacturers usage of the substance.

Generally Recognized as Safe (GRAS)

Under sections 201(s) and 409 of the Federal Food, Drug, and Cosmetic Act (the Act), a substance is under the category of GRAS if “any substance that is intentionally added to food is a food additive, that is subject to premarket review and approval by FDA, unless the substance is generally recognized, among qualified experts, as having been adequately shown to be safe under the conditions of its intended use, or unless the use of the substance is otherwise excepted from the definition of a food additive”. A substance can be qualified as GRAS through scientific procedure or if the substance was used in food before 1958, through experience based on common use in food. Under the GRAS notification program the manufacturers submit a notification, which is approved by a no objections letter. Other manufacturers can also refer to the approval, and FDA has no deadlines under the program.

A manufacturer may make an independent GRAS determination through reliance on qualified experts and the scientific literature. However, if the FDA considers the determination incorrect, it can take appropriate regulatory action. However, the burden is then on FDA to prove that the substance is not GRAS.

Prior Sanctioned Substances

These are the substances whose use in or on food are subject to approvals by the FDA or USDA, for a specific use. A manufacturer may use any material prior-sanctioned for its intended application without further FDA clearance. Similar to the case of GRAS substances, the prior-sanctioned substances may include substances over and above to those already listed in FDA’s regulations. The accordance of the prior-sanctioned status to a substance depends solely on the submission of an appropriate pre-1958 letter or other indication of acceptance. Though FDA is precluded from regulating a prior-sanctioned substance as a food additive, the agency can prohibit or set conditions on the use of any substance, which it has proof of adulterating food. Table 3.1, presents a comprehensive list of legislations pertaining packaged food in the US.

Table 3.1: US Legislative Overview

General Regulation on FCM	
Food, Drug and Cosmetics Act (1958)	
Title 21, Code of Federal Regulation	
Authorization/Notification required	Exempted from authorization
Direct Additive (21 C.F.R. Part 170.3)	Threshold of Regulation rule
Indirect Additive (21 C.F.R. Part 174-179)	GRAS <ul style="list-style-type: none"> • Common food ingredient before 1958 • Manufacturer self-determined GRAS • FDA listed GRAS • FDA approved GRAS • FDA GRAS notification
Food Contact Notification (FCN) program (only notification required)	Sanctioned before 1958

Source: Food Packaging Forum

Food Packaging Regulations in the European Union

There is a coexistence of national legislation and community level legislation in the European region for food packaging and FCM. The regulations are directly effective in the member states, the same need to be transposed by national parliaments for making it more effective. The EU Framework Regulation EC 1935/2004 is used for regulating the food contact materials at Union level, which includes all food contact materials including packaging, machinery and kitchen ware.

As per article 3 of the Framework regulation, no food contact materials shall transfer constituents into food at levels that endanger human health, and this is supported by Regulation 2023/2006 on Good Manufacturing Practice (EC 2023/2006). The Framework regulation allows for specific requirement on 17 individual food contact materials, of which six materials with their directive number are mentioned in the Table 3.2. The regulatory framework also provides for special rules on active and intelligent materials (those that are not inert by design). There are provisions regarding the procedure to perform safety assessments of substances used in manufacturing of FCMs involving Rules governing labelling, which are also mentioned in the regulatory framework. The European Food Safety Authority is the implementing agency of the framework.

Regulations for Plastic Materials

The most comprehensive measures on the use of plastic materials and articles are stipulated in the Commission Regulation (EU) no. 10/2011. It lays out the

rules regarding the composition of plastic food contact materials and provides with a list of substances, which are allowed for usage in the manufacturing of plastic food contact materials. It also specifies the checks on the use of those substances and provides the requirements for compliance applicable to plastic materials and articles used as FCM. The regulation is regularly amended.

To ensure the safety of plastic materials used for packaging, a mechanism of migration limits is used. These limits specify the maximum amount of the substances that are allowed to migrate to food, and are set out in the Regulation as 'Specific Migration Limits' (SML). These are decided based on the toxicity of each specific substance. To ensure the overall quality of the plastic packaging, the Regulation also sets out the Overall Migration Limit (e.g., OML of 60mg/kg food, or 10 mg/dm² of the contact material).

Regulations for Active and Intelligent Materials

By maintaining or improving the condition of packaged food, the active and intelligent materials enhances the shelf-life of packaged food. These materials absorbs or releases substances from or to the food or its surrounding environment. These materials are exempted from the general inertness rule in the EU regulations (Regulation no 1935/2004). Commission Regulation EC no 450/2009 is applied to these materials. The list of substances permitted for the manufacture of active and intelligent materials comes under EC no 450/2009.

Regulations for Recycled Plastic Materials

Once used, the plastic materials do not comply to the plastic regulation, as they may have been contaminated with other substances. The Commission Regulation (EC) 282/2008 is followed for recycled plastic materials and articles intended to be reused for packaging foods. There are two approaches that are followed for regulating the usage of recycled plastic as food contact materials, viz (i) the plastic depolymerized into monomers or oligomers have to meet the same requirement as the original materials; and (ii)the plastic that is mechanically recycled and transformed into pellets, need to undergo individual authorization for the recycling process by the European Food and Safety Authority.

Table 3.2: EU Legislative Overview

General Regulations on FCM	
Regulation EC 1935/2004 (on materials and articles intended to come into contact with food)	
Regulation EC 2023/2006 (on Good Manufacturing Practices)	
Specific Materials	
Ceramics	Directive 84/500/EEC
Epoxy Resins	Regulation EC 1895/2005
Regenerated Cellulose Film	Directive 2007/42/EC
Recycled Plastics Material	Regulation EC 282/2008
Active and Intelligent Packaging	Regulation EC 450/2009
Plastics	Regulation EU 10/2011
Specific Regulation	
Regulation EU 321/2011 (restricting the use of bisphenol A in polycarbonate infant feeding bottles)	
Regulation EU 284/2011 (import procedures for polyamide and melamine plastic kitchenware from China and Hong Kong)	
Regulation EC 1895/2005 (restricting the use of certain epoxy resins)	
Directive 93/11/EEC (regulating the release of N-nitrosamines and N-nitrosatable substances from rubber teats and soothers)	

Source: *Food Packaging Forum*

Food Packaging Regulations in Middle East Region

The Gulf Cooperation Council (GCC), comprises of the UAE, Bahrain, Kuwait, Oman, Qatar, and Saudi Arabia as its member nations. The standards and technical regulation with respect to food packaging, for GCC nations, comes under the purview of GCC Standardization Organization (GSO). These standards and regulations are also followed by Yemen. There are various standards developed by GSO, which the GCC nations must implement voluntarily. The standards must be adopted into national law to have legal effect in the Member States and Yemen.

General Requirements for FCM (GSO 2231/2012)

The articles, which are intended or reasonably expected to directly come into contact with the food material or are expected to transfer their constituents to food under normal or foreseeable conditions of use are covered under GSO 2231/2012. This standard includes general requirements for food contact materials and articles. It requires the materials to be manufactured by using good manufacturing practice (GMP) so that the transfer of constituents of a material to the food item could be eluded.

The GSO 2231/2012 standard stipulates provisions pertaining to the packaged food, by the active and intelligent packaging materials. The standard permits the development of particular measures for the substances, which may be used in the manufacturing of food contact materials. It also sets the purity standards and migration limits for these products. However, the standard excludes antiques that may contact food, and materials that form part of the food and may be consumed with it, such as meat casings and cheese rinds. Public and private water supply equipment are also excluded under this standard.

General Requirements for Food Packages (GSO 839/1997)

The general requirements for packages of food materials are stated in GSO 839/1997. The packages of food materials are defined as “containers made from packaging materials suitable for foods and used for their containment, protection, and ease of use, such as metal cans, glass or plastic bottles, tins, paper, plastic and textile bags, wood and plastic boxes, paperboard containers, or any other types of containers including primary and secondary packages”. The standard states that materials used in fabricating, forming, or treating packages for food must be “food grade” (i.e., it does not cause any hazards or health problems (GSO 839/1997, items 4.1 and 3.4)) and should not contaminate the packaged material as primary packaging has direct contact with the food material.

Technical performance requirements are also included under this standard, which includes design considerations, moisture, light and oxygen permeability considerations, and engineering requirements. The standard internally gives references to other GSO food contact standards.

General Requirements for Plastic Food Packages (GSO 1863/2013)

GSO 1863/2013 sets out various requirements for plastic packages. It defines plastic package as a package made of plastic to be used for “packaging a food material for purposes of attaining containment, protection and preservation.” The plastic material is also defined in the standard. It lays out specific technical requirements for plastic food packaging materials. As per this standard, the plastic package shall not temper the condition of the food materials and the food materials should be deemed safe for consumption after using this packaging type.

The guidelines provisioned for use of plastic packaging in food are in analogous to the guidelines issued under the European Union’s Regulation (EC) 1935/2004, regarding food contact materials. As in the EU, this standard requires plastic packages that directly contact food to bear a glass and fork symbol and to meet an overall migration limit of less than 10 mg/dm² or 60 mg/kg.

Importantly, GSO 1863/2013 has brought out a list of authorized monomers, other starting substances, macromolecules obtained from microbial fermentation, additives, and polymer production aids (PPA) that may be used in the manufacture of plastic food packages. These are described in terms of the chemical name and CAS Reg. No., a unique identifier (FCM substance no.), the EU packaging materials reference number, whether the substance may be used as an additive or PPA, and whether it may be used as a monomer or other starting substance, or a macromolecule obtained from microbial fermentation.

Regulations for Food Packaging in India

The food packaging and labelling requirements in India are notified by the Food Safety and Standards Authority of India (FSSAI). The revised regulation by FSSAI also specify that food packaging materials must comply with the Indian Standards (IS), which are listed in Schedules I, II and III, for paper and paperboard materials, metal and metal alloys, and plastic materials, respectively. Previously, the compliance with the standards was voluntary and the standards were available for purchase through the Bureau of Indian Standards (BIS). India's new packaging regulations has banned the use of recycled plastics in food packaging and newspaper and such materials for packing or wrapping food articles. Schedule IV of the regulations is a list of suggested packaging materials for different food product categories.

The Indian Regulatory System comes under the group of mandatory legislations articulated by various ministries and voluntary standards framed by various organizations. The laws and regulations pertaining to the packaging industry in India are:

- Food Safety and Standards Act 2006 (FSSA)
- Legal Metrology Act 2009
- The Agmark Rules

The Food Safety and Standards (Packaging) Regulations 2018 regulate the food contact materials and articles. In February 2020, FSSAI released a notice stating the draft of amendment for Food Safety and Standards (Packaging) Regulations 2018, which is to be known as Food Safety and Standards (Packaging) Amendment Regulations, 2020 related to specific migration limits of antimony and phthalic acid, bis (2- ethylhexyl) ester (DEHP) and Packaging Drinking Water.

General Requirements for FCM

The Food Safety and Standards Regulations 2018 (FSS) states the requirement for the products, which are used for the packaging of the food. The regulatory

standards for these materials are as per the Indian Standards given by the Bureau of Indian Standard (BIS). Besides, general and specific requirement with respect to packaging materials, the regulations also prescribe overall migration and specific migration limits of contaminants for plastic packaging materials where migration limit is described as “the maximum permitted amount of non-volatile substances released from a material or article into food simulants”. The regulations specify the suggestive list of packaging materials for different food product categories.

As per the regulations, packaging and storing of food is deemed to be unfit for human consumption if the containers are rusty, and or have become chipped and rusty. The chemical composition for aluminum, copper and brass containers are specified in the Indian Standard 20 and 21; not following them could lead to the product being deemed to be unfit for human consumption.

The standard lays out specifications for the containers made of plastic materials, which shall be followed when plastic materials are used as appliances or receptacles for packing or storing whether partly or wholly. Some of the standards are specified below:

- (i) IS: 10146 (Specification for Polyethylene in contact with foodstuffs)
- (ii) IS: 10142 (Specification for Styrene Polymers in contact with foodstuffs)
- (iii) IS: 10151 (Specification for Polyvinyl Chloride (PVC), in contact with foodstuffs)
- (iv) IS: 10910 (Specification for Polypropylene in contact with foodstuffs)
- (v) IS: 11434 (Specification for Ionomer Resins in contact with foodstuffs)
- (vi) IS: 11704 Specification for Ethylene Acrylic Acid (EAA) copolymer
- (vii) IS: 12252 - Specification for Poly alkylene terephthalates (PET)
- (viii) IS: 12247 - Specification for Nylon 6 Polymer
- (ix) IS: 13601 - Ethylene Vinyl Acetate (EVA);
- (x) IS: 13576 - Ethylene Metha Acrylic Acid (EMAA);

The FSS Regulation also provides for some general requirements for canned products and specific requirements for packaging of milk and milk products, edible oil/fat, fruits and vegetable products, canned meat products and drinking water.

Box 2 : Packaging and Related Regulations for Food Products and Regulatory Bodies of India			
Regulations	Ministry of Consumer Affairs, Food and Public Distribution	Ministry of Agriculture & Farmers' Welfare	Ministry of Health & Family Welfare
Legal Metrology Act 2009 <ul style="list-style-type: none"> • The Legal Metrology (Packaged Commodities) Rules, 2011 • The Legal Metrology (General) Rules, 2011, 	Enacted to adequately regulate the packaging of commodities.		
AGMARK		AGMARK is a certification mark employed on agricultural products in India, assuring that they conform to a set of standards approved	
Food Safety and Standards Act 2006			FSSAI established under FSSA which provides the food safety regulations for protecting and promoting public health.
Codex Standard (CAC) 1964 (not a law)			Endorsement by WTO under SPS and TBT. De-facto mandatory
Bureau of Indian Standards (BIS)	Lays out standards for products and helps in consumer awareness		

Source: Exim Bank Research

INDIAN PACKAGING INDUSTRY

The Indian packaging sector is among the industrial sectors witnessing highest growth potential, partly due to presence of packaging in almost every industry segment. The Indian packaging industry is expected to reach US\$ 72.6 billion by FY20, growing at a CAGR of 18% during 2016-21²⁷. Indian packaging industry is becoming a preferred hub for global packaging industry and it is emerging as one of the largest sector in India's economy²⁸. With steady growth over the past years, the industry is showing firm potential for expansion, including in the export markets.

Low cost of packaging, in some cases 40% lower than the costs in many parts of Europe, combined with India's resources of skilled labor, make the Indian packaging industry a potential sector for investment. Key user segments showing considerable potential for expansion are - processed foods, alcoholic and non-alcoholic beverages, fresh fruits and vegetables and marine products. The growing urbanization and increase in disposable income are helping the people to make informed choices with respect to food, which, in turn, is catalysing the demand for packaged food. In the recent years, packaging industry has emerged as an important sector driving technology and innovation growth in the country by adding value to the various economic sectors including agriculture and manufacturing. Manufacturing segments with high consumption of packaging products are, FMCG, personal care products, pharmaceuticals, cement, chemicals, fertilizers and agrochemicals. Demand for packaging materials is directly dependent on demand scenario prevalent in the end user segments.

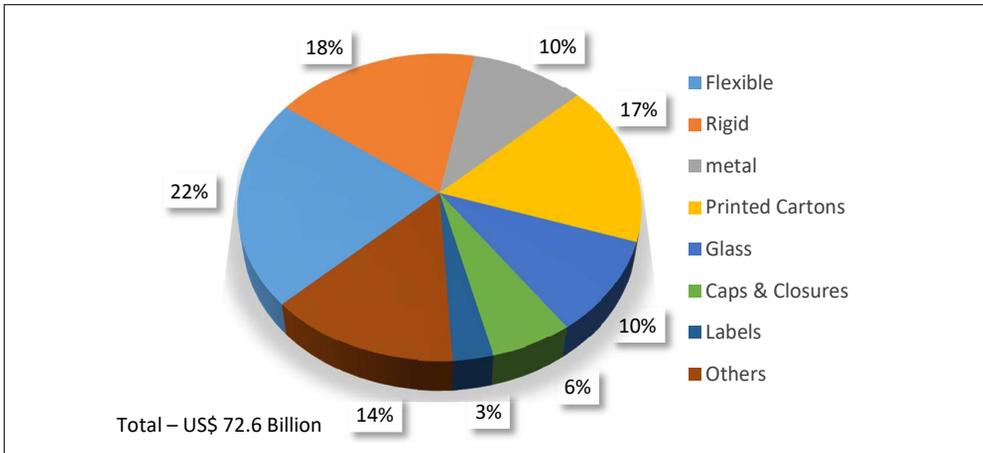
The per capita consumption of packaging in India, however, is on a lower side as compared to other countries. This low consumption level indicates the untapped potential in the sector. The global per capita consumption of packaging in terms of value was estimated at US\$ 115 per person per year; for India, it is estimated at around US\$ 55 per person per year²⁹. The per capita packaging consumption in India, in terms of volume, is significantly low at 10.5 kg, compared to countries, such as Germany and Taiwan with 42 kg and 19 kg, respectively. The per capita consumption of packaging in the US is 109 kg, followed by 65 kg in Europe, 45 kg in China and 32kg in Brazil.

²⁷ASSOCHAM-EY Study

²⁸Packaging Industry Association of India

²⁹Exim Bank's estimate considering Indian packaging sector's value at US\$ 72.6 billion

Exhibit 4.1: Packaging Material Breakdown in Indian Packaging Industry

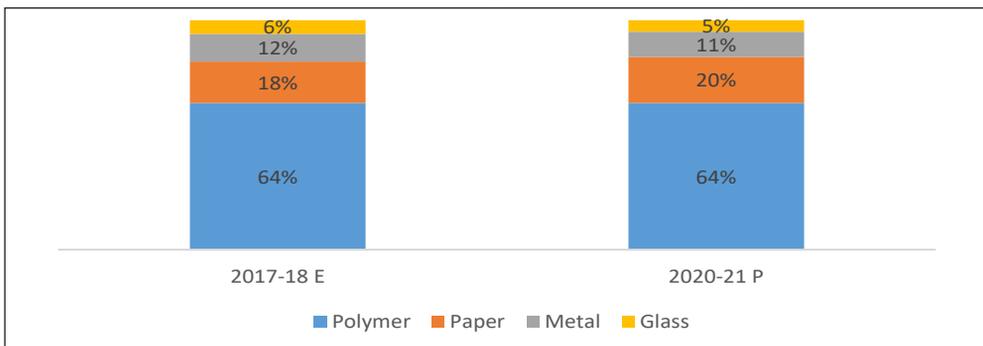


Source: Industry Sources

The packaging market in India consist of various materials, which are flexible, rigid, metal, glass and printed cartons, among others. A material-wise classification of the Indian packaging industry reveals, flexible materials having the highest share with 22% of the total packaging market, closely followed by the rigid packaging material with 18% share and printed cartons with 17% share of the total packaging market.

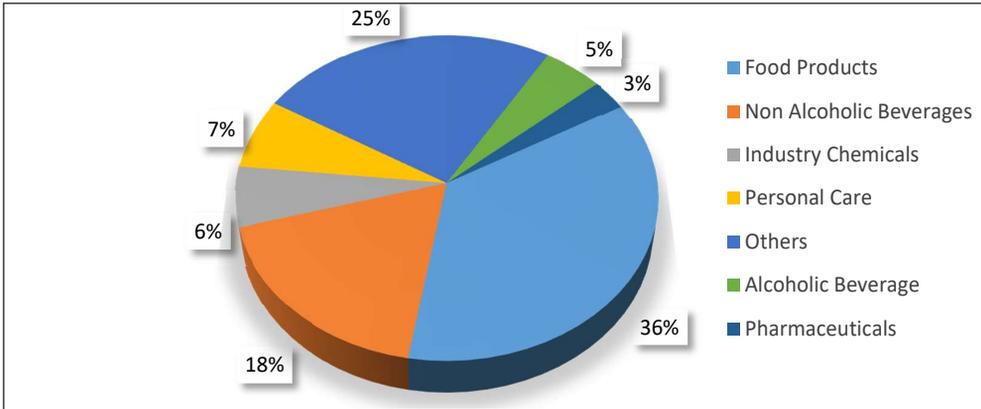
According to CRISIL research, in terms of revenue, plastic or polymer packaging has the highest share in the Indian packaging sector. The revenue share of plastic packaging stood at 64% in 2017-18, which is expected to remain steady over 2020-21. The revenue share of paper packaging, which was estimated to be 18% of total revenue during the year 2017-18, is expected to increase, while the share of glass and metal packaging is expected to fall over the same period.

Exhibit 4.2: Industry Revenue Breakup



Source: CRISIL Research

Exhibit 4.3: Demand from End User Sector (2017-18 E)

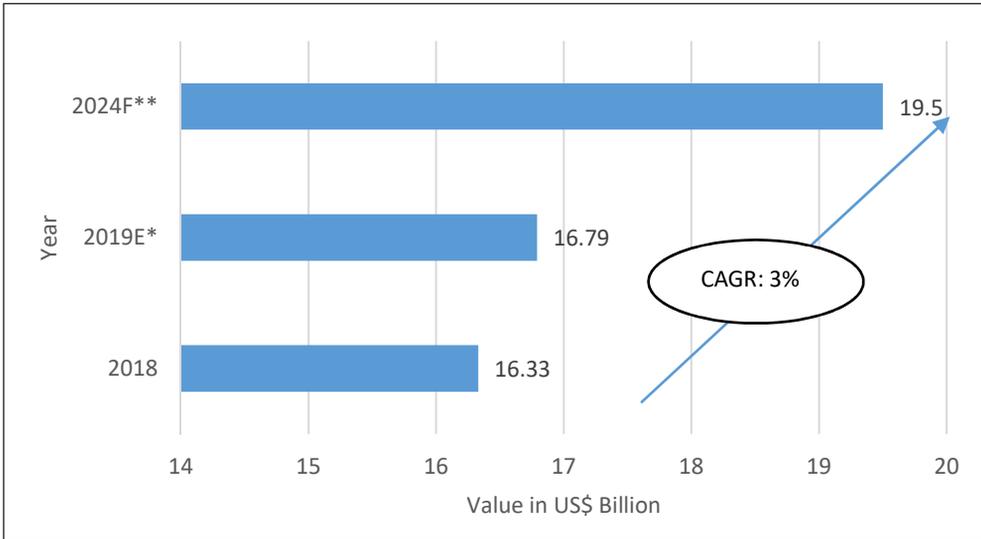


Source: CRISIL Research

The CRISIL Research further adds that in terms of demand for packaging from end user segments in India, food and beverages products exhibited the highest demand with 59% share in total demand generated for packaging. Further demand analysis and segregation shows that food products have a share of 36% while non-alcoholic beverages have 18% and alcoholic beverages has a share of 5% of total demand for packaging in the packaged food segment.

In India, packaging may be broadly divided into two categories viz, rigid packaging and flexible packaging. In the recent years, the demand for flexible packaging materials has been increasing faster than the demand for rigid packaging materials. The strong demand for flexible packaging material has been mostly arising from food & beverage industries, personal care, and pharmaceutical industries. According to an estimate, the value of flexible packaging market in India during 2018 was US\$ 16.3 billion, which, growing at a CAGR of 3%, is forecast to reach US\$ 19.5 billion in 2024.

Exhibit 4.4: Flexible Packaging Market in India

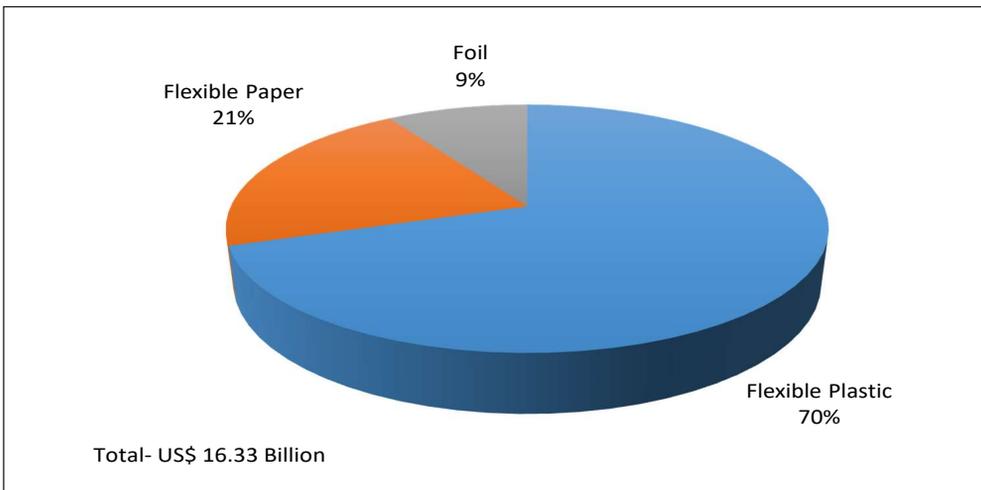


Note: *Estimated, ** Forecast

Source: Arizton

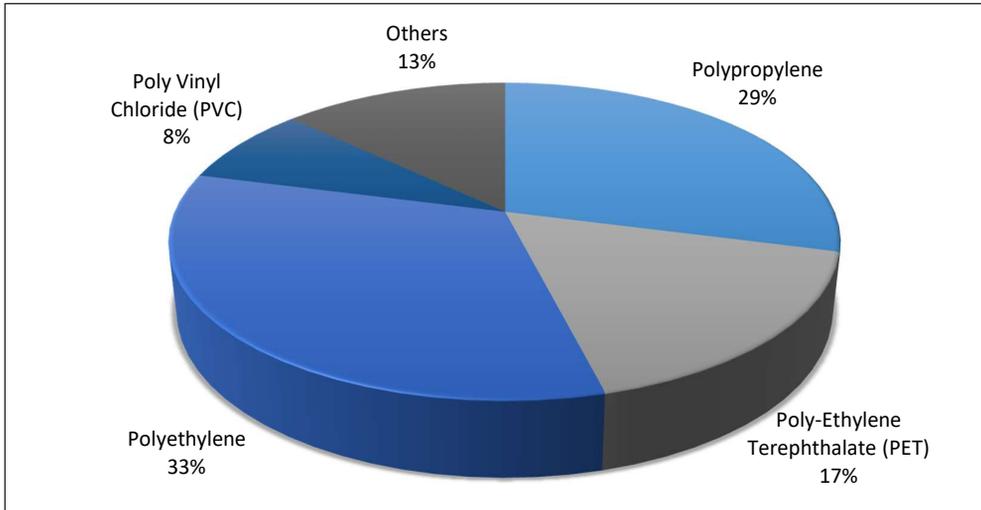
In the flexible packaging segment in India, flexible plastic has the highest share among the different materials used, with a market value of US\$ 11.43 billion and a share of 70% in the total flexible packaging market, during 2018. Other materials exhibiting considerable share in this segment are flexible paper and foil, having a share of 21% and 9%, respectively.

Exhibit 4.5: Flexible Packaging Market Breakdown by Material Type



Source: Arizton

Exhibit 4.6: Share of Plastic Packaging Products by Type

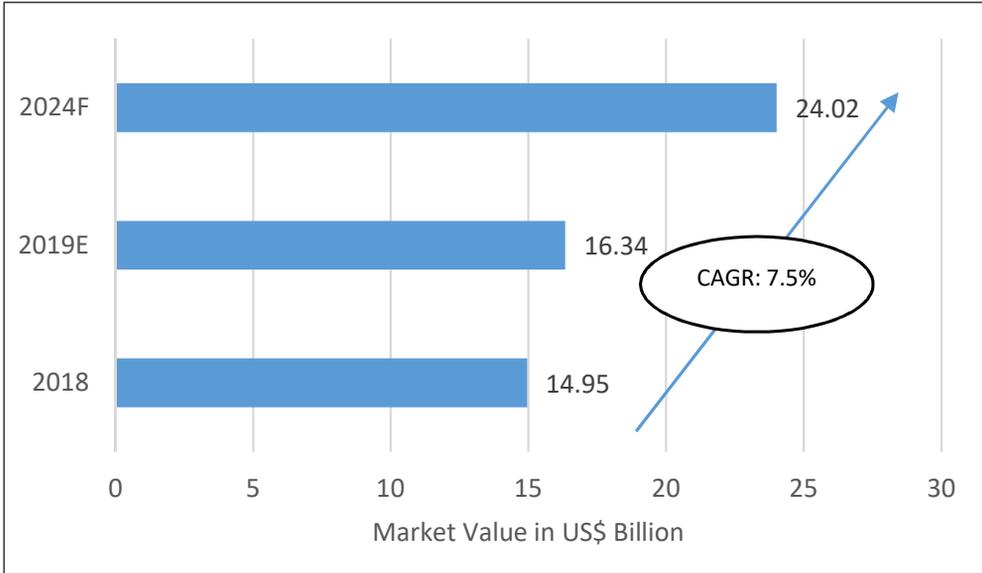


Source: Research on India, Flexible Packaging Market

The dominance of flexible packaging in the recent years has been largely due to its properties of durability, being a cheaper option, and its visual appeal. Flexible packaging are mostly monolayer, multilayer films and multi layered laminate sheets of plastics, which mainly include PE, PP, PET and PVC. Around one-third of the plastic products used by the packaging industry in India is composed of polyethylene and 29% of the products are polypropylene.

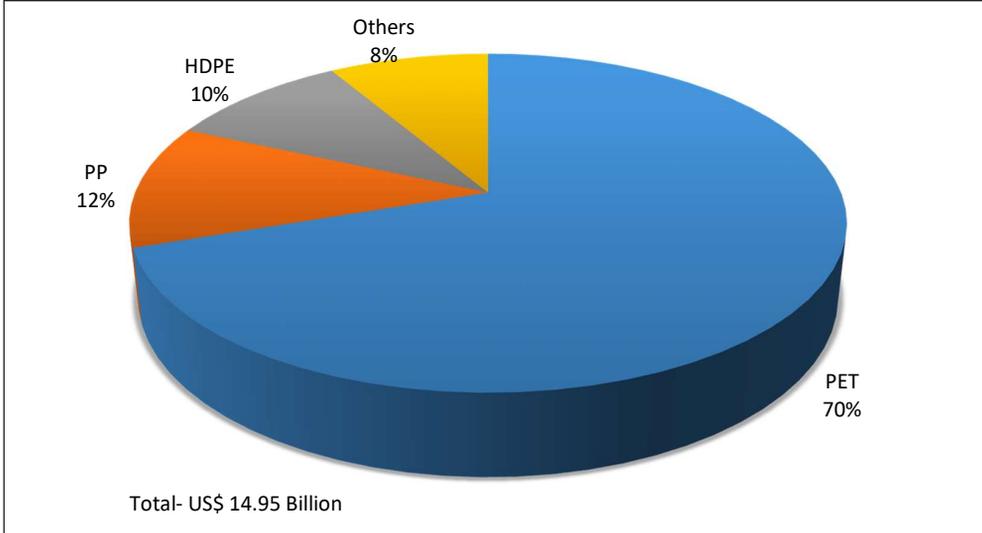
The rigid packaging market includes materials made of hard plastic, glass, aluminum, tin or cardboard. As per the estimates by Allied Market Research, the value of rigid plastic packaging market in India was US\$ 14.9 billion in 2018. It is projected to reach US\$ 24.02 billion in 2024 growing at a CAGR of 7.5%. Poly-Ethylene Terephthalate (PET) material has the highest share among the materials used in rigid plastic packaging. The estimated share of PET was 70%, followed by Polypropylene (PP) with 12% share in the total rigid plastic packaging market in India.

Exhibit 4.7: Rigid Plastic Packaging Market in India



Source: Allied Market Research

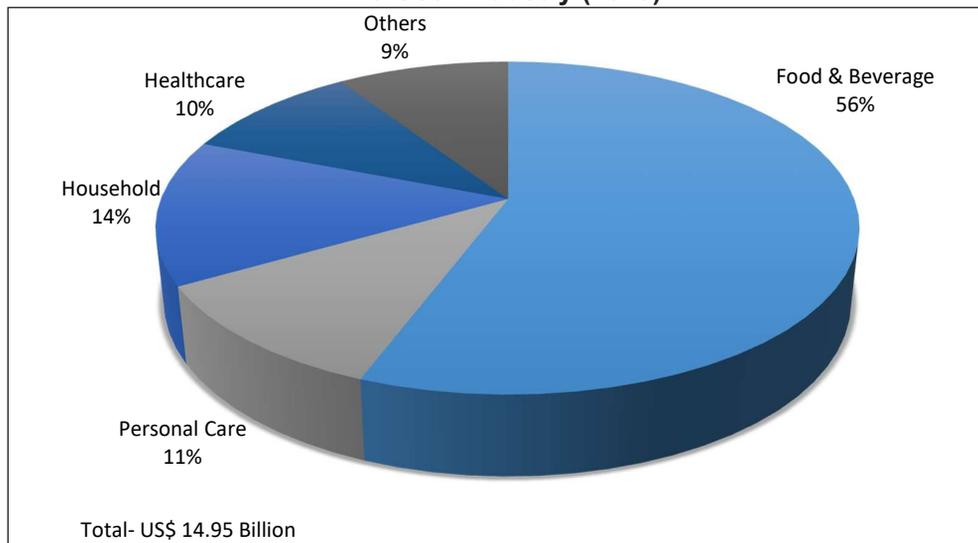
Exhibit 4.8: Rigid Plastic Packaging Market Share by Material Type (2018)



Note: PE- Polyethylene; PP- Polypropylene; PET- Polyethylene Terephthalate; HDPE- High Density Polyethylene

Source: Allied Market Research

Exhibit 4.9: Rigid Plastic Packaging Market Share by End User Industry (2018)



Source: Allied Market Research

With 56% share in 2018, the food and beverage sector had the highest share in the rigid plastic packaging market in India followed by the household segment with 14% share. Food & beverage and household segments collectively accounted for about 70% of the rigid plastics packaging market in India during 2018. Other end users are the healthcare industry, and the personal care industry.

Trade

The export basket of Indian packaging industry comprises mainly of flattened cans, printed sheets and components, crown cork, lug caps, plastic film laminates, craft paper, paper board and packaging machinery, while the imports mainly include tinfoil, and coating and lining compounds. Laminates and flexible packaging, especially PET and woven sacks have been registering fastest growth in exports from India.

India is a net exporter of packaging materials³⁰. The net export of packaging materials during 2018-19 was estimated at US\$ 504.1 million³¹, which increased by 15.8% from the previous year value of US\$ 435.1 million. The export of packaging materials from India was estimated at US\$ 843.8 million in 2018-19,

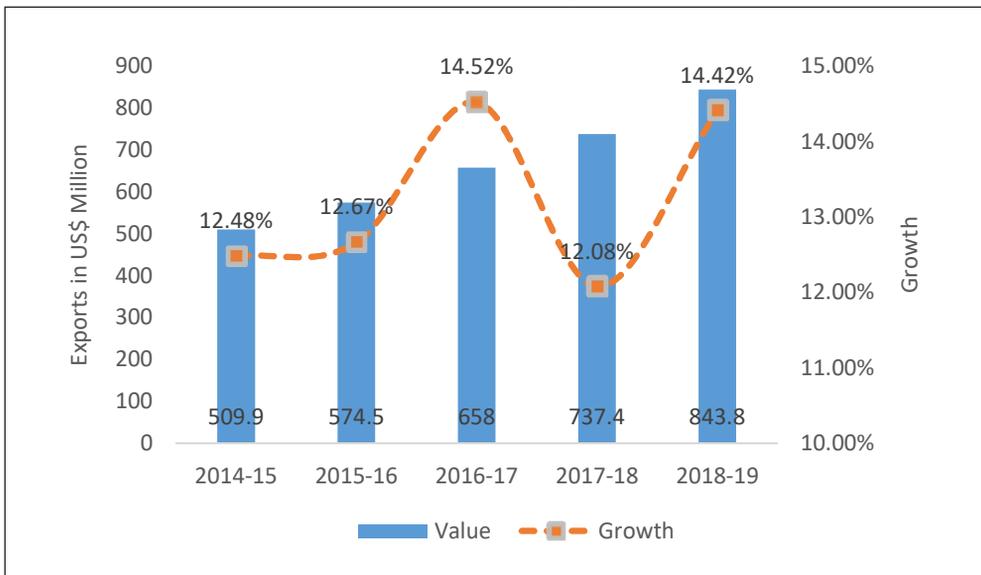
³⁰The packaging materials includes HS 392310, HS 392321, HS 392329, HS 392330, HS 392350, HS 392390 as per composition of packaging materials by DGCIS and further use of the word will be applicable for the mentioned HS codes

³¹DGCIS

witnessing a growth of 14.1% from the estimated value of US\$ 737.4 million during previous year. The export of packaging materials from India witnessed a CAGR of 13.4% over the period 2014-15 to 2018-19.

However, the share of India's exports in the global export of packaging materials remained low at 1.4% in 2018. Total global export of packaging material was estimated at US\$ 56.6 billion during 2018. The USA has been a major export destination for Indian packaging materials. In 2018, 19.2% of the total export of packaging materials from India was directed towards the USA. Other major export destinations for Indian packaging industry include the UK (8.3%), the UAE (5.2%), the Netherlands (3.8%) and Germany (3%). The US, Germany and the UK are among the top 5 importers of packaging materials, having a combined share of 26.3% in total global imports; however, India is far from featuring among the top 10 suppliers to these countries.

Exhibit 4.10: Export of Packaging Materials from India



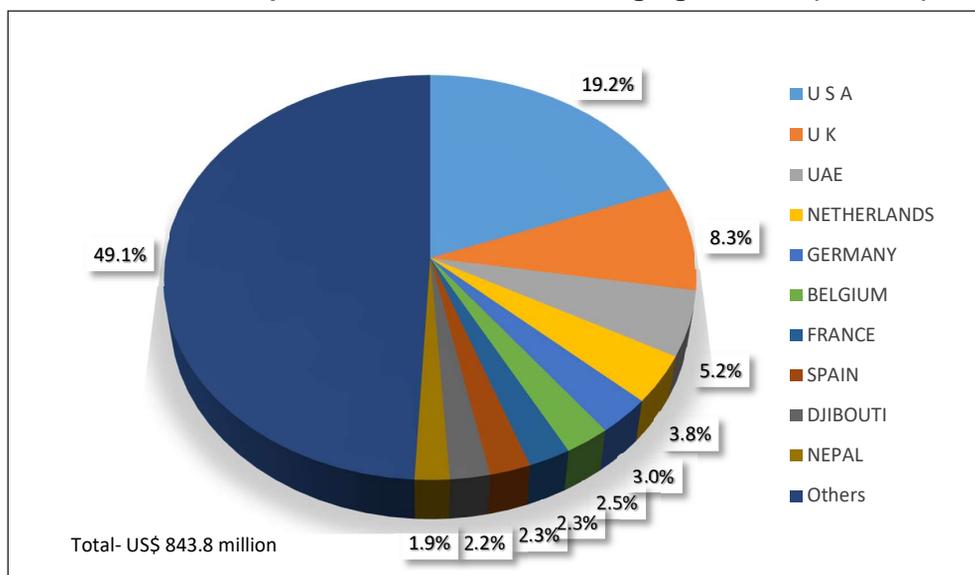
Source: DGCIS, EXIM Bank Research

Table 4.1: India's major Export Destinations for Packaging Materials

2017-18			2018-19		
Importers	US\$ Million	Share	Importers	US\$ Million	Share
U S A	133.1	16.8%	U S A	162.3	19.2%
U K	59.6	7.5%	U K	70.2	8.3%
UAE	46.6	5.9%	UAE	44.1	5.2%
NETHERLANDS	30.0	3.7%	NETHERLANDS	32.4	3.8%
GERMANY	28.2	3.6%	GERMANY	25.1	3.0%
BELGIUM	19.5	2.5%	BELGIUM	21.2	2.5%
FRANCE	17.7	2.2%	FRANCE	19.8	2.4%
SPAIN	17.1	2.2%	SPAIN	19.2	2.3%
DJIBOUTI	12.0	1.5%	DJIBOUTI	18.6	2.2%
NEPAL	15.9	2.0%	NEPAL	16.2	1.9%

Source: DGCIS, Exim Bank Analysis

Exhibit 4.11: Export Destinations for Packaging Material (2018-19)

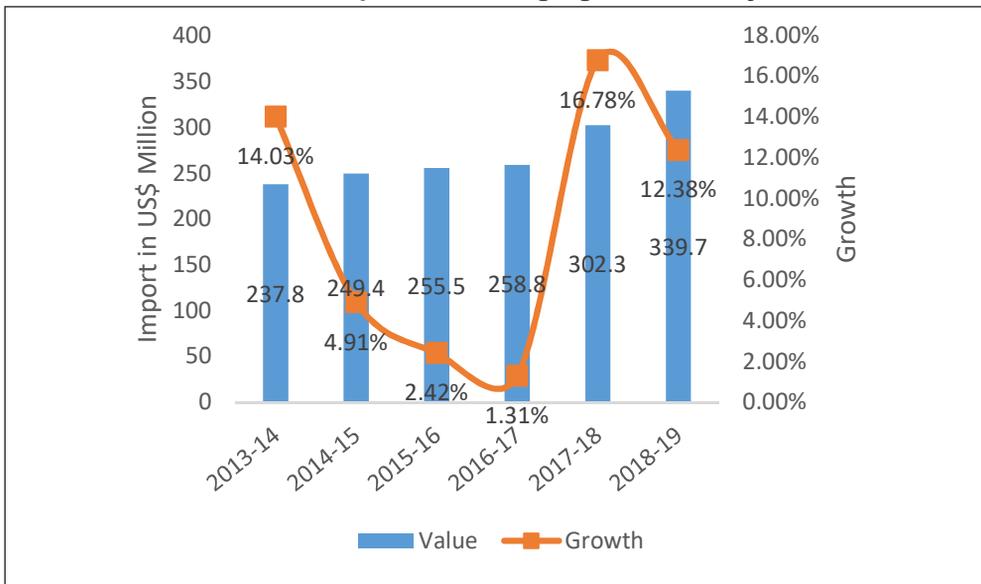


Source: DGCIS, EXIM Bank Research

India's share by value in total global imports of packaging materials stood at 0.6% during 2018, which remained steady over the last few years. The share in total global imports remained 0.5% during the period 2013-2016 before increasing to 0.6% in 2017. According to the data from the DGCIS, import of packaging materials by India was estimated at US\$ 339.7 million in 2018-19, witnessing a growth of 12.4% over previous year value of US\$ 302.3 million. Imports of packaging materials by India witnessed a CAGR of 8.03% over the period 2014-15 to 2018-19.

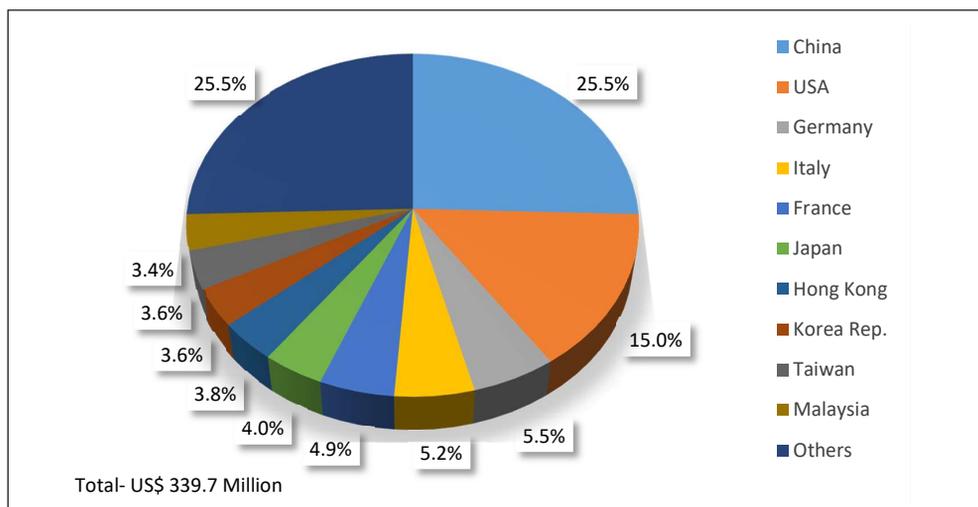
China is the major source of import of packaging materials by India, with a share of 25.5% in the total import of packaging materials. China has been persistently the top import source for packaging materials for India. In 2018-19, other major suppliers included the USA (15%), Germany (5.5%), Italy (5.2%), France (4.9%) and Japan (4%).

Exhibit 4.12: Import of Packaging Materials by India



Source: DGCIS, EXIM Bank Research

Exhibit 4.13: Import Source for Packaging Material for India (2018-19)



Source: DGCIS, EXIM Bank Research

Table 4.2: India's Major Suppliers of Packaging Materials

2017-18			2018-19		
Exporters	US\$ Million	Share	Exporters	US\$ Million	Share
CHINA	80.5	25.5%	CHINA	86.5	25.5%
U S A	45.8	14.5%	U S A	50.9	15.0%
FRANCE	20.2	6.4%	GERMANY	18.8	5.5%
ITALY	16.9	5.4%	ITALY	17.7	5.2%
GERMANY	14.8	4.7%	FRANCE	16.8	4.9%
JAPAN	12.3	3.9%	JAPAN	13.7	4.0%
MALAYSIA	11.1	3.5%	HONG KONG	13.1	3.8%
KOREA RP	10.7	3.4%	KOREA RP	12.3	3.6%
NEPAL	9.5	3.0%	TAIWAN	12.2	3.6%
TAIWAN	8.1	2.6%	MALAYSIA	11.5	3.4%

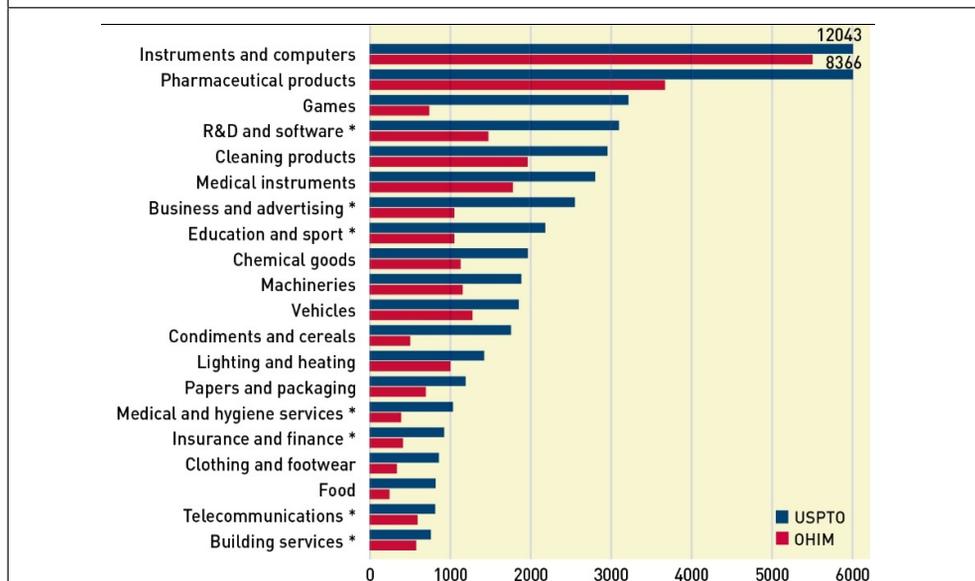
Source: DGCIS, Exim Bank Analysis

Research and Development

Packaging industry is very dynamic industry in terms of the design and method of packaging. Globally, food, beverage, and packaging companies have been recording the lowest spending on research and development, indicating little research-based innovation in these sectors compared to other industries. For example, while the variety of product variants in food manufacturing increases constantly, the processes used in the mixing, baking, distilling and processing of food and drink products are often well established and perfected techniques with little radical improvement over time.

In India, the average spending on research and development as percentage of sales, by companies engaged in the packaging sector, is significantly low at 0.36%³².

Box 3: Trademark Applications as Indicator of R&D in Global Packaging Industry



USPTO – United States Patent and Trademark Office;

OHIM - European Union's Office for Harmonization in the Internal Market

Source: WIPO 2015

³²This is the average R&D spending by top 9 listed companies, MSME spending is not accounted for. If that is considered then this figure will come out to be even lower.

Table 4.3: R & D Expense of Select Indian Companies in Packaging Industry

Company Name	2017-18			2018-19		
	₹ Million		R&D as % of sales	₹ Million		R&D as % of sales
	Sales	R&D Expenses		Sales	R&D Expenses	
Cosmo Films Ltd.	17962.7	63.7	0.4%	20503.9	69.1	0.3%
Essel Propack Limited	8522.5	53.2	0.6%	8463.1	61.5	0.7%
Garware Polyester Ltd.	8329.4	12.9	0.2%	9234.7	12.5	0.1%
Huhtamaki P P L Ltd.	22290.8	10.6	0.0%	23683.5	11.2	0.0%
Polyplex Corporation Ltd.	11069.9	43.8	0.4%	13504.1	45.5	0.3%
Uflex Ltd.	38347.0	9.3	0.0%	41735.3	7.8	0.0%
Ester Industries Ltd.	8244.9	43.5	0.5%	10280.6	77.5	0.8%
Time Technoplast Ltd.	21086.4	16.7	0.1%	24620.6	18.9	0.1%
Hitech Corporation Ltd.	3977.0	48.9	1.2%	4618.9	41.9	0.9%

Source: CMIE, Exim Bank Analysis

Trademark and Design Applications

The trademark and design applications filed and registered in India in the packaging sector has been increasing. However, in comparison to the total applications filed, share of packaging industry has been significantly low. During 2017-18, 1.28% out of the total trademarks filed in India were pertaining to the packaging Industry³³. In all, 3503 trademarks were filed in 2017-18 and 4594 trademarks were registered in the packaging sector. The number of registered trademarks exceeded the number of filed trademarks in 2017-18, due to aggregation of number of filed trademarks of the previous years, the registrations of which spilled over to the following years.

³³Here Class 39 of the trademarks is taken which is for Transport, Packaging and storage of goods; travel arrangement

Table 4.4: Trademark Filed and Registered in the Packaging Sector

Year	Trademark Applications in Packaging			Total Trademark Applications		
	Filed	Registered	Share of granted to filed	Filed	Registered	Share of Packaging in Total Filed Trademarks
2013-14	2344	938	40.0%	200005	67796	1.16%
2014-15	2513	495	19.7%	210501	41583	1.19%
2015-16	4169	950	22.8%	283060	65045	1.47%
2016-17	3551	3316	93.4%	278170	250070	1.27%
2017-18	3503	4594	131.1%	272974	300913	1.28%

Source: Office of the Controller General of Patents, Designs & Trademarks

During 2017-18, 8.8 % out of the total design applications which were filed in India were pertaining to the packaging Industry³⁴. Total 1043 design applications were filed in 2017-18 and 954 were registered for packaging sector.

Table 4.5: Design Applications Filed and Registered in the Packaging Sector

Year	Design Applications in Packaging			Total Design Applications		
	Filed	Registered	Share of granted to filed	Filed	Registered	Share of Packaging in Total Filed Design Application
2015-16	990	700	70.7%	11108	7904	8.91%
2016-17	935	608	65.0%	10213	8276	9.15%
2017-18	1043	954	91.5%	11838	10012	8.81%

Source: Office of the Controller General of Patents, Designs & Trademarks

Role of Exim Bank in Promoting the Packaging Industry

Exim Bank has been providing support to various industries and help enhance their export potential. The Bank, through its Eximius Centres for Learning has been organizing workshops and training programmes on export packaging, drawing expertise from various institutions, including the Indian Institute of Packaging. The Bank through its flagship online platform Exim Mitra, provides exporters with relevant information on packaging standards and certification requirements for exporting to various markets. Exim Bank's exposure to the packaging industry as on 31 January 2020 is ₹188.24 crore (US\$ 26.2 million³⁵), 0.25% of the total credit exposure to all industries. The Bank has been largely supporting the Indian

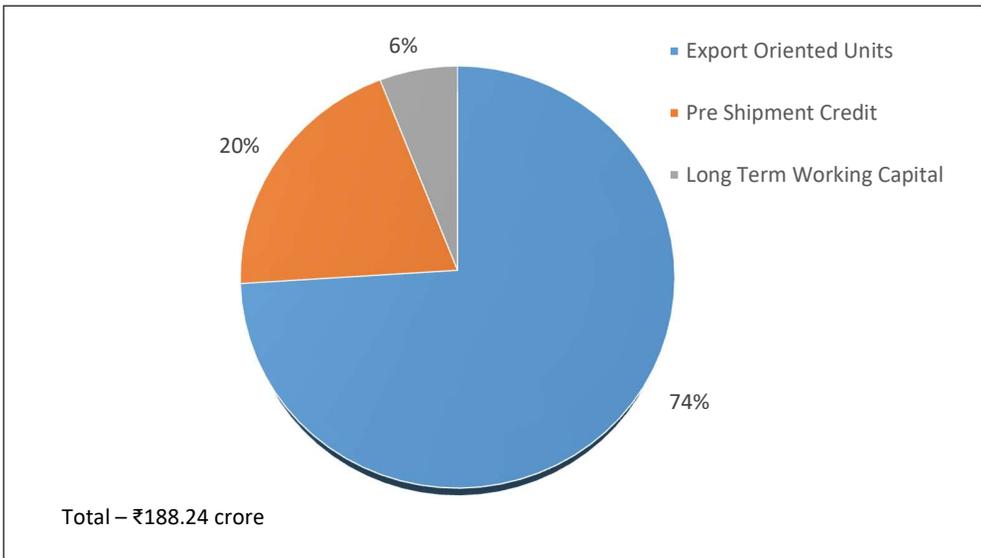
³⁴Here Class 09 of the Designs is taken which is for Packages and Containers for the transport or handling of goods

³⁵Conversion rate as of 31st January 2020

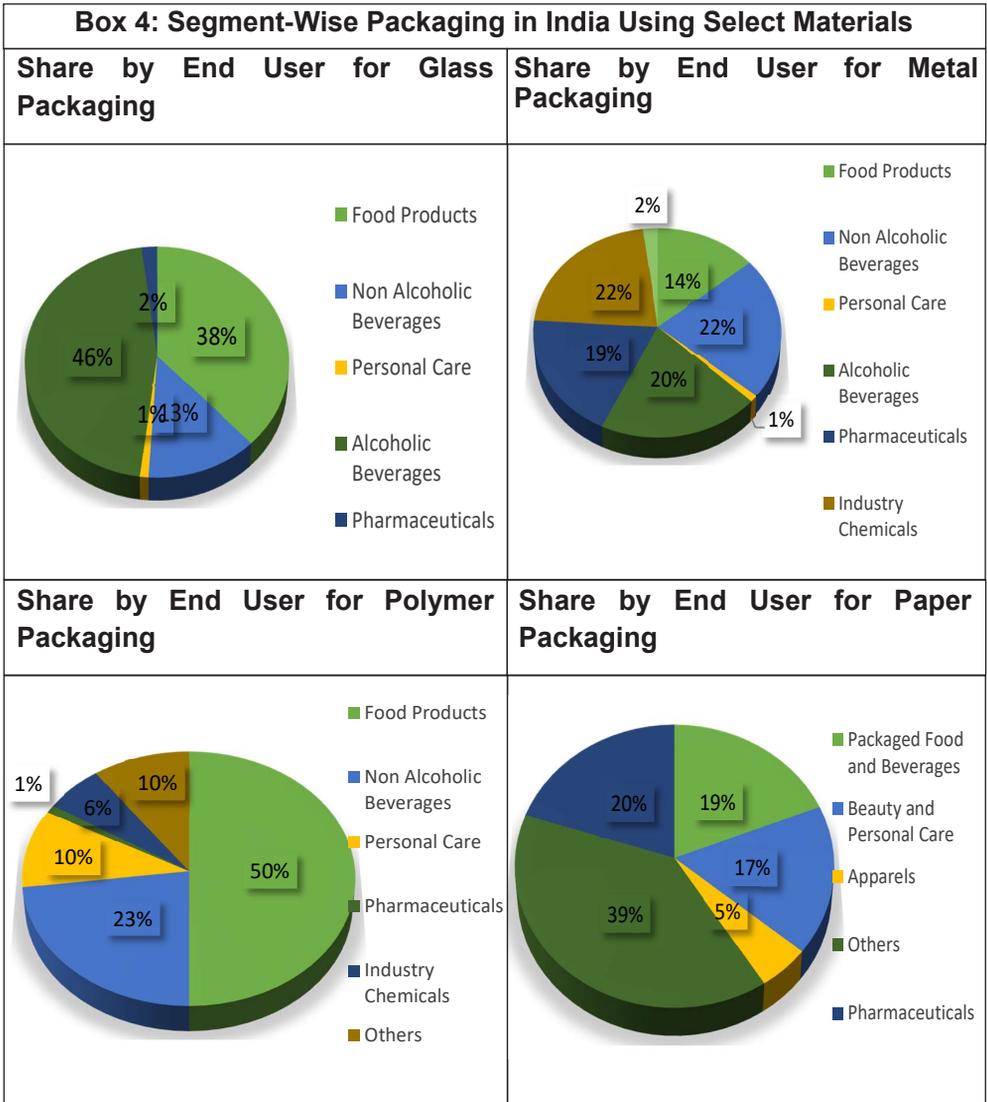
packaging companies by providing term loans for export-oriented units, working capital requirements and pre-shipment credit for enhancing exports.

Total credit flow from bank and financial institutions to the packaging industry in India is estimated at ₹84.9 Billion (US\$ 1.18 billion) in 2018-19, which equals to 0.34% of total credit flow to all industries. This includes long term borrowing of ₹44.04 billion and short term borrowing of ₹40.86 billion.

Exhibit 4.14: Exim Bank Support to the Packaging Industry, Program wise Share



Source: Exim Bank Analysis



Source: CRISIL Research

CHALLENGES

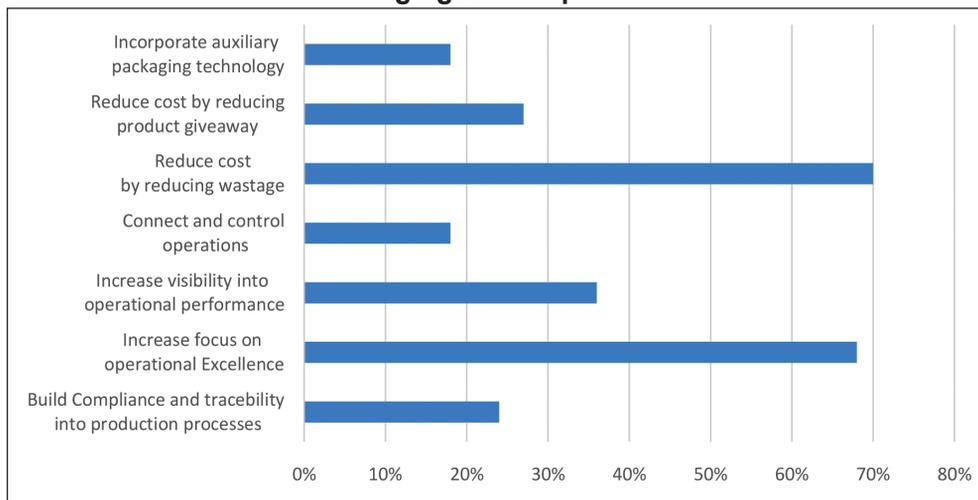
The packaging industry is dynamic and has been constantly evolving to meet the ever-changing demands of the industries it caters to. However, the industry is also constantly faced by various challenges in terms of cost, design, knowledge, regulations and environment. The changing economic conditions and taste and preferences of the consumer also possesses a challenge for the packaging industry to relevant in the dynamic environment. A few of these challenges are discussed in this chapter.

Technological Changes

Rapid changes in technologies to cope with the changing dynamics of the markets and consumer preferences have emerged as a major challenge for the packaging industry. The technological challenges faced by the industry is spread across the entire packaging manufacturing line. The whole process of getting goods from factory to shelf has been speeded up, with precision and consistency. Recent advances in technologies, such as smart packaging, non-destructive inspection methods, printing techniques, application of robotics and machineries, automation architecture, software systems and interfaces are increasingly posing challenges for the industry to automate and upgrade.

Food packaging, which forms the major part of the packaging industry's output, particularly in terms of innovation, faces technological challenges in broader areas that include (i) optimization of equipment and utilities; (ii) food safety and security; (iii) supply chain waste reduction; (iv) development of seasonal infrastructure; and (v) advanced automation and control methods. At a more micro level, challenges for the food packaging industry encompasses areas, such as limitations in (i) availability and use of packaging materials; (ii) systems for material flow; (iii) automation, instrumentation, and control scheme; (iv) degree of smartness in the sensors; (v) sophistication in the machineries and mechanisms (including application of robotics); (vi) inspection methods; (vii) printing methods; (viii) security identification; (ix) graphic design and digital work flow; (x) sanitation and sterilization; and (xi) factory-wide execution management strategy including supply-chain management.

Exhibit 5.1: Top Market Pressures Driving Companies to Upgrade Packaging Line Capabilities



Source: PKN Packaging News

In the absence of adequate research, health safety of new packaging technologies also poses considerable challenge for the industry in its development and further implementation. For example, in the case of nanotechnology based food packaging, there is a growing scientific evidence, which indicates that some free nanoparticles may cause harm to human biological systems because of their ability to penetrate cellular barriers, and induce oxyradical generation that may cause oxidative damage to the cells.

The packaging industry in India is a mix of both organised medium to large players as well as large segment of very small unorganised players. Currently, technologies prevalent majorly with large and medium manufacturers are related specialty film and laminates, multi-layer films, multi-layer blow molded containers, injection molded containers, roto molded containers, bulk containers, thin-wall glass containers, thin-wall metal containers, two piece metal containers, and aluminum containers.

Packaging, being dominated mostly by the unorganized sector with small players in India, automation and technology upgradation, is faced by the challenges, such as inadequate knowhow, skillset for adaptation and implementation, and investments.

Technology challenges in Indian packaging industry are also predominant in use and adaptation of material packaging. Material packaging is segmented into heavy, medium and light depending upon the shape, size and weight of

the material. Current trend of material packaging consists of shrink and skin packaging. However, MSMEs in Indian material packaging still practices minimal packaging methods.

Table 5.1: Material Packaging in MSMEs in India

Segment	Technology (MSME)	Current Trend
Heavy Material	Minimal Packaging	Shrink Packaging
Medium Material	Corrugated Packaging	Shrink Packaging
Light Material	Bubble Wrap Packaging	Skin Packaging

Source: Technology Gap Assessment in Packaging Techniques in MSME sector

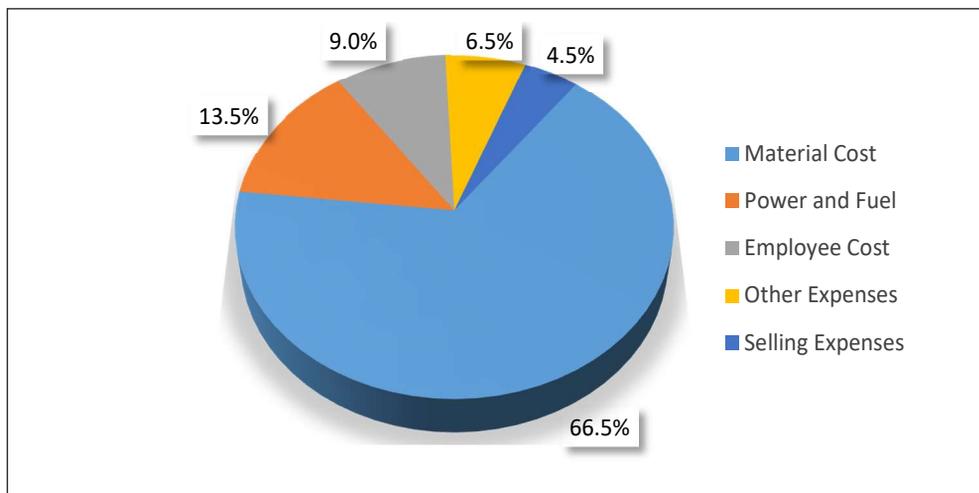
Box 5: Current Status of Technology Adaption in MSME Sector in Food Industry		
Segment	Technology (MSME)	Current Trend
Raw Food	Pouch Packaging	Vacuum Packaging
	Heat Steal Packaging	Freeze-Thaw Dehydration Technology
	Manual Packaging	
Processed	Pouch Packaging	Tetra Pack
	Aseptic Packaging	Aseptic Packaging
	Vacuum Packaging	Injection Moulded Plastic Container Packaging
	Heat Steal Packaging	Inert Gas Packaging
Semi-Processed	Vacuum Packaging	Vacuum Packaging
	Pouch Packaging	Tetra Pack
	Aseptic Packaging	Aseptic Packaging
	Heat Steal Packaging	Skin Packaging
Frozen	No Technology (Cold Storage facility is unavailable in MSME)	Freeze-Thaw Dehydration Technology

Innovation and Raw Materials

Various forms of packaging require various raw materials, viz., plastic, paper, cardboard and glass among others. Raw materials like Polyethylene (PE), Polyethylene Terephthalate (PET), Polypropylene (PP), and Polyvinyl Chloride (PVC) are used extensively in the plastic packaging. The cost of obtaining these raw materials has been increasing, with demand outstripping supply and reduced capacities in the refinery sector. Raw material cost though varies by types used, however, usually forms around 40% to 50 % of the operating cost in the global packaging industry.

Raw materials dominate the overall operating cost for the Indian packaging industry. It constituted about 48% of the operating cost in 2017-18³⁶. The rising raw material cost has been considerably putting profitability of the Indian packaging industry under pressure. The net margins in the packaging industry has been declining on account of the rising raw materials cost and depreciation cost.

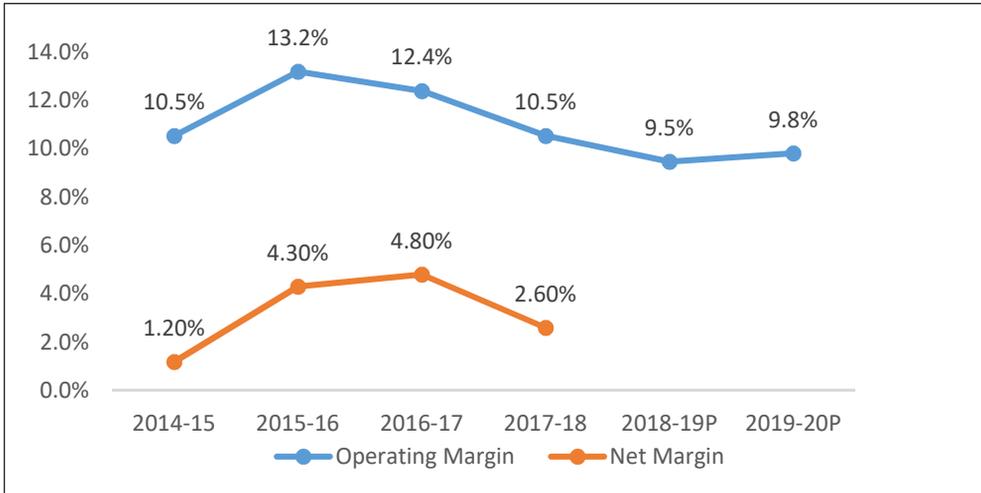
Exhibit 5.2: Expense Break Up for Firms in Packaging Industry (2017-18E)



Source: CRISIL, Exim Bank Analysis

³⁶CRISIL Research

Exhibit 5.3: Operating and Net Margin for Packaging Industry



Note: The actual data is available till 2017-18 and data for the next two years is projected data, so the net margin is not calculated for those two years.
Source: CRISIL, Exim Bank Analysis

The operating and net margins of packaging firms also reduces with the increment in the cost of raw materials. The projected operating margin for the Indian packaging industry is estimated at 9.8% for 2019-20³⁷. The operating margin has been low from the value ascertained during 2014-18.

Cost of raw materials have been significantly impacting the Indian packaging industry across most segments. The corrugated packaging industry has been largely impacted by non-availability of kraft paper domestically and high dependency of imports. The primary reason has been lacking adequate recyclable waste due to inadequate focus on waste management. With increasing demand from the e-commerce sector availability of kraft paper and improved waste collection and management will be critical for meeting the future demands of the industry.

In case of plastic packaging, volatility in crude prices directly impacts the manufacturers, which is often passed on to the consumers.

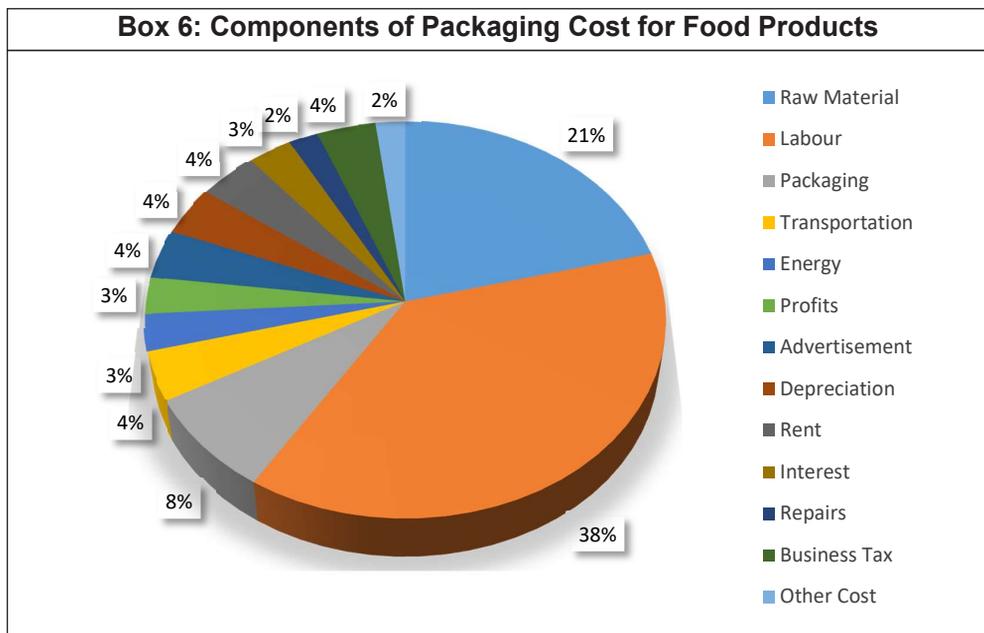
The cost of the packaging as a percentage of total selling price varies significantly across the industry largely depending on the type of products, design, and packaging requirements. According to the industry sources, the cost of packaging for a product ranges from 1.4 percent to 40 percent. Depending on the product line the average cost of packaging is estimated as US\$1 for every US\$11 spent.

³⁷Here data of a few companies, engaged in packaging sector, is taken for analysis

For food industry the cost of packaging is estimated to vary from 9 to 10 percent to up to 30 percent for frozen foods with increased specifications.

Products where packaging constitute a major portion of the cost of the product, increase in the cost of raw materials may have substantial impact on the cost of the product. This could have a direct impact on demand of the concerned product.

The current intense scrutiny of plastic packaging has led the packaging manufacturers exploring alternatives, such as plant-based fibres. An example, is microfibrillated cellulose (MFC) where plant fibre is broken down to micro levels and reconstituted as packaging material. This process can create materials that are stronger and lighter than those made of glass or carbon fibres, and MFC can be added to other packaging materials to strengthen them. However, research is still needed to find ways of producing this wrapping material in volumes, which is now confined to few grams that have been created in the laboratory. An additional challenge for any fibre-based packaging material is the ability to act as a barrier to elements that will degrade the contents, such as light, oxygen and moisture.



Source: Economic Research Service, USDA

Availability of Skilled Manpower

The packaging industry is labour intensive and requires skilled manpower for design development and innovation. Availability of skilled manpower has been a continuous challenge for the industry. According to a survey on 'Technical Gap Assessment in Packaging Techniques in MSME Sector'³⁸, lack of skilled labour emerged as the single largest (reported by 12.6 percent respondents) constraint for the industry. As per the industry sources, more than 35000 packaging experts are required currently for Indian packaging industry, while only 1.5 percent of it are produced each year.

The lack of skilled manpower are often also observed at the top management positions in the industry largely due to the dearth of skilled packaging professionals. With just few institutes in India, providing courses in the field of packaging and packaging technologies, there is a significant shortage of skilled professionals serving the packaging industry. There are also very few training centers and certification courses available in the field of packaging.

The cost associated with employing skilled professionals and experts are higher due to the demand supply mismatch, which impacts the pricing strategy and profitability of the companies associated with the packaging industry. The labor cost averages to around 20 – 35 percent of gross sales, varying in different industries. The packaging industry is also connected with various other industries through forward and backward linkages. An increase in labour cost in other connected industries also impacts the packaging industry in its cost management.

Lack of Credit Flow

One of the major challenges faced by the packaging sector is the shortfall in the regular flow of credit. Credit is required for maintaining the working capital as well as fulfilling the requirements of innovation and technology up gradation.

Timely and adequate credit availability is more crucial for the MSME sector, to maintain raw materials base and inventory. In the Technical Gap Assessment Survey on Packaging in MSME in India, inadequate credit availability emerged as the second most (reported by 12.1 % of the total respondents) challenging factor for the industry. Availability of institutional finance has been a major challenge for the MSMEs engaged in packaging sector.

³⁸NSIC

Challenges Associated with the Packaging Machinery Sector

The major challenges in the packaging machinery sector include rapid changes in technology and the expenditure on human resources. Machinery in the packaging sector is constantly evolving. Nonetheless, packaging manufacturers find it difficult to keep up with the changes mainly due to limited professional knowhow in the sector and costs involved in upgradation. Given that profitability lies in the production speed, automation is gradually penetrating the packaging machinery sector and subsequently minimizing the involvement of human resources. Manufacturers globally, are also adapting to the new technologies to sustain their market share.

Developing countries are largely dependent on the imports of packaging machinery to cope up with the rapidly changing technologies in packaging and commerce in the absence of an indigenous availability of such advanced machineries. This has often led to sub-standard or used machinery finding their way to the developing countries. To prevent such influx, many developing countries have even introduced legislations, explicitly prohibiting imports of any kind of second-hand machinery. Used and sub-standard machinery comes at a low cost comparative to the new ones or branded machinery, making the cost of operations viable for the developing country packaging manufacturers. Such practices and subsequent legislations have been a challenge for the packaging manufacturers in the developing countries.

In India, demand for packaging machinery and materials are predominantly in food processing and pharmaceutical sectors. About 45 percent of packaging machinery and products produced are absorbed by the food processing industry, 25 percent in the pharmaceuticals sector, and 10 percent each in personal products and industrial products segments. Indian packaging industry like other developing countries is heavily reliant on imported packaging machinery, adding significantly to the cost of production for the industry, besides exposing them to supply delays and loss of efficiency due to delayed maintenance service in case of breakdowns. India's imports of packaging equipment stood at US\$ 130 million during 2017³⁹. The rapidly changing packaging requirements, demanding frequent upgradation of machineries, have been creating additional cost pressure on the industry, impacting their competitive landscape.

Packaging industry as a user of machine tools in India has been much insignificant. Further, technological competitiveness of the Indian Machine Tools sector is low. While there are a few firms close to the international frontier in terms of product design capability and process technology, technological capabilities of

³⁹Wisconsin Economic Development Corporation

most players are extremely limited largely due to non-availability of skill sets in India. Majority of the players in the machine tools sector has a comparative disadvantage with respect to both product and process technologies, and are unable to produce high quality products due to limited availability of supporting process technologies, such as precision measuring, material engineering and process control. According to various studies, the defect rates of final products in India are often 5-10 times higher than that of developed nations, such as Japan and the USA. Lack of advanced packaging machinery produced within India have emerged as a considerable challenge for small manufacturers in the industry. In the case of packaging machinery, after sales services and maintenance have also emerged as limiting factor in the absence of adequate skill set.

The term “flexibility” has increasingly become a dominant term in the packaging machinery sector, that describes an equipment’s ability to handle a variety of products or formats. While flexibility is certainly emerging as a noble goal, however, has been failing to acknowledge the compromises it is leading to, which may further lead to lost efficiency. According to the industry experts, flexibility in packaging machinery may lead to compromise in at least one of the key areas, viz., performance, speed, price, changeover time/consistency, footprint or complexity.

Food Safety Regulations in Packaging

Packaging has a direct impact on food safety. Safety regulations in food packaging worldwide is a complex system involving global authorities, country specific authorities and multiple laws governing the use of materials, technologies, designs, and labelling that are generic as well as product specific. Packaging in food largely involves concerns in five key areas, viz., quality, contamination, physical damage, tampering and perception. The food packaging laws are often stringent and are subject to frequent revisions, modifications and amendments with shifts in preferences, dynamism in food supply chain, implementation of new technologies, outbreaks of diseases and implications in trade. The multiplicity and stringency of the laws, frequent changes in specifications, and resultant compliance remains the single most dominant challenge for the food packaging manufacturers, particularly for the MSMEs.

As packaging technology development is one of the key requirements to food loss reduction, and as addressing food loss is relevant to both smallholder food producers and food insecure consumers, the development of packaging solutions should be more oriented towards minimizing loss at production. However, present day innovations and responses are more private sector driven and export orientated, leading to gaps in packaging solutions in the backward linkages of the

value chain, resulting in complications in addressing the requirements of safety regulations and compliance.

The increasing trend by the multinational and large food companies towards processing traditional export commodities at the country of origin or source country, which are mostly developing countries, and introduction of new consumer-packed products from these developing countries to the world markets has been necessitating the developing country exporters to develop a thorough understanding of customer requirements in the developed country markets. This coupled with accompanying challenges in terms of marketing directly to the consumers in the target markets, using own brand names, and maintaining competitive packaging designs and of high quality, in line with the set regulations, have been posing constant challenges for the packaging manufacturers in the developing countries for producing suitable competitive products.

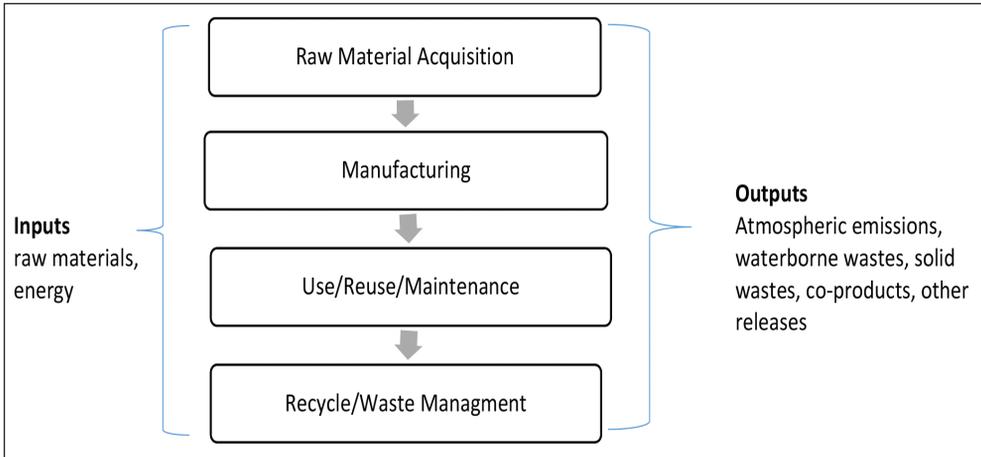
Environmental Concerns

Packaging processes has a direct and indirect impact on the environment. The direct environmental impact of packaging is the impact from production of the packaging materials used for primary, secondary and tertiary packaging. The environmental impact of packaging like other industries can be quantified in terms of air, water, and ground emissions, as well as in terms of a final waste product that must be eliminated. According to the industry experts, the relative contribution from packaging to the overall environmental impact is usually small.

In case of food packaging, while the direct environmental impact of packaging is the impact caused by production of packaging materials and end-of-life, its indirect environmental impact is caused by its influence on the food product's life cycle, e.g. by its influence on food waste and on logistical efficiency. To analyse and quantify the environmental impacts associated with various packaging materials, life-cycle assessment (LCA) has been an effective tool that is being utilised broadly to evaluate various environmental impacts of packaging materials. However, there are also several points in an LCA that can significantly change the result of the evaluation. These are, among others: the functional unit, system boundaries (geographical, natural as well as life cycle), data quality, and allocation. A traditional problem in LCA is the challenge to deal with processes or groups of processes with more than one input and/or output, and the limitations to deal with the use of recycled material in another product than the original.

A crucial challenge of evaluation and interpretation of the inventory results is that they depend on social and political preferences rather than on technical development.

Exhibit 5.4: Life Cycle Assessment of Packaging



Source: Life cycle inventory considerations for assessing the environmental component of sustainability for packaging materials (adapted from life cycle stages; Socolof et al., 2001)

An environmental assessment cannot mean only ecological impact analysis; neither can the judgment of environmental friendliness be based solely on the type of packaging material. Nonetheless, the rising environmental concern for the industry that has prompted people and government to take prohibitive actions has been with respect to the use of non-biodegradable materials. Reclamation of packaging wastes through recycling is being strongly promoted as sustainable options by legislative bodies globally. Challenges facing sustainable recycling solutions are many.

While environmental impacts tend to be lower with recycled materials, not all materials are good candidates for recycling. Combinations of materials also makes it difficult to separate (i.e., full-body shrink labels on bottles, direct printing, new plastic resins, coatings, single materials to multiple layers, etc.) posing substantial processing considerations. Contamination risks increases with commingled collection of a variety of items. Suitability of materials for processing and the use of recycled materials vary by material and type of product. There are open and closed loop systems; a closed loop system entails materials being recycled into the same material (i.e., glass bottles back into glass bottles), whereas an open loop system repurposes the materials. Metal and glass are generally amenable to closed loop systems. Paper made from a mix of feedstocks is generally weaker, use and reprocessing typically results in some fiber damage and weakening, and temperatures used are much more moderate and are not high enough to destroy organic contaminants. For plastics, the effort required for critical sorting steps to be conducted appropriately are enormous to minimise contamination risks.

BOX – 7 Case of Plastic Packaging and Environment

Plastic is one of the most inexpensive, lightweight and durable material and is used in various forms of packaging. Plastics have, perhaps, the most negative image, albeit of being lightweight and sturdy, thus giving high protection value with low direct environmental impact. Plastics represent 20 percent by weight of all packaging materials and are used to package 53 percent of all goods. Plastics, for the most part, are based on petroleum and natural gas. However, plastics' production accounts only for about 2 to 4 percent of overall consumption of oil and natural gas. Studies also suggest that a complete replacement of plastics by alternatives, such as paper, glass and metals and other biomaterials would increase the overall packaging consumption of packaging mass, energy and greenhouse gas (GHG) emissions. Alternatives has been revealed to have, in general, lower product to package ratio, resulting in the use of higher quantities of raw materials. They also require higher energy and water during manufacturing. In general, use of alternative packaging materials results in increased transportation requirement for product distribution, leading to more use of fuel, and more emissions.

Plastics are also a significant part of the composites used largely in packaging for their technological and economical advantages, such as paper-plastic composites, cellophane composites and plastic-plastic composites. Composites add substantial savings in materials and energy, considerably lower costs, and much less packaging waste. Researchers concluded that multilayer plastic packaging minimizes the quantity of waste destined to landfill. It uses less energy to produce, its energy content can be efficiently recovered, and it is a cost-effective solution. Plastics continue to have a negative image due to their challenges in management on disposal. Subsequently, countries have pledged to significantly reduce the use of plastics by 2030.

Replacing plastic in packaging

An estimate for Germany indicated that if the 32,000 tons of multilayer packaging used in 1991 should be substituted by other materials, 71,000 tons of paper, 100,000 tons of glass, 110,000 tons of steel, and 9,000 tons of aluminum would be needed, a total of 293,000 tons altogether. Not only it is nine times more packaging weight, but four and a half times more energy would be needed to produce the packaging materials, and the cost of packaging would increase three times. Going a step further, even assuming 90 percent collection rate, 90 percent of that quantity to be sorted and 95 percent of sorted material recycled would leave 67,000 tons of waste for disposal by other means. Even if certain amounts of the substitute materials would be combusted—such as paper—there would be 36 percent lower energy recovery than with the use of plastics.

Source: V. Williams, "Plastic Packaging for Food: The Ideal Solution for Consumers, Industry and the Environment"

Alternatives to plastic packaging, such as recycling and biodegradables have been emerging as probable solutions to addressing plastic waste management. Wastes from plastics packaging present a number of challenges in terms of recovery due to the composition and diversity of the plastics used and the fact that mixed wastes are often contaminated. There are several limits to plastic packaging recycling. Most restrictive are the technical limits. Due to the aging of the material and pollutants, such as additives, colors, and dirt, recycled postconsumer plastics can never completely replace virgin material. Due to the restrictive technical limits, mechanical recycling is not the major route in packaging plastics waste management and recommends feedstock recycling, such as hydrogenation, pyrolysis, gasification, or others, having process limitations in terms of complexities and costs.

Biodegradable or bioplastics are perceived to play an important role in the fields of packaging, replacing conventional plastics particularly in agriculture, food, consumer electronics and automotive. Biodegradable plastics are often perceived as the possible solution for the waste problem, but biodegradability is just an additional feature of the material to be exploited at the end of its life in specific terms, in the specific disposal environment and in a specific time, which is often understated. Currently, biodegradable plastic forms only 1% of about 300 million tonnes of plastic produced annually. Replacing the very efficient and decades old production system of petrochemical plastic remains a challenge primarily in terms of adaptability and costs associated with design and innovation, upgrading the machinery and technology to inherit the new form of packaging, which will be used as an alternative.

Biodegradable plastics comes in various forms, such as biodegradable, compostable, and oxo-biodegradable. Some bioplastics are perceived to biodegrade with oxygen and ultraviolet radiation, so litter can be left out in the sun for degradation. However, research has proven that it does not completely decompose releasing toxic chemicals, and the process takes years. The European Commission has recently recommended a ban on oxo-biodegradable plastics.

Most of the compostable plastics require industrial composting processes. Only a few are designed to biodegrade in backyard compost bins. However, success rates on backyard composting of compostable plastics are yet to be ascertained. Decomposition of bioplastics is reported to release methane, which is a more harmful greenhouse gas than carbon dioxide. Adequate and effective labelling of bioplastics for classified disposal has also been a challenge in replacement initiatives and waste management, particularly in food, where biodegradables are predominant.

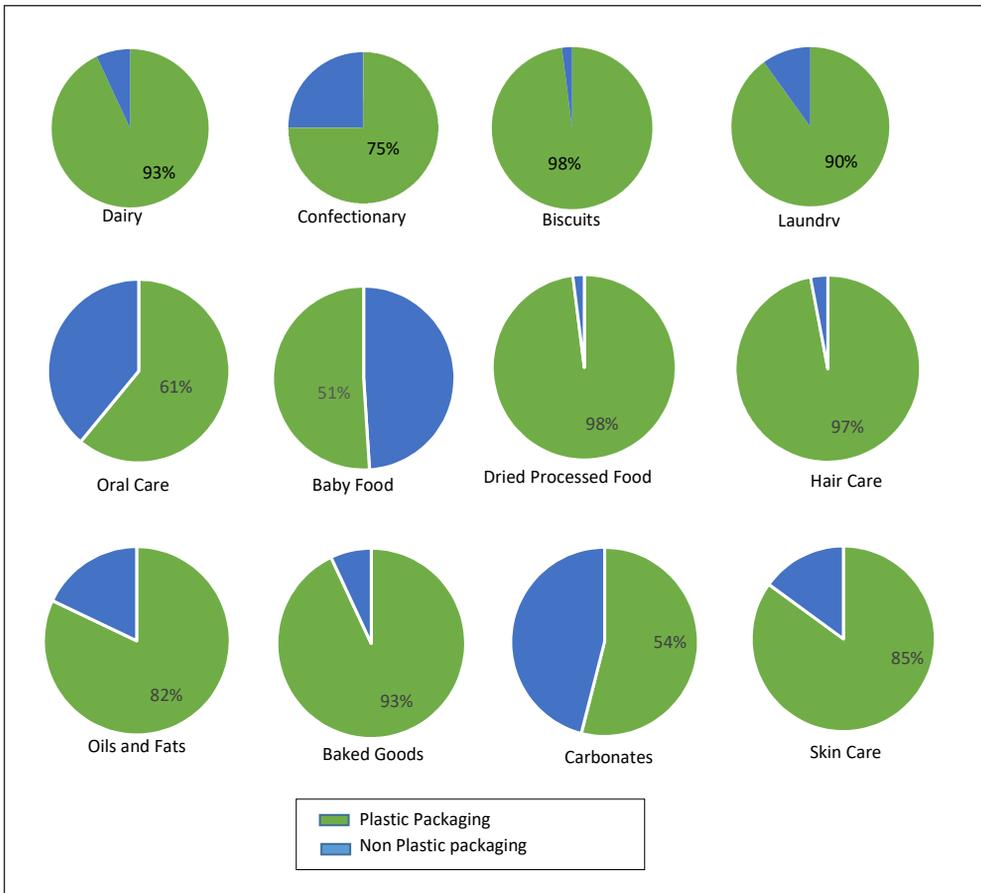
Eliminating Plastic Packaging in India

The plastic processing industry is estimated to be more than 22 million tonnes (MT) by volume and nearly half of this constitute single use plastic, according to a recent study by the Federation of Indian Chambers of Commerce & Industry (FICCI). India generates as much as 10000 tonnes per day of plastic waste with per capita generation of up to 5.7 kg of plastic waste per annum, which is growing annually at a rate of 8-10 percent. Plastic constitutes 6-7 percent of the total solid municipal waste in any major metro city in India⁴⁰. Most recycled plastics in India get shredded, melted, and reformed into goods—like lumber, fleece, or carpeting, eventually bound for landfills. As a result, the Government of India has been exploring options on banning some varieties of plastic. Some of the Indian states have already imposed a ban on single use plastics, lately.

Plastics are the material of choice in packaging FMCG products across categories globally. In India, an overwhelming majority of the FMCG products that households buy are packaged in plastic – so much so that some categories (e.g., biscuits, hair care) are almost exclusively packaged in plastic. Further, convenient packaging and online food packaging, and E-commerce packaging in India is largely plastic centric. A complete ban on plastic may pose some serious direct and indirect impact on the Indian packaging sector.

⁴⁰Central Pollution Control Board (CPCB)

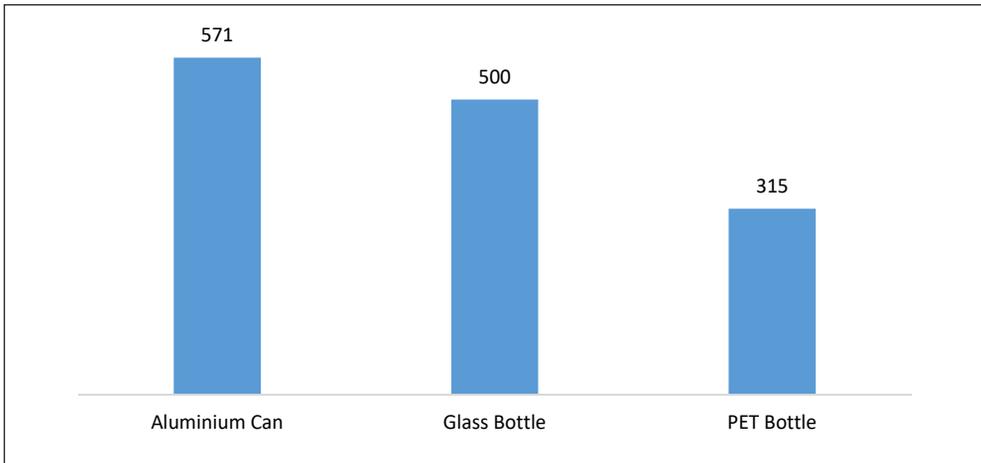
Exhibit 5.5: Use of Plastic Packaging for Various FMCG Products in India



Source: Euromonitor 2018

The ban on plastic is anticipated to directly impact around ₹ 53000 crore segment of plastic packaging, which provides employment to around 13 lakh people. Besides, the move may also increase the cost of packaging, resulting in increasing the overall cost of the end products. The multiplier effect of the same is foreseen to be even larger along all the segments using packaging.

Exhibit 5.6: Greenhouse Gas Emission for Various Packaging Types (lbs CO₂ & eqvts. Per 1000 units)



Source: FICCI, AIPMA

Packaging Design and Right Packaging

Packaging design continues to evolve with scientific and technological progress. The designing aspect of packaging emphasizes on two aspects, viz., functional parameters and printing parameters. The functional parameters are concerned about the height, weight, type of material, aesthetics and structure of the packaging. The printing parameters are relevant for the printing and labelling of the packaging material. Current age packaging design particularly food packaging, is expected not just to safely contain and transport products, but also to be a vehicle for communication of branding and other product attributes, such as health attributes, serving ideas, and convenience. With rapid changes in commerce, demography, environmental concerns and consumer preferences, packaging design are also under constant pressure to consistently re-innovate to suit the requirements. Globally packaging designs are facing increased demand for addressing consumer convenience, such as small package size, smart packaging, reusable packaging, and tracking and traceability; and environmental concerns, such as compostable and sustainable packaging. Increased e-commerce penetration is also making it increasingly essential to choose correct dimensions and materials for the packaging. With changing lifestyles, food packaging has been experiencing increased demand for innovation in designing and use of materials, with respect to longer shelf life of fresh and perishables, quality retention of fresh and processed products, and traceability enabled packaging, such as RFID. The rapidly changing needs of packaging design has been posing a constant challenge on the packaging manufacturers to remain competitive, particularly

for the small and medium ones in the less developed countries, due to lack of adequate resources in terms of knowhow, investments and skills. For developing countries, where unorganized sector dominates the packaging sector, such rapid changes in design innovations and labelling renders them largely uncompetitive in the market.

Cost of design development in packaging is also a limiting factor for the industry, particularly for the small players. Generally, 80 percent of the packaging costs go towards meeting customer convenience and requirements and the remaining 20 percent is used in other aspects of logistics. For example, in case of cosmetic industry, in lipsticks, the cost of the product is much lower than the cost of packaging. Most consumer products fall in this category.

In India, packaging design innovation, in terms of intelligent and smart packaging, as a percentage of total packaging is considerably low and is mostly concentrated in export product packaging. Particularly for food, packaging innovations, even for exports, have been primarily focused on packaging of primary processed products, such as grains, sugar, tea, and coffee. Innovation in packaging has been significantly low in perishables and tertiary processed products. As a result, around 90 percent of perishables in domestic markets are traded unpackaged, with significant percentage of wastage. Due to less focus on packaging, processed food market in India is also insignificant. Processing levels of food in India has also been stagnant at 2 percent for over a decade, adding further to the already high on farm food wastage. India being a price sensitive market, modern packaging technologies, such as active and intelligent packaging, have been largely commercially unviable due to the high cost of the products that comes in such packaging. To remain cost competitive, packaging material and technologies used in packaging by the manufacturers are also often poor in quality and inconvenient to use. Labelling and information provided on the packages are also often inadequate and or poorly covered.

Certification Multiplicity and Complexities

Packaging industry certifications are extremely complex and varied. These certifications are to verify that manufacturers are adhering to the highest standards in various areas of manufacturing of packaging materials, from processes and practices to customer focus and supplier relationships. Each certifying organization are different having different procedures to follow pertaining to the certification process. Packaging certification has become a necessary tool for trade in goods and products, particularly food products. For example, frozen food manufacturers often look for AIB certification on their boxes.

Similarly, retailers and distributors, claiming that their packaging is sustainable, look for either an SFI or FSC symbol on their packaging. Retailers and big grocery chains, such as Walmart, have very stringent certification requirements for their suppliers, which also include those in packaging. These certifications range from broad mandatory GFSI certification, third party audits, Global Market Program certification, that include for all operations from farm to final product including packaging, to compulsory product specific certifications again including packaging.

Besides being complex and tedious, multiple certification processes for packaging are also cost intensive. Different operations have different procedure of evaluation, hence there are no 'standard templates' or 'one fit all' process for the operators or manufacturers. Depending on the size of the unit, scale and the operations, a GFSI certification may cost over US\$ 7000 for a year, requiring a renewal annually. A combination of GFSI and FSMA certification may even cost up to US\$ 50,000. Average first year SQF certification cost may range from US\$ 5500 to US\$ 7500, which includes pre-audit, desk audit, certification audit, SQFI sign up fees, and related CB fees. Audit costs for the certification are one of the most cost intensive factors in the certifications. For example, SQF 2000 stage 1 offsite audit for single location may cost US\$1500 per day, and stage 2 on site audit may cost US\$3800 to US\$4000 per day per location. ISO-9001 is one the most cost intensive certification. Depending on the size of operations and preparedness the cost may range from US\$ 1000 to US\$ 80,000. In these certifications besides audit, the other most cost intensive and challenging factor is the implementation of the compliances required for the certifications. Such cost and compliance requirement have been not only challenging but often inhibitive for small operators.

In India, packaging certifications are often confined to the few large scale operators involved in international trade. For the predominant, around 22000, packaging manufacturers belonging to the MSMEs, certification has been a distant approach largely due to their limited awareness on the subject, scale of operations, limitations in technology adaptation, inability to meet the compliance requirements and investments and costs involved.



Source: Industry Sources, Exim Bank Research

India's domestic packaging certification infrastructure is much nascent and restricted to mostly bulk cargo packaging for hazardous products for trade and scattered certification of packaging materials pre-packaging. The mandatory UN certification, introduced by the Director General of Shipping, Govt. of India, primarily applies to the packages used by Indian exporters for carriage of dangerous goods by sea from India and also for transportation by air. The certified packaging bears the UN marking as indicated in the certificates, and packaged for hazardous products as required by the international standards. Indian Institute of Packaging (IIP) has been authorized as the nodal agency by Directorate General of Shipping and Directorate General of Civil Aviation, to undertake testing of bulk packages for the carriage of dangerous goods for export and also to issue the UN certificate. There are port to port transfer certification issued while transferring the packaged goods. However, these certification are not available while taking the goods via land or via rail. Food packaging is certified by the FSSAI with recently introduced requirements on FCMs. The recent norms on FCM are yet at a nascent stage of adaptation among the industry. The implementation of FCM may need a significant revamping of the existing operations by the manufacturers, which may pose considerable challenge for the small and the unorganized players.

Research and Development

Packaging is applied science combining knowledge from several disciplines that together contribute to the solution of a supply chain need. However, globally, the packaging industry has never been a driving force in holistic applied packaging research. Instead it has been fragmented into logistics research, material research, design and process research and market research, seldom recognising

the interdependence among researches carried out, i.e. the interdependence among material, production, logistics and marketing. Further, packaging as a subject has never been into mainstream education and research, and had been mostly confined to industries having packaging as part of their operations, hence, leaving gaps and delays in solutions in the supply chain needs related to packaging. The R&D spending has been low at around 0.36%⁴¹ and has also been confined to industries and its requirements in packaging mostly among the large players.

For Indian packaging industry the major challenges include limited indigenous R&D capability for design innovation, low research productivity, high capital investment requirement, process incapability, finishing, inadequate safety features, high costs, maintenance and operation, marketing and after sales service.

Firm level innovation in India has been considerably low. Technology acquisition from other nations has traditionally been the source of technologies. However, there has been minimal incentive, direction and capability to improve on them or update the existing technologies. Firm level absorption of acquired technology has also been low, particularly in MSMEs. The research spending as a percentage of sales amongst Indian manufacturers are also low when compared to the R&D spends of packaging companies in Taiwan, Korea, Brazil and other developing nations.

Policy Framework

Several regulations govern the Indian packaging industry – especially in the Food & Beverage and Pharmaceutical packaging sectors. Some major regulations include Prevention of Food Adulteration Act 1956; Plastic Waste (Management and Handling) Regulations, 2011; Food Safety and Standards (Packaging) Regulations 2018, and Food Safety and Standards (Labeling) Regulations 2018. Despite the early migration issues, the recently implemented Goods & Services Tax is expected to have a favourable impact on the organized packaging industry. Additionally, regulatory focus on sustainability is anticipated to increasingly necessitate the use of recyclable material requiring changes in the existing operations of the manufacturers. For instance, the Government of India has notified regulations proposing to impose a ban on all plastic bags with a thickness of less than 50 micron. Going forward, any regulatory uncertainty on use of materials may pose a major challenge to the packaging companies.

⁴¹R&D spending as percentage of sales of 9 listed companies

India's policy of import-substitution helped India achieve self-reliance in technologies for domestic production and consumption; however, the country could not adequately build capacities to create internationally competitive technologies to produce for the international markets, and also efficiently upgrade to advance technologies for the domestic market. As a result, there is a considerable lag and gap in acquiring export competitiveness across industries, including packaging industry.

Although Indian organizations are served by a network of national laboratories and institutional infrastructure, the quality is relatively poor when compared to those in the industrialized countries – putting India at a comparative disadvantage.

The role of national laboratories in designing and innovations varies from industry to industry. The success of national R&D activities are based on the level of laboratory-industry interaction and on the extent of market orientation of products and accessibility. Since most of the R&D efforts are limited to specialized institutes, rather than in-house efforts, market orientation has been traditionally a weak link.

Box 9: International Certifications in Packaging

 <p>ABS</p> <p>www.abs-group.com</p>	<p>ABS Quality Evaluations (ABS QE) works towards the performance of the companies' business, system, people and supply chain by helping the companies through management system certifications, verification, assessment and training. ABS QE facilitates the necessary certifications to get the product or service to the desired market.</p>
 <p>AIB</p> <p>www.aibonline.org/en</p>	<p>Main focus is on the global food industry and works towards food safety and grain based production capabilities.</p> <p>It was established as a technology and information center for bakers and food processors. They have expertise in the fields of baking production, experimental baking, cereal science, nutrition labelling, food safety and hygiene.</p>
 <p>FDA</p> <p>(Food and Drug Administration)</p> <p>www.fda.gov</p>	<p>Food and Drug Administration (FDA) is an agency within the U.S. Department of Health and Human Services.</p> <p>It Consists of the Office of Commissioner and four directorates overseeing the core functions of the agency which are Medical Products and Tobacco, Foods and veterinary Medicine, Global Regulatory Operations and Policy, and Operations.</p>
 <p>cGMP Compliant</p> <p>(Current Good Manufacturing Practice)</p> <p>www.fda.gov/drugs/developmentapprovalprocess</p>	<p>FDA ensures the quality of drug products by carefully monitoring drug manufacturer's compliance with its Current Good Manufacturing (CGMP) regulations. The CGMP regulations contain minimum requirements for the methods, facilities and controls used in manufacturing, processing and packing of a drug product to ensure that a product is safe for use and has the ingredients and strength it claims to have.</p>
 <p>FSMA</p> <p>(FDA Food Safety Modernization Act)</p> <p>www.fda.gov/food/guidanceregulation</p>	<p>FSMA is helping towards food safety system by shifting focus from responding to foodborne illness to preventing it. It has implemented rules that ensures the safety of the food supply, and is a shared responsibility among many different points in the global supply chain for both human and animal food.</p>
 <p>FSC</p> <p>(Forest Stewardship Council)</p> <p>us.fsc.org/en-us</p>	<p>FSC is an independent, non-profit organisation that works towards protecting forests for future generations. It provides a certification which ensures that products come from responsibly managed forests that provide environmental, social and economic benefits.</p>

 <p>G7 (G7® Idealliance)</p> <p>www.idealliance.org/g7spec</p>	<p>G7 is a method to ensure a similar appearance across multiple devices in the printing industry. G7 certification establishes a procedure to achieve colour accuracy from digital proof to printing press.</p>
 <p>GFSI Global Food Safety Initiative (Global Food Safety Initiative)</p> <p>www.mygfsi.com</p>	<p>The Global Food Safety Initiative (GFSI) works towards bringing together key actors of the food industry to collaboratively drive continuous improvement in the food safety management system around the world.</p>
 <p>ISO (International Organization of Standardization)</p> <p>www.iso.org</p>	<p>International Organization of Standardization is an international standard-setting body composed of representatives from various national standards organizations to ensure quality assurance procedures for many types of manufacturing processes.</p>
 <p>NSF (National Sanitation Foundation)</p> <p>www.nsf.org</p>	<p>National Sanitation Foundation is an independent, non-profit organization that certifies food service equipment and ensures it is designed and constructed in a way that provides food safety. NSF is internationally recognized and most food service equipments in the world are NSF certified.</p>
 <p>PEFC (Program for the Endorsement of Forest Certification)</p> <p>www.pefc.org</p>	<p>PEFC is an international, non-profit, non-governmental organization which promotes sustainable forest management by independent third party certification. PEFC works throughout the entire forest supply. It aims that timber and non-timber forest products are produced with respect for the highest ecological, social and ethical standards.</p>
 <p>SFI (Sustainable Forestry Initiative)</p> <p>www.sfiprogram.org</p>	<p>Sustainable Forestry Initiative is an independent, non-profit organization working towards promoting sustainable forest management. This forest certification standard includes measures to protect water quality, biodiversity, wildlife habitat, species at risk, and Forest with Exceptional Conservation Value. The standards is widely used across North America and has strong acceptance in the global marketplace.</p>

 <p>FSSC 22000 (Food Safety System Certification)</p> <p>www.fssc22000.com</p>	<p>The FSSC Food Safety System Certification provides a framework for effectively managing food safety and quality responsibilities. FSSC 2000 is recognized by the Global Food Safety Initiative (GFSI) and developed in response to the needs of the international food sector.</p>
 <p>SQF (Safe Quality Food)</p> <p>www.sqfi.com</p>	<p>SQF is a Food Safety Management Certification Scheme used to control food safety risks. Once the food safety management system is implemented it is audited and certified by a third-party certification body. The Food Safety Certification requirements provide a rigorous system to manage food safety risks and provide safe products for use by companies in the food industry.</p>
 <p>GMI (Graphic Measures International)</p>	<p>Graphic Measures International certifies, monitors and measures the performance of packaging suppliers. The organization works towards establishing processes for managing production and enhancing packaging quality.</p>
 <p>FEFCO (The European Federation of Corrugated Board Manufacturers)</p> <p>www.fefco.org</p>	<p>The European Federation of Corrugated Board Manufacturers is a non-profit organisation representing the interests of industry across Europe and addressing a wide range of issues, from technical topics to economical questions. It aims at providing the expertise and support needed to the corrugated industry decision-makers and employees of the sector. They also provide the information regarding the corrugated-packaging industry.</p>
 <p>Rainforest Alliance International</p> <p>www.rainforest-alliance.org</p>	<p>The Rainforest Alliance works towards biodiversity conservation by promoting sustainability in agriculture, forestry, tourism and other businesses. It also works towards sustainable livelihood by transforming land-use practices, business practices and consumer behaviour.</p>
<p>Source: Industry Sources</p>	

WAY FORWARD

Packaging is “a coordinated system of preparing goods for safe, efficient and cost-effective transport, distribution, storage, retailing, consumption and recovery, reuse or disposal combined with maximising consumer value, sales and hence profit”, hence, its importance in trade and consumerism have been intensifying. Technological innovations, focusing on marketing, labelling and prolonging shelf life, as well as protecting the environment, are transforming the future of packaging.

Some of the key technological developments in global packaging, other packaging solutions and implications for Indian packaging industry are discussed in this Chapter.

Materials and advanced packaging methods

Technological developments have been influencing the packaging industry in every sector. Food packaging being the dominant sector have been undergoing the most technological interventions in packaging. In the food and beverage sector, packaging is increasingly getting integrated with processing.

Sustainable Packaging: Packaging materials are selected based on the specific food types. Plastics have been used for long; however, with sustainable and green protocols recommending forgoing plastics, the renewed focus are on alternatives, such as biodegradable and sustainable packaging. Materials under development are polylactide acid (PLA) plastics, sugar cane pulp, fiber composite, and starch-based films. Plant based fibres in the form of Microfibrillated cellulose (MFC) are the prominent research area for sustainable packaging. However, there are three important issues to be considered in the evaluation of packaging sustainability; these are: (1) entire lifecycle of the package from raw materials through to end disposal to avoid problems being transferred from one part of the lifecycle to another (2) interactions between the package and the product it contains so that the environmental impacts of the product-packaging system as a whole are minimised (3) there is also a need to consider ‘triple bottom line’ impacts of packaging: on the business, on people and on the natural environment. The global sustainable packaging market size is expected to reach around US\$ 255 Bn by 2026 and is anticipated to grow at a CAGR of around 7% in terms of revenue during the period 2019-2026.

Active and Intelligent/Smart Packaging: Active packaging is a method, where the packaging material itself interacts with the food to confer longer shelf-life, higher safety, and improved hygiene. The presence of iron in such an approach slows down the oxidation process. Modified Atmosphere Packaging (MAP), a method whereby the package atmosphere has an artificially reduced oxygen level and inflated carbon dioxide level. Smart packaging is an advanced active packaging, relating to the use of sensors. Intelligent packaging, sometimes also referred as smart packaging, senses some properties of the food it encloses or the environment in which it is kept and helps in monitoring the state of these properties and conditions during transport and storage. Intelligent packaging devices include sensors, time-temperature indicators, gas sensing dyes, microbial growth indicators, physical shock indicators, and freshness indicators. Additionally, there are self-heating or self-cooling containers integrated with electronic displays, indicating important information on nutritional qualities and expiry dates. The process also includes some microwave packaging as well as packaging that has absorbers built in to remove oxygen from the atmosphere surrounding the product or to provide antimicrobials to the surface of the food. The action of indicators used in intelligent/smart packaging should be able to perceive and understand without the use of any external apparatus.

The advancement in these novel food packaging technologies involves retardation in oxidation, hindered respiratory process, prevention of microbial attack, prevention of moisture infusion, use of CO₂ scavengers/emitters, ethylene scavengers, aroma emitters, time-temperature sensors, ripeness indicators, biosensors and sustained release of antioxidants during storage. The global market for smart packaging is projected to reach US\$26.7 billion by 2024.

Nanotechnology in Packaging: Nanotechnology-based packaging, has been recently drawing considerable attention. This approach is concerned with molecular level material manipulation that can reduce spoilage or oxidation. Furthermore, there is secure hygienic production, processing and shipment. Nanotechnology-based sensors and coating materials can be used for pathogen and contaminant detection and tracing. Nanoscale silica spheres filled with molecules of a fluorescent dye have already been developed and are compatible with meat packaging, where they are able to detect the presence of the poisonous E. coli 0157 bacteria. Food monitoring based on anti-counterfeit technologies is currently in the research and development stage at various companies. Important research studies undertaken in the area of nanotechnology-based smart packaging include: barriers, mechanical and heat-resistance properties, sensing and signaling microbiological and biochemical changes, and traceability.

The global nano-enabled packaging market is expected to witness a CAGR of 12.9% during the period 2018-2024 and is projected to reach US\$ 72.3 billion by 2024. Despite the tremendous benefits of nanoparticles in food industry, there is great public concern regarding toxicity in human and the environment. Hence, there is an urgent need for regulation of nanomaterials before their incorporation into food processing, packaging, and food contact.

Antimicrobial Packaging: Antimicrobial food packaging systems have received considerable attention since they help control the growth of pathogenic and spoilage microorganisms on food surfaces. The three basic categories of antimicrobial packaging systems include incorporation of antimicrobial substances into a sachet connected to the package from which the volatile bioactive substance is released during further storage; direct incorporation of antimicrobial agent into the packaging film; and coating of packaging with a matrix that acts as a carrier for the antimicrobial agent.

The global antimicrobial packaging market is anticipated to grow at a CAGR of 5.2% during the period 2017-2024 from US\$ 7.7 Billion in 2016 to US\$ 11.5 Billion by the end of 2024. Food and beverages have the largest share in antimicrobial packaging. Rising demand for confectionery and bakery products are anticipated to drive the growth of the global antimicrobial packaging market. Asia Pacific is expected to dominate the overall market of antimicrobial packaging during the forecast period. Based on type, antimicrobial packaging market is segmented into commodity plastic, high performance plastic and engineering plastic, out of which, commodity plastic is expected to dominate the overall market of antimicrobial packaging over the forecast period.

Edible Coatings and Films: There is a growing interest in edible coatings due to various factors, such as environmental concerns, new storage techniques and development of markets for under-utilized agricultural commodities. The technique is fast catching up with the global food retail chains. Edible polymeric packaging materials can be made from polysaccharides, proteins and lipids as wrapping materials, standalone films, or can be fabricated into pouches and bags for subsequent packaging use. Can also be applied directly to the food product in a liquid form and then allowed to dry on the substrate. Edible films and coatings are generally used to improve the mechanical properties of the food, minimize respiration in fruits and vegetables, limit the movement of moisture and other gases, provide antimicrobial or antioxidant capabilities to the product, enhance the sensory properties, and extend the shelf life of the product. In some cases, blended films and coating are made by combining different ingredients to harness the advantages of the individual components to produce a material with

superior properties. Global edible packaging market size was valued at US\$ 697 million in 2016, and is projected to reach US\$ 1,097 million by 2023, growing at a CAGR of 6.81% from 2017-2023.

Retort Packaging: It is a form of semi-rigid flexible packaging made from heat-resistant laminated plastic. Food products, such as soups, pasta, rice, sauces, and cook-in-a-bag meals are sealed and sterilized in these pouches with a maximum temperature of 121°C. Thus, they are the preferred packaging for convenience, processed, and pre-packaged foods. Due to the sturdy packaging, retort pouches are reported to be protected during transportation and are also proven to be cost-effective during transit due to their light weight. They can considerably withstand temperature variations of up to 250 degrees and are leakage proof. Retort pouches are resource efficient as they utilize 5% of the packaging material and at the same time improve the food texture, flavor, and aroma. The technology is also reported to be energy efficient compared to packaging technologies using paper, metal and glass. The retort packaging market is projected to grow from US\$ 3.5 billion in 2020 to US\$ 4.5 billion by 2025, registering a CAGR of 5.1% from 2020 to 2025. The market is projected to grow following the surge in demand for more convenient food packaging. Pouches are forecast to have the largest market share in the segment and polypropylene as the raw material to have the highest demand among the raw materials used.

Aseptic Packaging: Aseptic packaging is a process in which food & beverages, pharmaceuticals, and others are sterilized separately from the packaging. These contents are further filled into the packaging container under aseptic conditions. Aseptic packaging is usually carried out at extremely high temperature to maintain the freshness of the products. The packaging eliminates the need of refrigeration, which makes it convenient for the 'on-the-go' consumers. Growing demand for packaged foods including ready-to-eat meals, dairy products, frozen meals, cake mixes, and snack foods is anticipated to drive the growth of the packaging. Increased shelf life and safety offered by aseptic packaging is expected to offer a competitive advantage for the technology. The aseptic packaging market was valued at US\$ 46.12 billion in 2019 and is expected to reach US\$ 66.5 billion by 2025, growing at a CAGR of 6.65% over the period 2020 – 2025.

Packaging machineries and automation

The world market for packaging machinery was valued at US\$ 36.8 billion 2017, and is estimated to grow to US\$ 42.2 billion by 2021 driven mainly by robotics and automation.

Robotics: Robots are transforming the packaging industry, particularly in the field of e-commerce. The ability of robotic arms to sort small items into boxes for delivery quickly and accurately has made them a most sought-after option with the manufacturers and retailers, particularly with medium and large scale operations. Robots offer flexibility in positioning and replacing for different jobs, while the systems can be reprogrammed to change their packing functions. Mobile robotic platforms that can navigate on their own around the warehouses, have also led to considerable efficiency improvements. Crates used to transport products, known as secondary packaging, are becoming increasingly important for retailers as the boxes are often placed directly on to supermarket shelves, rather than each item being unpacked. The whole process of getting goods from factory to shelf has been considerably fastened, with precision and consistency, alongside developments in sensors and computerisation monitoring at all time the performance of the robotic packaging. The future of automated packaging thus, is envisaged to have this type of “co-botics”, where robots work alongside humans to deliver a superior performance. Global packaging robots market size is expected to reach US\$ 4.6 billion by 2023, registering a CAGR of 9.6% during the period 2017-2023.

Automation: Implementation of advanced automation and control strategy in the food packaging domain plays a vital role. Compared to traditional methods, advanced control methods have several advantages. The modern architecture in food processing and packaging control system embeds a generic set of essential requirements with regard to timing, error diagnostics, coordination, periphery-control acknowledgement, and synchronization. Appropriate selection of technology standards can substantially improve the effectiveness of food processing and packaging. Readily available, enabling, and foolproof technologies can facilitate plug and play modular design strategy. Food processing and packaging industries entail: (i) integrated tool-set for design, implementation, installation, maintenance and modification of the automation architecture according to the requirements; (ii) connectivity to support change; (iii) generic but flexible data models to accommodate emerging standards; (iv) flexible information storage mechanisms; (v) runtime functionality across the system based on enterprise-wide network technology; and (vi) dynamic configuration and re-configuration of run-time systems over a distributed wireless platform, providing the inherent flexibility.

Safety and Traceability: In food processing and packaging, traceability has been extremely important in order to maintain safety and authenticity of the products.

Currently, the barcoding and RFID (Radio Frequency Identification) methods are being used extensively in packaging development for exchanging information sophisticatedly. RFID technology provides many advantages for temperature and humidity monitoring and tracking. Compared to conventional circuitry, RFID confirms a reduced amount of required instrumentation and interfacings. The most important feature with RFID is that it eliminates manual scanning, thereby saving considerable time and man hours, as well as decreasing the number of errors. Going forward, traceability guidelines is forecast to include withdrawal of dangerous food products from the market, operator responsibilities and requirements applicable to imports and exports.

Package Printing and Security: The use of printing inks in food packaging falls under the jurisdiction of the regulatory authorities, such as Food and Drug Administration (FDA). The regulations in effect require the ink materials to be manufactured under safe conditions and composed of organic compounds. Some of the current techniques used in this area include rubber plates with a raised image area that are printed with quick-drying inks directly on foil, plastic wrap, and other material, flexography printing, lithographic printing, and electron beam (EB) printing. Use of high quality inks and varnishes addresses many technical expectations including specific resistance, curing time, safety, and also sustainability and environmental challenges. Some food manufacturers incorporate packaging security in printing to combat issues ranging from consumer tampering to bioterrorism to product counterfeiting.

Digital printing has fastened innovation pace and speed-to-market, allowing just-in-time (JIT) systems to operate more efficiently as well as allowing for customization, portion packaging, and small-run printing. Digital printing for packaging is projected to have achieved rapid growth to US\$ 11.9 billion during 2020 registering a CAGR of 18.9% for the period 2015-2020.

Key trends in packaging

With E-commerce and e-retailing increasingly becoming the trend in the current age consumerism, packaging is evolving from just a protection and logistic tool to more consolidated solution for the markets and the consumers. Some of current trends in packaging solutions are:

Transit Packaging: E-commerce has emerged as the largest users of transit/protective packaging, creating a new segment altogether for the packaging industry. Global transit packaging market is projected to generate a revenue of

around US\$ 148 billion by 2024, growing at a CAGR of more than 3% during 2018-2024. The increasing penetration of local/regional vendors in the transit packaging market is stirring its growth globally. Transit packaging is broadly segmented into product type, end-user type, and geography. The global transit packaging market by product type is segmented into corrugated boxes, crates (wooden and plastic crates), pallets (wooden, plastic and metal pallets), and other protective packaging, such as bubble wraps, air cushions, foam packaging, insulated shipping containers, tapes, and protective mailers. The corrugated boxes dominated more than half of the total market share in transit packaging during 2018, registering a CAGR of around 4% during the period 2014-2018. The key end-user segment in the global transit packaging market is divided into food and beverage, retail, electrical & electronic industry, and industrial goods. Retail sector is the fastest growing end-user segment in the global transit packaging market, forecast to grow at a CAGR of around 4% during the period 2018- 2024. The growth in sector, however, has been varying across geographies largely due to the prevalent regulatory frameworks applicable to packaging and packaging materials in various countries, particularly in the food and beverage industry. A wide range of transit packaging products are used across the food and beverages sector depending upon the product being packed, nature of the product being packed, journey the product has to undergo and other durability and promotional factors. Regional economic development, rising investments, and increasing rate of consumption are also driving growth in this sector. In the recent years, China, India, Japan, and South Korea have emerged as the largest revenue generators in the global transit packaging market.

Omni – Channel Packaging: Omni-channel refers to retailing with both a physical and digital presence. Packaging companies across the globe are increasingly trying to assess the appropriateness of existing product packaging to suit an omni-channel strategy. With digital market places becoming increasingly the commonplace, the utility of traditional product packaging, and logistics packaging, are also transcending the barrier between physical and virtual. Bridging the divide between packaging for the two channels are currently, in focus by both consumer product companies as well as packaging manufacturers. Packaging for the omni-channel therefore, impacts the manner that a product packaging is designed right from the development process. The package development in the omni channel thus, offers from a multi-sensory, 3D experience in an effective 2D. This entails re-inventing and re-hashing current packaging not just structurally but also in terms of imagery/colours that can effectively include both the segments.

Packaging in omni channels thus, aims to have presence of products on-the-shelf as well as the virtual store consistent, seamless and with integrated brand communication across channels. For enhancing the benefits from packaging to suit the omni-channel, manufacturers and brand owners also emphasize on creating cost-effective packaging, which in addition to differentiating the brands, also provides appropriate damage protection and is optimized for delivery through multiple touchpoints in an online-retail channel. Focus on sustainability/'green' is an added packaging consideration. According to the industry reports, omni-channel influenced retail sales is projected to grow 58 percent by 2022. Going forward, a significant part of innovation in primary / secondary packaging for the omni-channel is forecast to focus on the areas, such as:

- Structural optimization – from material to design, suitable across the chain; robust primary packaging with vibration resistance, reduce transit damage and need for excessive secondary packaging; changes in package structure (material, space saving, reduced weight) for significant cost savings.
- Sustainable solutions - reducing environmental impact by reduction in packaging waste generation, increasing business profitability; applying cost effective packaging innovations including 'green and recyclable packaging'; and responsible sourcing of raw material.
- Increasing shelf life – tailored packaging for perishables (food and beverage) to suit the long supply chain; preserve the packed contents over the last mile.
- Enhanced security – increased digital penetration to mitigate the risk of counterfeiting, and as a prerequisite for higher transactions and purchases; aid product tracking along the distribution chain; enhanced security measures ranging from the more traditional methods (including RFID, holograms, or secure inks) to smart labels / smart caps.
- Customer experience – creating balance between functionality and aesthetics; creating customized / personalized packaging as a pillar of brand promotion; creating memorable packaging that translates into making a lasting impression.

Implications for Indian Packaging Sector

Indian packaging industry is at the crossroads. The inevitable shift from the traditional and unorganized sector is already evident in the gradual evolution of the Packaging Industry in India with emerging of some clear market leaders in the respective sub-segments. A large part of the growth in the industry can be

attributed to the transformational shift. Despite the transitions in the last decade, unorganized players still form around 45 to 50 percent of the industry.

Consolidation and M&A

Most of the product packaging in India by the unorganized sector has little or no product differentiation; hence, there is an intense competition among these small players at the regional levels based on cost competitiveness and product pricing. Further, most customers of this segment have multiple suppliers for the same product category in order to mitigate and diversify supply side risk. As a result of this and coupled with the fast changing dynamics of the industry these small players have been witnessing competitive pressure and looking for growth avenues due to stagnancy in businesses. This provides a significant opportunity for the leading players in the organized segments to consolidate the market.

Despite limited activity in the packaging space in India, historically, last decade has witnessed global players in the sector identifying Indian packaging industry as an attractive investment avenue. There has been profound presence of global players largely in the flexible packaging segment, which has witnessed a certain degree of consolidation due to the acquisitions and mergers. Such consolidation has been envisaged to bring in the much needed investments in the industry in technology, scale and skill development. With rapid change in consumerism in India towards convenience foods and products, this space is projected to witness further consolidation in medium to long term.

However, the other main segments of the packaging industry, such as folding cartons, corrugated cartons, and rigid packaging continue to be dominated by domestic players who though have built leadership positions in respective sub-segments in terms of products or end markets served, have limited access to technology and reach to global standards to position themselves internationally competitive.

Table 6.1: Merger and Acquisition Transactions in the Packaging Space in India (since 2012)

Year	Target Company	Segment	Bidder
2017	Oricon Packaging	Closures	Pelliconi
2017	Axiom Packaging	Closures	Guala Closures
2017	Max Speciality Films (49% stake)	Flexible Packaging	Toppan Printing
2017	Plus Paper Foodpac	Paper Packaging	Nippon Paper
2016	Powerband Industries (74% stake)	Flexible Packaging	Intertape Polymer Group
2015	Kamsri (Pharmaceutical Packaging)	Paper Packaging	Essentra Plc
2015	Packaging India	Flexible Packaging	Amcor
2014	Positive Packaging	Flexible Packaging	Huhtamaki
2013	Janus Packaging (65% stake)	Paper Packaging	Edelmann
2013	Parikh Packaging (60% stake)	Flexible Packaging	Constantia Flexibles
2012	Tiveni Polymers (75% stake)	Pharma Packaging (Plastic)	Gerresheimer
2012	Webtech Industries (51% stake)	Labels	Huhtamaki
2012	Ruby Macons	Paper	MeadWestvaco
2012	Neutral Glass & Allied (70% stake)	Glass Packaging	Gerresheimer
2012	Interlabels	Labels	Skanem
2012	Uniglobe Packaging	Flexible Packaging	Amcor

Source: *Avendus*

Key Potential Segments

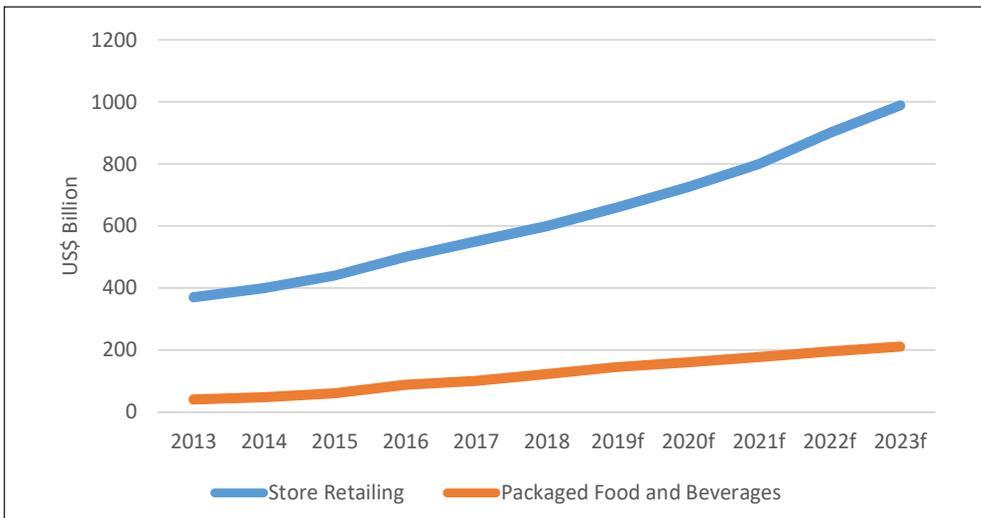
Food Packaging

The food packaging industry was estimated to be worth US\$ 40 billion in 2018. The industry is expected to reach around US\$ 55 billion by 2020. Urban regions account for 80% of the packaged food in India. The main categories of packaged food are bakery products, canned processed food, frozen processed food, meal replacement products and condiments. Nonetheless, the aggregated level of food processing and packaging is significantly low in India at around 10%⁴². With a per capita consumption of 24 kg per year, the Indian packaged food market is still at an early stage.

⁴²Rabo Bank

With rising urbanization, growing largest pool of young and middle to high income population, the industry is slated to undergo a transition from loose to packaged, processed food and beverage products in the next five years, and this is projected to aid growing consumption of packaged food and beverages in the country opening up new avenues for packaging development and trade. Store retailing, which constitute largely of food products is projected to grow at a CAGR of 10.5%, (2013-2023) to reach USD 984 billion by 2023, indicating inroads of packaged products in the semi-urban and rural regions. A consolidation of domestic manufacturers in the food packaging sector is anticipated to enhance investments and preparedness towards global standards of packaging. Food accounts for around 38% of flexible packaging market in India. Increased focus of the global players in this segment by way of acquisitions is anticipated to give much fillip to the food processing and packaging sector.

Exhibit 6.1: Trends in Indian packaged food and beverage and store-retailing market size, 2013-2023f



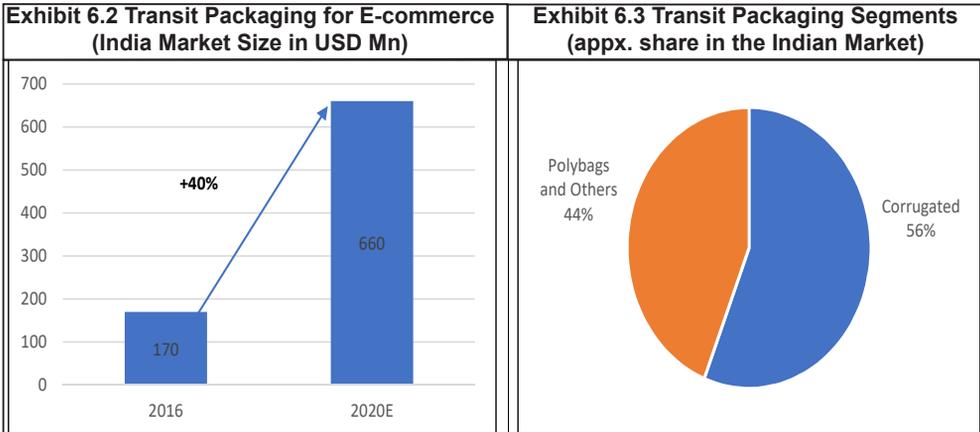
Source: Euromonitor, Rabobank Report

Transit and Corrugated Packaging

Increasing organized retail and the boom in E-Commerce, in the recent years, have also emerged as major growth drivers for the Indian Packaging Industry. E-commerce in India is projected to grow rapidly at a CAGR of 27% from 2017 to 2026 to reach US\$ 200 billion by 2026. With the steep growth in E-commerce and E-retailing, demand for transit packaging in India is set to witness an unprecedented growth. Despite the strong growth exhibited by the industry in the past few years, it is still in a nascent stage. Currently, India's share in the overall parcel shipments (transit packaging) worldwide is less than 1%⁴³. China and the USA account for more than 60% of the global transit packaging market. With a high growth potential, transit packaging market in India is set to grow four fold over the next four years, fueled by the growth in online retail sales; the sector, thus, is slated to become a meaningfully large segment.

Presently, there are only a handful of organized players catering to the transit packaging requirement in the e-commerce segment. The industry is highly fragmented with the presence of a number of small scale and unorganized players, who are not geared enough to cater to the expected rise in demand for transit packaging from the online channels. This increase in volumes is projected to have strong structural implications on the transit packaging industry necessitating an operational transformation going forward. The multi-fold increase in the number of shipments is forecast to inevitably give rise to an ecosystem of organized players of scale having ability to cater to large volume requirements of requisite quality. Further, it may also lead to consolidation of small players, and integration of ancillary industries, such as kraft paper and polybag segments.

⁴³Avedus



Source: Avendus Analytics 2019

Corrugated packaging comprises roughly 60% of the e-commerce transit packaging market globally. The Indian corrugated box industry is projected to grow from US\$ 2.5 billion in 2018 to US\$ 8.9 billion in 2023 in terms of revenue, growing at a CAGR of 22% during the period 2018-2023⁴⁴. The industry is highly fragmented with over 18,000 players with 10% belonging to the organized sector and 90% comprising of unorganized sector. The organized sector caters to 45% of the corrugated production, while 55% of the production comes from the unorganized sector. By use of technology, the organized sector uses automatic and semi-automatic machineries, whereas the unorganized segment is mostly labour intensive with manual production. The production capacity of the organized sector ranges from 1500MT to 3000MT per annum while that of the unorganized segment lingers around 100 MT per annum. India's corrugated production per capita is also one of the lowest in the world.

⁴⁴Ken Research

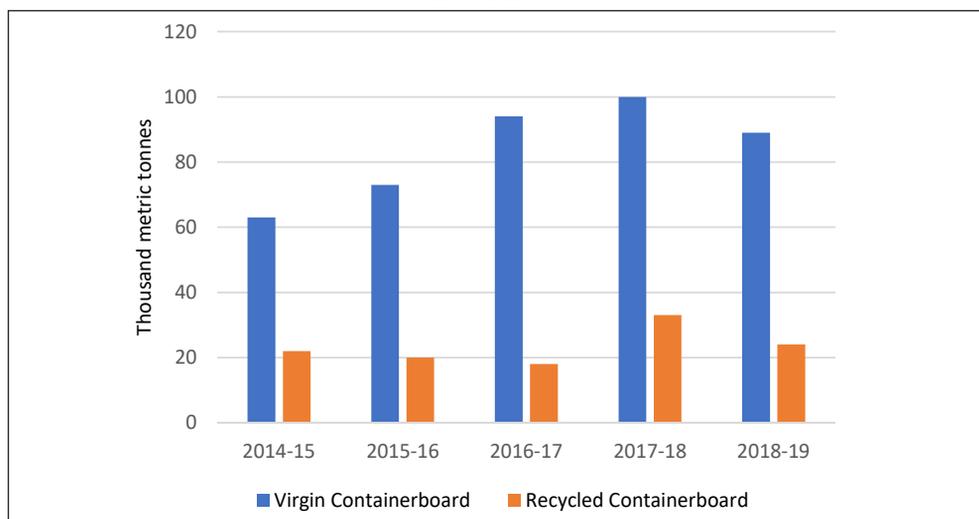
Table 6.2 India's Corrugated Production Per Capita Estimates 2011-2016

2011				2016			
Particulars	Population (in Mn)	Corrugated Production (in Msm)	Per Capita (in Msm)	Particulars	Population (in Mn)	Corrugated Production (in Msm)	Per Capita (in Msm)
China	1,348	50,341	37	China	1,382	68,639	50
India	1,207	6,275	5	India	1,289	9,566	7
Indonesia	240	4,525	19	Indonesia	255	6,876	27
Thailand	64	3,146	49	Thailand	66	3,810	58
Total Asia	3,254	68,791	21	Total Asia	3,423	94,772	28

Source: *India Corr Expo, 2019*

The industry is also heavily dependent on imported raw materials, in the absence of adequate domestic capacity and production, such as for containerboard, paperboard and krafts paper. The raw material industries are also largely fragmented with organized segment share in production ranging from 10% to 24% varying by segment. Of the total domestic production of 17 million tonnes per annum (tpa) by the domestic paper industry, packaging paper and paperboard production constitute the largest share of 8.7 million tonnes per annum, growing at 8.37% annually. Under the baseline scenario (2017-18), by 2024-25, domestic consumption is projected to rise to 23.5-million tpa and production to 22.0-million tpa. About one million tpa of integrated pulp, paper and paperboard capacity is required to be created in India on an annual basis over the current capacity to meet the growing demand. This will require serious consolidation in the industry and considerable investments in the operations. While the industry has been making significant capital investments to ramp-up capacities, the gestation period is long and the economic viability of the investments has been impacted significantly by raw material shortage and rising imports. There is a considerable pressure from the industry associations to limit imports of container board and other raw materials for packaging. Nonetheless, imports will continue to support domestic corrugated paper packaging requirements, especially in virgin containerboard.

Exhibit 6.4: Imports of Virgin and Recycled Containerboard in India, 2014-2019



Source: Government of India, Rabobank Report

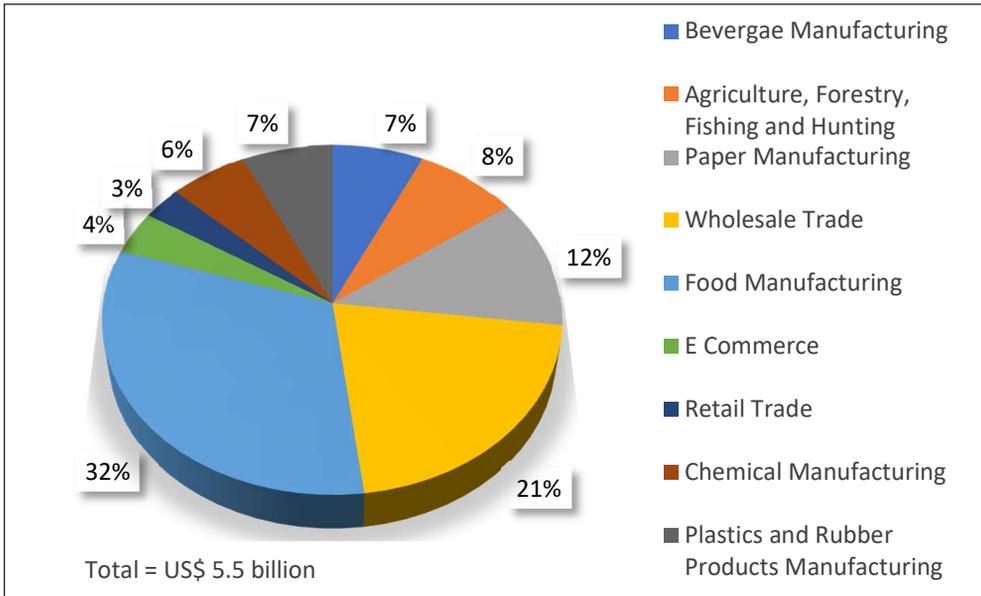
Table 6.3: Imports of Kraft Paper by India

HSN	Paper type	Imported Qty (in '000 tons)			5 Year CAGR [FY13-18]	10 Year CAGR [FY08- 18]	Proportion of FY18 total Paper imports	Largest supplier in FY18
		FY08	FY13	FY18				
4804	Uncoated Kraft Paper & board	57.2	153.2	226.1	8.1%	14.7%	6.1%	USA - 37%

Source: Ministry of Commerce, GOI

M&A activity in the industry has remained limited to the acquisition of a few stressed assets in the past. The limited availability of efficient assets has been a deterrent in M&A activity in the segment. At the same time, domestic and large international players are increasingly looking for market opportunities in the growing Indian market. Some global companies have already set up base in India and foresee to grow further with new converting plants. Many leading players are also entering the Indian market by greenfield investments in containerboard manufacturing. According to the industry experts, such large scale greenfield investments is set to drive significant consolidation in the industry, particularly in the corrugated converter and containerboard segments, leading to much needed development in the industry.

Exhibit 6.5: Consumption of Corrugated Box Market by End Users in India 2020



Source: India Corr Expo, 2019

The procurement of machineries with latest technologies from China, Taiwan and other Asian countries by the manufacturers in order to fasten the production and achieve product accuracy is also expected to drive the future of Indian corrugated box industry.

Box 10: Upcoming Corrugated Paper Packaging Greenfield Projects in India				
Company (country)	Type	Capacity	Investment size (USD m)	Status
Nine Dragons Paper (China)	Pulp, paper & board	not announced	650	Memorandum of understanding signed. First phase to be completed by 2022
Asia Pulp & Paper (Sinar Mas Group) (Indonesia)	Pulp, paper & board	5m metric tons	3,500	Memorandum of understanding signed. Project needs to be confirmed.
Emami Paper Mills (India)	Paper & packaging board (multi-layered)	0.45m metric tons	285	Project deferred for now.
Oji Group (Japan)	Corrugated converting plant	72m m2 per year	27	Scheduled to be operational by the end of 2019.

Source: Industry information, public reports, Rabobank 2019

Print Packaging

India is the fastest-growing print packaging market across all segments, growing on an average of 12.4% per year during the period 2016-2020. Indian print packaging is slated to surpass Germany in 2020 to rank fourth with US\$ 5.6 billion in revenue. According to the industry sources, the fast-moving consumer goods and food products are the sectors that offer the best opportunities for print packaging. Advances in multicolour flexo printing is also projected to facilitate in-house flexo printing and do away with screen printing, contract printing on offset presses, aiding the print packaging segment.

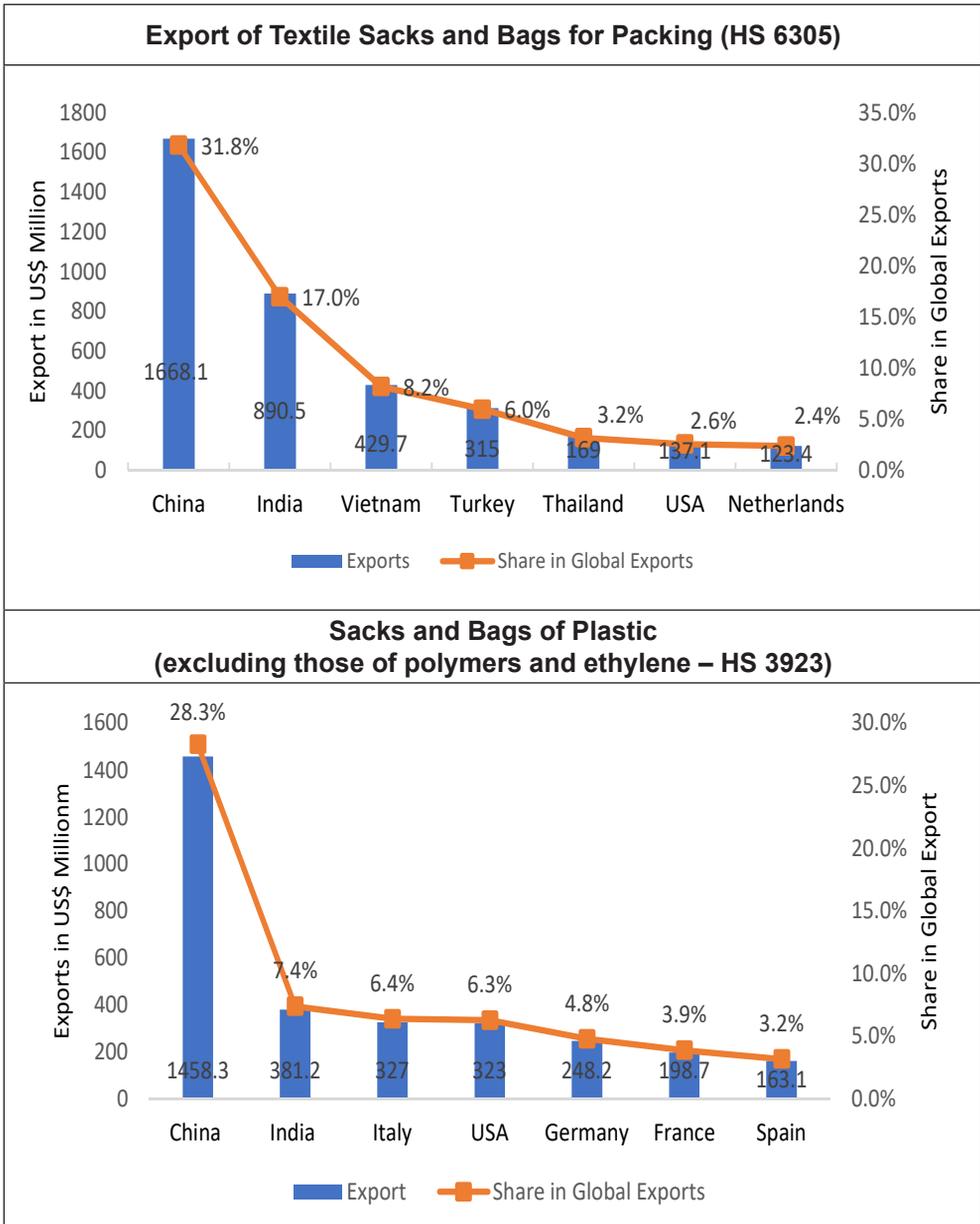
Flexible Intermediate Bulk Container (FIBC)

FIBC (Flexible Intermediate Bulk Container) is an industrial container made of flexible fabric that is designed for storing and transporting dry, flow able products, such as grains, horticultural products, sand, fertilizer, and granules of plastic. In the last decade India has emerged as the second largest market leader in this segment after China. The worldwide market for FIBC is expected to grow at a CAGR of 5.0% during the period 2017 to 2023, to reach to US\$ 9.2 billion in 2023, from US\$ 6.8 billion in 2017⁴⁵. India's output in FIBC is over 200,000 million tonnes per annum (MTPA), of which food grade FIBC output is over 67 MTPA⁴⁶. India is the second largest exporter after China in the FIBC segment. India exports FIBC to 114 countries. FIBC gained prominence in the Indian packaging industry due to increased use by the mineral industry and food industry. The production cuts by developed economies due to increase in cost of production owing to increasing labour cost coupled with stringent regulatory norms has also resulted in increased sourcing from India and China. The growth of the industry is largely driven by increase in exports of food and horticulture and chemicals. Additionally, the low-cost of shale gas, that is used as a major feedstock for the manufacturing chemicals, is driving enhanced production of chemicals, which is also driving the demand for FIBC bags. The increased need to reduce the overall weight of bulk packaging and transporting materials has also been driving the demand for FIBC containers in several other industrial sectors, such as construction, boosting market growth in the segment. One of the major trends that is forecast to gain traction in the FIBC containers market in the coming years is the usage of bio-based raw materials. The increased awareness towards the usage of synthetic plastics is projected to induce manufacturers to develop eco-friendly plastics that are easily recyclable.

⁴⁵Global Info Research

⁴⁶Careratings 2013-14 (latest available data)

Exhibit 6.6: Growth in FIBC Segments and Exports from India



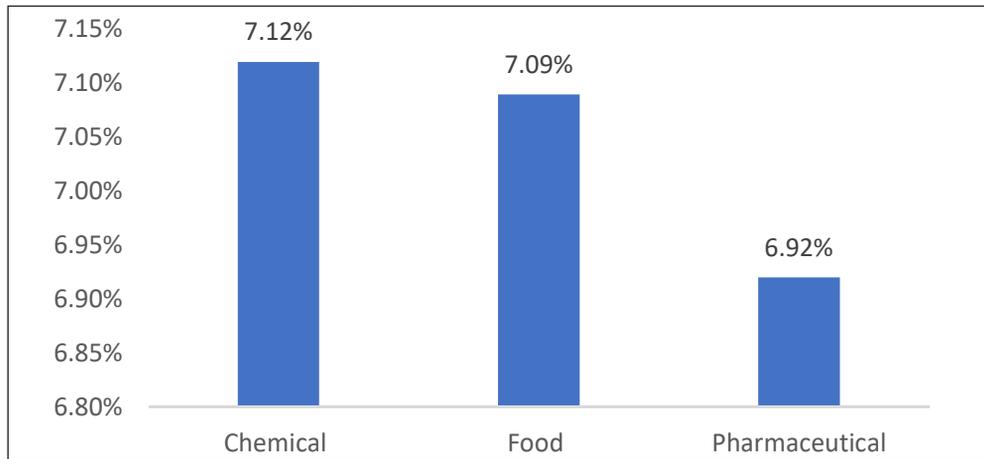
Source: ITC Trade Map, Exim Bank Analysis

The total global export of sacks and bags, of a kind used for the packing of the goods, of all types of textile materials was estimated at US\$ 5.2 billion in 2019. China is the leading exporter followed by India with latter having a share of 17% in the global export of the same. The global export of sacks and bags witnessed a CAGR of 0.2% over 2015-2019 period, while the exports of the same from India witnessed a CAGR of 9% over the same period.

The total global export of sacks and bags of plastics (excluding those of polymers and ethylene) was estimated at US\$ 5.2 billion in 2019. China is the leading exporter followed by India with the latter having a share of 7.4% in the global export of the same. The global export of sacks and bags witnessed a CAGR of 1.9% over 2015-2019, while the exports of the same, from India, witnessed a CAGR of 15.7% over the same period.

The Indian FIBC industry is projected to grow significantly driven by global demands in chemical, food and pharmaceuticals industry.

Exhibit 6.7: End User Segment Growth of Indian FIBC CAGR (2016-21)

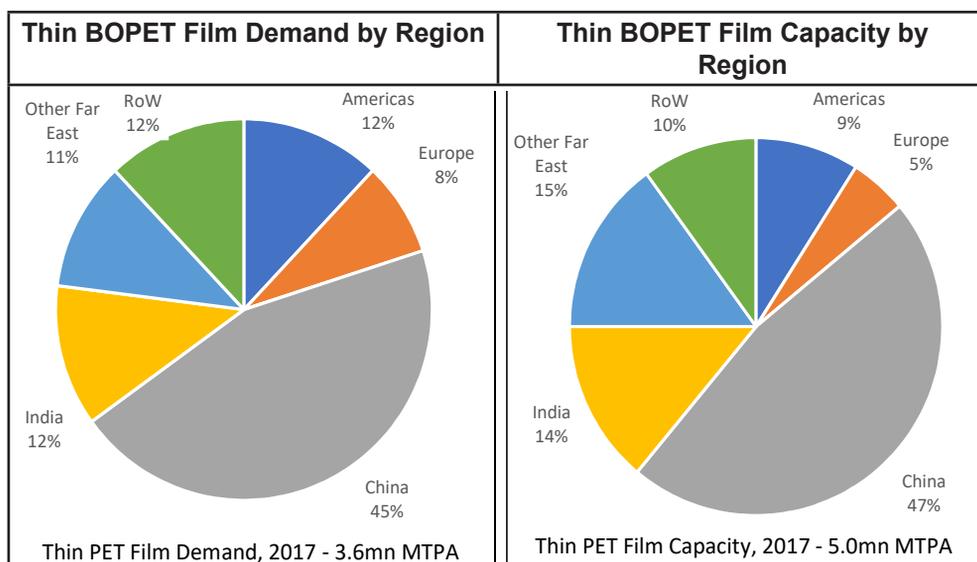


Source: Annual Report COMSYN Ltd.

Packaging Films

The global flexible plastic packaging market is estimated at US\$ 140 billion in 2016, and is likely to expand at a CAGR of 5.2% to over US\$ 200 billion by 2022. Films, one of the key raw materials for plastic packaging, is currently estimated as a US\$ 68 billion market accounting for about 23% of the packaging market. Within various plastic films, global PET (BOPET - biaxially-oriented polyethylene terephthalate) films accounts for 17% of the market and is estimated to be US\$ 11 billion in size. BoPET is a polyester film made from stretched polyethylene terephthalate (PET) and is used for its high tensile strength, chemical and dimensional stability, transparency, reflectivity, gas and aroma barrier properties, and electrical insulation. Global demand for thin BOPET film is expected to grow 5–7% annually over the next few years with India and other Asian countries outgrowing at 9–10% annually⁴⁷.

Exhibit 6.8: Global Plastic Films by Region



Source: Polyplex Annual Report

⁴⁷Edelweiss Research

The largest application of thin BOPET film is flexible packaging, which accounts for 72% of total thin film consumption. The high consumption is mostly led by the food and beverages sector and consumer staples, whose demand is non-discretionary and thereby, steadily feeds the packaging demand. According to PCI Wood Mackenzie, the Indian flexible plastic packaging industry is about US\$ 5.5 billion and is expected to grow over 10% annually to US\$ 9 billion by 2022. The BOPET films industry is fragmented with the top ten players commanding about 40% of capacity. India is one of the significant players in this industry, globally, with three Indian companies in plastic film packaging among the top ten global players. The flexible packaging segment and BOPET films' superior technical properties underpin structural growth for the Indian BOPET films industry. The growth of the top Indian plastic films companies is projected to be driven by global competitiveness backed by scale, operational strength, onshoring models and better product portfolios. While the business of the BOPET film industry is cyclical in nature, the earnings of the Indian BOPET film companies are projected to grow at a CAGR of 15% from 2018-19 to 2020-21 and RoCE at a CAGR of 13-14% during the same period. With China's dominance diminishing in the segment due to government driven closure of irrational capacity expansion and the stakeholders under pressure to deliver economic return, Chinese BOPET industry now accounts for about 47% of the global thin BOPET film capacity, but accounts for a miniscule portion of global trade. Despite a large share of global capacity, the impact of Chinese producers in international markets is limited because of a combination of quality, multiplicity of products, language, fragmented end user industry, tariff barriers and lack of onshore presence, paving favourable path for global expansion for Indian BOPET industry.

Box 11: Top Indian Players in Global BOPET Industry			
Particulars	Uflex	Polyplex	Essel Propack
Expertise	Fifth largest player in BOPET films globally, largest player in organised packaging space in India	Eight largest player in BOPET films globally to move upto among the top five post expansion	Has established global leadership in the oral care tube packaging category (market size: 14bn units) with 33% market share Contribution of oral care to overall revenue stands at 64%, as on FY19E
Geography wise opportunity	Strong presence in Dubai, Mexico, Egypt, Poland in films and India driven by packaging. High-growth India market accounts for 56% of overall sales mix	Within BOPET, PCL has 8% market share in India, 25% market share in highly profitable Turkey, 20% share in Thailand and 9% share in Indonesia (expected to go upto 20% post the capex)	Geographically well diversified with 35% of sales from AMESA (India and Egypt); 20% from Americas (US, Mexico and Colombia); 21% from Europe (Poland, Russia and Germany) and 24% from East Asia Pacific (China and Philippines).
Growth opportunity	Play on the cycle uptick in the USD 11 bn BOPET market for next 3 years; Play on the USD 5.5 bn flexible packaging market in India and the INR 20 bn tetrapack market in India	Cycle uptick in BOPET with 16% capacity addition	Focusing on the non-oral care category which is three times or more large as compared to oral care tube market. It is estimated that the non-oral category to be a USD 5 bn market (based on overall tube packaging market of USD 6.75 bn as per Mordor Intelligence)
Moving up the value chain	High margin metallised films and packaging together contribute 60% of sales by value	Value-added sales, has increased from 35% to 49% over FY14-18	Non-oral category's revenue contribution has grown from 29% in FY16 to 42% in FY19, recording a strong 23% sales CAGR over FY16-19.

Source: Edelweiss research

Edible Film and Wrap

The global edible film packaging market size is projected to grow from US\$ 527 million in 2019 to US\$ 679 million by 2025, growing at a CAGR of 4.3%. The growth in edible packaging solutions can be attributed to government initiatives, advancements in packaging technologies, and the development of new sources for edible packaging solutions. China, Indonesia and India are among the key markets targeted by edible packaging manufacturers and distributors due to the favourable government policies, such as ban on single use plastics, and established base of raw materials in terms of plant based sources that support the growth of the segment in these countries. The edible packaging industry is segmented on the basis of source into plant and animal. The market of plant based sources is projected to record a larger market share between 2019 and 2025. Edible packaging is steadily emerging as a sustainable alternative for container applications in foodservice and delivery applications.

Seaweed and algae have emerged as popular raw material sources in the manufacturing of edible packaging products. The inherent nature of seaweed as a nutrient-rich source of food further bolsters the adoption of seaweed in packaging applications, without the need for additional chemicals. Commercial seaweed farming across countries in Asia is emerging as a sufficient supply base for the industry.

Seaweed can be adapted across multiple food and beverage applications and pharmaceuticals. Beverages have shown a strong sector for growth in the market. Foodservices industries' use of plant based edible packaging include product lines, such as wrapping paper, containers, and replacements for plastic sachets.

About 844 seaweed species are documented from India. With 7500 km stretch of coastline, India has considerable potential in production of seaweed. The Central Salt and Marine Chemicals Research Institute (CSMCRI) at Bhavnagar, Gujarat in India has been doing pioneering work in the area in research and propagation of seaweeds as potential food and food applications. Strengthening of research in the area with appropriate investments and encouraging commercialization of edible seaweed and algal production and processing may result in India emerging as one of the global leaders in the industry.

Global edible packaging wrap market by ingredient type protein, polysaccharides, lipids, composite films, and surfactants, which are considered safe for human consumption, is projected to grow from US\$ 697 million in 2016 to US\$1,097 million by 2023, growing at a CAGR of 6.81% from 2017 to 2023. Protein-based

films are expected to grow at a CAGR of 7.5% during the same period owing to its benefits to the human body and the protein layers can be easily applied onto the small portions of food items. Rise in consumption of packaged food is projected to drive the edible packaging market significantly. Asia driven by growth in China, Japan and India, is projected to emerge as the third largest region of edible wrap packaging. Other factors driving the growth of the segment will be the advancement in technologies, such as nanoencapsulation of composites, and shelf life enhancement. However, high cost of manufacturing of edible packaging and stringent regulatory frameworks will be the limiting factor in its growth path.

Advances in Machinery and Equipment

There are about 600-700 packaging machinery manufacturers in India, of which 95% are in the small/medium, and unorganized sector. The Indian packaging machinery manufacturers in the small and medium and unorganised sector mostly fabricate general-purpose equipment to serve the basic needs of the industry. Majority of the updated machinery needs of the industry is met through imports. India imports over 25% of its total packing machinery requirement from Germany, Italy, Switzerland and lately Taiwan, Korea and China. Indian imports of packaging equipment consist mainly of highly-automated advanced machines and systems. In 2018, India's total import of machinery from Europe was estimated at US\$ 16.15 billion. Food processing and packaging machinery was the third most important sector in terms of volume in European export of machineries. India is also the second largest sales market in Asia for the German machinery industry. However, lately, growing interest of Indian packaging manufacturers in machines made in China, Taiwan and other Asian countries has been meta-morphing to next level of European machines. Many Indian packaging machinery manufacturers are also entering into alliances with Chinese, Taiwanese and European manufacturers leading to facilitating technology transfer and upgradation of operations in the industry.

Key segments of machinery imports in the industry have been for manufacturing aluminium beverage cans. Machinery for cleaning and drying containers; automatic high-speed labelling machines and capping machines; sealing machines for cans, boxes, and other containers; machinery for filling, and closing bottles and cans, packing/wrapping machines and moulding machines are the other potential segments.

Due to intense competition in the end-user market the cost of equipment, the low running/processing cost and the ability to seamlessly incorporate the equipment in the facilities remain the primary factors influencing sales and purchase of machinery, followed by upgrading and after sales services.

The Indian Machine Tools Industry has a major role to play in this area. Currently, the structure of the machine tool industry is rather skewed, 80% of production comes from 25 companies in the organized sector and balance from over 300 fragmented small size and unorganised companies. Approximately 75% of Indian machine tool producers are ISO certified. Government of India-owned Hindustan Machine Tools Limited (HMT) is the single largest producer with a 32% market share in total machinery manufacturing. Public Sector Enterprises like Hindustan Machine Tools Limited and Heavy Engineering Corporation (HMTP) Limited besides Mysore Kirloskar Limited also contribute significantly in the sector.

Though Indian machine tool industry manufactures a range of both conventional and computer numerically controlled (CNC) products, such as metal cutting and metal forming tools, and also offers many special purpose machines, robotics and handling systems, the pace of innovation, upgradation and development has been considerably low compared to the requirements of the packaging industry. The machineries developed also lacks in competitiveness with the international counterparts.

Going forward, in order to make the Indian packaging machinery industry to be self sufficient, and curtail imports, as also to enhance mechanization and advancement across the packaging sector, the Indian machine tools industry needs to significantly scale up in terms of investments in R&D driven technology, skilled manpower, production capacities, speed and quality of production, and testing abilities, supported adequately by post sales and upgrading services. The industry also has to focus significantly on remaining cost competitive with the products. Focus should be also on consolidating the industry, which will significantly aid the scaling up objectives. In order to build up a robust production capacity and bridge the gap between production and end user requirement, the emphasis for the machine tool industry should be on creating an effective connect with the packaging manufacturing industry through productive interactions and developing understanding of their needs.

Technology Needs

The technological advancements in packaging sector have been rapid with the advent of the space and the information technology, which gradually required and also facilitated the changes in consumer food habits and preferences across the world. While some of the large Indian manufacturers are making use of the new technologies to increase production, meet international quality standards and thereby increase profitability, the unorganized manufacturers are adopting technology in a sporadic manner. Although market opportunities in

technology upgradation have been emerging in the recent past, requirement of investments, with the long gestation period have been impeding the adoption of new technologies.

While investments in technology development in a developing country scenario like that of India has been often trade reactive, a dual investment scenario has been observed where very little investment has been made so far in developing traditional technologies, and in providing packaging solutions for the entire value chain, particularly for the food sector. For the agrarian economy, like India, the focus of investments has also been on products that interests the international packaging industries.

Thus, for India, where SMEs and unorganized players are integral part of processing and packaging manufacturing, technology developments and advancements should take into account the applicability and appropriateness to the level of need and capacities of the would-be adopters. It may be imperative to invest on developing, upgrading, channelizing and accurizing the indigenous technologies and integrate them with marketing and advertising. This is been increasingly practiced in other developing countries with established exportability in packaged food, such as Thailand, Philippines, Malaysia, Indonesia and Egypt.

Although packaging opportunities abound on the basis of needs and requirements of the food sector (and other sectors as well) in India, the translation of actual demand is contingent on meeting the specific packaging needs of the product. To maximise the benefits of packaging and profitability in food supply chain, the packaging technology solutions should focus on reducing food losses at every stage along the value chain, viz., production, post-harvest, distribution, processing, wholesale, retail, and consumption.

Technology development should not be in isolation and should effectively consider the interdependency of the activities in the supply chain, viz., packaging design and supply chain design. It is imperative for packaging technology developers in India to emphasize on:

- gaining understanding of the supply chains serving different industries and organisations in detail, analyse the consequences of new supply structures and changes that influence packaging.
- developing tools to demonstrate how to utilise packaging in product development, thus making products competitive in different markets.

Restructuring R&D

Packaging is an applied science combining knowledge from several disciplines that together contribute to the solution of a supply chain need. The R&D in packaging therefore, should be a consolidated approach of combining material, production, logistics and marketing. Globally, the national R&D services is driven much by industries' and trade requirements, while in India, national R&D services work much in silos. In India, while larger manufacturers in the packaging sector have their own R&D infrastructure, MSMEs and unorganized manufacturers largely depend on the national R&D infrastructure for their technology needs. Creating an effective connect between the industry and national R&D services is therefore, crucial for developing internationally competitive indigenous technologies and bringing the MSMEs in the packaging sector under the ambit of R&D driven technology advancements.

In order to keep pace with the global developments in the packaging sector, there is an urgency in relooking at the way national R&D set up has been operating in terms of degree of awareness on the industry needs and preparedness of the systems in providing appropriate solutions to the needs. This may also need a restructuring of the national R&D set up.

Traditionally, packaging in Indian R&D was not a part of applied research or mainstream research and was treated mostly as an ancillary research area for transportation of goods. Hence, there has been less focus on packaging R&D infrastructure in India, with just handful of institutions providing packaging studies as subject of research and development.

In the current scenario of packaging requirement, the revamping of the national R&D infrastructure need to be inclusive. Besides, building research capacity in the dedicated national institute of packaging, and effectively employing universities in research and development for the packaging industry may aid R&D upscaling. This may include implementing packaging engineering/studies as mainstream subject and research area, and mandatory industry interaction by way of R&D driven internships.

Improving coordination among R&D programmes through mergers and consolidation of institutions that work in similar areas of packaging research and creating 'Centres of Excellence' may also aid in scaling up the public R&D infrastructure and industry connect. Emphasis should be on promoting strong linkages among R&D institutes/universities and industrial extension agencies and manufacturing enterprises. International cooperation among R&D institutes and building linkages for technology development and technology transfer should also be emphasized. Addressing IPR issues should be inclusive. Equipping and encouraging national institutes for providing contract R&D services to international packaging manufacturers may aid technology and knowledge upgradation in the public R&D facilities.

Box 12: Indigenous Packaging of Olive Oil in Egypt

Indigenous Packaging Made Waves and Facilitated Sustained Presence in Export Market

Industry level

Competition in the global olive oil consumer market is fierce and is monopolized by traditional producing countries like Italy and Spain, and there is very little room for newcomers, unless in bulk, where the oil would be bottled under known brands of traditional producers.

Country level

Egypt emerged as an olive oil exporting country only in the mid-nineties and the tiny export quantities were mostly in bulk. As such, the country lacked image and branding which negatively affected producers who wanted to export added value olive oil in consumer packages.

The packaging strategy:

Objective: to add uniqueness to the product through packaging which would attract consumers, and Egyptian olive oil producers innovated a premium package with well executed details for export markets.

The package: consisted of a wooden box made out of recycled light wooden boards covered with papyrus which is a thick paper-like material produced from the pith of the papyrus plant, *Cyperus papyrus*. The papyrus is hand-painted with scenes of Egyptian old civilization.

The outcome: For this innovative packaging style, consumers in export markets were attracted to buy from a new non-traditional producer with little track record in the market. The painting on the packaging though bears no relation to olive oil what so ever. The package, which is entirely hand-made, also helped sustain the livelihood of craftsmen and women and young artists.



Information source: FAO, Olive Oil Producer Egypt

Promoting industry networks for a consortium approach to industry R&D activities and integrated development of new product designs and production processes, with the intensive involvement of, and collaboration with suppliers may make public R&D in the sector more industry driven. Making resource allocation more performance driven may render public R&D institutions more demand driven and service oriented.

National R&D institutes should acquire international accreditations for granting product certification in India and for providing, in competition with private consulting firms, effective technological extension services in order to help Indian packaging firms improve their manufacturing and design capabilities. National accreditations at par with international agencies may also help address the issues with high cost of certifications.

As to packaging machinery, R&D and creativity with technology with locally designed equipment suited to local needs and conditions will help propel packaging industry development substantially. This may also drive exports of machineries at a regional level catering to similar operating conditions and needs.

Finally, investments in R&D in the sector has to be significantly raised from current dismal rate of less than 0.36%, to achieve competitiveness in R&D and technology development in the industry.

Optimizing Packaging Cost

For cost sensitive market like India, packaging cost is of prime concern for the packaging manufacturers as well as the end users, to whom the cost of packaging development is eventually passed on, e.g., in the case of food value chain, these include users from the farm, processing and the distribution sectors. Packaging cost is a significant factor in product pricing. A comprehensive analysis of the true value of packaging and the options available, including factoring the demand for commodities requiring packaging, resource availability and innovation capacities, among others, can place the cost of packaging in the right perspective.

Packaging cost is a factor of length of the manufacturing chain and the cross sections involved. For forward looking packaging manufacturers, cost of import of technology has been a deterrent in adaptation of the technologies. For MSMEs, remaining cost competitive or increasing their competitive intensity has been a major factor in adapting operational changes and pricing products.

Major items of packaging costs include, corrugated container cost, protective packaging material cost, protective packaging material labour cost, overhead cost, cost of compliance for regulatory harmonization, return and replacement costs, shipping cost, repair and discard costs, insurance cost, opportunity cost,

inventory cost, customer retention cost, and buffer inventory cost. In the current dynamics of the packaging industry, research reveals that adoption of smart packaging technology may considerably eliminate some of these costs and improve on the other necessary cost elements. According to various industry research, some of the most essential factors identified in reduction of packaging cost include: research on reduction cost by redesigning, reducing multi layering, recycling, storage space optimization, process improvement, supply chain cost management, materials substitution and reusing.

Nevertheless, challenges in reduction in packaging cost is compounded by factors, such as growth in the number of alternative packaging materials, growth in the number of suppliers as global procurement strategies dominates, changing process and materials technologies, highly volatile commodity pricing that can have either a minimal or significant impact on final packaging material prices, the need for continued investment in new packaging technologies, supplier unwillingness to share cost and operating information with customers, tendency for suppliers to over-engineer products in order to improve profit margins and maximize quality performance and incentive for suppliers to minimize their costs even if total supply chain costs increase. Thus, going forward, competitiveness of the current packaging suppliers and manufacturers will be a key factor in determining the overall packaging supply chain costs.

Working out a cost index for packaging with appropriate weightage may be an alternative for the packaging industry in optimizing cost. One of the prominent practices by the global players in working out the index has been to evaluate the performance of all the materials and determine their costs and rate them. Reducing the packaging weight has been an important factor. For example, continuing use of expensive raw material but reducing the weight, packaging manufacturers in Canada have been able to reduce packaging costs by around 50% in the last two decades. Similarly, adopting latest alternatives, such as wrapping stretch films as per government approved regulations in food services and retail is also aiding cost reduction in food supply chains.

A major concern on packaging cost for SMEs has been to package containers for transport. The options have been to use cheaper single use containers or invest in multiple-use containers. Many packagers are increasingly turning to reusable containers (totes, boxes and bins), reusable pallets, and pallet pooling systems (pallet rental) for multiple transport trips in closed-loop and managed open-loop shipping systems.

Reusable transport packaging has a higher initial cost than the single use ones or limited use transport packaging, because of their durability in design and being manufactured using longer lasting materials. Other costs concern may include

new material handling equipment and storage systems, reverse logistics (the return transportation of empty reusable packaging components), maintenance and repair, and asset tracking and depreciation. However, these costs are often off-set by the saving opportunities and frequency of reuse over the extended useful life of the packaging.

Pre-packing and Contract packing arrangements may be an impactful option for SMEs to effectively address the cost and investment concerns on sourcing of raw materials, equipment and technology for packaging. This is practiced as an export packaging option in many food exporting developing countries. The contract involves receiving the goods unpacked in the packing stations and the packing operations performed centrally on behalf of several exporters. Smallholder producers/packers purchase packaging materials collectively, either through informal groups or cooperatives to benefit from bulk purchase discounts, procure high value/imported packing materials, and thus save on transport costs, which otherwise adds substantial cost to their small operations. These arrangements also address their investment needs of technology and equipment.

Container standardization is being increasingly adapted as a cost reduction strategy, and has given rise to a wider range of package sizes to accommodate the diverse needs of wholesalers, consumers, food service buyers, and processing operations. Use of recycled packaging materials for products including food, which pose no or less challenge of contamination may also aid cost reduction for SMEs in their operations.

As global aggregators and importers increasingly prefer packaging at source of production, these arrangements may help the SME packaging sector enhance their viability substantially.

Plastic Packaging

A complete elimination of plastic from packaging may not be a viable option. The impact it would have on economy, employment, environment and consumers will be multi-fold and far-fetched. More prudent solution is thus, required to address the prime concern that has dented the plastic packaging industry in the recent years; - the environmental concern with plastic waste disposal and management.

Creating a robust regulatory framework on sustainability in plastic packaging may include significantly revamping the existing plastic recycling infrastructure in the country. There are around 3500 organized and 4000 unorganized plastic recycling units. The main challenge has been lack of crucial infrastructure for waste collection and segregation, and support for small recyclers. Though several polymer clusters has been created in various parts of the country, infrastructure

challenges, high investment, and inadequate policy push limits their optimal functioning. To address the major concern of reusable and compostable waste collection, innovative technologies, such as optical sensors and floatation devices could be adopted on large scale with adequate investment, which will result in improved sorting process. Besides, best practices of other developed nations could also be adopted for reducing waste to ensure reduction in use, reuse and recycling of packaging materials.

A five pronged approach to enhance the usability and utility of plastic waste through collaborative approach between the government and the industry may address the sustainability concern of the plastic packaging industry, viz.,

- Segregate waste at source for reuse and recycle
- Enhance the economic value of plastic waste through regulation
 - (a) Mandate usage thresholds
 - (b) Incentivizing use of plastic waste
- Encourage industry education on plastic waste management and enhance producer responsibility via CSR initiatives
- Educate the masses to segregate at source
- Invest in and pilot re-use technologies

Government initiatives and policy interventions

A conducive policy environment is crucial for the development of the Indian packaging sector, while the industry strive to achieve competitiveness in operations.

While the large players in the industry has been building their capacities by effective imports of technology and machineries, the cost of importing technologies has been a deterrent to forward-looking companies in the MSMEs resulting in mediocre quality of operations and difficulty in achieving economies of scale. Since MSMEs are the dominant constituent of the industry, it is crucial that initiatives and policies are skewed towards addressing the needs of the MSME segment.

Of the three packaging sub sectors, potential for India exists more in package manufacturing and packaging services than in packaging machinery. This is in the light of the fact that the packaging machinery sub sector is highly dominated by the developed economies. Developing the traditional packaging manufacturing units in the MSMEs with appropriate policies on investments, R&D, technology

influx and standardization may make the units viable, productive and export oriented. This may also curtail our import needs.

With increasing penetration of e-commerce, e-retailing and aggregators and importers preferring packaging at source, packaging services for MSMEs may be encouraged by adequate policy interventions.

Encouraging public private partnerships in establishing Packaging Parks at centers where clusters are active may help in scaling up the objectives of MSMEs and enhance productivity.

Focus should be on developing indigenous technologies in packaging through R&D initiatives and investment policies and creating an ecosystem for them to integrate in the strategic marketing and promotional channels.

Mandating national packaging laboratories and public R&D services to focus on developing technologies that have impact on manufacturing and machine tool technologies.

The Government, through its institutions like IIP, may encourage firms, through the dissemination of relevant information, to acquire packaging technology that would best suit for India. In order to achieve this, the Government may establish Technology Trackers in leading countries, such as Germany, Taiwan, Japan and the USA, to track the development of technology in key packaging segments.

Promote technology -based FDI partnerships among foreign and local enterprises especially in the medium-scale enterprises with the view to developing India as global outsourcing and subcontracting base.

The Government may also consider developing goal oriented entrepreneurship development programs at engineering and R&D institutes. The Government may also consider promoting knowledge building and implementation of global standardizations to create export competitiveness.

There is also a need for encouraging subcontracting to MSMEs so that the MSMEs are well integrated in the overall manufacturing. It is also essential to design vendor improvement and certification programs for the participating MSMEs, as suppliers of raw materials, intermediates, and components.

Strengthening of Indian Institute of Packaging (IIP) with appropriate investment so that the requisite investments could be made in research and development and technology upgradation. IIP could also serve as an one point source of classified information on Indian packaging industry for the MSME segment.

Box 13: Technology Upgradation in Packaging Schemes by Government of India

Technology upgradation is an initiative of the Government of India, that encourages the adaptation of modern technology, aid MSMEs to procure techniques that in turn help to increase their sustainability in the global market. As support for MSME enhancement, 7 schemes have been initiated in association with this scheme.

Major Initiatives Under the Marketing Assistance and Technology Upgradation Programme

1. Technology Upgradation in Packaging;
2. Skill Upgradation or development for modern marketing techniques;
3. Competition Studies;
4. Special attention for North-Eastern Region'
5. Providing new market opportunities through State/District level local Exhibitions/ Trade fairs;
6. Encouraging Corporate Governance Practices;
7. Generation of marketing Hubs; and
8. Reimbursement to ISO 18000/ISO 22000/ISO 27000 certification.

Objectives of Technology Upgradation in Packaging

- (a) Facilitate and support the growth of MSMEs.
- (b) Linking with industries.
- (c) Creating awareness about the importance of modern technology and techniques.
- (d) Further, create ultimate global market opportunities.

Specific Visions under the Technology Upgradation in Packaging

1. Encourage technology upgradation in the MSME sector.
2. Additionally, spread awareness regarding modern packing technology.
3. Subsequently, conduct gap analysis for the packing materials that can be exported.
4. Most importantly, adapting and using of the modern packaging technology.

Nature of Assistance

Based on the activity, the technology upgradation in the packing scheme provides financial assistance as given below:

Awareness programs

Focus is on conducting awareness programs that concentrate on new packaging techniques and ideas. ₹ 0.5 lakhs earmarked. The unit and Gol to bear the charges in the ratio 20:80. Most of these activities are day long programmes. Consequently, the scheme envisages to cover all the miscellaneous charges relating to the programs. Following the approval, the Gol releases the aid in 2 installments. Initial 50% on approval with the appropriate contribution from the units. The remaining half by way of reimbursement.

Cluster studies

Studies focusing on the packaging status and the significance of upgradation to be supported. Accordingly, the scheme earmarks financial aid up to ₹ 10 lakh for each study. Focus is on the gap analysis of the packaging i.e., current packaging against modern packaging techniques. Evaluated by competent agencies in the MSME clusters by following guidelines of open Expression of Interest (Eoi), under the Department of Expenditure. Following the approval, GoI assistance is released in 3 installments i.e., 25%, 35%, and finally 40%.

Unit Interventions

For meeting packaging requirements. An amount of ₹ 9 lakhs for 10 units has been earmarked. The installments are in 4 tranches. After approval, the first 25% of the amount is released. The next two installments of 25% each are released as intermediates. After the submission of a report from the unit, the last installment is released.

The SSC (in full form) to review the funding and is the final decision making authority. Even though the installments are preset, they can be altered in special cases.

Nodal Agencies

AS-MSME, DC-MSME, and the Government of India (GoI) are the main agencies for monitoring and implementation of the programmes. A Screening cum Steering Committee (SSC) under the same units are in charge of review and monitoring. The AS and DC of MSME is to act as the chairman. However, the Joint Secretary of MSME, Joint Secretary & Chief of NMCC, director of Indian Institute of Packaging, Member, Representatives of STQC and BIS Member, Representatives of Industry Associations like CII/ Member FISME/ FICCI, to represent as members. the Joint Dev. Commissioner/Director from the office of DC-MSME will act as members of the secretary.

Target Units and Products

- Rice Milling
- Auto Components
- Packaged Foods
- Confectionery
- Pharmaceuticals
- Leather Goods
- Plastic Components
- Electronic Toys
- Ready-made Garments
- Agricultural Implements
- Hardware
- SS Utensils
- Hand Tools
- Ball Bearing
- Scissors and Knives
- Electric Mixer, Grinder
- Corrugated Box and Packaging
- Laboratory Glass-Wares

Source: Ministry of Small and Medium Enterprises, Govt. of India

Box 14: Moulded Paper Pulp Packaging - An Alternative for Single Use Plastic

Moulded paper pulp also called moulded fiber is an environmental friendly packaging material that is recyclable, compostable, and eventually biodegradable and could be used as an alternative to oil-based packaging products, such as expanded polystyrene (EPS) or vacuum-formed polyethylene terephthalate (PET).

It has been used since the 1930s to make containers, trays and other packages. Moulded pulp packaging experienced a decline in the 1970s after the introduction of plastic foam packaging. In fact, moulded pulp consists mainly of water and wood fibers, which are primarily composed of cellulose.

Moulded pulp packaging (MPP) items are generally produced by mixing water with wood pulp made either from virgin fibers or recovered paper/paperboard, agro waste, rice husk, sugarcane bagasse etc., usually old newspaper, with a consistency commonly of 4% to 1% by weight. The pulp recipe depends mainly on the surface quality and stiffness properties required. The production process of the different moulded pulp product types varies especially in respect of the drying method, which is usually performed in heated oven.

This packaging type possess various advantages in terms of application as well as materials used. The moulded pulp containers include disposable food containers, disposable food trays, disposable paper plates, disposable paper bowls, etc. By adding FDA tested food-grade oil and water repellent into wood pulp, the process is strictly tested. Moulded paper pulp product may decompose fully in the soil, and can be used in the microwave oven. By adding anti-bacterial agents, anti-static electricity, enhancer and other materials, the need of the majority product packaging, along with the environmental and aesthetic features are addressed. The moulded paper packaging and traditional plastic packaging show similar performance on shock resistance. It can be widely used in packing electronics, electrical appliances, and communications products. Its excellent environment character brings out the product value, and thus has the ability to gradually replace Styrofoam and plastic packaging.

STRATEGIES AND RECOMMENDATIONS

The Packaging industry is of high significance for the economy. It has potential to grow more rapidly and take India among the top markets for packaging solutions. However, there are a few challenges which are to be addressed, for unlocking the path of higher growth trajectory for the Indian packaging industry. The key challenges faced by the industry and the way forward are highlighted in the earlier chapters; here we summarise some of the key strategies and recommendations to overcome the challenges faced by the industry.

Addressing the Technological Changes

Rapid changes in technology, spread across the entire manufacturing line, have emerged as a major challenge for the packaging industry. To address this challenge it may be imperative to invest on developing, upgrading, channelizing and accurizing the indigenous packaging technologies and integrate them with marketing and advertising. This has been increasingly practiced in other developing countries, such as Thailand, Philippines, Malaysia, Indonesia and Egypt, where there is an established exportability of packaged food products.

Although packaging opportunities abound on the basis of needs and requirements of the food sector (and other sectors as well) in India, the translation of actual demand is contingent on meeting the specific packaging needs of the product. To maximise the benefits of packaging and profitability in food supply chain, the packaging technology solutions should focus on reducing food losses at every stage along the value chain, viz., production, post-harvest, distribution, processing, wholesale, retail, and consumption.

Reducing the Cost of Raw Materials and Innovation

Rising cost of raw materials and innovation poses challenges for the packaging industry. According to various industry research, some of the most essential factors identified in reduction of packaging cost include redesigning, reducing multi-layering, recycling, storage space optimisation, process improvement, supply chain cost management, materials substitution and reusing. Working out a cost index for packaging with appropriate weightage may be the way forward for the packaging industry in optimizing the cost. One of the prominent practices by

the global players in working out the index has been to evaluate the performance of all the materials and determine their costs and rate them.

Increasing the Availability of Skilled Manpower

Availability of skilled manpower not only helps the packaging industry in its day to day functioning, but also in undertaking the research and development activities. Besides the training and education provided by the Indian Institute of Packaging (IIP) in the area, there is need to increase packaging training and R&D institutes where degrees and diploma are provided in the fields of packaging. The presence of such technical institutes could provide fillip to the packaging and allied units through innovative design and development. Simultaneously, training could be provided to people already working in the field of packaging in emerging technologies. The skill development programs in the field of packaging will also help in increasing the number of trained and skilled personnel available to the manufacturing sector. The Skill India Program, an initiative by the Government of India, could be a useful platform in this regard, where some basic training could be provided in the field of packaging.

Strengthening the Packaging Machinery Sector

At present, the packaging industry in India relies heavily on imported machinery. This is compounded with rapid changes in technology and limited availability of skilled manpower. It is essential to strengthen the packaging machinery sector so that the packaging industry remains self-reliant. In order to make the Indian packaging machinery industry self-sufficient, as also to enhance mechanization and advancement across the packaging sector, the Indian capital goods industry needs to significantly scale up in terms of investments in R&D driven technology, skilled manpower, production capacities, speed and quality of production, and testing abilities, supported adequately by post sales and upgrading services. The industry also has to focus significantly on remaining cost competitive with the innovative products.

Complying with Food Safety Regulations in Packaging

In order to comply with the food safety regulations that are associated with packaging, there is a need to create awareness among the producers, especially among the MSMEs, and other unorganised and informal sections. Increasing awareness about the required standards and regulations of packaging in the target markets could help in making the packaging as per the required standards. Traceability has been considered as an important parameter in order to maintain safety and authenticity of the products. Many countries impose regulations that

require the printing ink and its materials to be manufactured under safe conditions and composed of organic compounds. The SPS and TBT notifications issued by the countries, with respect to packaging, are sometimes in their regional language, which could be difficult for exporters to understand. Creating awareness among the exporters and packing industry professionals could help in greater regulatory compliance and boosting the exports.

Compliance to Environmental Standards

It is a wellknown fact that packaging processes has a direct and indirect impact on the environment, especially the plastic packaging segment. The direct environmental impact of packaging is the impact from production of the packaging materials used for primary, secondary and tertiary packaging. There is a need to innovate in the field of flexible packaging as further norms restricting the use of plastic without finding any suitable alternative could be daunting the growth prospects of the industry. More prudent solution is thus, required to address the prime concern that has dented the plastic packaging industry in the recent years; - the environmental concern with plastic waste disposal and management. A five-pronged approach may be adopted to enhance the usability and utility of plastic waste through collaborative approach between the government and the industry. These are:

- Segregate waste at source for reuse and recycle
- Enhance the economic value of plastic waste through regulation
 - (a) Mandate usage thresholds
 - (b) Incentivizing use of plastic waste
- Encourage industry education on plastic waste management and enhance producer responsibility via CSR initiatives
- Educate the masses to segregate at source
- Invest in and pilot re-use technologies

Packaging Design and Innovation

Packaging design continues to evolve with scientific and technological progress. Globally packaging designs are facing increased demand for addressing consumer convenience, such as small package size, smart packaging, reusable packaging, and tracking and traceability; and environmental concerns, such as compostable and sustainable packaging. There is a need to channelize the resources and encourage innovation in packaging design. Indian Institute of

Packaging (IIP) and other national R&D institutes could help in improving the design capabilities of MSMEs and other firms in the informal sector, which may not have their own research and development departments.

Certification Multiplicity and Complexities

International certifications in packaging industry are extremely complex and varied. Besides the cost of acquiring certification is also exorbitant. A collaborative approach may be adopted wherein the national R&D institutions seek accreditations from international certification agencies. In addition, through diplomatic channel, efforts should be made to seek effective technological extension services from global R&D majors with the objective of helping Indian packaging firms improve their manufacturing and design capabilities. Parity of national accreditations with that of international agencies may also help address the issue of high cost of certifications. A single certification program could help in saving time and in turn could help in timely completion of export orders. Increasing the certification institutes for packaging could also help in speeding up the time taken for certification. Strengthening of the national certification environment through adequate policy intervention and investments may also be considered.

Restructuring Research and Development

The research and development is an integral part of the growth of any industry. Needless to emphasize the importance of R&D in the packaging sector which integrates materials, production, logistics and marketing. In India, while larger manufacturers in the packaging sector have their own R&D infrastructure, MSMEs and unorganized manufacturers largely depend on the national R&D infrastructure for their technology needs. Creating an effective connect between the industry and national R&D services is therefore, crucial for developing internationally competitive indigenous technologies and bringing the MSMEs in the packaging sector under the ambit of R&D driven technology advancements. Besides, building research capacity in the dedicated national institute of packaging, and effectively employing universities in research and development for the packaging industry may aid R&D up-scaling.

Policy Framework and Government Initiatives

A conducive policy environment is crucial for the development of the Indian packaging sector, while the industry strive to achieve competitiveness in operations. Encouraging public private partnerships in establishing Packaging Parks at various manufacturing centers may help in scaling up the objectives of MSMEs and enhance productivity. The Government, through its institutions,

like the IIP, may encourage firms, through the dissemination of relevant information, to acquire packaging technology that would best suit for India. In order to achieve this, the Government may establish Technology Trackers in leading countries, such as Germany, Taiwan, Japan and the USA, to track the development of technology in key packaging segments. The Government may also help promote technology based FDI partnerships among foreign and local enterprises especially in the medium-scale enterprises with the view to developing India as global outsourcing and subcontracting base. There is also a need for encouraging subcontracting to MSMEs so that the MSMEs are well integrated in the overall manufacturing. It is also essential to design vendor improvement and certification programs for the participating MSMEs, as suppliers of raw materials, intermediates, and components. IIP may be strengthened with appropriate funding so that the requisite investments could be made in research and development and technology upgradation. IIP could also be strengthened to serve as an one point source of classified information on Indian packaging industry for the MSME segment.

Annexure – FCM regulations

Country	Authority responsible	Type of regulation for FCM
<p>European Union – 28 states</p>	<p>European Commission (EC)</p>	<p>Regulatory authority.</p> <ul style="list-style-type: none"> • They have 4 specific regulations on FCM based on positive list of individual substances– 2004, amended from time to time. • (Plastics (10/2011/ EU), recycled plastics (282/2008/EC) ceramics (Directive 84/500/EEC), regenerated cellulose (Directive 2007/42/EC) and active/ intelligent packaging materials (450/2009/EC). For these DOC is mandatory. • Specific measures on substances are present – i.e. positive list of monomers and additives.
<p>Member states can have their own regulations too if that FCM is widely used. e.g. Denmark</p>	<p>European Safety Standards Authority (EFSA). European Reference Laboratory for FCM (EURL – FCM) Danish Veterinary and Food Administration (DVFA) part of the Ministry of Environment and Food is responsible solely.</p>	<p>Legally established under general Food Law - Regulation 178/2002. Responsible for risk assessment and a source of scientific advice to EU. Scientific knowledge and technical competence on testing methods on FCM is maintained.</p>

		<p>Responsible for FCM – substance database</p> <ul style="list-style-type: none"> • Most FCM regulations are harmonized with EU. • They have national regulations too. For e.g. recommended limit for the total content of organic fluorine in paper and board FCM recently in 2016. • DOC and information on their food safety management system – is required for all types of FCM. • Registration of producers, importers and wholesalers of FCM.
France	Directorate General for Competition, Consumer Affairs and Repression of Fraud (DGCCRF)	<ul style="list-style-type: none"> • Along with EU regulations they also have Country regulations. E.g. document DM/4B/COM/002. • Opinions and advice given by French Food safety Agency.
Germany	Bundesministerium für Ernährung und Landwirtschaft (BMEL)	<ul style="list-style-type: none"> • EU regulations are incorporated into national regulations (German Consumer Goods Ordinance) • “Food commodities and animal feed code (LFGB)” replaced LMBG in 2005 takes care of FCM.

	BfR (Bundesinstitut für Risikobewertung)	<p>Risk assessment institute.</p> <ul style="list-style-type: none"> • Recommends LFGB. • Regulations on FCM can be found in database “BfR recommendations for materials in contact with food products”.
Ireland	Food Safety Authority of Ireland (Ministry of Health)	<ul style="list-style-type: none"> • EU regulations are incorporated into national regulations i.e. FCM are regulated by EU legislation. • They also have recommendations for silicone, paper or rubber used as FCM.
United States	US Food and Drug Administration	<p>Main regulatory body.</p> <p>Modified positive list system with pre marketing clearance.</p> <p>Federal Food, Drug and Cosmetic Act (FFDCA, Title 21 United States Code 348). 21 CFR 170.3 defines the term FCM.</p> <ul style="list-style-type: none"> • FCM fall into - positive lists (indirect additives) (21CFR, 174-179), GRAS (21CFR, 182-186), Prior sanctioned substances (21CFR 181) or comply with Threshold of Regulation (21 CFR 170.39).

	USFDA Science Board, USFDA Food Advisory Committee Center for Food Safety and Applied Nutrition (CFSAN)	Advisory scientific body. “Indirect Additive” Database – consist of regulated indirect food additives.
Countries having non- specific/ few regulations for FCM		
North America – Canada	Canada’s Food Directorate Surveillance - Canadian Food Inspection Agency & Bureau of Chemical Safety in Health	Responsible for food safety from FCM <ul style="list-style-type: none"> • positive list system • Letter of No Objection (LONO) on voluntary basis. • Controlled separately under Division 23, Part B of the Food and Drug Act and Regulations.
South American Countries	Common market of the south -MERCOSUR (Argentina Brazil, Paraguay, Uruguay, Venezuela)	Harmonized Regulations. <ul style="list-style-type: none"> • Positive list approach based on EU’s regulation 2011 and USFDA. • But legal confirmation for a specific substance to be taken from concerned authorities • Final FCM / package needs to have premarket approval/ registration. • If FCM not present in positive list, they must be petitioned for inclusion in MERCOSUR positive lists to national sanitary authorities. • GMC 26/03 – defines FCM.

<p>Argentina</p> <p>Brazil</p> <p>Mexico</p> <p>Other South American countries – Chile, Bolivia, Ecuador and Peru</p>		<p>Ministry of Health - regulatory agency CONAL (National Food Commission) – advisory scientific body.</p> <p>Ministry of Health - through its regulatory agency - ANVISA – National Agency of Sanitary Surveillance.</p> <p>In Argentina and Brazil FCM are defined and regulated independently.</p> <p>Ministry of Health (SSA) – through COFEPRIS</p> <ul style="list-style-type: none"> • Have no specific regulations on FCM and no specific regulations for their use. • Have regulations on packaging materials. • Have no specific regulations on FCM. • Have some food packaging requirements in their regulations for food & beverages. For e.g. Bolivia, Peru and Ecuador have some standards on food packaging materials.
<p>China</p>	<p>National Health and Family Planning Commission (NHFPC)</p>	<ul style="list-style-type: none"> • China's Food Safety Law takes care of FCM. • GB standards and MOH notices provide positive list of FCM.

	AQSIQ (Chinese government's enforcement agency)	<ul style="list-style-type: none"> Recently put forth 53 mandatory national standards for FCM an articles [6]. <p>Quality Safety (QS) Certification may be needed for some FCM i.e. plastic food contact articles from AQSIQ.</p>
Australia and New Zealand	Food Standards Australia New Zealand (FSANZ)	<ul style="list-style-type: none"> Positive list system. They have their respective country standards too but not specifically on FCM. e.g. plastic materials for food contact use should comply with the Australian Standard AS 2070-1999
Japan	Japanese Ministry of Health, Labour, and Welfare (MHLW) — Pharmaceutical and Food Safety Bureau, Department of Food Safety, Standards and Evaluation Division and Food Safety Commission	<ul style="list-style-type: none"> Food Sanitation Law of 1947 and industry standards (voluntary), sanctioned by specific well established trade associations. They have 3 different types of specifications: <ol style="list-style-type: none"> 1. General - for all containers and packaging. 2. Material – specific standards 3. End-use application for packaging. Official list of approved FCM is absent. But industry groups have created voluntary standards which have led to formulation of positive list of FCM.

South Korea	Ministry of Food and Drug Safety (MFDS)	<ul style="list-style-type: none"> • Food Sanitation Act - general requirement for FCM. • MFDS formed additional standards and regulations for FCM. • These standards are titled as “Korean Standards and Specifications for Utensils, Containers and Packaging of Food Products” (revised, 2013) – has 5 parts. One part covers all FCM.
Taiwan	Taiwan Food and Drug Administration	<ul style="list-style-type: none"> • Food Sanitation Act – 1975, revised in 2011. • FCM are covered under Taiwan’s “Sanitary Standard for Food Utensils, Containers and Packages,” revised - August 2013. • The standard doesn’t contain a typical positive list; the substance not in list can still be used, provided it meets all applicable and stated requirements.
Thailand	<ol style="list-style-type: none"> 1. Thai FDA- of the Ministry of Public Health 2. Ministry of industry 3. Department of Science and Technology 	<ul style="list-style-type: none"> • Food Act and ministerial notifications take care of them. <p>These 3 ministries regulate FCM.</p> <ul style="list-style-type: none"> • MPH is responsible for execution of Food Act and issue of ministerial regulations

	<p>Thai Industrial Standards Institute (TISI)</p> <p>ASEAN Center for Food Contact Materials Testing</p>	<ul style="list-style-type: none"> • Thai FDA – responsible for regulation (i.e. reviewing and granting approvals). <p>They have both mandatory (e.g. TIS 2440- 2552 (2009) stainless steel) and voluntary standards (e.g. TIS 524-2539: melamine utensils)</p> <p>Issues Certificate of Analysis (COA) of food contact materials for Thai exporters.</p>
Indonesia	<p>National Agency of Drug and Food Control (NADFC), Ministry of Industry, Ministry of Trade</p> <p>National Standardization Agency of Indonesia (BSI)</p>	<p>These groups do their part in ensuring safety of food from FCM at various levels.</p> <ul style="list-style-type: none"> • Indonesian’s new Food Law 18/2012. • They have a list of prohibited substances and permitted substances including its migration limit (as maximum migration limits). • “Safe for food contact” and National Standard (SNI) logo present. <p>National Standard, SNI 7626.1 – is on testing of FC substances migrating from packaging (2011)</p>
Philippines	<p>Dept. of Agriculture (DOA) and Dept. of Health (DOH)</p>	<ul style="list-style-type: none"> • Food Safety Act of 2013 • DOA includes National Food Authority; DOH includes FDA and Center for Food Regulation and Research. • Both take care of FCM.

Singapore	Agri-Food and Veterinary Authority (AVA)	<p>Responsible for enforcing Sale of Food Act and implementing regulations including FCM.</p> <ul style="list-style-type: none"> • But they don't have a positive or negative list. • Food Control Division of AVA suggested manufacturers and importers to conduct safety assessments for their products. • Pre –market approval is not required and any substance may be used provided they don't impart harmful substances.
Vietnam	Ministry of Health (MOH), Agriculture and Rural Development (MARD) and Industry and Trade (MOIT)	<ul style="list-style-type: none"> • Vietnam's Food Safety Law (No. 55/2010/QH12) specifies FCM to conform national technical regulations along with Ministry of Health regulations on food packages and containers. • These ministries are working on developing relevant circulars and technical regulations.
Malaysia	Food safety and Quality Division, Ministry of Health	<ul style="list-style-type: none"> • Sections 27-36 (A) of food regulations 1985, stated specific requirements of package/ containers. • 13th schedule deals with tests of food container/ packaging for storage and cooking of food.

		<ul style="list-style-type: none"> • They have strict restrictions on recycling of packages and containers. • They don't have a positive or negative list approach.
Uganda	Uganda National Bureau of Standards (UNBS)	<p>Formulates, promotes and enforces standards.</p> <ul style="list-style-type: none"> • US 1659:2017, Materials in contact with food -Requirements for packaging materials. States general requirements of packaging items for food contact and their subsequent use. • It is one among the compulsory Uganda standards. • Covers many and different aspects of FCM. • Labeling specific requirements of these materials is also stated.
Tanzania	<p>Tanzania Food and Drugs Authority (TFDA) – Ministry of Health, Community Development, Gender, Elderly and Children (MOHCDGE).</p> <p>Tanzania Bureau of Standards (TBS)</p>	<p>Responsible for regulating quality, safety, and effectiveness of food along with other aspects.</p> <ul style="list-style-type: none"> • Tanzania Food, Drugs and Cosmetics Act of 2003 – covers a brief note on packaging. • And product specific requirements. • They don't have specific regulations relating to FCM. <p>Tanzania Standard (TZS 538-1991) defines packaging.</p>

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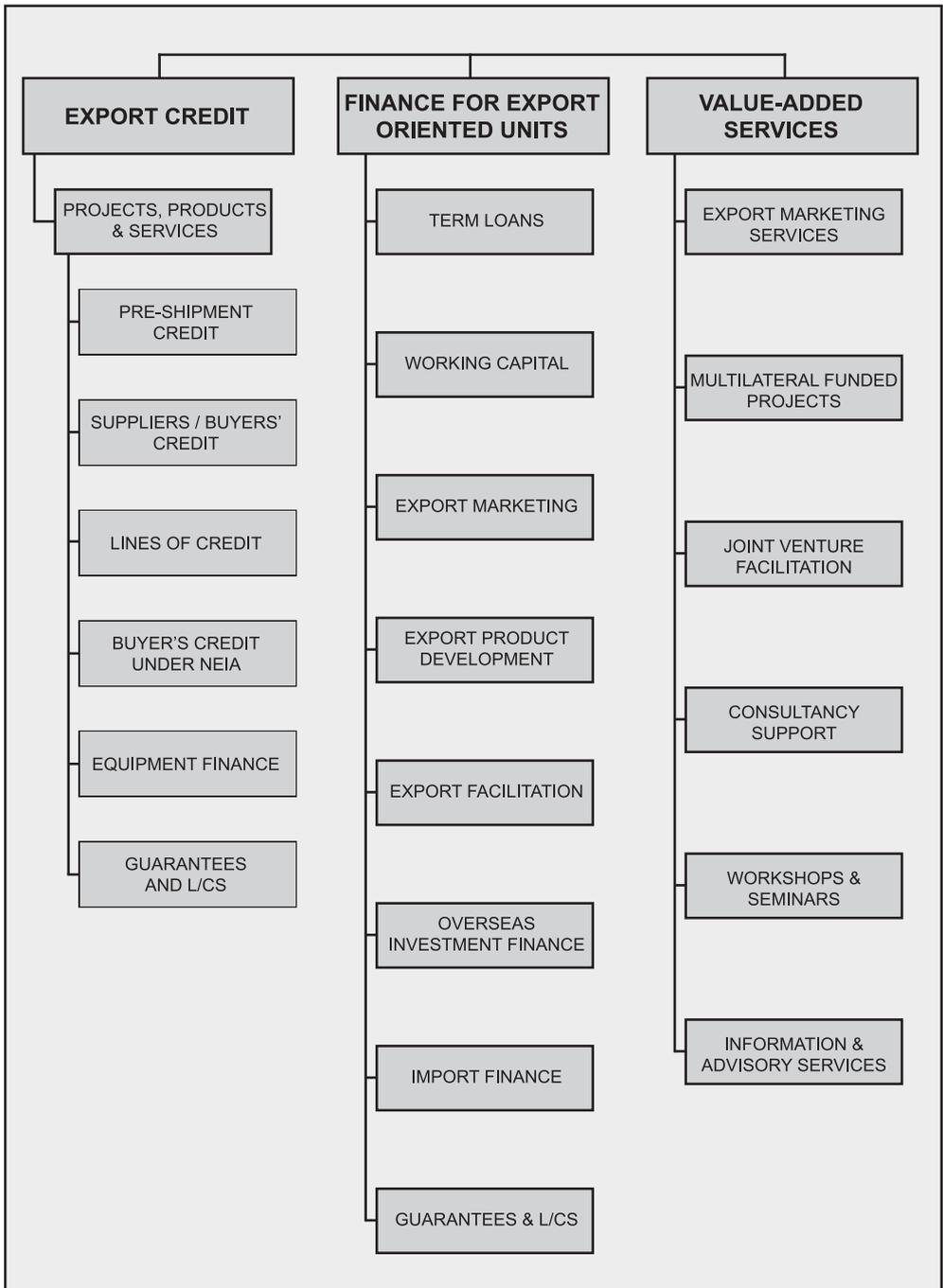
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