"The Role of Packaging in Manufacturing – A Brief Understanding"

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I. Introduction

There are approximately 7 billion human beings on the planet and unless one is completely remote from modern civilization, one is constantly touched by packaging in some way or the other. Some people may not be aware of the economic value of packaging, simply because they are not in the packaging conversion industry, nor in the packaging supply chain, nor in the retail industry, and so they do not appreciate the role packaging plays in getting product to them. But without packaging, the Gross Domestic Product (GDP) of a country would significantly reduce in value. This is simply because product cannot be shipped from source to manufacturer to retailer to consumer, through the supply chain, without proper packaging. Packaging must be developed from specific materials, into specific shapes and texture, scientifically designed to suit the product being packaged, to suit the hazards of the transit journey, to maximize the shelf life of the product and to ultimately positively influence the consumer purchase decision, resulting in a contribution to the GDP of the country. Therefore it is quite understandable to accept the total packaging sales in a country as an indicator of the strength of the country's economy, as almost everything sold must first be packaged. Yet the total value of a country's packaging as a percentage of the country's GDP is small.

1.1 What Is Packaging?

In achieving the sale of the product, the packaging must also protect the product, not only from transit and physical damage, but also from microbial and bacterial deterioration as well as climatic hazards, like heat, cold, moisture, frost etc. In this role, especially with respect to food product, packaging significantly reduces the wastage of food during the transit journey. Packaging must also identify, track and trace the product. Consumers are now more than ever aware of product shelf lives, product traceability to the packer / product originator, enabling effective product recall in instances where product integrity is questionable. Packaging must also differentiate itself on the shelf where it competes with thousands of other packaging for consumer choice. Also, the packaging must inform the consumer. The consumer purchase decision is made between 2-5 seconds once the package in the hands of the consumer in the shopping aisle. Therefore it is imperative that the packaging talks intelligently to the consumer within this crucially miniscule time interval. The package also plays a role in effective merchandising of the product on the shelf because it must conform to the height, width and footprint as per shelf requirements. Unitization of product into a point of sale SKU is yet another role of packaging, as packaging serves to group or consolidate product into 'a packet of cigarettes' or a 'box of Easter eggs' etc. In so doing the package also facilitates the solution of logistical difficulties, enabling effective transportation of the product. An important part of packaging's role is to ensure that the energy invested in producing goods and transporting them from source through the supply chain to the shops and home is not wasted. Therefore packaging must be viewed as a benefit to be maximized rather than as a cost to be minimized, so that products, through their packaging, are made available at the points of sale, and sold to enhance GDP, in support of the World Packaging Organization's motto, "Better quality of life, through better packaging, for more people"

1.2 Definition of Packaging

Packaging shall mean all products, made of any material whatsoever, to be used for the containment, protection, transfer, issuance and presentation of goods, from raw materials to finished goods, and from the producer to the user or consumer. Disposables used for this purpose are also classed as a packaging material. The definition of 'packaging' is also based on the following criteria:

1. Items shall be considered to be packaging if they fulfil the abovementioned definition without prejudice to other functions which the packaging might also perform, unless the item is an integral part of a product and it is necessary to contain, support or preserve that product over its entire design life and all elements are intended to be used, consumed or disposed of together.

2. Items designed and intended to be filled at the point of sale (POS) and 'disposable' items sold, filled or manufactured at the POS shall be considered to be packaging provided they fulfil a packaging function.

3. Packaging components and ancillary elements integrated into packaging shall be considered to be part of the packaging into which they are integrated. Ancillary elements hung directly on, or attached to, a product and which perform a packaging function shall be considered to be packaging unless they are an integral part of this product and all elements are intended to be consumed or disposed of together.

II. The Evolution of Packaging

Product packaging plays several important functions which enable commerce and trade. The functions of modern day packaging go beyond containing, protecting and preserving products. It also includes functions to communicate, promote and transact products. Packaging provides several visceral cues designed to affect consumers' perception of the product and influence their behaviour. These functions are considered normal today, but it took over 150 years for product packaging to evolve into a carefully designed artefact that integrates multiple functions of commerce into a thin film wrapped around products. Growing competition and continuous technological innovations have shaped the evolution of packaging since 1860s. As we researched key technology and material innovations during this vast period, it became evident that these developments revolved closely around cultural phenomenon and consumer behaviours prevalent around given time periods. So we sectioned our analysis across 6 time periods and mapped the technological developments against cultural developments. This approach provided unique lenses to look at the history of packaging and revealed very interesting perspectives on where things stand today and how we can design better for the future of packaging.

Industrial revolution created a sudden demand for better products as trade flourished and more goods became available to consumer. Since materials were expensive, packaging was limited to luxury goods only. The period during and after WWI saw a remarkable number of packaging innovations like moulded glass, cardboard boxes, metal cans, and cellophane that made packaging commonplace. This pushed manufacturers to establish an identity to sell to consumers. The Great Depression marked the rise of supermarket culture and it drastically changed distribution and consumption patterns worldwide. This behavioural change of self-service model called for packaging to assume the role of a 'silent-salesman'.Post WWII consumerism enjoyed the conveniences offered by the single use-and-throw materials that heralded with the discovery of aluminium foil, and plastics.

The rise of digital technologies in later half of 20th century allowed businesses to scale rapidly and become global. With unprecedented competition, packaging came to be the way of differentiating product on the shelf. As much as packaging has become essential to the business, it is also recognized as a threat to the environment. And hence much research continues not just to find new materials, but also to find optimal and sustainable solutions. In last couple of decades, advances in personal computing, and mobiles have significantly transformed consumer behaviour and thus their expectations. With access to information every time, everywhere, they value engaging experiences that provide a utility or novelty. Since the birth of barcodes, many digital technologies have continually been tested to bring reforms to retail experiences. And once again product packaging is at the Center of these developments. With the rising notion of the Internet of Things, coupled with advances in mobile computing, RFID, Augmented Reality, and Biosensors, we are at the tipping point where delightful digital experiences will position product packaging as an ESP or Emotional Selling Point.

2.1 1860s, 1870s, 1880s: The Era of Dual Use Packaging – The second wave of Industrial Revolution began during this time and with major developments in railroads, trade suddenly flourished. Materials and processes during this time were still expensive and laborious. During this time packaging was primarily seen as a way of storage, and reserved for only high value goods like jewellery, gift items, shoes, and premium foods. As the materials were indispensable, they were structurally designed to serve a function after product use. Thus, dual use packaging was a solution to command high price and assure ingenuity of the manufacturing quality.

2.2 1890s, 1900s,1910s: Building Brand Identity –With rising trade, the phrase "let the buyer beware" became popular since inferior and impure quality products were disguised and sold to uninformed customers by counterfeits. This posed serious threat to original manufacturers and they began to mark their product with their identification to alert potential buyers. But that was not sufficient, so manufacturers turned to use packaging in innovative ways to establish their brand identity.

2.3 1920s, 1930s, 1940s: The Era of "Silent Salesman" –In the early part of the 19th century, retailers played an important role in making a trade happen. Food items were sold in loose and needed wrapping and weighing. This meant that consumer had to wait while their orders were made up. But the rise of cheap and clean packaging solutions had solved this problem to a large extent and retailer's role in facilitating a trade started to marginalize. This allowed for huge retail chains to come in where products were displayed on the shelf, and

consumer themselves had to make a purchase choice. The big chains had a price advantage, and were slowly gaining momentum. But immediately after The Great Depression, supermarkets became a dominant force and marked a major shift in the consumer behaviour. Manufacturers once again turned to product packaging to be the silent salesman—differentiating from competition and affecting a sale.

2.4 1950s, 1960s, 1970s: Convenience As The Motivation –Most development of the mouldable metals and plastics, happened much earlier than this period, but its exploits were primarily limited to military use. But after WWII, the consumer market exploded with the continuous innovations in aluminium and plastics. Owing to mega efforts of giants like DuPont, Dow Chemicals, and the likes—shinier, sturdier, cleaner, more flexible, and modern looking materials were available at cheaper price compared to traditional materials. This provided impetus to re-invent existing packaging solutions and plastics and metal cans took over majority of consumer packaging, while paper was limited in use and glass reserved for high value products only.

2.5 1980s, 1990s, 2000s: The Rise of Digital – This era was marked by the rise in computing abilities and the evolution of printing technologies as a result. Digital printing technologies, coupled with innovative transactional capabilities provided an unprecedented speed of execution and rapid scaling of business became possible. While the growing fascination with plastics lead to innovation in packaging shapes and materials, it meant other materials like paper and glass found themselves limited in its use for packaging. This widespread adoption of plastics paved way for use-and-throw behaviour, and non-decomposable packaging waste became primary constituent of landfills as a result. In early 2000's, EPA created stringent laws for businesses to control and reduce environmental impacts. As a result, finding sustainable materials and optimizing waste became a prime agenda, heavily influencing the package design. Now a days, it is a business imperative to reduce the amount of packaging for products not just for its financial benefits, but the emotional connect it offers for consumers—making them feel good about their choice.

III. Types of Packaging

Packaging may be of several different types. For example, a transport package or distribution package can be the shipping container used to ship, store, and handle the product or inner packages. Some identify a consumer package as one which is directed toward a consumer or household. Packaging may be described in relation to the type of product being packaged: medical device packaging, bulk chemical packaging, over-thecounter drug packaging, retail food packaging, military materiel packaging, pharmaceutical packaging, etc. It is sometimes convenient to categorize packages by layer or function such as primary, secondary, tertiary etc.

3.1 Primary packaging or sales packaging:Primary packaging is the term used to designate the layer of packaging in immediate contact with the product; in other words, it is the first packaging layer in which the product is contained. As such, primary packaging is constructed both with the product itself and any existing secondary layers of packaging in mind. The properties of the product (form, dimensions and consistency) evidently dictate the main priorities of primary packaging. Primary packaging can have diverse applications and functions, depending on the product, and transit and storage variables. The most obvious, and important, function is to protect and preserve the product from damage, external interference or contamination, spoiling and chemical imbalances. Primary packaging also serves to keep a product in storage, often for long periods of time. In this case, it is imperative that primary packaging keep the product absolutely sealed off from its environment. Ease of handling and shelving is a further aspect of primary packaging are as limitless as the range of available consumer products. Some of the most common types include blister packs, clamshell packaging, shrink-wrapping, paperboard packaging, unit dose packs and many more.

3.2 Secondary packaging or grouped packaging: Secondary packaging designates the packaging used to group various pre-packaged products together (the first layer of packaging, in direct contact with the product, is called primary packaging). As secondary packaging is not in direct contact with the actual product, its use and application usually differ distinctly from those of primary packaging, although the purpose of both types may at times converge. Secondary packaging can be said to have two central functions:

- Branding & Display. Secondary packaging plays a vital role in the marketing strategy surrounding the product. This is especially relevant in the case of display packaging.
- Logistics. Secondary packaging serves to group several products together for ease of handling, transport and storage. This means that secondary packaging must be able to:
- Contain relatively large volumes of primary packaged products.
- Transport the product safely to its retail or consumer destination.
- Keep the primary packaging in its original condition during storage.

Secondary packaging is intended to protect not only the product, but also the primary packaging, which often is the packaging most visible to the consumer in retail displays. The most common examples of secondary packaging include cardboard cartons, cardboard boxes and cardboard/plastic crates.

3.3 Tertiary packaging or transport packaging: Transport packaging focuses on the packaging requirements of goods in transit, in particular for items traveling overland by road or rail (as opposed to overseas packaging). Transport packaging is very often a local affair (see export packaging for international transport) and therefore needs to be designed with local conditions and expectations in mind.

- Protection-First and foremost, transport packaging must serve to protect goods in transit. Given the nature of road and rail infrastructure, transport packaging should be manufactured so as to absorb unintended shocks, impacts or accidents of any kind, as well as protect against the elements such as humidity, excessive temperatures or heavy weather.
- Versatility Transport packaging must take into account the possibility of multiple stages in transit before the product reaches its final destination. This includes multiple off-loading, re-packaging, re-loading and possibly storage of the product(s). Transport packaging should thus be versatile enough to facilitate this process when necessary.
- Customized solutions Transport packaging should be as individual as the product itself and perfectly match the product's consistency, size and dimensions. The focus here is on packaging that is lightweight, robust and easy to handle and that takes up as little space as possible.

3.4 Industrial Packaging: Industrial packaging is used to package a product during or after the manufacturing process. This is usually, but not always, done at the production site and requires specifically customized industrial packaging solutions tailored to the product in question.

- Protection and preservation during storage Industrial packaging differs from other types of packaging in the level of protection it provides for extended storage. Attention is given to the thickness and strength of the material that is used, as well as to closure and secure locking mechanisms. Industrial packaging must also give priority to conserving the product for long stretches of time during storage, keeping the product hermetically sealed and free from external contamination.
- Customized materials Tailor-made industrial packaging is only as good as the materials it uses. As industrial goods are often either heavy, bulky, sensitive to external contact or hazardous, industrial packaging materials include:
- stainless steel
- corrugated containerboard, paperboard and fibreboard
- wood, for e.g. plywood, OSB and QSB boards, durelis boards (solid and skeleton wooden crates, wooden skids)
- plastic (bottles & containers; heavy-duty shrink-wrap)
- International standards Industrial packaging must be able to meet international packaging standards, as well as quality control requirements of the countries of manufacture and destination.

IV. The Need For Packaging

Proper packaging of consumer goods is a necessity whose demand is growing at a rapid pace with each passing day. Its demand is growing with the increase in more and more industries and the production of goods that require durable casing or covers to keep them preserved, no matter how they are handled or far the goods travel. And a perfect, durable and safe packaging solution is what each consumer demands for their goods and services. It is apparent that good packaging also requires attractive labelling in the right format, durable and hardy components that make up the casing and obviously reliable and effective machinery parts that will make all of this possible. The following are the major benefits of packaging.

4.1 Physical Protection

The basic benefit of packaging is the protection of goods to be sold. It prevents damage during transport and storage from the elements, vibration and compression through a physical layer of protection. The objects enclosed in the package may require protection from, among other things, mechanical shock, vibration, electrostatic discharge, compression, temperature, etc.

4.2 Barrier protection

A barrier to oxygen, water vapour, dust, etc., is often required. Permeation is a critical factor in design. Some packages contain desiccants or oxygen absorbers to help extend shelf life. Modified atmospheres or controlled atmospheres are also maintained in some food packages. Keeping the contents clean, fresh, sterile and safe for the duration of the intended shelf life is a primary function. A barrier is also implemented in cases where segregation of two materials prior to end use is required, as in the case of special paints, glues, medical fluids, etc. At the consumer end, the packaging barrier is broken or measured amounts of material are removed for mixing and subsequent end use.

4.3 Information transmission

Packaging can provide information to a consumer regarding the product contents. This information may be promotional, factual or mandated by consumer law.Packages and labels communicate how to use, transport, recycle, or dispose of the package or product. With pharmaceuticals, food, medical, and chemical products, some types of information are required by government legislation. Some packages and labels also are used for track and trace purposes. Most items include their serial and lot numbers on the packaging, and in the case of food products, medicine, and some chemicals the packaging often contains an expiry/best-before date, usually in a shorthand form. Packages may indicate their construction material with a symbol.Information that is useful to consumers and companies such as Supermarkets are printed on packaging. This includes, ingredients, sell by dates, price, special offers, manufacturers address, contact information, product title, barcode and more. The bar code is extremely useful to the shop selling the product. When the barcode is scanned, the computer system automatically determines if the product needs reordering. Also, the price of the product appears at the till.

4.4 Containmentor agglomeration

Small objects are typically grouped together in one package for reasons of storage and selling efficiency. For example, a single box of 1000 pencils requires less physical handling than 1000 single pencils. Liquids, powders, and granular materials need containment.Products that contain multiple items use packaging to keep all items contained prior to purchase. Product containment also allows a product to be sold in larger quantities.

4.5 Portion control

Single serving or single dosage packaging has a precise amount of contents to control usage. Bulk commodities (such as salt) can be divided into packages that are a more suitable size for individual households. It also aids the control of inventory: selling sealed one-litre bottles of milk, rather than having people bring their own bottles to fill themselves.Packaging can control the size and quantity of a product. Portion control helps control inventory, create product consistency and can help regulate prices.

4.6 Marketing

Packaging is the front line of marketing. Through design and marketing communications, packages can help sell a product and differentiate it from similar products. The packaging can also help promote product branding. Packaging and labels can be used by marketers to encourage potential buyers to purchase a product. Package graphic design and physical design have been important and constantly evolving phenomena for several decades. Marketing communications and graphic design are applied to the surface of the package and often to the point of sale display. Most packaging is designed to reflect the brand's message and identity.

4.7 Attraction

How a product is packaged may be what attracts the consumer to take a look on the product as is sits on store shelves. For this reason, many companies conduct extensive research on colour schemes, designs and types of product packaging that is the most appealing to its intended consumer.

4.8 Convenience

Packages can have features that add convenience in distribution, handling, stacking, display, sale, opening, reclosing, using, dispensing, recycling, and ease of disposal

4.9 Security

Packaging can play an important role in reducing the security risks of shipment. Packages can be made with improved tamper resistance to deter manipulation and they can also have tamper-evident features indicating that tampering has taken place. Packages can be engineered to help reduce the risks of package pilferage or the theft and resale of products: Some package constructions are more resistant to pilferage than other types, and some have pilfer-indicating seals. Counterfeit consumer goods, unauthorized sales (diversion), material substitution and tampering can all be minimized or prevented with such anti-counterfeiting technologies. Packages may include authentication seals and use security printing to help indicate that the package and contents are not counterfeit. Packages also can include anti-theft devices such as dye-packs, RFID tags, or electronic article surveillance tags that can be activated or detected by devices at exit points and require specialized tools to deactivate. Using packaging in this way is a means of retail loss prevention.Packing can make items tamper-resistant, can help reduce theft and can help prevent harm from dangerous products.

4.10 Rising Standards of Health and Sanitation

As the people are becoming health conscious they like to buy packed goods. The reason is that the chances of adulteration in such goods are minimized.

4.11 Self-service Outlets

Nowadays self-service retail shops are becoming very popular, particularly in big cities. Because of this, the role of sales assistants has gone to packaging.

4.12 Innovation Opportunity

With the increasing use of packaging more innovation opportunity becomes available in this area for the researchers.

4.13 Product Differentiation

Packaging is helpful in creating product differentiation. The colour, material and size of the package make difference in the perception of the buyers about the quality of the product.

V. Packaging And Sustainability

Even though packaging is an extremely small fraction of a country's GDP, and consequently, also a small fraction of the country's waste stream, the packaging industry, globally, is nevertheless, aware of the impact of packaging on the future of the planet.From 200 BC to the year 1850, human population grew modestly to about 1 billion people. After the onset of the Industrial Revolution, the discovery of oil, as well as the discovery of medicine, there has been a population explosion. The global population at the start of the 21st century was 6 billion people, which was double that of 50 years before. The graph below indicates the human growth profile over the years and also projects human growth into the year 2100 as high, moderate and low growths as predicted by the UN. Consequently, and coupled with the Industrial Revolution back in the 1800's, the fossil fuel usage has shown a dramatic increase since 1750 and carbon dioxide emissions are now exceeding the atmosphere's capacity to absorb carbon dioxide.The 2007 IPCC (Intergovernmental Panel on Climatic Change) report estimates that anthropogenic greenhouse gas emissions was 49 billion tons in 1994, an average of 130 million tons each day is exhausted into the Earth's atmosphere, all due to rapid industry expansions and man's desire for lifestyle changes.

To this end, packaging industries across the continents, networked through the World Packaging Organization (WPO) as well as many other global packaging material specific organizations, are all working towards a common goal, to constantly reduce, rework, recycle, recover, renew packaging materials, enabling a measurable reduction on the total Global Packaging Carbon Footprint. This is achieved with new mind-sets at the point of packaging design. At the design stage, choice of materials is vital, choice of pack design, choice of manufacturing process, choice of print method, choice of supply chain are all considered so that the impact of packaging on the planet is substantially minimized. But it is important to understand and accept that packaging designs supporting reduction in carbon footprints rely on past packaging design successes as well as on current development of packaging material technologies that can enable such progressive developments in packaging. Therefore we say that the future of packaging design is really the past of packaging design being modified in the present. It is important for humanity to understand that resources are limited and that every effort must be made to conserve resources and adopt a responsible commitment to leaving a legacy to future generations.

VI. Growth of Packaging Industry In India

Packaging continued to register a positive volume performance in India during 2015. The growth was driven by the recovering economy and falling inflation rate, which enabled consumers to buy more products. This in turn drove demand for packaging. The Indian Institute of Packaging (IIP) is a national apex body which was set up in 1966 by the packaging and allied industries and the Ministry of Commerce, Government of India, with the specific objective of improving the packaging standards in the country. The Institute is an autonomous body working under the administrative control of the Ministry of Commerce. Packaging witnessed various launches in 2015, which took the form of new packaging types. Nonetheless, consumers remained price-conscious and continued to seek value for money. This led to rising demand for bulk packs, multipacks and smaller packaging, while discounting also remained prevalent.

6.1 Product extensions and product formats boost demand for packaging variety

Variations in product features, such as availability in solid and liquid formats, have led to launches of different pack types in India. For instance, laundry detergents have become available in flexible packaging, folding cartons and as liquid detergents in plastic bottles. Similarly, air fresheners are available in folding cartons, metal aerosol cans, plastic bottles and blister and strip packs. Moreover, combination packs of different types of products have gained prominence in the country, where companies use this strategy to cross-sell their different brands. In home care, this trend was first adopted by private label offerings, such as *Caremate* from Future Consumers, but has since been adopted by its competitors, including locals and internationals.

6.2 Changing distribution patterns impact packaging

In addition to demographic changes, the packaging industry in India also has to respond to changes in the way consumers shop. Strategies have to be adapted to suit urban and rural areas, and also vary across regions in India. Many lower-income demographics are paid on a daily basis and can only afford to shop daily preferring local convenience stores as opposed to shopping on a weekly basis in city Center supermarkets. This has boosted demand for lighter weight packaging as well as smaller formats as such outlets have less shelf-space to stock goods. Outlets such as these also require smaller transport packaging, given lack of space and a desire to minimize packaging waste. Moreover, products tend to be turned around faster, therefore the outer packaging has to be convenient for retailers to handle, dispose of or recycle.

6.3 Pack size polarization

Despite rising disposable incomes in the country, Indians remain price-conscious and seek value for money. As such, larger pack sizes offered at more competitive prices have become more common in categories, such as liquid soap and shampoo. Moreover, bar soap can also be found in a wider variety of sizes ranging from 90g to 200g. Demand also rose for smaller pack sizes, which require a lower financial outlay, enabling consumers to afford products that may otherwise be outside their financial reach. Impulse purchases and single serve products have also boosted demand for smaller packaging, with smaller packs being easier to carry.

6.4 Value for money will continue to characterize the packaging market over the forecast period

Packaging trends that characterized much of the review period will remain in place over the following five years. Despite rising disposable incomes, consumers will remain price conscious and will seek value for money. For manufacturers and retailers, rising environmental awareness will work in tandem with consumer demand, leading to lighter weight packs that are cheaper to transport and to produce, and which provide cost-savings that can then be passed on to end-users. Pack sizing will become increasingly important, as consumers will seek pack sizes that offer good value for money, whether large, bulk formats, for regular use or for sharing, or smaller packs for on-the-go or impulse consumption.

VII. Nanotechnology – The Future Packaging

Nanotechnology is promising new and invaluable techniques as well as paradigm shifts in thought processes for the packaging industry. The radical technology is set to revolutionize the concept of packaging design by maximizing the primary functions of packaging, while protecting the environment as well as creating economic and social benefits not only in the packaging industry but also across the spectrum of manufacturing. Nanotechnology refers to 'the control or active change of matter at the atomic, molecular, or macromolecular level, in which one of the components affects functional behaviour.' Nanotechnology therefore manages particles no more than 100 nanometres in any dimension.

VIII. Conclusion

Whether you're getting ready to create packaging for a product you're selling or you're considering changing the packaging of an existing product, you may be wondering if the appearance of a product's package is important. Many product providers may think that the product and its performance is more important than what the packaging looks like, but the product packaging can play a role in the success or failure of the sales of the product. Every year, 95 percent of new products fail. The reason is simple: Most customers don't have the time or energy to weigh the advantages and disadvantages of the products in their shopping carts, so they use a shortcut to make their decision. That shortcut is your product's packaging. Packaging is powerful because it tells consumers why your product and brand are different. Great packaging is especially significant for growing startups because it can have a direct impact on sales and a company's overall appeal. Packaging can continue to influence a company's sales as it grows larger, too. Poor packaging can have an even more dramatic effect

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