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**DEVELOPMENT OF WOOD PLASTIC COMPOSITE PALLET FOR INDIAN  
MARKET AND DETERMINING THE PROFITABILITY OF THE INVESTMENT**

Examiner(s): Prof. Juha Varis,  
Prof. Timo Kärki

## **ABSTRACT**

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Pallet are one of the main aspect of material handling system. Most of the pallet in circulation are made up of wood, however the market share of plastic pallet is also increasing rapidly. In India, the pallet industry in valued at approximately Euro 858.3 Million, with wood pallets dominating the market. However, with wood resources dwindling in India, timber imports are increasing and plastic being a non-environmental friendly resource, it is crucial to find an alternative solution to such a problem.

This research work gives a detail description of developing a wood-plastic composite pallets for Indian market. The report aims to determine the current status of the Indian Pallet market and how a foreign firm can establish its unit of operation in India to produce wood-plastic composite pallets. The main feature of this research is the usage of waste material as raw material to produce composite pallet. Also, the research aims to identify

the profitability of the investment if a foreign firm decides to invest in India and starts its production operation. The design and analysis is done of two size of pallets 600x400 mm and 800x600 mm.

The design and analysis results determine the load capacity of the pallet which is similar to that of wooden pallets. The economic evaluation of the initial investment of Euro 1 Million shows return of investment at 110.51 % for 600x400 mm pallet and 48.36 % for 800x600 mm pallet. Furthermore, the breakeven point for the return of investment will be achieved in quarter 6 for 600x400 mm and quarter 7 for 800x600 mm.

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## LIST OF SYMBOLS AND ABBREVIATIONS

<i>G/cm<sup>3</sup></i>	Grams per cubic centimetres
%	Percent
°C	Degree Celsius
<i>BIS</i>	Bureau of Indian Standards
<i>BO</i>	Branch Office
<i>CAGR</i>	Compound Annual Growth Rate
<i>CGST</i>	Central Good and Service tax
<i>DIN</i>	Director Identification Number
<i>DPIN</i>	Director partner Identification Number
<i>FC</i>	Fixed Costs
<i>FDI</i>	Foreign Direct Investment
<i>GDP</i>	Gross domestic Product
<i>GPa</i>	GigaPascal
<i>GST</i>	Goods and Service tax
<i>IGST</i>	Integrated Goods and Service tax
<i>INR</i>	Indian National Rupees
<i>IS</i>	Indian Standard
<i>JV</i>	joint venture
<i>Kg</i>	Kilogram
<i>Kgs</i>	Kilograms
<i>LLP</i>	Limited Liability Partnership
<i>LO</i>	Liaison Office
<i>Mn</i>	Million
<i>MPa</i>	Mega Pascal
<i>MT</i>	Metric Ton
<i>NRO</i>	Non-Resident Rupee
<i>PAN</i>	Permanent Account Number
<i>PE</i>	Polyethylene
<i>PET</i>	Polyethylene terephthalate
<i>PP</i>	Polypropylene

<i>PW</i>	Plastic Waste
<i>R</i>	Rating
<i>RBI</i>	Reserve Bank of India
<i>RoC</i>	Registrar of Companies
<i>ROI</i>	Return of Investment
<i>SGST</i>	State Good and Service tax
<i>SWL</i>	Safe Working Load
<i>TMSW</i>	Total Municipal Solid waste
<i>TPA</i>	Tonnes per annum
<i>VC</i>	Variable Costs
<i>WOS</i>	Wholly Owned Subsidiary
<i>WPC</i>	Wood Plastic Composite

## 1 INTRODUCTION

Material handling is one of the key aspects of almost every type of industry whether it is manufacturing, construction, warehousing, medical etc. and pallets have played an essential role in material handling since 1930s (Soury, Behravesh, Esfahni & Zolfaghari 2009, p. 4183; Lee & Xu 2004, p. 67). Pallets not only improve the material handling process however at the same time reduce the storage costs and thus they are crucial in handling and transportation of material in a supply chain (Bengtsson & Logie 2015, p. 414). Pallets are used in every stage of a manufacturing process whether supporting load of raw material from supplier to manufacturer, or supporting load of finished goods from manufacturer to distributors and from distributors to retailers (Roy, Carrano, Pazour, & Gupta 2016, p. 358).

In Europe, there are approximately 280 million pallets in use every year (Roy et al. 2016, p. 358). In comparison, in United States about 450-500 million pallets are manufactured every year, adding to the already existing 2 billion pallets which are in circulation (Roy et al. 2016, p. 358; Elia & Gnoni 2015, p. 730). All these pallets carried out approximately 80% of entire trade and logistics in United States (Roy et al. 2016, p. 358).

Usually materials for making pallets includes wood, metal and plastic. However, majority of the pallets made are from wood, and approximately 400 million wooden pallets produced every year, this accounts for 86 % of the global pallets sales. Wooden pallets are ecofriendly, durable and can be recycled and repaired easily. In comparison with metal or plastic pallets, wooden pallets are inexpensive but they have certain disadvantages over them. (Soury et al. 2009, p. 4183; Khoo, Ratnam & Khalil 2008, p. 1733-1734.)

One of the major disadvantages of wooden pallets is their proneness to environmental degradations caused by factors such as fungal, moisture, heat etc. Another disadvantage is the fastening methods such as nailing or screwing used in joining parts of wooden pallet together cannot ensure product performance over a long period of time. Finally, producing wooden pallets require excessive amount of wood which results in forest depletion and can

further result into major environmental hazards such as landslides and floods. (Soury et al. 2009, p. 4183; Khoo, Ratnam & Khalil 2008, p. 1733-1734.)

The disadvantages of wooden pallets, has prompted some of the manufacturers to use metal and plastics as the raw material for pallets manufacturing (Soury et al. 2009, p. 4183; Khoo, Ratnam & Khalil 2008, p. 1734). Metal pallets offers high strength, toughness and long service life; however, they are expensive to produce and are heavier thus adding weight to the shipment and increasing the transit costs. Plastic pallets are in use since 1960s but mainly in the applications that require proper sanitation. After 1990s, plastic pallets are not only favourable for their sanitation reason but also due to their economic benefits and advantages over wooden pallets. (Lee & Xu 2004, p. 68.) The market share of plastic pallets has grown significantly over past few years and will continue to grow in the near future (HexaResearch 2015).

Plastic pallets are lighter in weight, more durable and have high strength in comparison with wooden pallets. Usually the price of plastic pallets price is 3 to 5 times more costly than wooden pallets, however, this additional cost is balance with additional number of shipments or trips plastic pallets undergoes in their long life cycle. Another big disadvantage of plastic pallets in the material itself, as plastic is non-biodegradable and thus it is dangerous to environment if not disposed properly. However, plastic pallets can be recycled but it is an expensive procedure and some countries did not possess appropriate waste management systems. (Soury et al. 2009, p. 4183; Khoo et al. 2008, p. 1734.)

Using material such as Wood plastic composite (WPC) which offers the benefits of both plastic and wood in terms of strength and recyclability respectively, is a viable solution to tackle the environmental issues and sustain the growth of pallet market. WPC is a mixture of crushed wood fibres/flour and a polymer matrix usually thermoplastics such as Polyethylene terephthalate (PET), Polypropylene (PP), Polyethylene (PE), Polyvinyl Chloride (PVC), Polypropylene (PP) etc. The wood fibres enhances the properties of the plastic and act as a reinforcement. (Soury et al. 2009, p. 4183.) These fibres are easily available from various sources of scrap woods, are renewable, have low density and have relatively high strength-to-weight ratios. With the world, focus more towards sustainability and environmental concerns, WPC pallets made up of scrap wood and

recycled plastic have huge prospective to replace wood and plastic pallets. (Khoo et al. 2008, p. 1734.)

Linear WPC profiles for pallets are produce using extrusion process and then assembled by fastening methods such as nailing or screwing. The main benefit of extrusion process to produce pallet profiles is that it allows the designing and optimization of profile by enhancement in the design of extrusion die. (Soury et al. 2009, p. 4183.) Producing WPC pallets in single piece using injection moulding process is another option and using injection moulding, forming complicated shapes is possible (Schwarzkopf & Burnard 2016, p. 25).

### 1.1 Background Research of WPC Pallet Market

The majority global market share of WPC material is currently in applications such as construction and automotive (Schwarzkopf & Burnard 2016, p. 20). WPC is quite popular in United States and Europe for the purpose of outdoor exterior decking and construction material. Approximately, 9 % of world's WPC production happens in Europe (Sommerhuber, Wenker, Rüter & Krause 2017, p. 236.) WPC material has gain a substantial market share across the globe, in Europe with 260,000 tons of annual production in 2012 and predicted to reach 400,000 tons per year by 2020. Currently North America has the largest production share of WPC pallets with annual production of 1.1 million tons, China comes at second with 900,000 tons. (Carus, Eder, Dammer, Korte, Scholz, Essel, Breitmayer & Barth 2014, p. 2.) In India, the adaptation of WPC material has started to take place recently in the 21<sup>st</sup> century. This is mainly because of decline in forest area in India for clearing land for urbanization or using wood for consumer goods.

With increase in global manufacturing, pallet market is predicted to grow at compound annual growth rate (CAGR) of 5.24 % over 2015-2021 (ResearchNester 2016). The sales of pallets across the globe has increased by 5 % through 2017. This surge is prominently in large and developed markets like North America and Western Europe with the total number of units rising from approximately 4 billion in 2012 to approximately 5.1 billion by 2017. (Andel 2014.) Over the next six years, the application of pallets in the industries such as food and beverages will grow at a significant pace. This is mainly because of the requirements of these industries to ensure high standards of cleanliness and reduce

contamination for which pallets are a suitable option. Further, pallet plays a vital role in packaging sector as they facilitate in transportation of goods according to user need. (HexaResearch 2015.)

Currently in developing countries such as China and India, pallet application is usually less in comparison with the size of their construction, warehousing and manufacturing activities. However, these countries will have highest percentage increase in the usage of pallets mainly because they has emerged as the prime manufacturing base for the world economy and served majority of western clients. (Andel 2014.) The major industries that will cause the growth in pallet market growth in these countries are packaging and automobile sectors (HexaResearch 2015).

### 1.2 Objective

The aim of the research work is to understand the current market scenario of Indian Pallet industry and identify the opportunities for usage of WPC material in the Industry. In addition, the research work will involve developing special type of pallets specifically for Indian market. Further, this research will also focus on identifying key routes and factors that a foreign firm should take into consideration while investing in India. Finally, the research is aim to calculate economic evaluation of investment and finding out the profitability of the investment.

### 1.3 Research Problem and Questions

India is transforming into new global manufacturing base for serving the needs of majority of western clients and many western firms are opting India as its new manufacturing site destination. This outsourcing has resulted in spread of supply chain network to a large geographical area. One of the key factor of this supply chain is the material handling and shipping, of which pallets are an integral part.

With the rise in manufacturing and warehousing sectors in India, the direct beneficiary of the growth in pallet industry which has seen a steep growth in recent years and will continue to do so. Currently wooden and plastic pallets primarily dominate the pallet industry in India. However, the growth of this industry can be hamper due to certain

factors such as declining wood resources in India, high cost of importing timber from other countries and usage of plastic possessed environmental issues.

The research questions taken into consideration in this research paper are, what is the current scenario of Indian pallet market, what is the potential of WPC pallet in India, what is the correct procedure a foreign firm need to follow to enter in Indian market and how much profitable this investment will be.

#### 1.4 Hypothesis

The hypothesis that are been tested in this research work is-

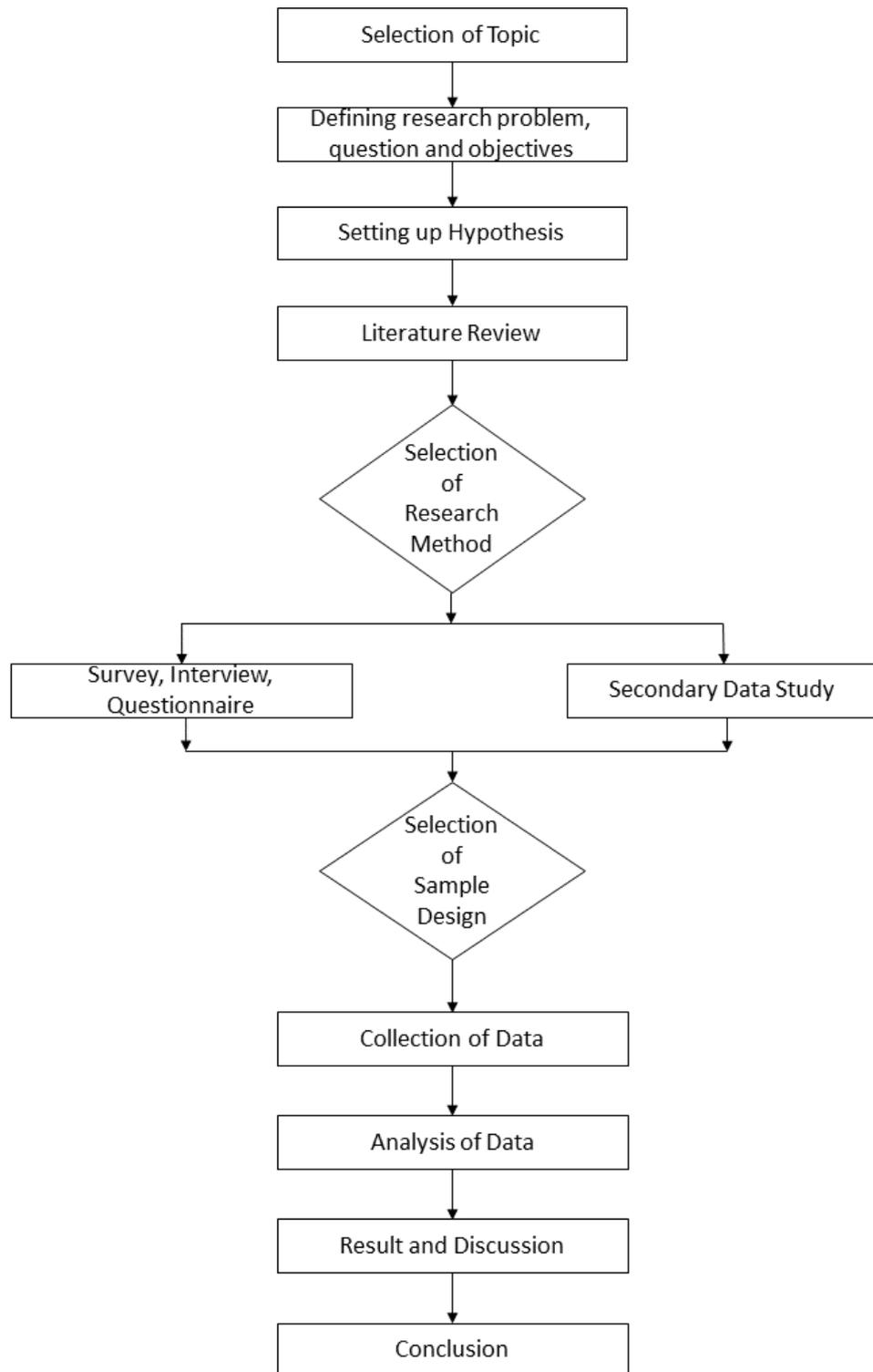
- Indian pallet industry is growing rapidly and mainly dominated by wood pallets.
- New government regime has made it easier for the foreign firms to start its operation in India.
- In current scenario, investing in Indian Pallet market is profitable due to high rate of returns.

#### 1.5 Limitation

The scope of the research work is limited to Indian pallet market and will be focused towards WPC material. In addition, the comparison of WPC pallets in terms of annual sales, cost and sustainability is with either wood or plastic and no other material such as metal is considered. Furthermore, to restrict the scope of research further the design and analysis phase will be focused on small size pallets such as 600x400 mm and 800x600 mm. Finally, due to the huge size of India as a nation, the research will be concentrated mainly for Northern and Western India because of the presence of huge industrial sectors in these regions. The regulations and procedure for investing in Indian market is taken into consideration from the point of view of a Finnish firm. The exchange rate is considered at Indian National Rupees (INR) 72.5 = 1 Euros for this research.

#### 1.6 Research Methods

The research work is comprised of both qualitative and quantitative methods for data collection. The research will identify the gaps in the pallet industries in India and focus on how WPC material can replace wood and plastic in the Indian pallet market. Figure 1 represent a brief description of research methodology used in this research.



**Figure 1:** Flowchart of research methodology

## 2 INDIAN PALLET MARKET OVERVIEW AND SURVEY

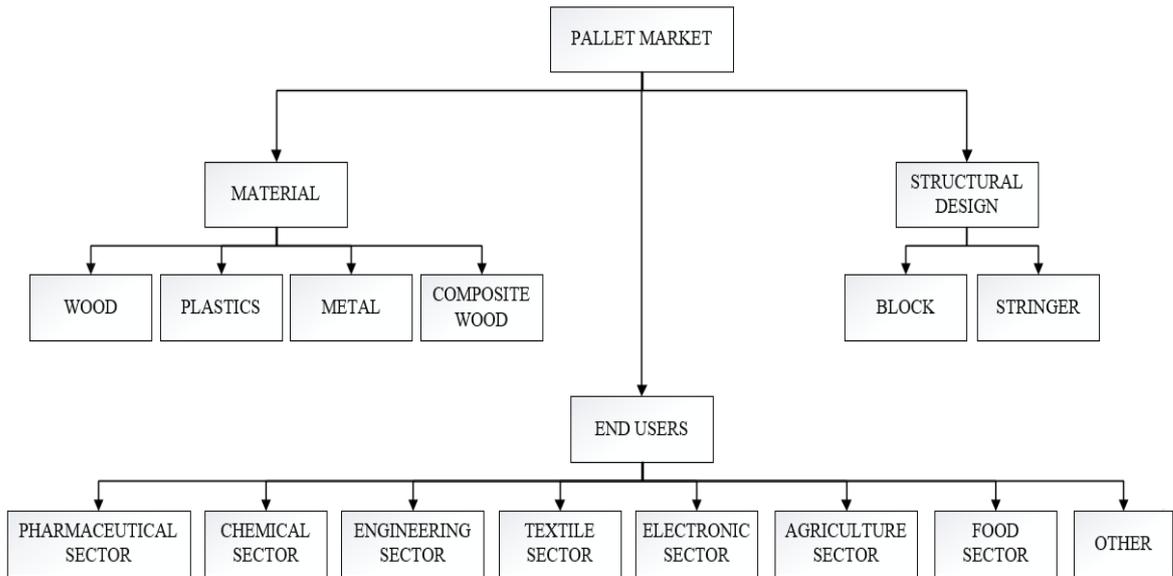
At the end of 2016, Indian Pallet Market was valued approximately INR 6,223.1 Cr. or Euro 858.3 Million (Mn). Further, the current projection states that the industry will continue to progress at a CAGR of 13.9 % during the span of 2016-2024. This growth is mainly due to the forecasted progress in the country's Gross domestic Product (GDP) by 7.7% over the same period. The pallet demand in India will grow at a substantial rate due to the development in manufacturing sector and expansion of warehousing and logistical infrastructure in India. One recent trend in the Indian pallet market is the large retail stores chains using pallet as prime material handling equipment. (PMR 2016.)

This major surge in the country's GDP is mainly due to the government measures to allow Foreign Direct Investment (FDI) and open Indian market to foreign investors by relaxing rules and regulation for investing in India. Other factors, that add to the rise of country's GDP is the new government programs such as "Make in India" and rolling out new Good and Service tax (GST) structure.

However, factors such as decline in international trade due to trade barriers, economy policies etc. can hamper the growth of pallet industry in India. Further, India is still a labour-intensive industry, majority of the industries still rely on manual labour work for material handling, and penetrating into such sectors could be a major challenge. Other factor is the environmental concern related to usage of wooden pallets and disposal of plastic pallets in India could have negative impact on the growth. (PMR 2016.)

### 2.1 Definition and Taxonomy

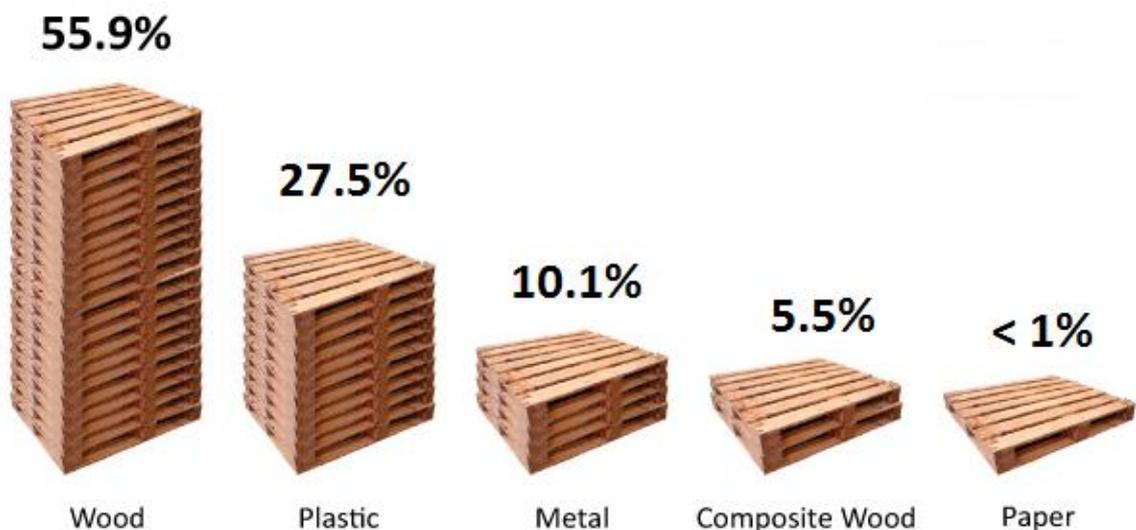
Pallets are generally defined as a load bearing structure that are used to provide a rigid base for shipping and storage of goods and products that are termed as a unit load. According to Khoo et al. (2008, p. 1733), "pallets are designed so that products and goods can easily be retrieved and delivered using lift trucks such as forklift and pallet jacks." The major classification of Indian pallet market is into material type, structural design and end users as shown in figure 2.



**Figure 2:** Taxonomy of Indian Pallet Market (mod. PMR 2016).

## 2.2 Material Type

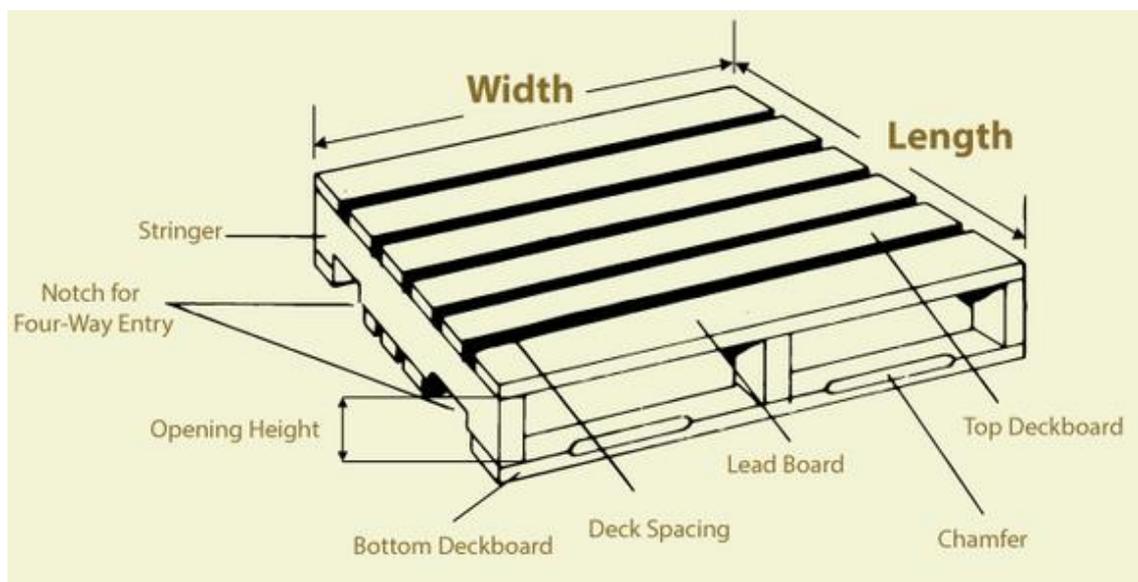
Wood, plastics, metal and composite wood are the major classification of Indian pallet market according to the material type. The wooden pallet dominates the Indian pallet market similar to the global trends where wooden pallets are in majority as shown in figure 3. However, the market share of plastics pallets in India is relatively higher in comparison with the global market share. Further, plastics pallets will likely to register a relatively high CAGR during the period 2016-2024. (PMR 2016.)



**Figure 3:** Indian Pallet Market share based on material type (mod. PMR 2016).

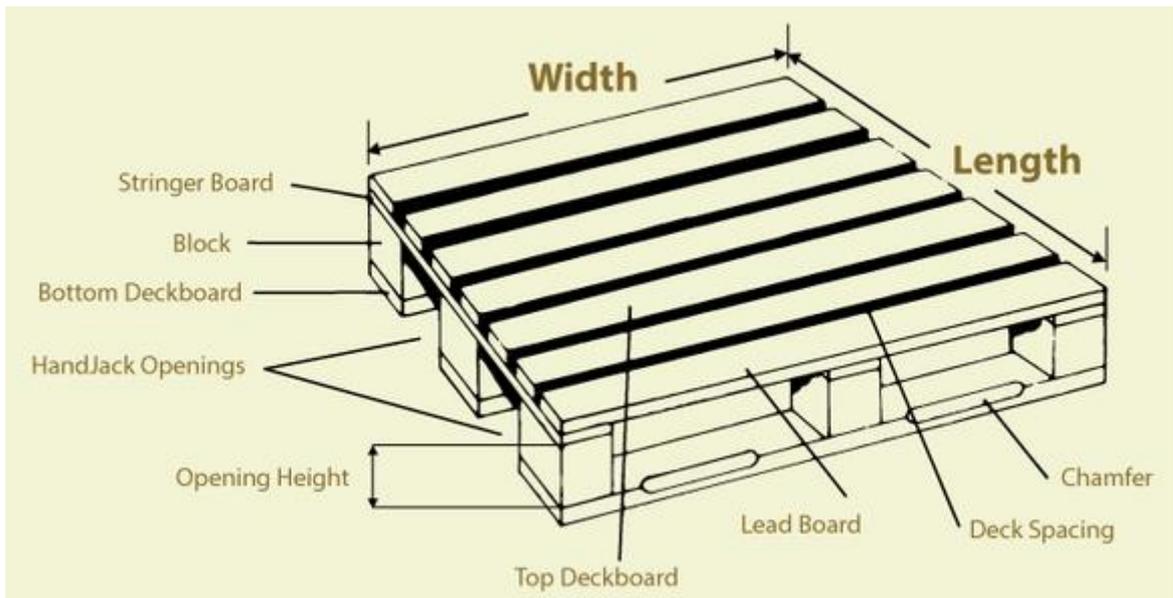
### 2.3 Structural Design

The two classes of pallets according to which pallets are classified based on design are block and stringer pallets. A stringer pallet consists of rectangular stringers (usually 3), which is a wooded part that cover the entire length of the pallet and support the unit load. (Anthony 2013.) The top edge of stringer is fastened to the top deck and the bottom edge of stringer is fastened to the bottom deck. If a stringer pallet is without any bottom deck it is called as a skid. Usually stringer pallets are two-way pallets, however if the stringer can be notched to provide for a partial four-way entry as shown in figure 4. (Hoffman 2014.)



**Figure 4:** Stringer Pallet (Hoffman, 2014).

A block pallet consist of a rectangular blocks instead of a stringer but the block is placed at the corners of the deck as shown in figure 5. The blocks are fastened to the top and bottom deck on the pallet. The number of blocks may vary from four to twelve depending on the size of pallet to support the top deck boards. Further, there is also a thin stringer board between the blocks and deck boards. The length of block pallet is defined by stringer length and the width by deck board's length. (Hoffman, 2014). Over the period of 2016-2024, the block pallets will expected to lead the structural design category and grow at a CAGR of 12.4% (PMR 2016).



**Figure 5:** Block Pallet (Hoffman, 2014).

#### 2.4 End Users

Various sectors of industries used pallet as a medium of material handling equipment and the trend is likely to grow in the future. This is mainly because of the better safeguard for the product and the people during the transportation and handling in comparison with manual labour and reducing the storage costs. The major industrial segments where pallets are dominating currently are engineering, pharmaceuticals, chemical, electronics, textile, agriculture, food and beverages. However, amongst all the product segments, engineering and pharmaceutical segments accounts for 40 % of the market share of Indian pallet industry collectively. (PMR 2016.)

### 3 FOREIGN INVESTMENT INTO INDIAN MARKET

A report by United Nations, predicts Indian economy growth rate at 7.1 % this year and reaching 7.5 % in 2018 (The Hindu Business Line 2017). This is despite the fact of the demonetization program started by Indian government in November 2016, which resulted in removal of about 86 % of total Indian currency in circulation. Initially the program reduce the consumer spending and decreases the investment but within few months, the economy catches up to its normal growth rate. (Worstall 2017; Trading Economics 2017.)

Since 1991, India had open its doors for foreign investors to invest in various sectors in India. This new investment and trade policies had significantly increased the economic growth, improved customer choice and decreased poverty. Foreign Investment in India is currently at all-time high this is because the investor wants to invest in the growing market and also take advantages of low-cost wages. At the same time these investors wants to reach a large portion of consuming class that is predicted to grow three times, to 89 Mn household by 2025. (Kaka and Madgavkar 2016.)

In early 2015, India exceeds China and United States in terms of top destination for Greenfield investment. During this time, India received \$31 billion of foreign investment in comparison of \$28 billion to China and \$27 billion to Unites States. These numbers are significantly higher when compared with previous year investments that were \$12 billion in the first half. This is mainly because of new Indian Government that has taken numerous valuable steps in order to attract foreign investors and doing business in India easier since it came in power in May 2014. (Profit NDTV 2015; The Times of India 2015; Iyengar 2015.)

In 2014, after the new government came into power, country witnessed 47 % increase in Foreign Direct Investment (FDI) projects. Further, new government programs such as “Digital India” and “Make in India” were also started in order to attract more FDI to India. In addition to that, government had also relaxed several FDI norms and policies in various sectors that provide easy establishment of companies in India and a fair tax regime. With “Make in India”, government is trying to convert India into a global manufacturing hub

and compete against China. India also improved its rank to 55<sup>th</sup> from 77<sup>th</sup> in global competitiveness index. (Profit NDTV 2015; The Times of India 2015; Iyengar 2015.) This chapter explain how foreign companies can investment in India especially Indian Pallet Market and what benefits they might get for their investment and how profitable their investment could be.

### 3.1 Foreign Direct Investment Approval Routes

FDI in India is possible by two mean either automatic route or with approval government route. For automatic route, foreign companies did not need any approval from the government for investment whereas in government route, companies require a prior permission from the government of India in order to start any business operations. FDI in India is prohibited in certain sectors (See table 1 Appendix 1) and sectors where investment is permitted under government route are subjected to caps on investment (See table 2 Appendix 1) (India Legal Help 2016a, p 2-3.) (Makeinindia 2016.)

All other sectors that are not mentioned in prohibited and government route comes under the category of automatic route. However, certain sectors in automatic route can be subjected to caps on investments (See table 3 Appendix 1) similar to in government route sectors. (India Legal Help 2016a.) The only difference is that the foreign firm did not require any approval from any authority in India. For an Indian firm that receive FDI either via automatic or government route has to report the investment and division of shares to Reserve bank of India. (Makeinindia 2016.)

### 3.2 Entry Modes

Entry modes provides foreign firms various ways to enter into Indian market either directly or indirectly, when selecting an appropriate entry mode a firm has to compromise between control over the company and cost of commitment. The general entry modes available for the foreign companies to invest in India are exporting or trading mode, licensing to an Indian firm to conduct business on the foreign firm behalf, joint venture with a local firm (JV) and wholly owned subsidiary (WOS). WOS could be either Greenfield or acquisition. Usually, exporting and licensing falls under the category of non-equity based entry modes whereas JV and WOS are equity based. (Kumar & Annushkina 2011, p. 105.)

According to Agarwal & Ramaswami (1992, p. 2.), “the choice of an entry mode of a target market is influenced by three types of determinant factors: ownership advantages of a firm, location advantages of a market and internationalization advantages of integrating transactions within the firm”. Ownership advantages of a firm are those that originates from the firm’s intangible assets such as technology or brand image and the ability of the firm to produce distinguished goods. Location advantages are connected to the host market in terms of higher market potential and low threat for investments this will enable the firm to earn more profits from the market. Internalization advantages arise from the extremal ambiguity in the marketplace. (Kumar & Annushkina 2011, p. 105.)

Usually firms which possess high ownership advantages such as Intel, Microsoft etc. prefer to go for high control modes such as majority ownership of JV or a WOS. Also, if the market has high location advantages such as Indian market, firms can choose to go for high control modes. However, the cost of investment in quite in high control mode but at the same time it offers more protection to the company’s assets and specialized skills. Further, a firm entering in a host market with high location advantages with high control modes tends to have more profit potential over long term. (Kumar & Annushkina 2011, p. 105.)

A major drawback of high control mode entry is that in case of exit from the market such as India the costs are relatively high and huge amount of fines are imposed on the firm by the local authorities. This situation mainly comes due to political turmoil or a policy change by the Indian government. In such situations when the market is subjected to high external ambiguity, firms can opt for low control modes such as exporting. (Kumar & Annushkina 2011, p. 105.)

In case the firm is in doubt about high investment in the Indian market, it can choose to establish a Liaison Office (LO) or Branch Office (BO) in India. LO acts as a communication channel between the firm’s head office abroad and its customer in India. It can engage in activities such as promoting exports or imports in India and promote technical or financial alliances between parent firm and local Indian firms. However, a LO is neither permitted to perform any kind of business activity in India nor it is allowed make any income in India. All the expenditure of the LO are to be taken care by the Head office

of the firm. Therefore, the sole purpose of a LO is to collect information about the market and the provide information about the firm to the customer. (India Legal Help 2016a, p. 4.)

Foreign firms which are doing manufacturing or trading business can establish a BO in India after getting permission from Reserve Bank of India (RBI) and can perform several functions such as

1. Exporting/importing of goods
2. Provide consultancy services
3. Perform research work in the field of parent firm operations
4. Promote technical or financial alliances with local firms
5. Act as a buying or selling agent for the parent firm in India
6. Provide information technology services and technical support for the goods sold by parent firm in India

However, a BO cannot engage in retail trading business in India and cannot carry out any production activities in India. Further, any profits generated by BO can be remittable from India after appropriate taxes. (India Legal Help 2016a, p. 4-5.)

A foreign firm can establish a unit in Special Economic Zones for carrying out manufacturing process after getting approval from RBI. However, certain conditions must be fulfilled in such cases, the unit should operate in the sectors of 100 % FDI, the unit should obey part XI of Companies Act, 1956 (Section 592 to 602) and unit should run on a standalone basis. The permission for establishing either LO or BO varies from sector to sector. In case of areas where FDI is permitted 100 % via automatic route, RBI gives permission for establishing LO or BO. And, the areas where 100 % FDI is not permitted under automatic route, the permission is given by Government. (India Legal Help 2016a, p. 5.)

In case foreign firm choose not to go with LO/BO themselves, they can have an association with a local person who will be a partner in India. This local partner can perform all the activities and role of LO/BO at a much lower cost. This partner conduct market research, act as a distributor for the foreign company, act as a procuring representative for the firm and can deliver after-sales supports and services to the customers in India. Further, these local associates will bring understanding of Indian business and key connections to the

relationship. Though, it is important to define clear roles for local associates to avoid any issue later in the future. Also, no prior approval is needed from any authority to form a relationship with a local associate. (India Legal help 2016a, p. 7-8.)

For manufacturing activities in India, it is beneficial to have a JV or WOS unit, this unit can be in a form of Limited Liability Partnership (LLP) or a company. A foreigner can establish a company in India under Companies Act of India, which is the most favoured option of entrance method into Indian market. However, the option of forming a LLP firm in India is available since November 2015 and many foreign investors are showing interest in this entry mode. Any other form of entry mode such as proprietary firm, partnership firm or trust is not allowed for foreign investors. (India Legal Help 2016a, p. 9.)

### 3.3 Wholly owned subsidiary- Limited Liability Partnership vs Company Firm

LLP's in India are formed under The Limited Liability Partnership Act 2008. LLP structure is simple, easy to integrate, offers tax benefits and it also easier to wind up LLP in comparison to a company. However, forming a LLP has some condition for FDI, such as, the nature of business of LLP should relate to the business areas where FDI is permitted 100% under automatic route and the sector should not have any performance related condition prescribed under its FDI policy. The cost of incorporating a LLP firm is dependent on the total capital investment of the firm and also the state in which the firm is listed as shown in table 1. (India Legal Help 2016a, p. 11-12.)

*Table 1: Cost of incorporation of LLP in different states (India Legal Help 2016a, p. 12).*

<b>Capital</b>	<b>Cost of establishing a LLP</b>			
	<b>Delhi</b>	<b>Maharashtra</b>	<b>Gujarat</b>	<b>Madhya Pradesh</b>
INR 10,000/ Euro 137.93	INR 13,900/ Euro 192	INR 14,300/ Euro 197	INR 13,900/ Euro 192	INR 15,800/ Euro 218
INR 1 Mn/ Euro 13793	INR 27,400/ Euro 378	INR 32,400/ Euro 447	INR 32,400/ Euro 447	INR 32,400/ Euro 447
INR 10 Mn/ Euro 137931	INR 38,450/ Euro 530	INR 48,450/ Euro 668	INR 43,450/ Euro 599	INR 43,450/ Euro 599

Capital	Cost of establishing a LLP			
	Delhi	Maharashtra	Gujarat	Madhya Pradesh
INR 100 Mn/ Euro 1.38 Mn	INR 38,450/ Euro 530	INR 48,450/ Euro 668	INR 43,450/ Euro 599	INR 43,450/ Euro 599
INR 1 Billion/ Euro 13.8 Mn	INR 37,650/ Euro 519	INR 47,650/ Euro 657	INR 42,650/ Euro 588	INR 42,650/ Euro 588

LLP offers the various benefits including simplicity of partnership firm and benefits of limited liability which are offered to only companies previously. LLP firm will continue to operate even if the partners are changes as the firm is capable to make contracts and hold property in its name similar to any company. LLP is a separate legal entity but the partners are restricted to their respective agreed input in the LLP. The partners to have no accountability for any un-authorized action of other partners and this protect the individual partners from misconduct of other partners. A LLP agreement between the partners govern the mutual rights and duties of each partner. LLP structure is spreading rapidly in India because of its simplicity and non-existence of any severe penalties which are forced by Companies Act 2013. For any small or medium type of manufacturing business LLP is the best and in future LLP can be converted into a company. (India Legal Help 2016a, p. 11.)

LLP firm must have minimum 2 partner and 2 designated partners. However, partners can also be designated partners. The step of formation of new LLP in India are as follow:

1. Any partners who are Indian citizen need a Permanent Account Number (PAN) from the Income Tax Department of India.
2. Foreign persons do not need a PAN but they must have a valid passport with proof of address. The person should ensure that he must have a copy of passport and proof of address attested by the Indian embassy located in its home country.
3. Any person who is supposed to become the designated partner must have a digital signature that can be purchased from a company in India.
4. Every first designated partner must get a Director partner Identification Number (DPIN). A digital signature is necessary to apply for a DPIN and one person can only have a single DPIN. If someone already have a Director Identification Number (DIN) that is required for forming a company, they do not need to have DPIN.

5. Choose the state for registering the LLP firm. Further, it is easier to transfer the LLP firm registered office both within the state and outside it.
6. Every partner must decide their share of contribution and decide the objective of the firms
7. Select at least one name up to six at maximum, in order of preference. Also, consider that the name are in order to the objective of the LLP firm.
8. Check that no previous registered LLP firm has the same name. This can be done by checking name availability on the portal (<http://www.mca.gov.in>).
9. Apply for the name to the concerned Registrar of Companies (RoC) via Form 1 by logging into the website (<http://www.mca.gov.in>). The applicant has to pay INR 200 or Euro 2.75 as processing fees along with the digital signature of the applicant. In case, the name is already registered, one can reapply with a new firm name on the same application.
10. After the approval of firm name, the registration of new LLP firm can begin by using Form 2 available at the above mentioned portal and attached the necessary documents. This process must be completed within 3 months of name approval.
11. Once the forms are processed, the corporate identity will be generated and the applicant can get Certificate of Incorporation from RoC.
12. With the help of solicitor/company secretary, draft a LLP agreement and arrange for its stamping with suitable stamp duty.
13. The partner will signed the LLP agreement. However, it is not necessary to have a LLP agreement for a LLP firm. It is totally up to the partners and their understanding and trust of each other.

(India Legal Help 2016a, p. 17-18.)

Companies in India are formed under the Companies Act 2013. Any firm formed under company act, is basically a voluntary joining of persons for doing business having limited liability. The company is a separate legal unit and it is distinct from its forming members. The company is capable of rights and duties of its own. The main component of a company firm are its members or stakeholders. These members are the real owners of the company and they appoint the directors for the company, who are actually responsible for managing the company. Therefore, there is a difference between the ownership and the governing of activities of the company. (India Legal Help 2016a, p. 12-13.)

When the owners want to establish their company, they must disclose the names of all the stakeholders, its director's name, registered office of the firm, nature of business and its authorized share capital, which is defined as the amount of funds that the stakeholders offers to invest in the company. Whereas, paid-up capital is amount that stakeholders contribute as a share investment on any particular date. It is important to note that paid-up capital cannot be more than the authorized share capital. Similar to LLP, the cost of establishing a company is associated with authorized share capital and state in which it is registered as shown in table 2. (India Legal Help 2016a, p. 13.)

*Table 2: Cost of Incorporation of Private Limited Company (India Legal help 2016a, p. 14).*

<b>Capital</b>	<b>Cost of establishing a Private Limited Company</b>			
	<b>Delhi</b>	<b>Maharashtra</b>	<b>Gujarat</b>	<b>Madhya Pradesh</b>
INR 10,000/ Euro 137.93	INR 25,125/ Euro 346	INR 26,200/ Euro 361	INR 26420/ Euro 364	INR 32450/ Euro 447
INR 1 Mn/ Euro 13,793	INR 67,610/ Euro 932	INR 68,200/ Euro 940	INR 71920/ Euro 992	INR 73450/ Euro 1,013
INR 10 Mn/ Euro 137,931	INR 251,710/ Euro 3,471	INR 256,800/ Euro 3,542	INR 267,520/ Euro 3,690	INR 254,050/ Euro 3,504
INR 100 Mn/ Euro 1.38 Mn	INR 1,086,710/ Euro 14,989	INR 1,136,800/ Euro 15,680	INR 966,620/ Euro 13,332	INR 1,089,050/ Euro 15,021
INR 1 Billion/ Euro 13.8 Mn	INR 9,186,710/ Euro 126,713	INR 9,686,800/ Euro 133,611	INR 7,716,620/ Euro 106,436	INR 9,189,050/ Euro 126,745

A company can be either formed as a private limited or public limited company. In case of private company, it must have minimum 2 stakeholders and the maximum limit can be up to 200 stakeholders. In comparison, a public limited company have minimum 7 stakeholders and with no upper limit of stakeholders. Both private and public company didn't require any minimum paid-up capital for establishing a company. Further, the cost of creating a public company is higher than a private company. (India Legal Help 2016a, p. 13.)

If the stakeholders and directors are non-Indian, it is vital for them to get their identity and address proof attested by Indian embassy present at the home country of the foreign person. This is an important process as it will allow the foreign person to get digital signature and getting Director Identification Number (DIN). The estimate time for all foreign investors for completion of all the formalities at the consulate will take around 6 weeks. The foreign stakeholders are supposed to bring their share of capital through normal banking channels. (India Legal Help 2016a, p. 14.)

Any company registered in India with foreign ownership can also have all of its director as foreign person. However, it is compulsory for one director to stay in India for at least 182 days every year. Other directors can live abroad and conduct business while living abroad. Furthermore, according to the schedule 5 of Companies Act 2013 under section 196, it is compulsory for the company to appoint a Managing Director which is a resident of India. However, with the approval of Indian government it is possible to appoint a non-resident as Managing Director. (India Legal Help 2016a, p. 15.)

According to section 173 of the Companies Act 2013, the board of directors must have a meeting once at least every 3 months and at least 4 times a year with maximum 120 days gap between 2 meetings. However, for a small company, the meeting can be conducted every half of the calendar year with a gap of minimum 90 days between the two meetings. There is provision given to the board of directors to participate either in person or through video conferencing. For the stakeholders meeting, it can be held once a year but it must be in the city where the company is registered. (India Legal Help 2016a, p. 15.)

However, in case of stakeholders meeting video conferencing is not possible so the foreign stakeholder have to travel to the city of meeting to attend it. Though foreign companies, can have two Indian stakeholders with one share each of value INR 10 and they can attend the general meeting instead of foreign stakeholders. Usually for ease of doing business, foreign companies prefer to have an Indian stakeholder and director. But this stakeholder and director have zero investment in the company and just hold a share on INR 10. (India Legal Help 2016a, p. 15-16.)

There are certain steps that are important to follow in order to establish a company, these are:-

1. Any Indian stakeholder or director of the company must have a PAN issued by Income Tax Department of India.
2. Foreign persons who are either stakeholders or directors do not need a PAN but they must have a valid passport with proof of address. The person should ensure that he must have a copy of passport and proof of address attested by the Indian embassy located in its home country.
3. All promoters need to have a digital signature that can be purchased from a company in India.
4. Every first stakeholder and director must get a DIN. A digital signature is necessary to apply for a DIN and one person can only have a single DIN.
5. Choose the state for registering the company. It is easier to change office within state but changing to other state is expensive.
6. Next, the stakeholders must decide the authorized share capital for the company, there is no lower or upper limit for that.
7. Deciding which type of company will be formed either private or public.
8. Select the main objective of the company.
9. Select at least one name up to six at maximum, in order of preference.
10. Check that no previous registered company has the same name.
11. Apply for the name to the concerned RoC via Form INC-1 by logging into the website (<http://www.mca.gov.in>). The applicant has to pay INR 1000 or Euro 13.8 as processing fees along with the digital signature of the applicant. In case, the name is already registered, one can reapply new name on the same application.
12. After the approval of name, the registration of new company can begin. This is done by using required forms (Form INC-7, DIR-12 and INC-22) which are available at the same website. This process must be completed within 60 days of name approval.
13. Using a company secretary or solicitors, arrange to draft memorandum and articles of association.
14. Stamping of memorandum and articles with the appropriate stamp duty.
15. At least 2 subscribers must signed the memorandum and articles and one person should witnessed it.

16. Once the forms are processed, the corporate identity will be generated and the applicant can get Certificate of Incorporation from RoC.

It is beneficial to have a Practicing Company Secretary involved in the completion of registration process. The charges vary according to the city and the reputation of the Secretary. The Company Secretary can give estimation of the expenses but he will ask for certain information such as authorized share capital, state of registration, number of stakeholders and directors and type of company such as private or public. Also consider that apart from these steps, there are certain formalities which are related to the RBI even if the sector has 100% FDI automatic route. (India Legal Help 2016a, p. 19-21.) Finally, a brief comparison of LLP and a private limited company is shown in table 3.

*Table 3: Comparison between LLP and a Private Limited Company (India Legal Help 2016a, p. 10-11).*

<b>Parameter</b>	<b>LLP</b>	<b>Private Limited Company</b>
<b>Applicable Law</b>	LLP Act 2008	Companies Act 2013
<b>Cost of formation</b>	INR 13,900 – 48,450	INR 25,125 onwards
<b>Minimum Capital</b>	Not prescribed	Not prescribed
<b>Minimum number of members</b>	Two partners	Two stakeholders
<b>Maximum members</b>	No limit	Maximum 200 members
<b>Charter Documents</b>	LLP agreement	Memorandum of association and articles of association
<b>Resident Director</b>	One of the designated partners must be Indian	At least one director must be Indian
<b>Managed By</b>	Designated Partners	Directors
<b>Audit</b>	Not required for small firms	Compulsory
<b>Foreign Investment</b>	Permitted only in sectors where 100 % FDI is allowed by automatic route without any type of conditions or cap.	Subject to FDI policy
<b>Winding Up</b>	Easy	Very Difficult

<b>Parameter</b>	<b>LLP</b>	<b>Private Limited Company</b>
<b>Punishment for default</b>	Mild to moderate	Extremely High

### 3.4 Joint Venture Company

Foreigner investor can also opt to form a JV with a local Indian investor or a firm, in order to reduce the cost of investment. The two types of JV in India are Contractual JV and Equity based JV. Contractual JV is basically a work agreement without forming a new entity such as a franchisee. In equity based JV, a distinct business entity is formed according to the agreement between two or more parties. The ownership of the entity is shared amongst the parties. For a foreign investor, the business entity can be in the form of a company or a LLP. These two forms are the most preferred structure for JV in India. The features, structure and step of formation of both company and LLP JV are similar to that of WOS. A brief comparison of JV Company and JV LLP is shown in table 4. (India Legal Help 2016b, p. 2-3.)

*Table 4: Comparison of JV Company and JV LLP (India Legal Help 2016b, p. 9-10).*

	<b>JV Company</b>	<b>JV LLP Firm</b>
<b>Liability</b>	Limited Liability	Limited Liability
<b>Complexity in Formation</b>	For foreigners, the majority of the time is getting the documents attested at the Indian consulate and time taken in the delivery of those documents – 4 weeks approximately	
	Company formation in 1-3 weeks	About 2 weeks
<b>Cost of Incorporation</b>	INR 25,000 onwards Depending on authorized share capital and state of registration	Between INR 10,000 – 20,000
<b>Minimum members</b>	Two stakeholders	Two partners
<b>Maximum members</b>	Maximum 200 stakeholders for private company. No limit for public company	No maximum limit on partners

	<b>JV Company</b>	<b>JV LLP Firm</b>
<b>Capital</b>	Capital investment made by parties according to JV agreement. Subjected to caps (if applicable)	Investment by partners according to LLP agreement
<b>Management Controls</b>	According to JV agreement	Rights and duties as described under LLP agreement
<b>Ownership</b>	Ownership shared by the parties	Ownership shared by partners as per extent of capital contributed
<b>Government Approvals</b>	Subjected to FDI policy of government	Only possible in sectors where 100 % FDI permitted via automatic route
<b>Exit Route</b>	Three options- either one partner buy the share of other partner, both partners sell their shares to 3 <sup>rd</sup> person and last is shutdown of company. Winding up a company is a difficult process requiring court approval.	Winding up a LLP is a easier process than company. Can be done with approval of parties and the terms mentioned in LLP agreement.

Some of the key features of an equity based JV are –

- An agreement can be prepared that defines either to create an entirely new entity or one party to join the ownership of an existing business operation owned by the other party.
- The ratio of the contribution made by the different parties defines the distribution of profit and losses incurred by the business entity.
- Shared ownership and management by the all the parties involved.
- Shared duties related to finances and capital investment

However, it is not essential that an equity based JV fulfil all the features. For example, sometime one party can choose to just invest and not take care about managing the operations of the entity. Also, sometime a foreign firm which is providing technology and knowledge can also choose not to invest in the entity but still wants to have certain control

on managing operations in order to ensure that the entity is going according to their vision. (India Legal Help 2016b, p. 4.)

### 3.5 Permanent Account Number, Bank account and Visa for foreigners

It is not necessary for foreign citizen who are investing in India to have a PAN but it is always beneficial to have one as the process to get PAN is quite simple. The documents needed to get PAN are one identity proof and one address proof. Both documents can be covered if the foreigner have a passport and a copy of passport attested by Indian consulate from his/her home country. The application can filled at online website <https://tin.tin.nsdl.com/pan/form49AA.html>. (India Legal Help 2016a, p. 23-24.)

The type of bank account foreign citizens or entity can open in India is mainly Ordinary Non-Resident Rupee (NRO) Accounts. For a Finnish citizen, who wish to open an NRO account in India, it did not require any prior permission from RBI or government. NRO accounts can be opened as current accounts, savings accounts, recurring or fixed deposit accounts. These accounts can be operated in joint with another person who may or may not be a resident of India. The money held in these accounts can be used for the purpose for paying expenses and doing transaction in INR. However, the money in the account cannot be used for foreign exchange with a resident of India against repayment in INR. Though, the money can be transfer abroad with some restriction and limits. It is not advisable for a foreign firm either JV or WOS in India, to have foreign currency accounts in India unless the firm also generate revenue in foreign exchange. (India Legal Help 2016a, p. 33-34.)

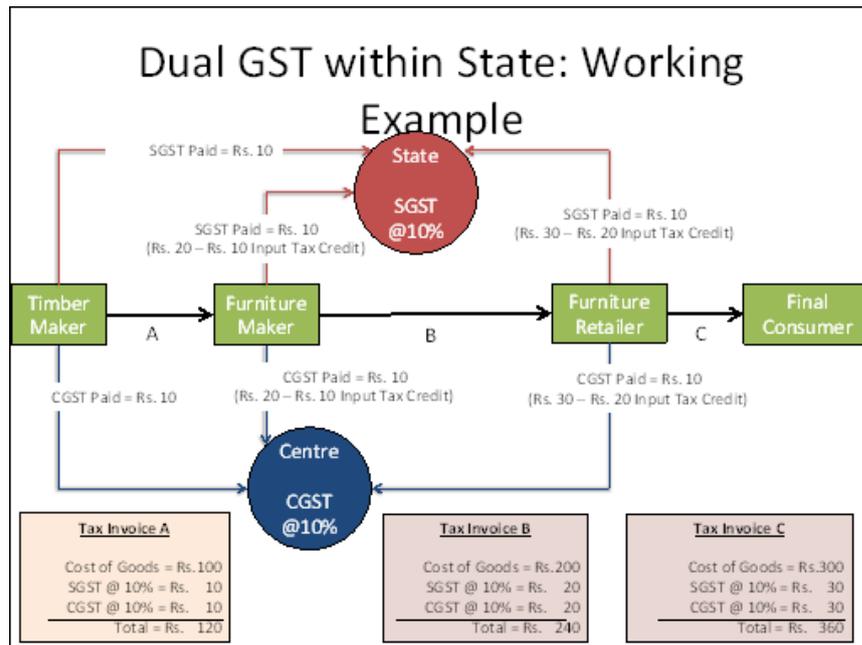
For a Finnish citizen to live in India, he/she will require a visa. The two most common forms for visa available for Finnish citizens for doing business are E-visa and business visa. E-visa grant the foreigner to enter and live in India for the duration of 30 days from the date of arrival but it cannot be extendable in India. It is grant only single entry in India and documents required are just passport, return ticket and photo. The application for E-visa can be filled at <https://indianvisaonline.gov.in/visa/tvoa.html>. The application can be filled minimum 4 days and at maximum 30 days in advance before the travelling to India. (India Legal Help 2016a, p. 39-41.)

The duration for business is maximum 5years and it can be extended in India. This visa also grants multiple trip access. Business visa is usually granted to foreigners who are coming to India for establishing business venture, purchasing or selling goods, attending meetings, etc. The documents require for this visa are financial statement, passport, papers stating the purpose of visit such as company letter, invitation to a meeting or trade fair, etc. (India Legal Help 2016a, p. 41-43.)

### 3.6 Goods and Service tax structure

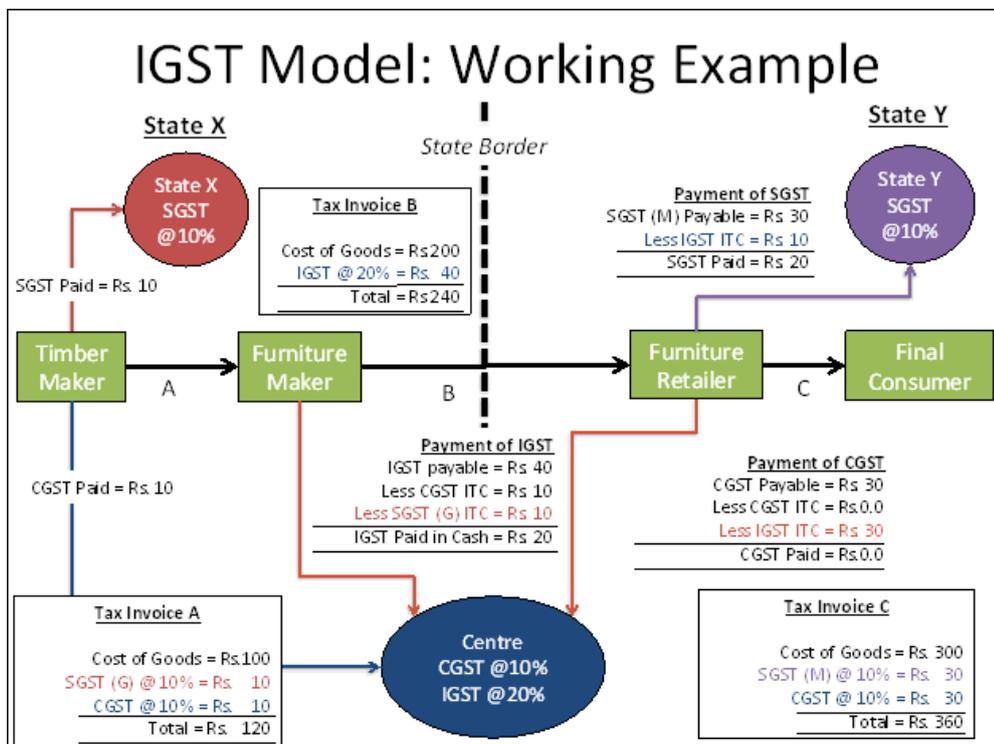
On 1<sup>st</sup> July 2017, Indian government implemented new GST structure for entire India covering manufacturing, warehousing, transportations, consumer goods sectors etc. GST is a single indirect tax system for the entire country, which allows India to be a unified common marketplace. It is a single tax on the goods and service, straight from the manufactures to the customers. At central government level, taxes such as central excise duty, additional excise duty, service tax, countervailing duty and additional duty of customs have been incorporated under GST. And at state government level taxes such as state value added tax or sales tax, entertainment tax, central sales tax, octroi and entry tax, purchase tax, luxury tax etc. are incorporated in GST. (GSTIndia 2017.)

GST is composed of two components Central GST (CGST) and State GST (SGST) and both centre government and state government will simultaneously levy GST. Taxes will be levied on both goods and services. Central government is responsible for levying and collecting CGST and state government is responsible for levying and collecting SGST. Figure 6 represent a schematic of a working model of Dual GST within a state in India. (GSTIndia 2017.)



**Figure 6:** Diagram for working of dual GST in India (GSTIndia 2017).

In case of goods purchased or sold across states, centre will collect Integrated GST (IGST) on all the inter-state goods supply. Figure 7 represent a diagram of a working model of IGST for inter-state transactions.



**Figure 7:** Diagram for working of IGST for an inter-state transaction (GSTIndia 2017).

The major impact of GST will be on manufacturing sectors, which contributes heavily to the country's GDP. Due to robust IT systems, all the tax related service including registrations, returns, payment etc. will be done online thus making the process simpler and transparent. With a same tax structure across entire nation, it will improve ease of doing business in Indian and the choice of doing business will no longer be dependent on location. (GSTIndia 2017.) GST will reduce cost of production by direct tax reduction and uniformity in the tax rates thus thereby will improve the competitiveness of goods produced in India in the international market. It will also provide hassle free supply of goods as the country now has single market meaning no extra taxes for goods crossing one state border to another state, thus smooth flow of goods within country. Further, it will help in restructuring of supply chain management in India. (Jain 2017.) Also, it will promote small scale industries by reducing the exemption threshold from INR 1.5 Crores to INR 20 Lakhs (Abhyankar 2017).

### 3.7 Labour law

The labour laws in India are very challenging for the foreign citizens to start a business venture in India. This is mainly because of the presence of labour unions and their strong political connections. But all these can easily be resolved by taking certain steps such as: -

- Try not to have any employee with on a salary less than INR 10,000 or Euro 138 per month. If possible try to keep it above INR 15,000 or Euro 207 per month.
- Try to keep least number of employees on company's payroll and try to outsource more.
- Try to ensure that total workforce in the company should be less than 20, though only applicable in small or medium scale industry.

(India Legal Help 2016a, p. 54.)

If the foreign firm can ensure that no employee is earning less than INR 10,000 or Euro 138 only few labour laws will be relevant to the firm such as: -

- Employees State Insurance Act, 1948 – This law is valid in case the total number for employees are 10 or more and to only those who are earning less than INR 15,000 per month. Under this act the firm will deduct 1.75 % of the worker wages and add 4.75 % from its funds, which will make the total contribution of 6.5 % of

the worker salary. The workers covered under this act will receive medical and insurance benefits from the government.

- Payment of Gratuity Act, 1972 – Only applicable in case the total workforce is 10 or more. Under this act, the firm must provide perks to the employee who had served for continuous 5 years or more at the time he leaves the company either via termination or resignation or if he dies.
- Employees Provident Funds and Miscellaneous Provision Act, 1952 – The act applicable in case the firm has 20 or more employees. The firm deduct 10 % of the worker salary and put the same amount as its own contribution and deposit the overall sum to the provident fund. The employee can withdraw his/her fund when he/she is unemployed or after retirement or under some emergency.

(India Legal Help 2016a, p. 54-55.)

## 4 DESIGN AND MANUFACTURING OF COMPOSITE PALLETS

The size selected for the designing of the pallets are 600x400 mm and 800x600 mm. The designing and analysing of pallets is done using Solid works 2016. In addition, certain criteria mentioned in Indian standards for pallets are also taken into consideration while designing and analysing the products.

### 4.1 Indian Quality Standard

Bureau of Indian Standards (BIS) is the national organization under Ministry of Consumer Affairs, Food & Public Distribution, Government of India and was established by BIS Act in 1986. The main activities of BIS are formulating, issuing and implementing standards. (ConsumerAffairs 2016.) The role of BIS is to ensure uniform quality standards for various groups of manufactured and agricultural products, execute testing of products and issue license to use official mark of BIS that indicate the product in compliance according to the BIS standards (Duignan 2013).

According to BIS (2017), “BIS has been providing traceability and tangibility benefits to the national economy in a number of ways - providing safe reliable quality goods; minimizing health hazards to consumers; promoting exports and imports substitute; control over proliferation of varieties etc. through standardization, certification and testing.” The certification by BIS varies from product to product depending on their effects on public health and safety. For products like milk powder, X-ray equipment, gas cylinders etc., the certification is mandatory by BIS, whereas in some other cases such as Pallets, the certification can be voluntary or optional. (Duignan 2013.)

Though pallets comes under the category of optional certification by BIS, it is beneficial and build more credibility towards the customers if BIS certify the product. However, currently BIS does not have any specific standard that directly relates to using WPC as the raw material. However, BIS is open for any revision in the current standards that may or may not correlate to WPC material or formulate a new standard for the WPC material pallets specifically. (Kamal 2017.) Table 5 describe the standards that are related to the designed product.

*Table 5: Standard numbers and their scope.*

<b>INDIAN STANDARD (IS) NUMBER</b>	<b>STANDARD TITLE</b>	<b>SCOPE</b>
IS 3971 : 2005	Pallets for material handling – Vocabulary	Defines the basic terminology concerning pallets as a medium of material handling.
IS 7276 : 1989	Non-Expendable general purpose flat pallets for through transit of goods – Specification	Concern the overall dimensions for pallets and dimensions of pallets related to handling equipment such as forklift, hand pallet truck etc.
IS 6219 : 1989	Methods of test for general purpose flat pallets for through transit of goods	Specifies the methods for tests of pallets and the evaluation of the designed load capacity of both existing pallets and new design pallets.
IS 13546 : 1992	General purpose flat pallets for through transit of goods performance requirements	Determine the recommended levels of performance for pallets that are tested by the methods mentioned in IS 6219: 1989.
IS 11982 : 1987	Design rating and Safe Working Load (SWL) for general purpose flat pallet for through transit of goods	The standard is applicable to pallets whose rating is determined by tests mentioned in IS 6219: 1987 and the performance requirement according to IS 13546: 1992.
IS 11983 : 1987	Guidelines for marking of general purpose flat pallets for through transit of goods	Required in case the manufacturer wants to mark the pallet with BIS certification.

<b>INDIAN STANDARD (IS) NUMBER</b>	<b>STANDARD TITLE</b>	<b>SCOPE</b>
IS 14535 : 1998	Recycled plastics for the manufacturing of products – Designation	Determine the identification and classification of recycled plastics material on the basis of properties and applications.
IS 16058 : 2013	Dunnage pallets made from recycled plastic wastes for warehousing applications – Specification	Specify the dimensions, material requirements and tests for dunnage pallets.

The basic design specification includes the nominal overall dimensions of pallets, vertical dimensions for lifting equipment, horizontal dimensions concerning to the entry of lifting equipment, dimension of the width of the wing, dimension of the bottom deck members, and squareness. In case of nominal overall dimensions, the manufacturer set the dimensions according to the recognized unit load size such as 1200X800 mm pallet size for a unit load size of 1200X800 mm. The vertical dimensions for the entry of lifting equipment such as forklifts or hand pallet truck shall not be less than 98 mm in general pallets, however in case of pallets with free entry it shall not be less than 95 mm and in case of partial entry the vertical dimension of notches shall not be less than 45 mm. (see figure 1 Appendix 4) (IS 7276 1989, p. 1-2.)

According to IS 11982 (1987, p. 1), design rating is defined as “the designed load capacity of the pallet, in kilograms (kgs), assuming an evenly and uniformly distributed load.” The relationship between the design rating and SWL is the crucial for the performance of the pallets and is dependent on the nature of load. Any particular design of the pallet is suitable for transporting different types of loads and thus it shall have different SWLs depending on the nature of the load. (See table 1 Appendix 5) (IS 11982 1987, p. 1.)

An unloaded pallet has only one rating (R), which is its designed load capacity with a uniformly distributed load. The manufacturer determined the rating according to the tests, it is represented in kgs and cannot be changed. (IS 11982 1987, p. 1.) For marking of pallet with a BIS stamp, the pallets are marked with the appropriate codes from A to G

according to their rating (see table 2 Appendix 5). Marking of SWL on the pallet is not allowed. (IS 11983 1987, p. 1.)

#### 4.2 Material Selection and Availability

The key components for WPC material are wood, plastics (mostly thermoplastics) and some additives. Though not all thermoplastics are suitable to produce WPC components, only those that can be processed at temperature below 200 °C. This is mainly because wood has limited thermal stability. However, certain thermoplastics Nylon 6, Nylon 6/6, ABS etc. that have high processing temperature can also produce WPC components with superior quality. (Klyosov 2007, p. 50.)

Most effective thermoplastic that are compatible with the injection moulding process are PE, PP, and PET. In volumetric terms, PE is the largest plastic type manufactured globally. With a low melting temperature of 106-130°C, it is perfectly compatible with wood and to be used for producing WPC components. Since PE is rather soft, the WPC components produced out of it, are easier for nailing, screwing, cutting etc. WPC components made out of PE can be used for outdoor purpose also, this is because PE has zero moisture absorption rate. Also, it is highly chemical and oxidation resistant (Klyosov 2007, p. 51-52.)

PE as a material itself is flexible and not very strong. So in cases with major concern of safety, WPC made out of PE is reinforced with metal inserts to provide extra strength to the overall component structure. PE can be further classified into different forms such as:

- High-Density PE (HDPE)
- Medium-Density PE (MDPE)
- Low-Density PE (LDPE)
- Linear Low-Density PE (LLDPE)
- Very Low-Density PE (VLDPE)

Table 6 shows density and melt flow index of different types of PE. (Klyosov 2007, p. 52.)

*Table 6: Classification of PE on basis of density (Klyosov 2007, p. 53; Jordan et al. 2016, p. 412).*

<b>PE</b>	<b>Density (g/cm<sup>3</sup>)</b>
HDPE	0.941-0.965
MDPE	0.926-0.940
LDPE	0.915-0.925
LLDPE	0.915-0.925
VLDPE	0.870-0.914

In general, most common used PE types are HDPE, LDPE and LLDPE. However, majority of the WPC made up of PE use HDPE as prime source of raw material. Even though the density of HDPE is marginally greater than LDPE but due to presence of little branching in the HDPE the inter-molecular force and tensile strength is higher in HDPE. HDPE also has high stiffness of HDPE in comparison to LDPE and LLDPE due to high flexural strength of the HDPE material (See Appendix 3 for more details). (Klyosov 2007, p. 54.) According to Klyosov (2007, p. 55), “as the crystallinity of HDPE is generally higher than that of LDPE, the following HDPE properties, . . . , are higher than that of LDPE: strength modulus, density, shrinkage, creep resistance, wear resistance and hardness.” On the other hand LDPE have better process ability and impact resistance (Klyosov 2007, p. 55).

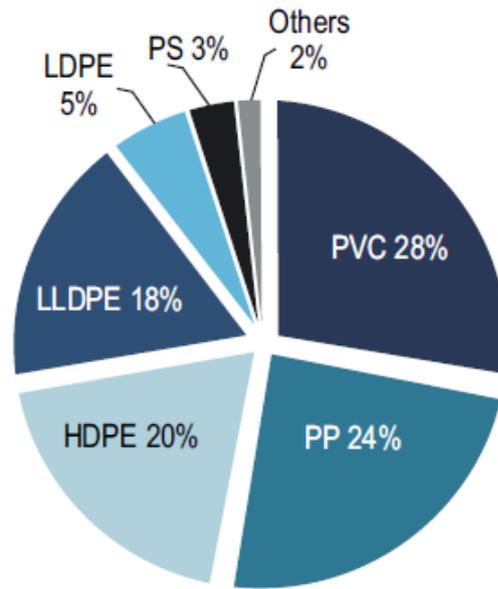
Though HDPE has higher stiffness in comparison with LDPE but it less when compared with PP. In general PP is lighter, stronger and stiffer in comparison to PE. It also have high creep resistance, less wear rate and is less slippery. The major disadvantage of PP is its stiffness due to which fastening the material using nails and screw is difficult. (Klyosov 2007, p. 56.) Table 7 show some values of mechanical properties of common thermoplastics and wood that are used for manufacturing WPC components.

Table 7: Mechanical Properties of thermoplastics and wood (Materials Data Book 2003, p. 10-12).

<b>PROPERTIES</b>	<b>PE</b>	<b>PP</b>	<b>PET</b>	<b>WOOD (Longitudinal)</b>
<b>Density (g/cm<sup>3</sup>)</b>	0.91 – 0.96	0.89 – 0.91	1.29 – 1.4	0.6 – 0.8
<b>Young's Modulus (GPa)</b>	0.62 – 0.89	0.89 – 1.55	2.76 – 4.14	6 – 20
<b>Yield Stress (MPa)</b>	17.9 – 29	20.7 – 37.2	56.5 – 62.3	30 – 70
<b>Tensile Strength (MPa)</b>	20.7 – 44.8	27.6 – 41.4	48.3 – 72.4	60 – 100

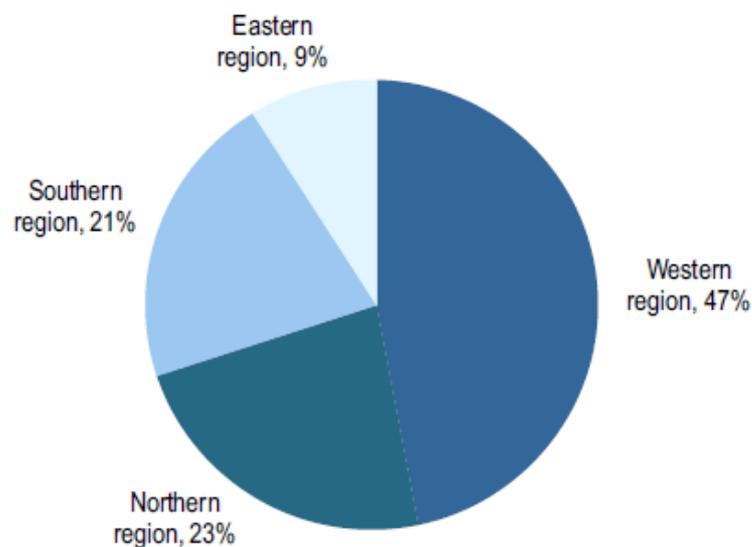
The current usage of plastic in India is about 12 Mn tonnes per annum (TPA) and it is predicted to reach 20 Mn TPA by 2020 mainly due to the growth of industrial sectors such automotive, packaging, electronics, construction, healthcare and consumer goods (Business Standard 2016). The total consumption had increased from 8.5 Mn TPA in 2013 to 12 Mn TPA at the end of 2016. However, per capita consumption of plastic in India is 9.7 Kg/person, which is relatively less in comparison with United States and Europe which is 109 and 65 Kg/person respectively. (Panchal, Kapoor & Agarwal 2014, p. 5.)

PE is the most consumed form of plastic by Indian Industry. The volume of PE consumption was 3.6 Mn TPA in year 2013, followed by PVC and PP at 2.1 Mn TPA and 1.8 Mn TPA respectively in the same year. The division of demand of plastics by types in year 2013 is shown in figure 8. PE plastic which includes HDPE, LDPE and LLDPE, accounts for 43 % of the total share. (Panchal, Kapoor & Agarwal 2014, p. 7-8.)



**Figure 8:** Demand breakup of plastics by types in year 2013 (mod. Panchal, Kapoor & Agarwal 2014, p.8).

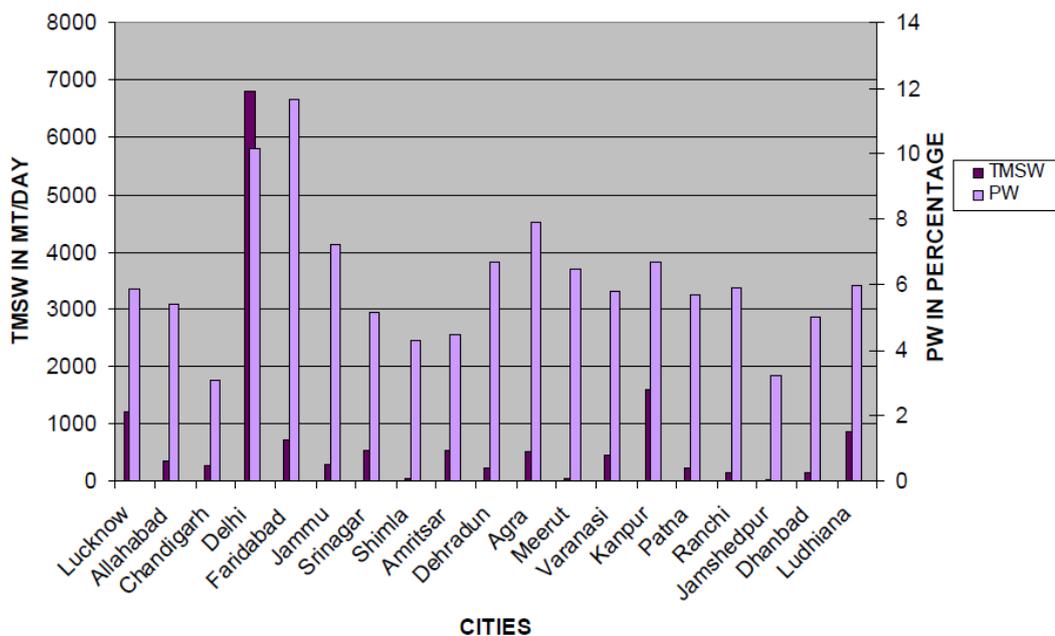
On the basis of region, the major consumption of plastic is in Western India, which is about 47 % of the total consumption. Western India comprise of region of Maharashtra, Gujarat, Daman & Diu, Dadra & Nagar Haveli, Madhya Pradesh and Chhattisgarh. North India which comprise of region of Jammu Kashmir, Himachal Pradesh, Punjab, Haryana, Uttarakhand, Rajasthan, Uttar Pradesh and Delhi. The distribution of plastic consumption on the basis of region is given in figure 9.



**Figure 9:** Region wise plastic consumption in year 2013 (mod. Panchal, Kapoor & Agarwal 2014, p.10).

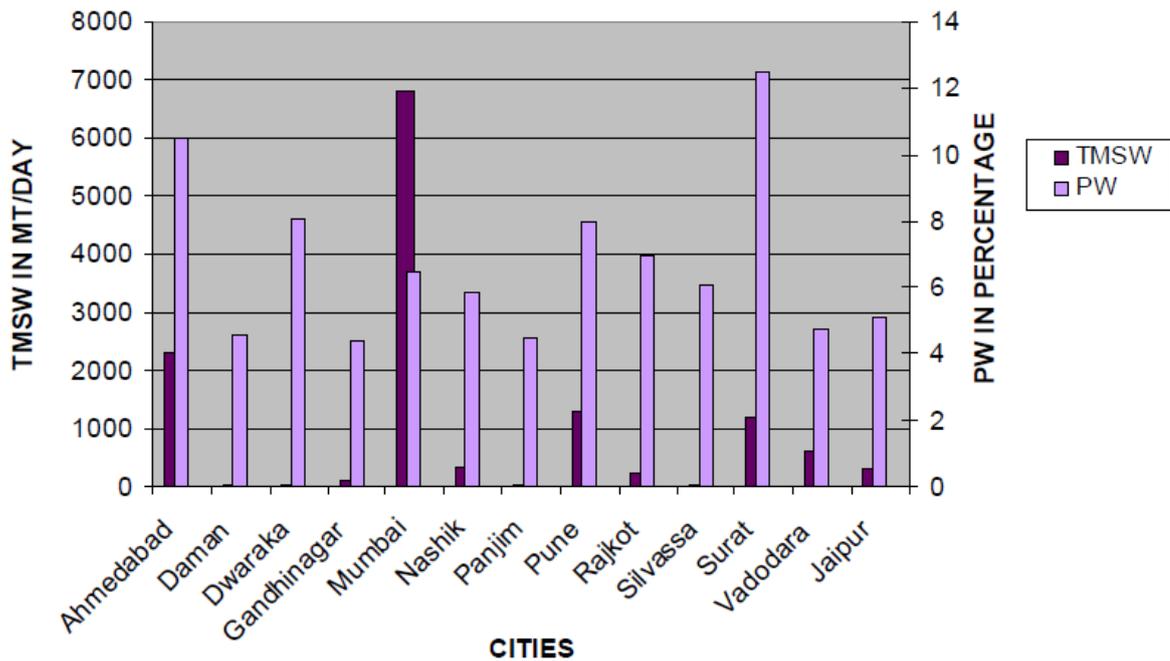
Since the purpose of this project is to produce WPC pallet using waste material in India. The next phase is to identify location and suppliers for both wood and plastic waste. And since the major consumption is in northern and western India, the generation of waste will also be higher in comparison to other regions.

The total amount of plastic scrap generated in India in year 2008 was 15,342 tons/day. Out of which only 9,205 tons/days was collected and 6,137 tons was left uncollected (CPCB 2013, p. 2). Figure 10 represent the Total Municipal Solid waste (TMSW) generate in Metric Ton (MT)/Day and share of Plastic waste (PW) percentage in the various cities in northern region of India.



**Figure 10:** Northern region TMSW generation vs PW generation (mod. Nigam 2015, p. 26).

Figure 11 represent the TMSW generated in MT/Day and share of PW percentage in the various cities in northern region of India.



**Figure 11:** Western region TMSW generation vs PW generation (mod. Nigam 2015, p. 44).

According to Nigam (2015, p. 70), “assessment and quantification of plastics waste generation in TMSW in 60 cities of India suggests that out of total plastic waste, thermoplastics content is about 94 %.” Figure 12 shows the percentage share of each type of thermoplastic in the plastic waste. HDPE/LDPE has the highest share of percentage with 66%, which is equivalent to 43.94 Kg/MT. PP has the second largest share with 10 % (6.50 Kg/MT), followed by PET 9 % (5.69 Kg/MT). PS and PVC share is 5 % (3.13 Kg/MT) and 4 % (2.72 Kg/MT) respectively. (Nigam 2015, p. 71.)

A survey for plastic scrap dealers was conducted in order to know the availability of the material and the price range. The results of the survey can be found in table 8 below:

Table 8: Survey result of plastic scrap suppliers.

Name of Supplier	Location	Material	Price Range (Euro) /kg	Additional Information
Didar Trading	Delhi	All	0.53 – 0.67	
Durga Plastic	Delhi	HDPE, PP, LDPE (Granules)	0.80 – 0.90	Colour choice (R,B,G); Crates, bin, box etc.
Pawan Plastic	Delhi	HDPE	0.46	
		PET	0.57	
		PP	0.34	
		Pallet Scrap	0.46 – 0.49	
Shree Sai Enterprises	Delhi	PVC, PET	0.43	
CDR	Delhi	ABS, PET, PP	0.43 – 0.65	
Shri Krishna Plastic	Delhi	PS	0.41 – 0.57	Granules also available
		PU	1.28	
		PC	0.84 – 0.93	
		HDPE	0.93 – 1.07	HDPE Drum
PK Industries	Amritsar	HDPE	0.57 – 0.86	
Rawalwasia Plastic Industries	Bhiwani	PP	0.54 – 0.64	Min 800KG

For wood waste, the scrap of wood is usually in the price range of INR 5-20 or Euro 0.06-0.30 per Kg. Some waste wood suppliers in north and western regions of India are –

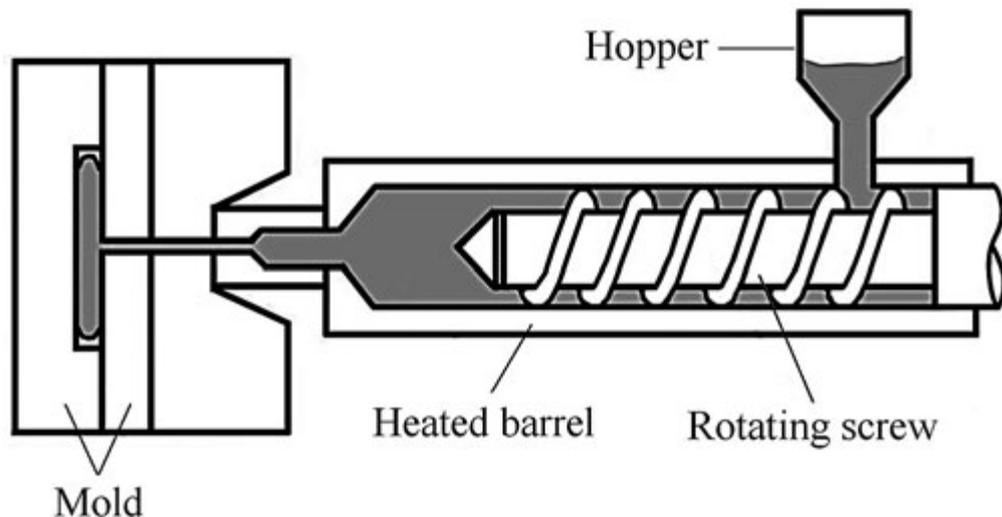
- Delhi NCR - Green-o-tech, Attari Trader, Shri Sai traders, Mohammad Imran trading etc.
- Gujarat – KS Traders, Gayatri Traders, SK Traders, Shrinath Trading etc.
- Maharashtra – Kalpataru Packing, Fiza Enterprises, Abdul Razak & Sons etc.

(IndiaMart 2017.)

### 4.3 Process Description

Injection moulding and extrusion are the two major processing methods for producing WPC components. Linear profiles of WPC material are prepared using extrusion method. However, to achieve faster operation speed and complex shapes, injection moulding is the most preferred processing technology for both polymers and WPC material. Injection Moulding is also beneficial to produce components more economically and in unlimited amounts with less or zero finishing operation required. Injection moulding requires high capital investment in machinery, moulds and other auxiliary machines; therefore, it is more economical if used as a mass production process. (Rosato and Rosato 1986, p.3.)

The basic types of injection moulding machines are reciprocating screw injection machine, screw-type preplastifying machine, piston-type preplastifying machine and ram injection-moulding machine (Rosato and Rosato 1986, p. 8). Usually the injection and the clamping units are placed horizontally but sometime vertical arrangement can be possible. Reciprocating screw injection is the most widely used injection process. (White 1983, p. 96-97.) A typical injection moulding machine consist of a mold, hopper, heating barrel or chamber and rotating screw in case of reciprocating screw injection machine as shown in fig.12 (Zheng, Tanner and Fan 2011, p. 1-2).



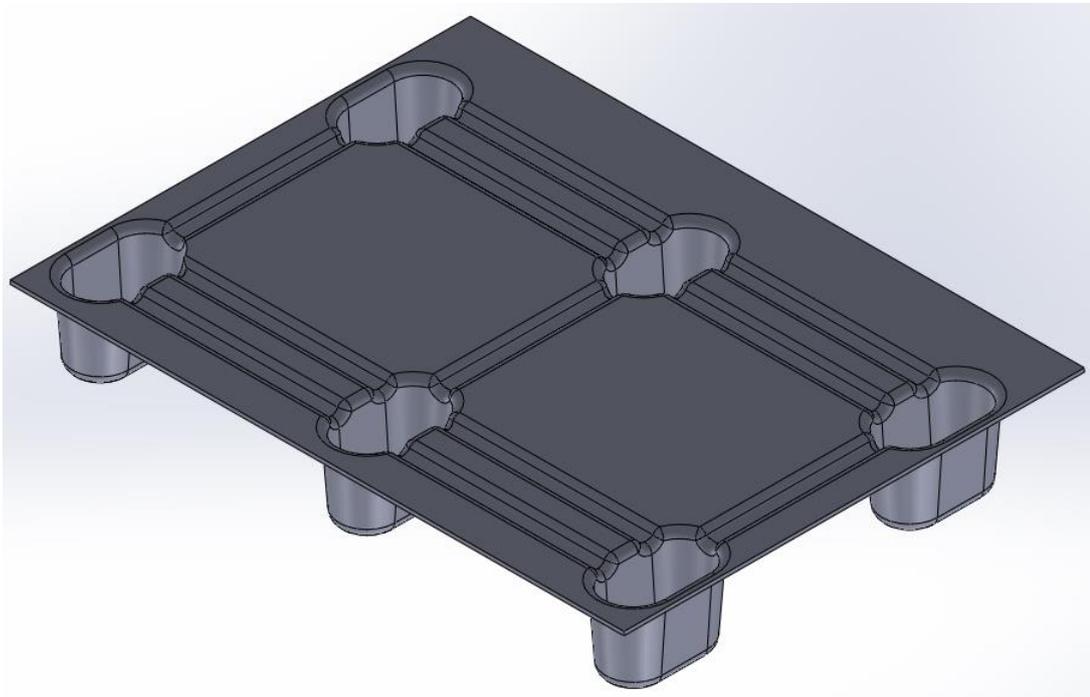
**Figure 12:** Sketch of reciprocating screw injection moulding machine (Zheng, Tanner and Fan 2011, p. 2).

The plastic granules and wood chips are fed into the injection moulding machine through hopper. The heating and melting of particles takes place inside the barrel due to friction

heat generated by rotating motion of the screw and also from the conduction heat coming from the heating units attached with barrel. The molten material travel towards the front of the screw. This stage is known as plasticizing stage. After this, the injection stage follows, where the molten material is forced into the cavity of closed mould. The clamping units ensure that the mould remains in its places for the entire process. The material inside the mould starts to cool down and solidify. The material now takes the shape of the cavity of the mould. After removing the solid part from the mould, the entire process starts again. (Zheng et al. 2011, p. 1-2; White 1983, p. 86.)

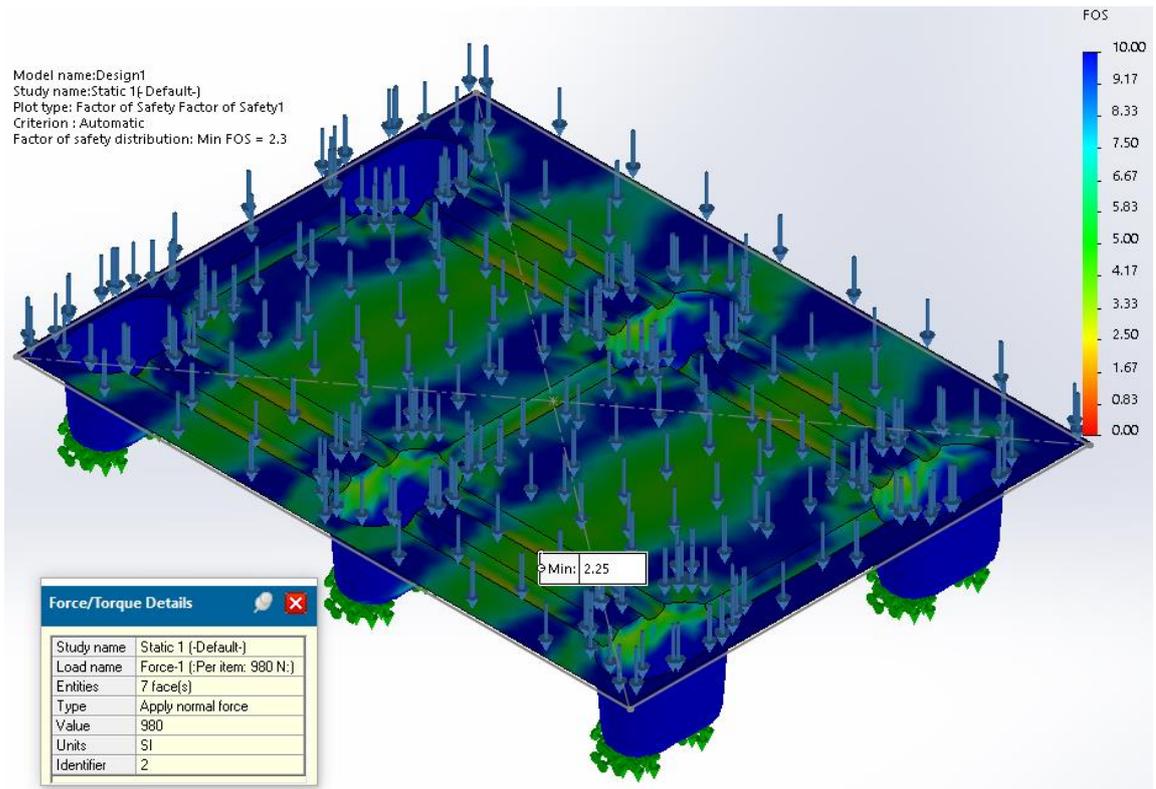
#### 4.4 Design and Analysis

In total four different designs of pallets were made, out of which three were for 800x600 mm dimension of pallet and one design for 600x400 mm. All the designs were prepared according to the IS as mentioned above. For the analysis purpose, the Factor of Safety (FOS) is considered at 2.25 to determine the load bearing capacity of the pallets. The technical drawings for all the designs are in Appendix 4. Figure 13 represents the design 1 for the 800x600 mm pallets, which is a four way entry pallet design.



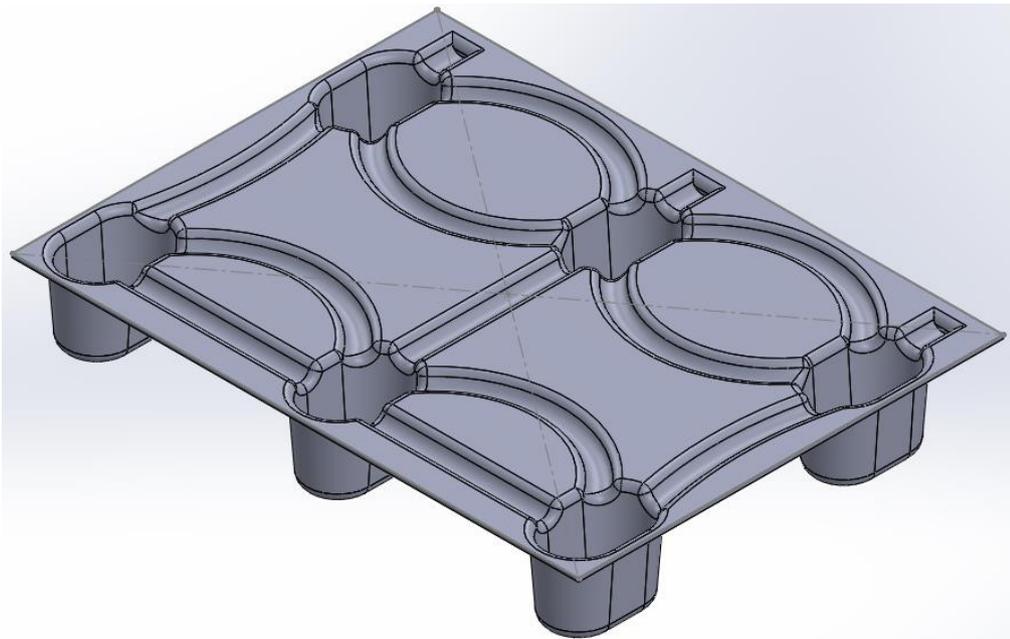
**Figure 13:** Design 1 (800x600 mm)

Figure 14 represents the static load analysis of design 1 with ensuring FOS at 2.25. The final load capacity at FOS 2.25 for design 1 was 980 N.



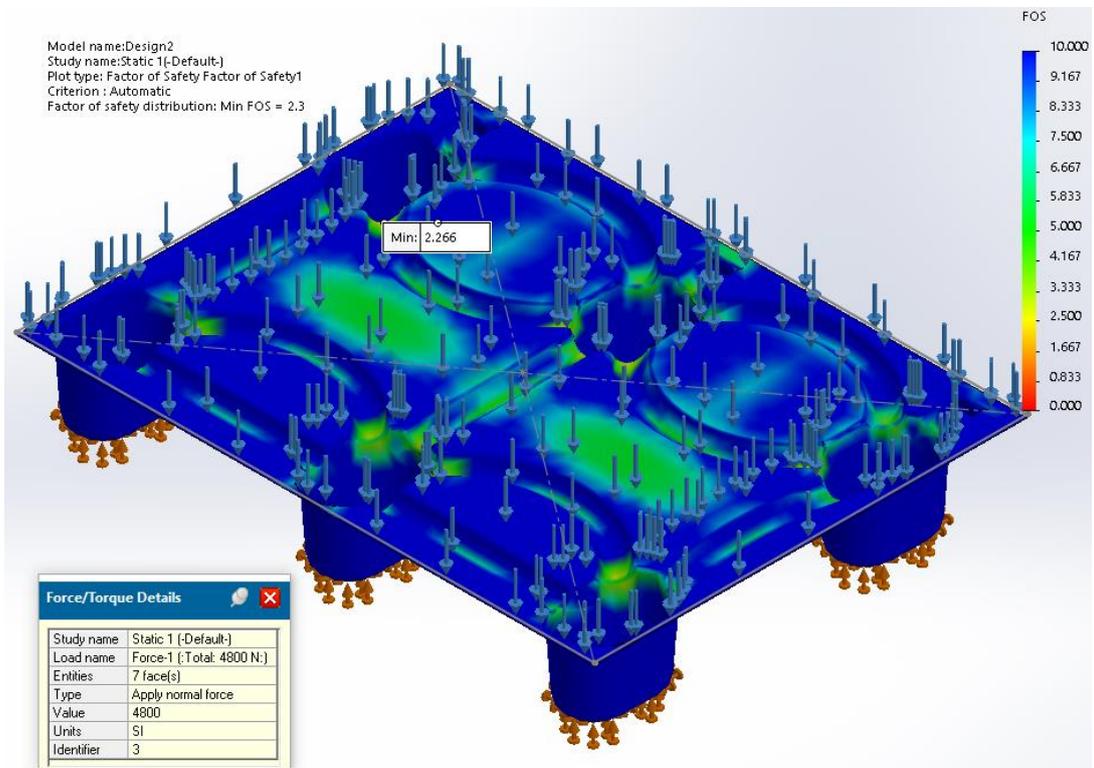
**Figure 14:** Analysis of design 1 (800x600 mm)

Figure 15 represents the design 2 for the 800x600 mm pallets, which is a four way entry pallet design.



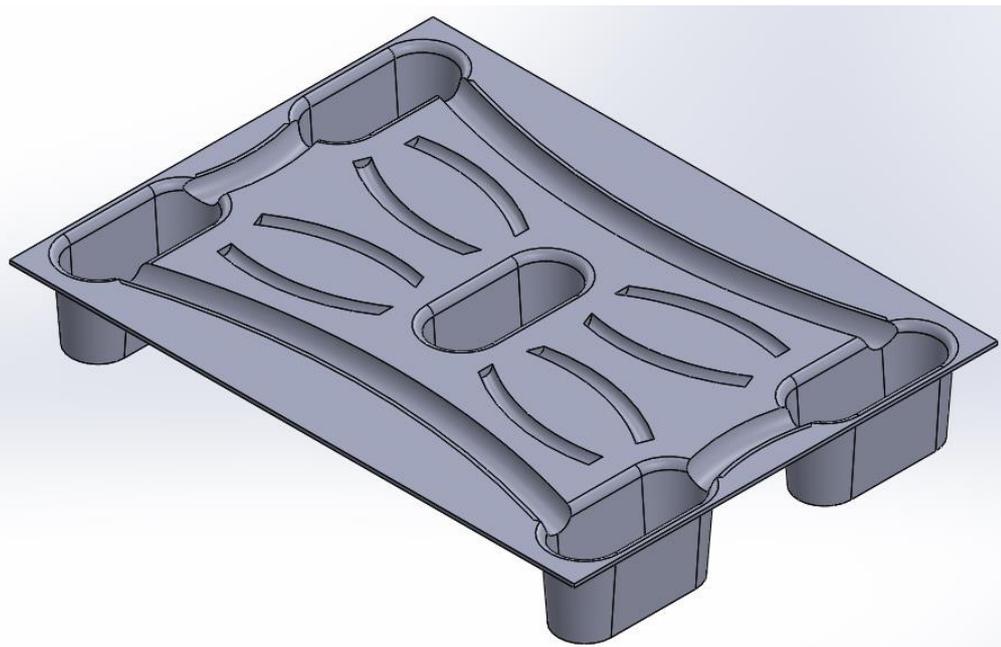
**Figure 15:** Design 2 (800x600 mm)

Figure 16 represents the static load analysis of design 2 with ensuring FOS at 2.25. The final load capacity at FOS 2.25 for design 2 was 4,800 N.



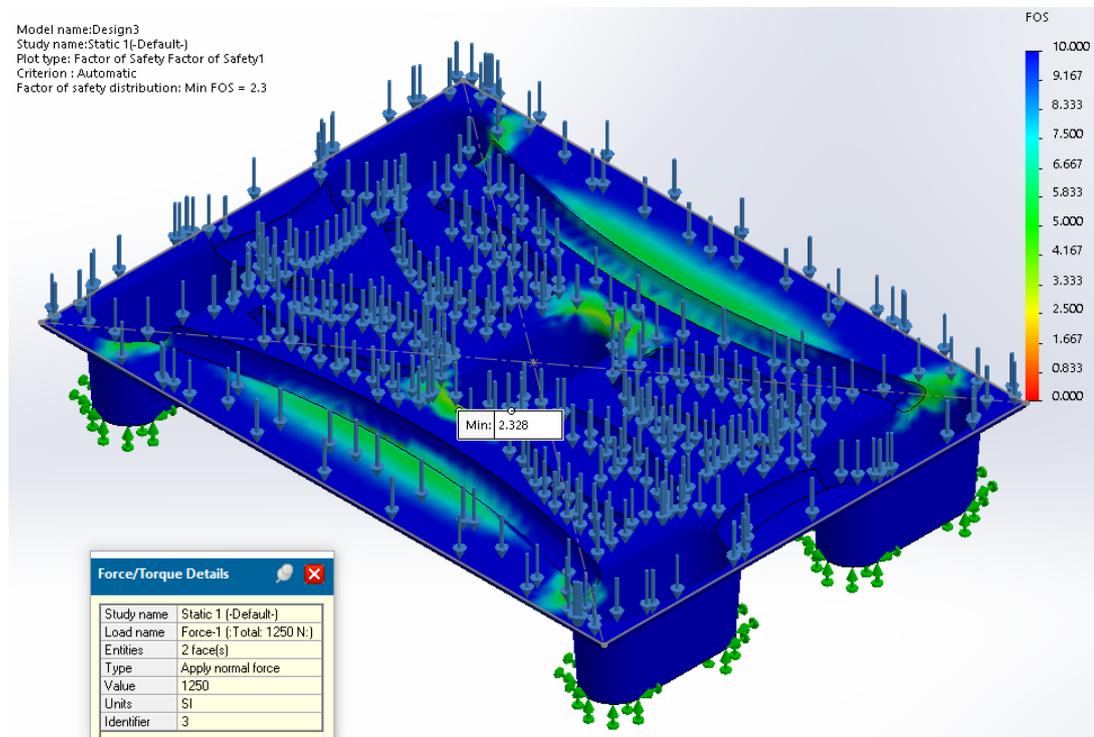
**Figure 16:** Analysis for design 2 (800x600 mm)

Figure 17 represents the design 3 for the 800X600 mm pallets, which is a four way entry pallet design.



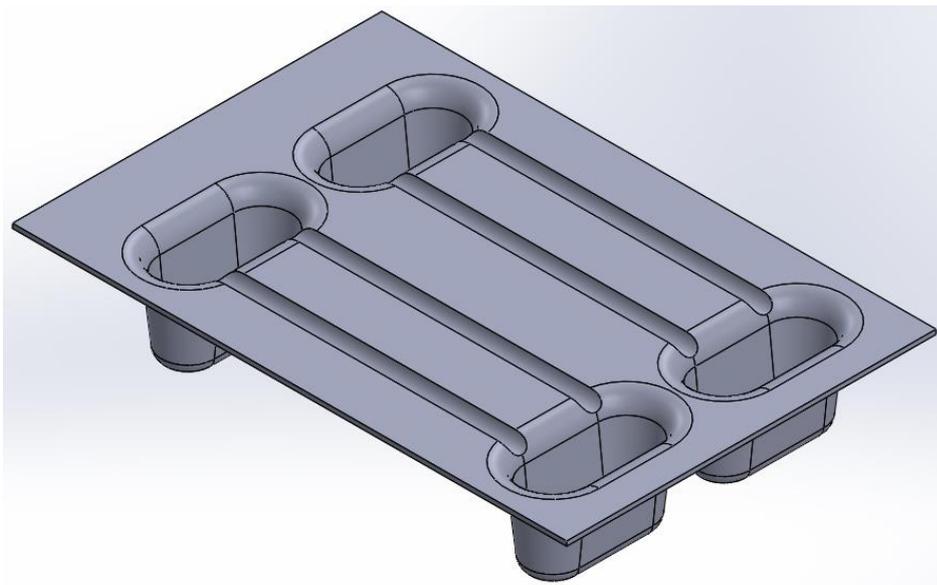
**Figure 17:** Design 3 (800X600 mm)

Figure 18 represents the static load analysis of design 3 with ensuring FOS at 2.5. The final load capacity at FOS 2.25 for design 3 was 1,250 N.



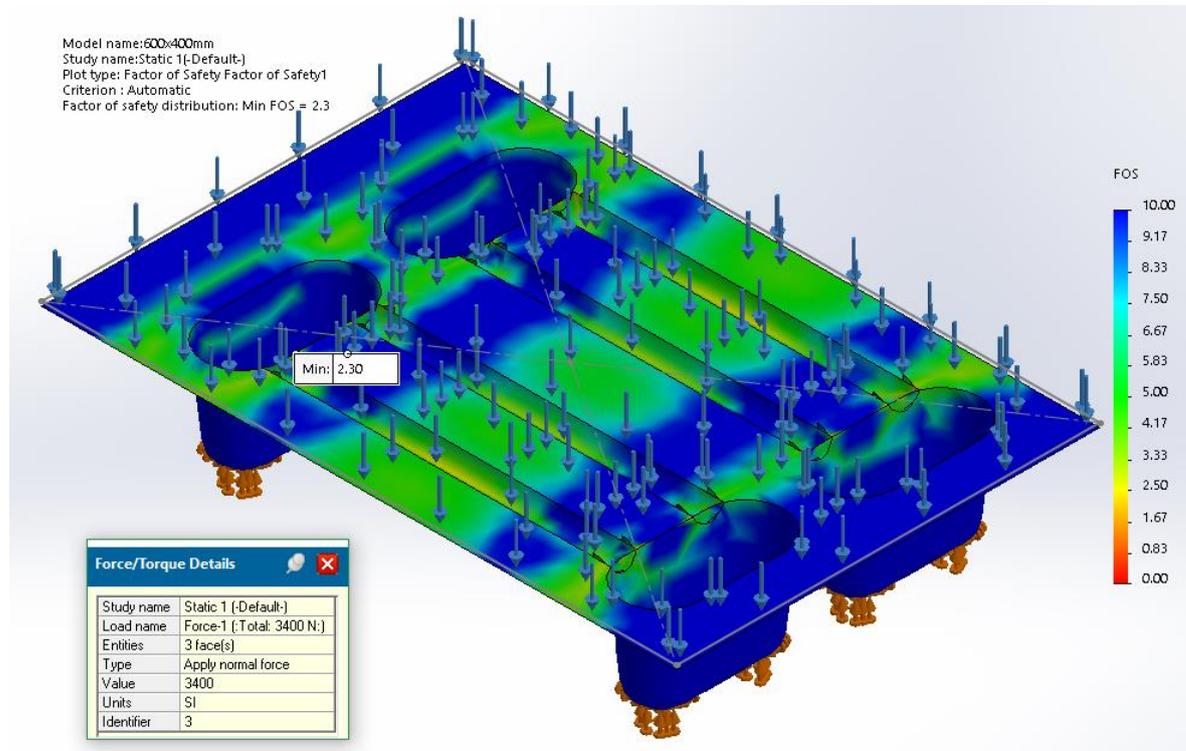
**Figure 18:** Analysis for design 3 (800x600 mm)

Figure 19 represents the design 4 for the 600x400 mm pallets, which is a four way entry pallet design.



**Figure 19:** Design 4 (600x400 mm)

Figure 20 represents the static load analysis of design 4 with ensuring FOS at 2.5. The final load capacity at FOS 2.25 for design 1 was 3,400 N



**Figure 20:** Analysis for design 4 (600x400 mm)

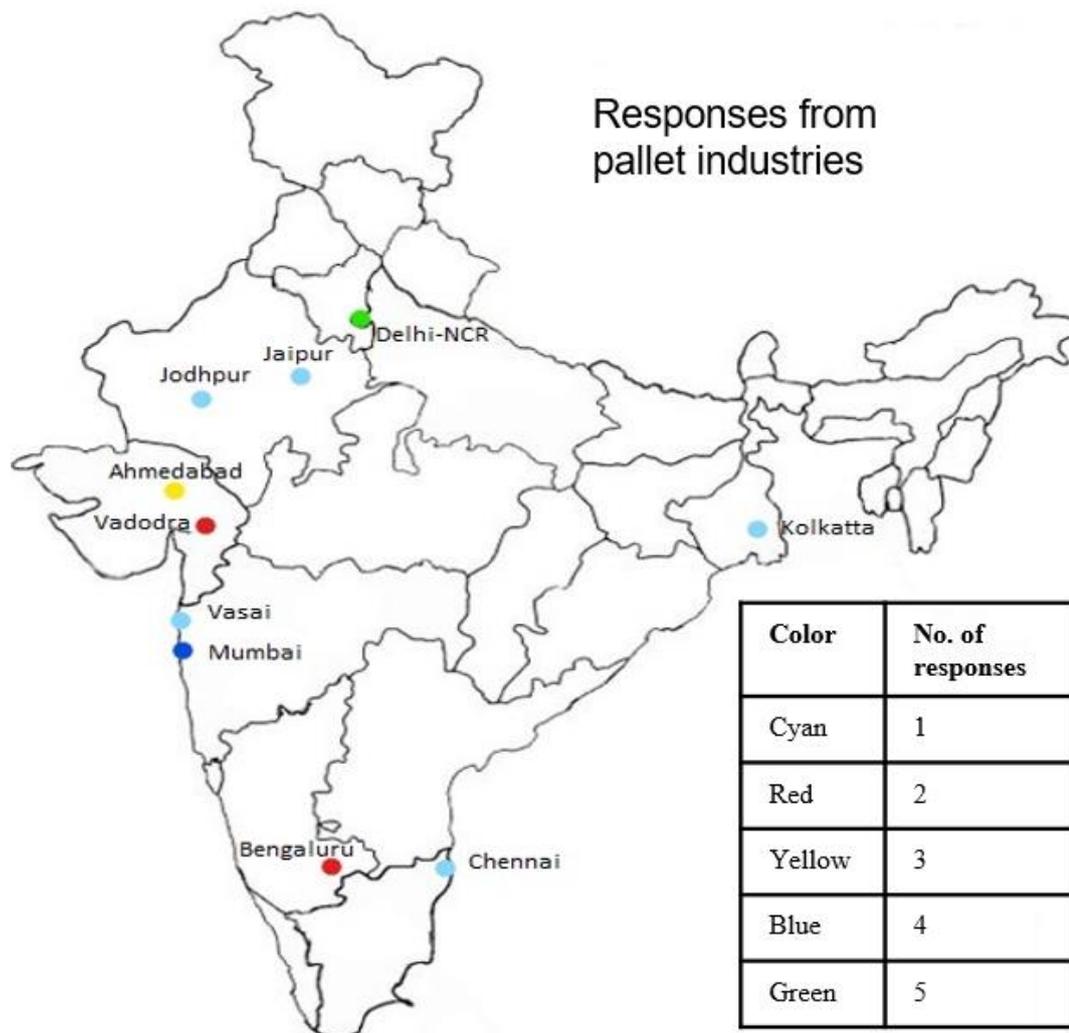
Table 9 describe the load capacity of every pallet obtain from the analysis by ensuring FOS 2.25 and the corresponding rating of each pallet according to the IS 11983 (See table 2 appendix 5).

*Table 9: Pallet design and their corresponding load capacity and rating.*

Pallet	FORCE (N)	LOAD CAPACITY (Kg)	RATING
Design 1 (800x600 mm)	980	99.93	-
Design 2 (800x600 mm)	4800	489.46	A
Design 3 (800x600 mm)	1250	127.46	-
Design 4 (600x400 mm)	3400	346.7	A

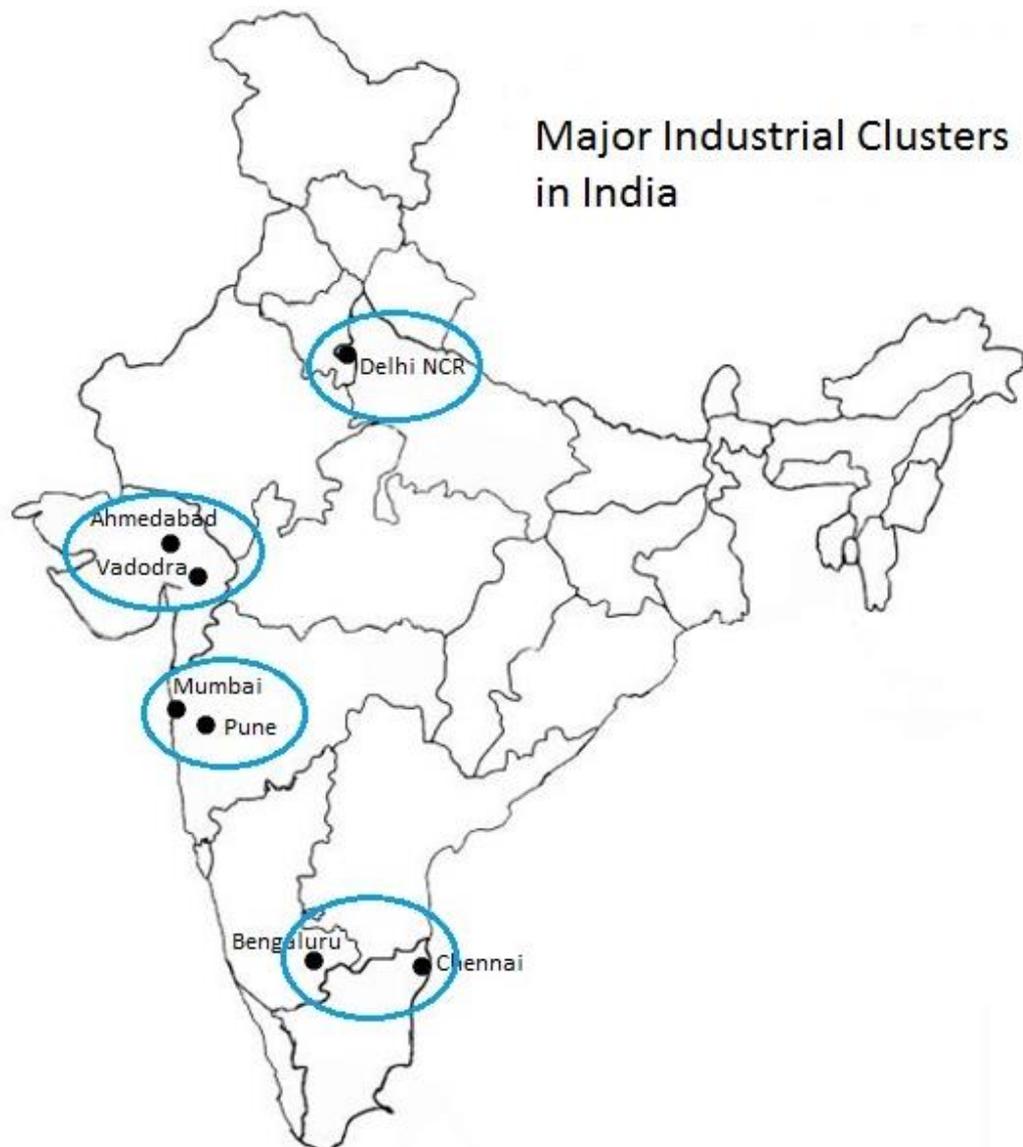
## 5 MARKET SURVEY AND RESULTS

In order, to better understand the Indian Pallet Market a survey was conducted in which response from both plastic pallet manufacturers and wood pallet manufacturers was recorded. The online survey was conducted during the period 1<sup>st</sup> March 2017 to 31<sup>st</sup> March 2017. In total, the survey was completed by 16 plastic pallet manufacturers and 6 wood pallet manufacturers. A brief description of responses can be found in figure 21. The survey questionnaire was separately crafted for wood and plastic pallet manufacturers (See Appendix 7).



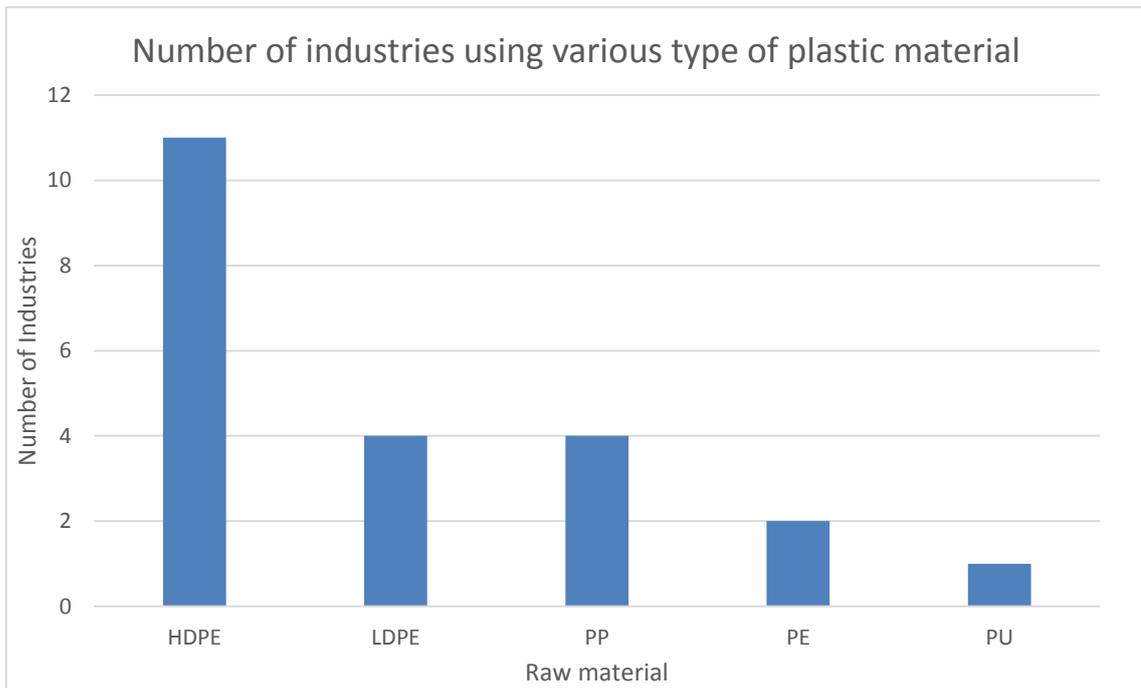
**Figure 21:** Survey response across India

It is also important to know that these location from where these responses by the pallet manufacturer comes is directly related to the major industrial clusters in India as shown in figure 22.



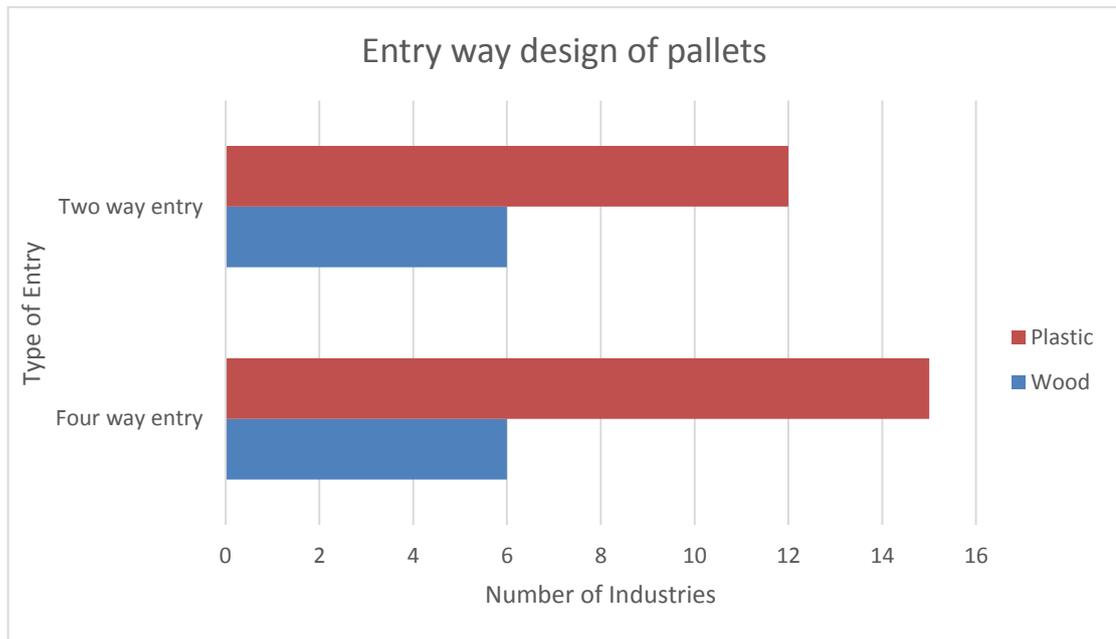
**Figure 22:** Major industrial corridor in India. (MakeinIndia 2016).

As mentioned in the chapter 2, Indian Pallet Industry is classified into various segments and the survey highlights the distribution of operations of various industry working in Indian Pallet Market. The plastic pallet manufacturing industry is further divided on the basis on plastic used as the raw material for manufacturing pallet. Figure 23 represent the division of plastic pallet market based on raw material.



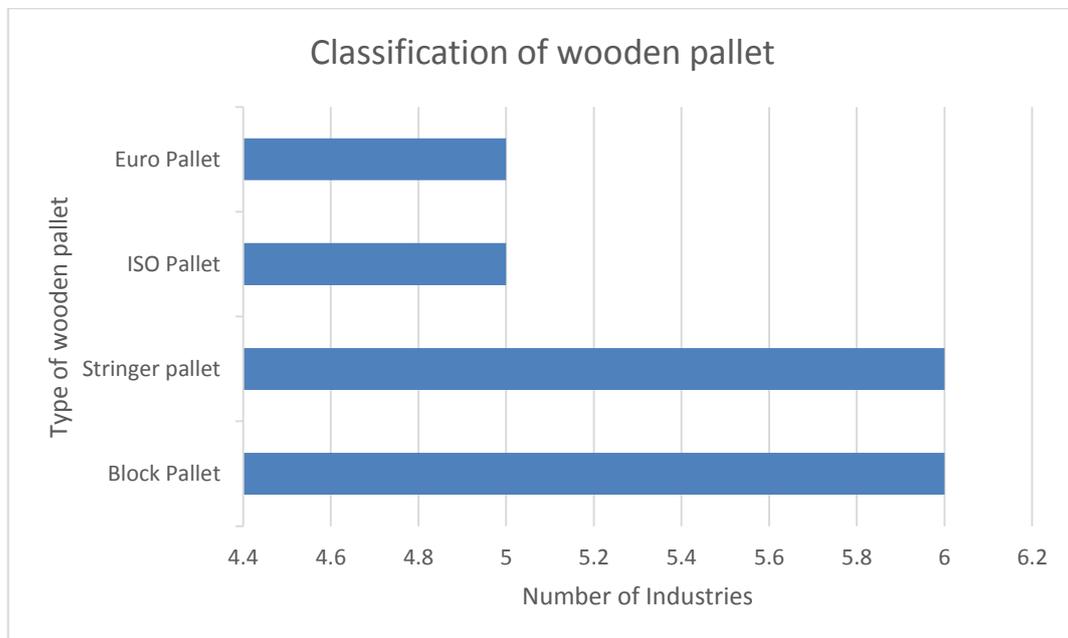
**Figure 23:** Number of Industries and the prime raw material for producing plastic pallet in India.

Another aspect on which Indian pallet market is classified is the type of entry or design of the pallet. This is crucial in order to develop the type of pallet which is currently in demand in India, so that any foreign company entering into Indian market can directly focus on the same design to stay in competition. Figure 24 represent the response from both plastic and wood industries for the type of design of pallets they are currently producing.



**Figure 24:** Classification according to entry way

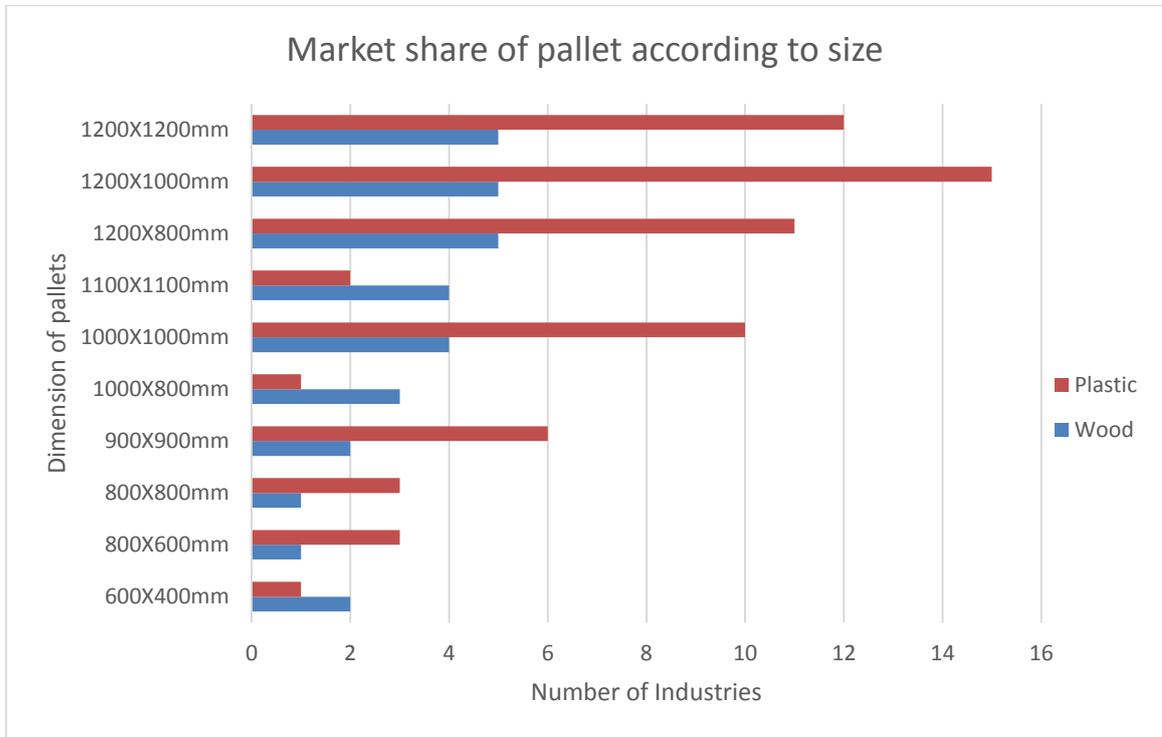
For wood pallet industry, the further classification of pallet on the basis of design is shown in figure 25.



**Figure 25:** Classification of wood pallet based on types

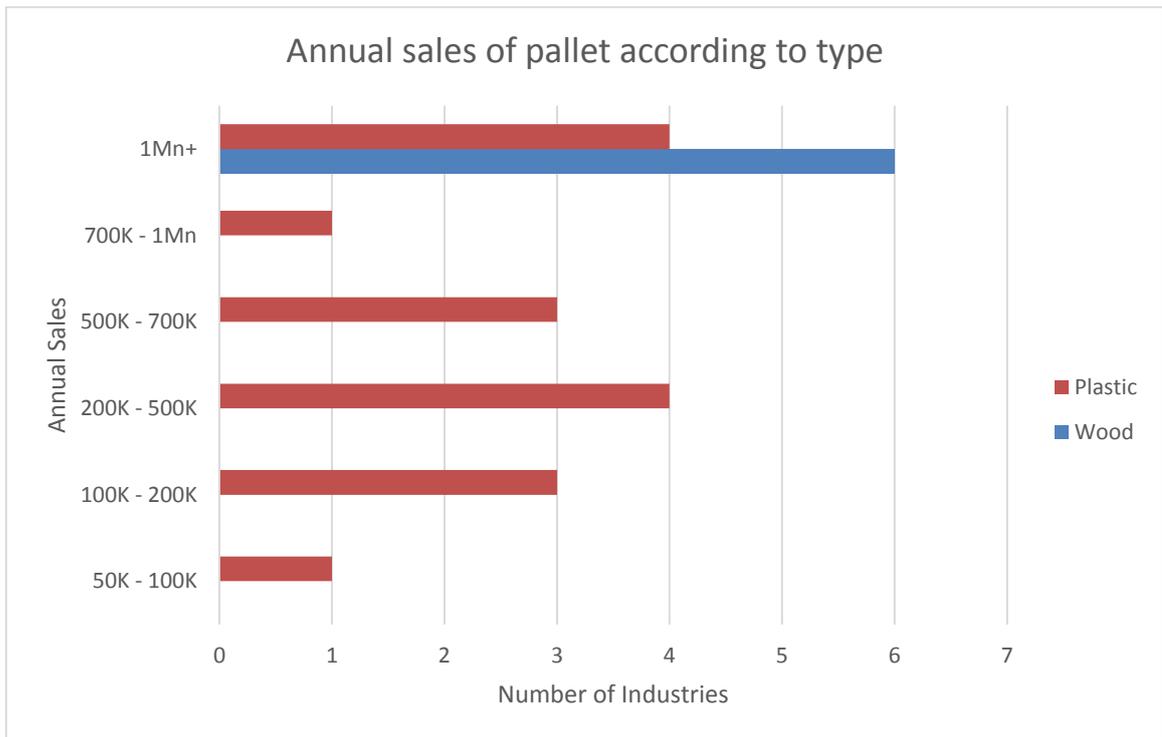
Figure 26 shows the division of the Indian pallet industry on the basis of dimension of pallets. This result is important in order to understand what pallet size is currently most preferred in India and also to get the better understanding of the smaller pallet size market.

Since the objective on the report is to find the market for the smaller size pallet (600x400 mm & 800x600 mm) in India for a foreign firm to establish a unit.



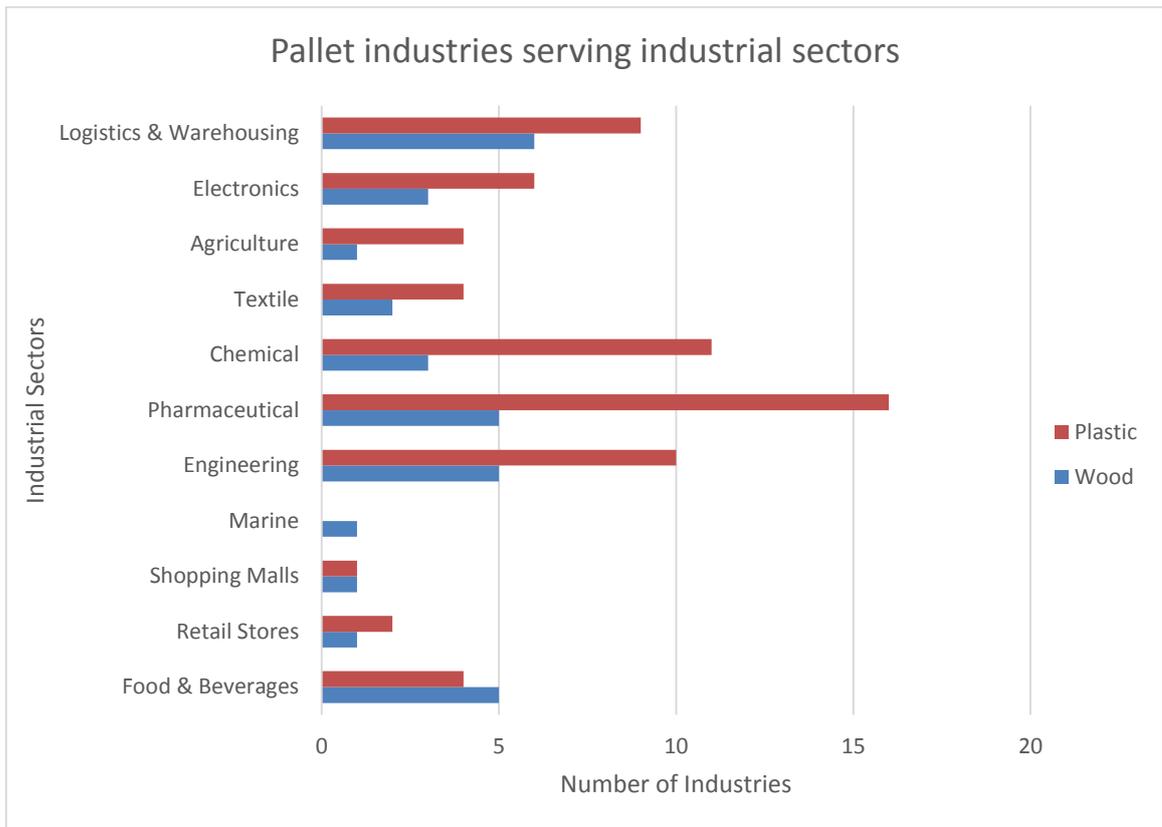
**Figure 26:** Market share of pallet according to size

It is also important to understand the current market share of both plastic and wood pallets in term of annual sales and how both industry will likely to grow in future. Figure 27 represents the annual sales of the both plastic and wood pallet industries who participated in the survey. With the wooden pallet industry heavily dominating in both India and globally, it is not surprised to see the results as clearly in favour of wooden pallets. But recent trends show that plastic pallets are growing in market share rapidly.



**Figure 27:** Annual sales of pallet according to type

Since the main aim of any business entity is to earn profit, it is also important to understand the current competitive landscape of the Indian pallet market. It is vital for the future of any new venture to identify its customers and the market segments it can target in order to remain in competition and earn profit. Figure 28 represents the major customers to which the respondent industries are supply their products.



**Figure 28:** Major industrial customers served by pallet industry

Finally, the last segment of survey was to identify the current market price of all the pallets depending on their size and type. It is essential to know this information in order to set a selling price of the WPC pallet because the main aim is to compete with both plastic and wooden pallets in terms of price and load capacity. Table 10 represent the current price range of wooden and plastic pallets.

*Table 10: Price range of wooden and plastic pallet in India.*

Material Type	Price Range (INR)	Price Range (Euro)
Wooden Pallet	500 – 1500	6.9 – 20.7
Plastic Pallet	1,000 – 4,000 +	13.8 – 55.2 +

## 6 ECONOMIC EVALUATION

It is essential for any new venture to know the profitability, return of investment and payback period in order to execute their plans effectively. For any foreign firm, establishing a unit in India, they must know all the fixed cost and variable cost related to the investment. This is also necessary to determine a selling price for the component by taking in consideration all the expenses and the profit.

Also, after determining the selling price of the product, it is necessary to set up an achievable annual sales target. According to the market survey and literature review usually an industry operating in pallet manufacturing can have above 1 Mn pieces as annual sales. However for this calculation the annual sales are considered at 600,000 pieces for first year of operation. (See Appendix 6) This will help in calculating the revenue and profitability analysis. Further, it is vital to identify the parameters which can affect the costs at the time of execution of project, this can be done by doing sensitivity analysis of those parameters. The calculations of both fixed and variable cost is done on the basis of annual sales.

### 6.1 Capital Investment

The capital investment considered of this investment are the mainly the tooling and machine costs. The cost of all the machines and one set of tooling is given by the industry for such kind of operations and the value is 800,000 €. This include the entire production line of injection moulding machines alongside the tools. Further, additional fixed cost such as office space, material handling equipment, basic renovation etc. is considered at 200,000 €. Therefore, the total capital investment will be 1 Mn €.

### 6.2 Fixed Cost

The fixed costs (FC) considered of this investment are the mainly rent of the building, interest on the capital, depreciation cost of the machines, maintenance cost and insurance cost. The area of building required for such kind of investment is 2,000 m<sup>2</sup>. This include 1,300 m<sup>2</sup> built up area for the production line, offices etc. and 700 m<sup>2</sup> open or green area according to the Indian government regulation which can be used for sorting and storing

material. The open area can have a shed in order to prevent the material from exposure to environment. The location for the establishment of industrial unit is selected on the basis of its proximity to the major industrial clusters in North and Western region of India and also according to the availability of raw material supplier in the particular region. Table 11 shows the monthly and annual rent for three different location in India for the total land area of 2,000 m<sup>2</sup>.

*Table 11. Monthly factory rent based on location (mod. 99acres 2017).*

LOCATION		FACTORY RENT /MONTH	MAINTENANCE CHARGE/ MONTH
Delhi NCR	IMT Manesar	1,862 € approx.	70 €
	Gurgaon Pace City	3,035 € approx.	70 €
	Noida Hosiery Complex	3,035 € approx.	70 €
	Noida Sector- 63 and 64	3,035 € approx.	70 €
Gujarat	Vadodara	1,931 € approx.	13.8 € - 41.3 €
Maharashtra	Pune	4,758 € approx.	138 € - 207 €

For the calculation purpose, the location selected for the establishing a unit is Vadodara with monthly rent of the building approx. 1,931 € and maintenance charges 41.3 €. The overall annual rent including the annual maintenance will be:

$$\text{Overall Annual Rent} = 23,667 \text{ €}$$

The depreciation cost is considered to be 10 % of the machine cost, maintenance is considered at 1 % of the investment, insurance at 1 % of the investment and interest on the investment is considered at 10 %. Table 12 describes the value of all fixed costs.

*Table 12: Summary of fixed costs.*

		<b>Euros/Year</b>
Maintenance	3 % of total investment	30,000 €
Insurance	1 % of total investment	10,000 €
Interest	10 % of total investment	100,000 €
Depreciation	10 % of total investment	100,000 €
Rent		23,667 €
<b>TOTAL FC</b>		<b>263,667 €</b>

For annual volume of 600,000 pieces the FC/piece will be:

$$\text{FC/piece} = 0.44 \text{ €}$$

### 6.3 Variable Costs and Overhead Cost

The variable costs (VC) includes the rent of the building, labour cost, raw material cost, utility costs and insurance. The labour cost includes the basic salary, value of provident fund and insurance (if applicable). The normal working duration in India is 8 hours per day which exclude lunch time and 6 days in a week. For the first year of operations, the total number of shifts operating in the plant is selected to be 1 shifts per day with each shift having 3 or 5 workers. In addition, 1 supervisors, 1 accountant and 1 gatekeeper is also needed for smooth working of operations. Also, since the total number of employees in the firm will be less than 10, therefore no insurance and provident fund value will be needed. Further, the total number of working days considered for the calculation is 300 days per year. (See appendix 6) Table 13.

*Table 13. Salary structure of workers and other employees.*

	<b>Workers</b>	<b>Gatekeeper</b>	<b>Supervisor</b>	<b>Accountant</b>
<b>Number of Staff</b>	3 or 5	1	1	1
<b>Basic Salary per person per month</b>	138 €	138 €	276 €	276 €
<b>Provident Fund</b>	-	-	-	-
<b>Insurance</b>	-	-	-	-

	<b>Workers</b>	<b>Gatekeeper</b>	<b>Supervisor</b>	<b>Accountant</b>
<b>Total Monthly Salary/person</b>	138 €	138 €	276 €	276 €
<b>Total Annual Salary/person</b>	1,656 €	1,656 €	3,312 €	3,312 €

The total labour cost in case of 3 workers will be:

$$\text{Labour Cost} = 13,248.00 \text{ €}$$

Since the annual sales estimated for the first year is 600,000 therefore the labour cost per piece will be:

$$\text{Labour cost/piece} = 0.022 \text{ €}$$

The total labour cost in case of 5 workers per shift will be:

$$\text{Labour Cost} = 16,560.00 \text{ €}$$

And the labour cost per piece for 600,000 annual units will be:

$$\text{Labour cost/piece} = 0.028 \text{ €}$$

The utility costs consist of water and electricity costs. Both water and electricity costs vary from state to state, hence since the location selected for the establishment of industrial unit is Vadodara, the price rates for the same are taken into consideration. The daily water consumption is assumed to be about 2,000 litres including water for industrial use and human needs. Therefore, the annual water consumption for 300 working days will be:

$$\begin{aligned} \text{Water consumption} &= 2,000 * 300 \\ &= 600,000 \text{ litres or } 600 \text{ cubic metre} \end{aligned}$$

The current price of water for industrial purpose in Gujarat is INR 19.5 or Euro 0.26 per cubic metre (The Times of India 2017). Therefore annual water cost will be:

$$\begin{aligned} \text{Water Cost} &= 600 * 0.26 \\ &= 156 \text{ €} \end{aligned}$$

Since the contribution of water cost will be quite negligible, there is no point to add this cost parameter in the main variable cost.

The energy consumption for all the machine and the entire production setup is calculated to be 146,000 kWh per year. The current price of electricity in Gujarat is approx. INR 5.1 or Euro 0.07 / kWh. The annual electricity cost for the industrial setup would be:

$$\begin{aligned} \text{Electricity Cost} &= 146,000 \times 0.07 \\ &= 10,220 \text{ €} \end{aligned}$$

The share of electricity cost in per piece of pallet will be:

$$\text{Electricity Cost /piece} = 0.017 \text{ €}$$

The material cost comprise of cost of wood scrap, plastic scrap and additives. The amount of material required to manufacture the pallet depends on design and size of pallet. The main composition (% weight) of the WPC material used in this report for the design and analysis purpose is  % plastic,  % wood and  % +  % additional chemicals. The density, volume, weight and material composition of both pallets can be found in table 14.

*Table 14: Composition of material by weight in 600x400 mm and 800x600 mm size of pallets.*

Pallet Size	Material Density (Kg/m <sup>3</sup> )	Volume (m <sup>3</sup> )	Mass (Kg)	Material Composition (Kg)			
				Weight of Plastic	Weight of Wood	Weight of Chemical 1	Weight of Chemical 2
600x400 mm	1240	0.00192	2.3808	<input type="text"/>	<input type="text"/>	1 <input type="text"/>	2 <input type="text"/>
800x600 mm	1240	0.00384	4.7616	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

The above average value of scrap plastic (mainly PP, HDPE, and LDPE) which is about Euro 0.90 /Kg is selected from the previous chapter for cost calculations. Similarly the above average value of wooden scrap that is about Euro 0.20 /Kg is also selected from previous chapter. The price of additional chemicals are given by the industry, Chemical1 price is Euro  /Kg and Chemical2 price is Euro  /Kg. (Further calculations see Appendix 6)

The total material cost for one 600x400 mm size pallet will be:

$$\text{Material Cost /piece} = 1.40 \text{ €}$$

The total material cost for one 800x600 mm size pallet will be:

$$\text{Material Cost /piece} = 2.80 \text{ €}$$

Total VC per piece is composed of material cost, utility cost and rental cost and is shown in table 15 and an overhead of 60 % of total variable cost is taken for calculations.

*Table 15: Total VC and overhead for both size of pallets.*

Size of Pallet	Number of workers	Total VC /piece	Overhead Cost	Total VC /piece + Overhead Cost /piece
600x400mm pallet	3	1.44 €	0.86 €	2.30 €
	5	1.44 €	0.87 €	2.31 €
800x400mm pallet	3	2.84 €	1.70 €	4.54 €
	5	2.84 €	1.71 €	4.55 €

#### 6.4 Total Manufacturing Cost

The total manufacturing cost per piece is the calculated by adding VC per piece and FC per piece. The total cost per piece depending on the size of pallet is shown in table 16.

*Table 16: Total manufacturing cost of both size of pallets.*

Size of Pallet	Number of workers	Total VC /piece + Overhead Cost /piece	FC /piece	Total Manufacturing Cost
600x400mm pallet	3	2.30 €	0.44 €	2.74 €
	5	2.31 €	0.44 €	2.75 €
800x400mm pallet	3	4.54 €	0.44 €	4.98 €
	5	4.55 €	0.44 €	4.99 €

### 6.5 Expense, Revenue and Profitability Analysis

The annual expenses are estimated from the manufacturing cost of the product and the production volume. Also, from the market survey it is determined that the lowest selling price of wood pallet is Euro 6.9 and for plastic pallet is Euro 13.8. From this, the selling price of WPC pallet is set to be Euro 6.9 for 600x400 mm and Euro 10.34 for 800x600 mm per piece. Therefore, the annual expenses, revenue and profit considering the maximum value of manufacturing cost for both size of pallets is shown in table 17.

*Table 17: Annual expenses and revenue of both size of pallets.*

	<b>600x400 mm</b>	<b>800x600mm</b>
<b>Unit Manufacturing Cost</b>	2.75 €	4.99 €
<b>Annual Volume</b>	600000	600000
<b>Annual Expense</b>	1,649,286 €	2,992,058 €
<b>Unit Selling Price</b>	6.90 €	10.34 €
<b>Annual Volume</b>	600000	600000
<b>Annual Revenue</b>	4,140,000 €	6,204,000 €
<b>Annual Gross Profit</b>	2,490,713 €	3,211,942 €

In order to analyse the profitability over the years, several assumptions have been made:

1. The plant's life span is considered to be 10 years.
2. Linear depreciation is considered the life span of the plant. This is, 10 % of the fixed capital investment, resulting in a whole 100 % in 10 years.
3. Taxes are not considered.
4. The plant is fully operational from its construction.

The gross profit margin is calculated by below mentioned formula:

$$\text{Gross Profit Margin} = \frac{\text{Gross Profit}}{\text{Sales Revenue}} \times 100 \quad (1)$$

Gross Profit Margin (600x400 mm) = 60.16 %

Gross Profit Margin (800x600 mm) = 51.77 %

The operating profit is calculated by:

$$\text{Operating Profit} = \text{Gross Profit} - \text{Operating Expenses} \quad (2)$$

Where operating expenses are the annual total VC including overhead costs.

Operating Profit (600x400 mm) = 1,105,094 €

Operating Profit (800x600 mm) = 483,551 €

The operating profit margin is calculated by:

$$\text{Operating Profit Margin} = \frac{\text{Operating Profit}}{\text{Sales Revenue}} \times 100 \quad (3)$$

Operating Profit Margin (600x400 mm) = 26.69 %

Operating Profit Margin (800x600 mm) = 7.79 %

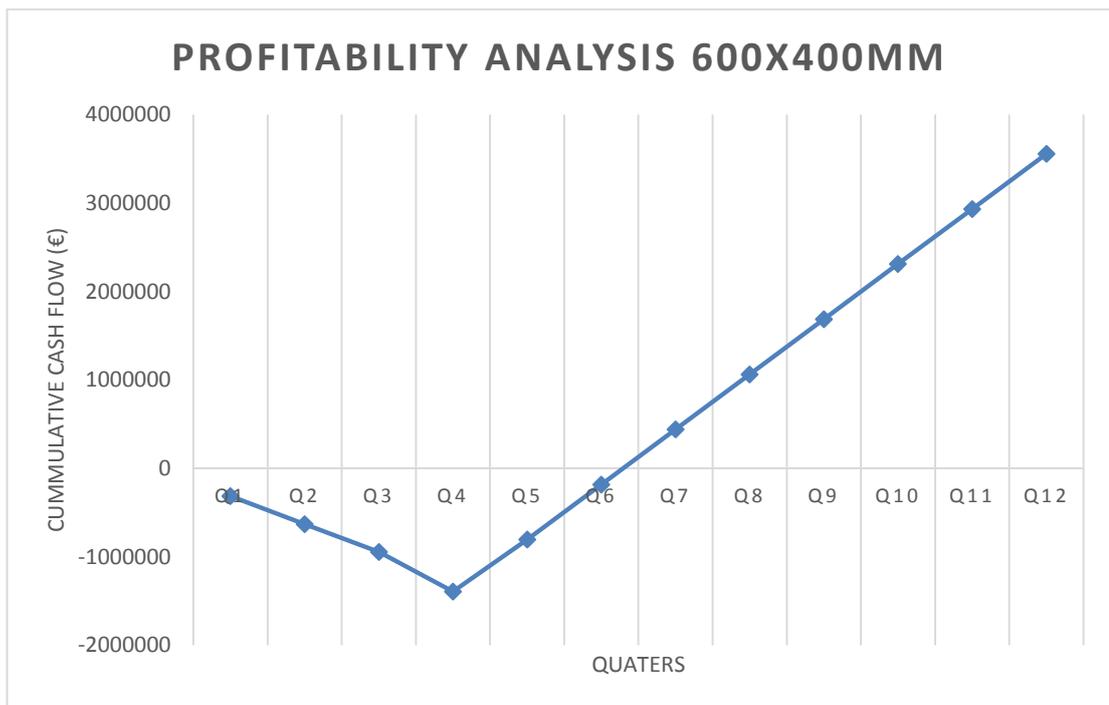
The return of investment (ROI) is calculated by:

$$\% \text{ ROI} = \frac{\text{Operating profit}}{\text{Total capital investment}} \times 100 \quad (4)$$

% ROI (600x400 mm) = 110.51 %

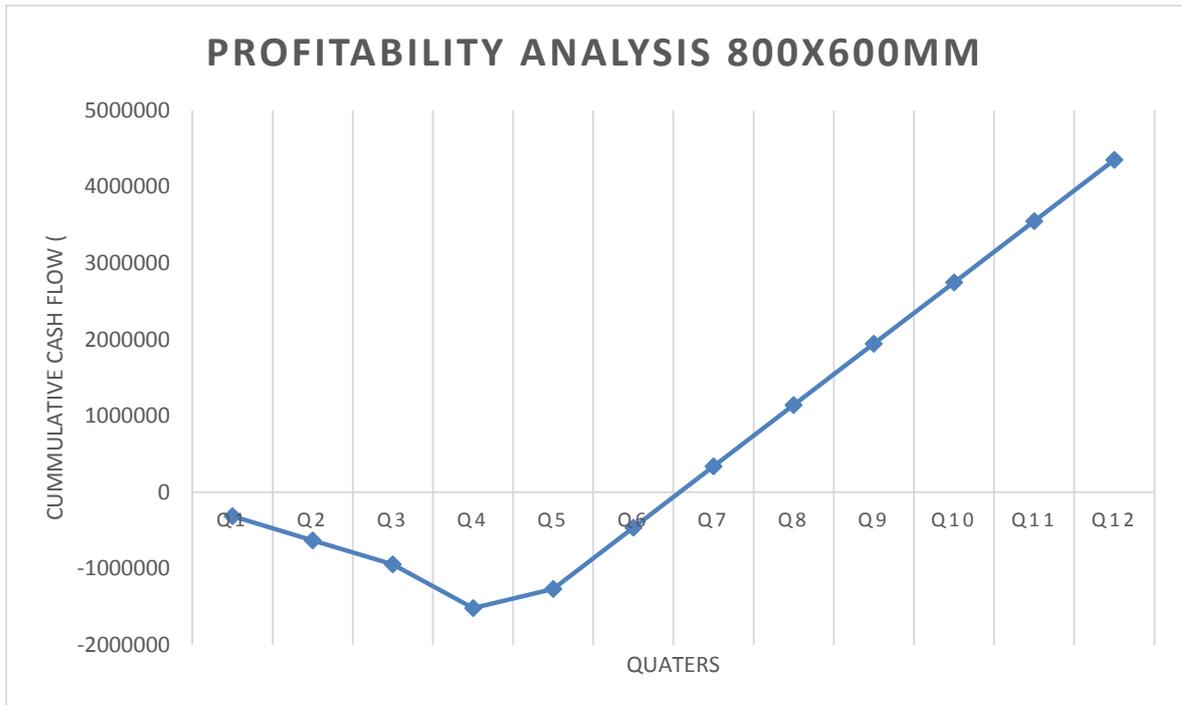
% ROI (800x600 mm) = 48.36 %

The detail description of profitability analysis for 7 years is shown in Appendix 6. For 600x400 mm size pallet the summary of profitability analysis and the breakeven point is shown in figure 29. The breakeven point for the entire investment will be achieved in quarter 6.



**Figure 29:** Profitability analysis of 600x400 mm.

For 800x600mm size pallet the summary of profitability analysis and the breakeven point is shown in fig. 30. The breakeven point for the entire investment will be achieved at the start of quarter 7.



**Figure 30:** Profitability analysis of 800x600mm.

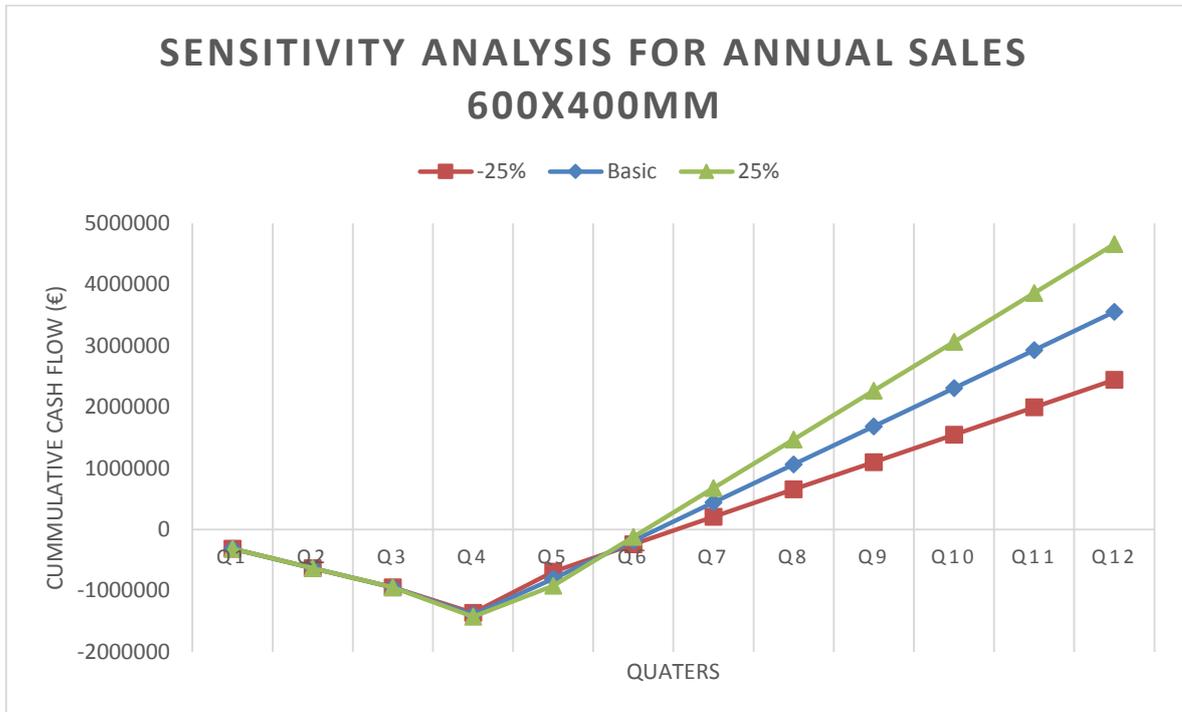
## 6.6 Sensitivity Analysis

The economic evaluation of the investment is based on the best estimation of parameters such as costs, volume, etc. that majorly contributes to the profitability and success of the investment. However, these parameters will not always likely to remain the same or could also change at the actual time of investment. Therefore, the actual cash flow will largely be affected by these parameters and hence it is also important to understand the actual effect of any change in such parameter on the success of investment. The major parameters that are taken into consideration for sensitivity analysis are sales volume, material cost and selling price. Further, all the parameters have been varied within a range of  $\pm 25\%$  of their original value.

### 6.6.1 Annual sales

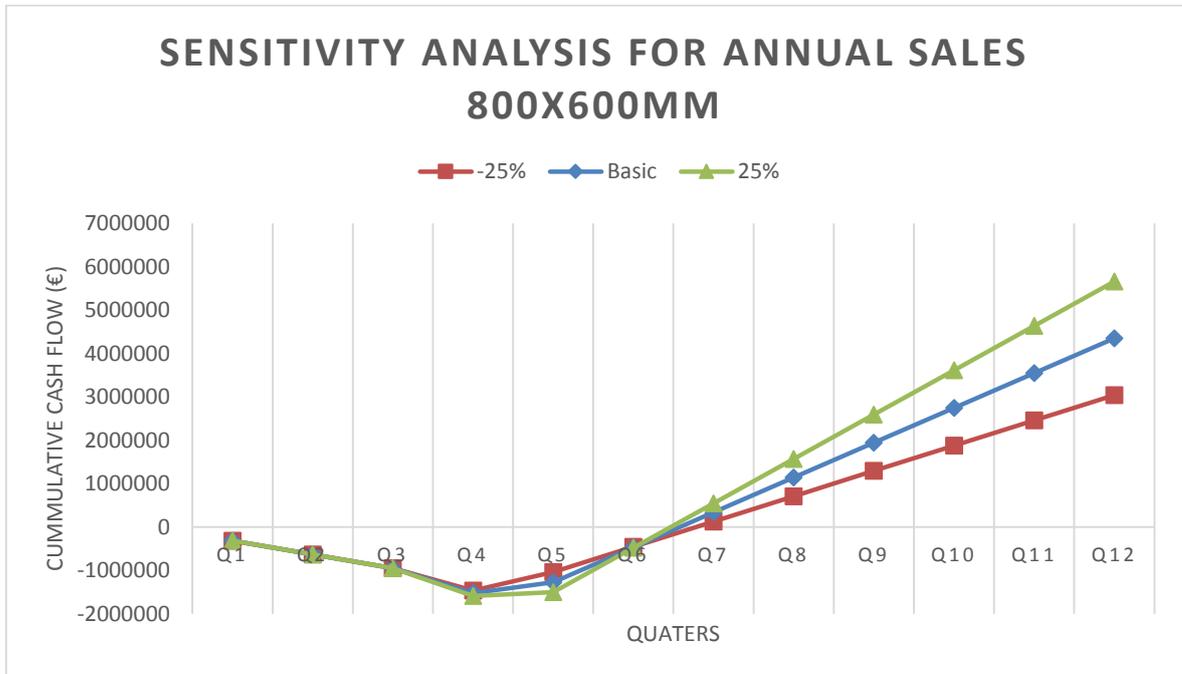
Annual sales have key role in the determining the profitability of the investment. Hence, it is important to understand the impact of any changes in the annual sales on the overall

profitability and achievement of breakeven point. Figure 31 represent the sensitivity analysis for annual sales of 600x400 mm size pallet. In case of 25 % decrease in sales the breakeven will be achieved in quarter 7 otherwise in other case it will be achieved in quarter 6.



**Figure 31:** Sensitivity Analysis for Annual Sales of 600x400 mm.

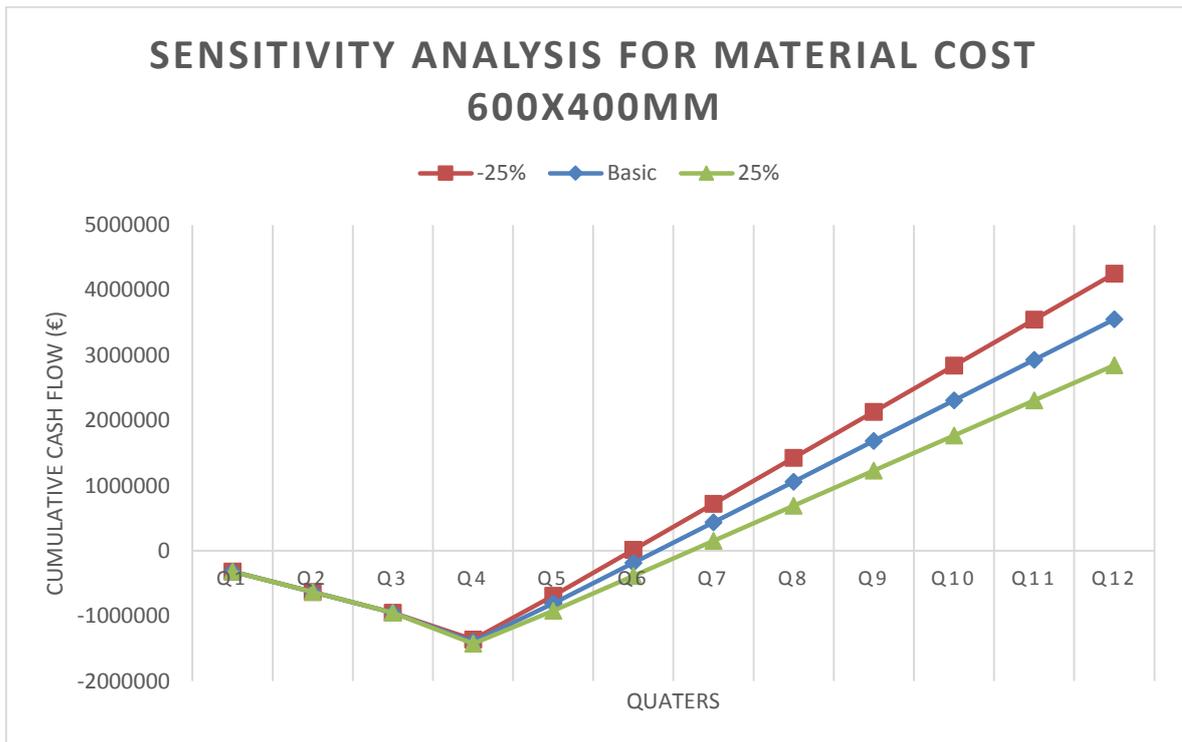
Figure 32 represents the sensitivity analysis for annual sales of 800x600 mm size pallet. In all case the breakeven will be achieved either at the start of quarter 7 or in middle of quarter 7.



**Figure 32:** Sensitivity Analysis for Annual Sales of 800x600 mm.

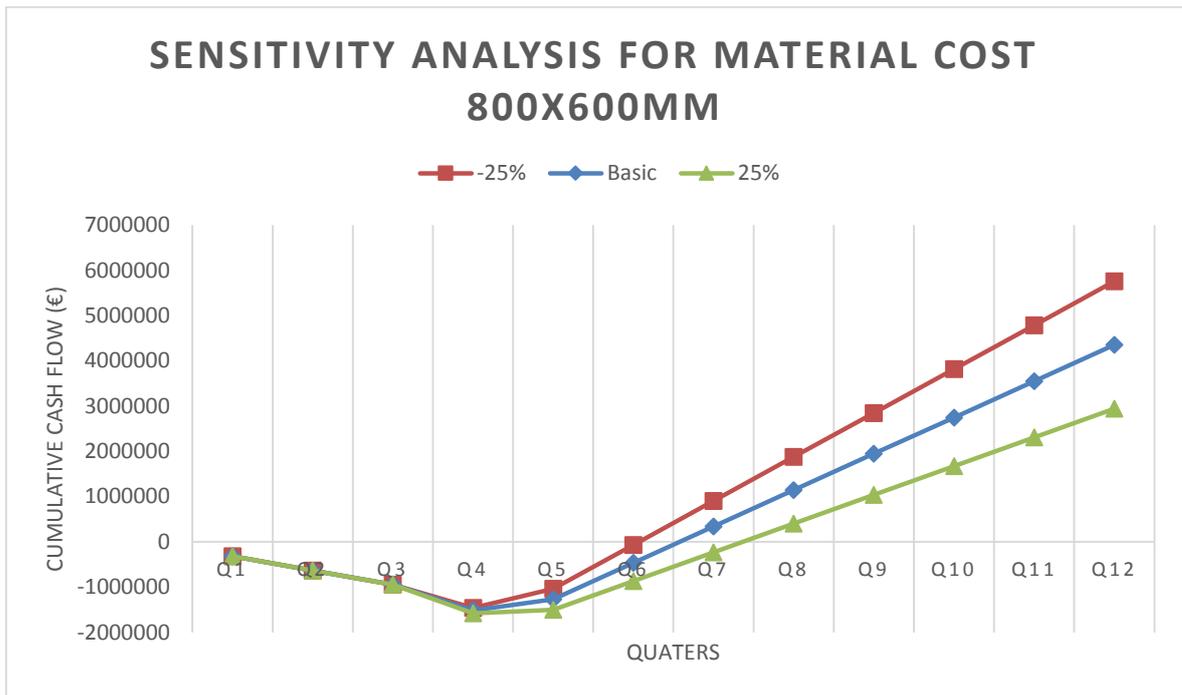
### 6.6.2 Material Cost

The material cost contributes to almost 50 % of the total cost of the product in this case hence any rapid changes in the cost of raw material can significantly affect the cash flow. Therefore a sensitivity analysis is crucial in such case to determine the difference in case the material cost increases or decreases. Figure 33 the sensitivity analysis for 600x400 mm pallet. The breakeven point in case of -25 % and basic is in quarters 6 but if the material cost is increased by 25 %, the breakeven point will be achieved in quarter 7.



**Figure 33:** Sensitivity Analysis for Material Cost of 600x400mm.

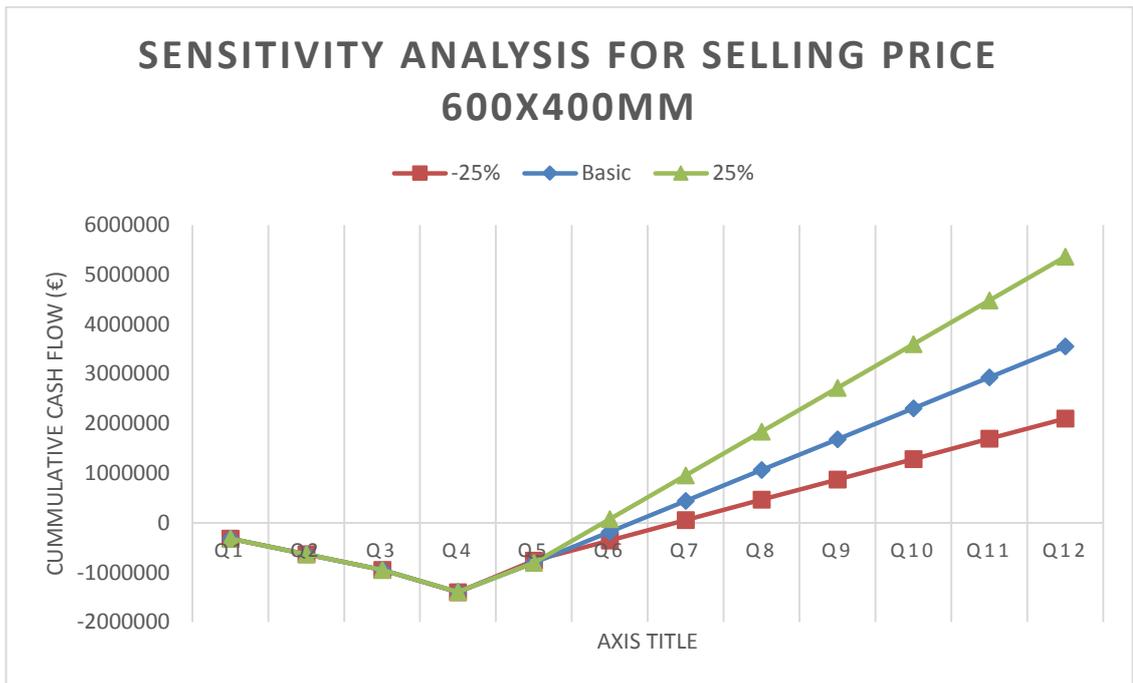
Figure 34 represent the sensitivity analysis of material cost of 800x600mm. In case of -25 %, the breakeven will be achieved in middle of quarter 6. Whereas in case of 25 % increase in material cost the breakeven will be achieved in end of quarter 7.



**Figure 34:** Sensitivity Analysis for Material Cost of 600x400mm.

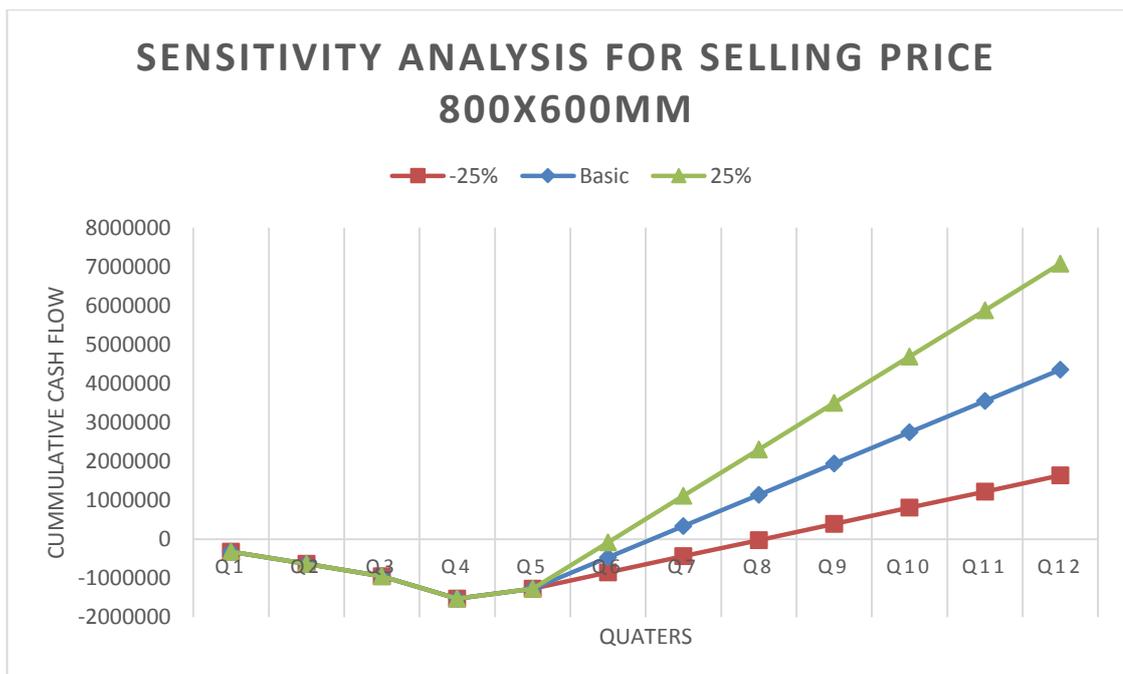
### 6.6.3 Selling price

At the basic level, the selling price of the product is set at the minimum according to the results obtained from the market survey. However, in case of increased competition or providing discounts to the customers, the firm can opt to reduce the price which may result in different profitability ratio and the breakeven point then normal one. Figure 35 represents the sensitivity analysis for the selling price of 600x400 mm. In case of 25 % increase in selling price the breakeven point will be achieved in quarter 6 similar to normal conditions. However, if the selling price is decreased by 25 %, the breakeven point will be achieved in quarter 7.



**Figure 35:** Sensitivity Analysis for Selling Price of 600x400 mm.

Figure 36 represents the sensitivity analysis for selling price of 800x600 mm size pallet. In case of 25% decrease in selling price, the breakeven point will be achieved in quarter 8. Whereas in case of 25% increase in selling price, the breakeven will be achieved earlier in quarter 6.



**Figure 36:** Sensitivity Analysis for Selling Price of 800x600mm.

## 7 DISCUSSION

The growing economy of India is a perfect destination for any foreign firm looking to expand its operations. This mainly because of lower manufacturing cost and growing consumer base with high spending power. Thus making the investment more profitable over time. With new reforms in foreign investment thus allowing foreign firms to open a unit in India with more ease and comfort. LLP is the best form of company type that is suitable for the foreign firm to run its operations in India as it is simple to form and wind up and also provide same benefits as a company.

The designing and analysis process of both size of pallets was according to the IS, however since it is not obligatory to have an IS certification from BIS on pallet not all the standards were followed. Standards which are related to designs were being followed this is mainly because of the interaction of the pallets and the forklift or hand pallet truck which required certain criteria to be properly fulfil. It is also important to remember the BIS didn't have any standard that are related to specific material type of WPC which is being used to manufacture pallet in this research. Furthermore, it is also important to remember that in this case BIS is open to take into consideration any application for introducing a new standard or making any changes in the existing standard.

The process of material selection was done according to the availability of the material in the country. The major constituent of the WPC material are wood and plastic, since the strength to the structure is provided by plastics it is important to select proper plastic type. Also, certain plastic such as PVC is incompatible with the process therefore is removed from the process of material selection. The plastics which are mainly studied in this research are various forms of PE such as HDPE, LDPE mainly because of their availability in the country.

In India, PE is the most consumed plastics in the industries specifically in north and western region of the India because of high clusters of industries in these two regions. PE accounts for about 43% of the total market share of plastic followed by PVC and PP at 28% and 24% respectively. Further, the amount of PE scrap is also relative higher in these

two region which is used to manufacture the WPC pallets. In addition, the availability of the plastics scrap is backed by the survey done for the plastics scrap dealers.

The design process involves selecting the size of pallet which was compatible with current process. Therefore, two size 800x600 mm and 600x400 mm were selected for designing and analysis purpose. The dimensions of the pallets were kept according to the IS 7276 and according to the process capability. The pallets were analysed with a FOS of 2.25 which was taken from the IS 11982 and were later given a load rating also according to the IS 11983.

It was inevitable from the literature review about the size and growth prospect of the Indian Pallet market. However, it was still important to determine the actual status of the market and thus a market survey was necessary. In the market 16 plastic and 6 wood pallet industries took participated and registered their responses. The key points from the market survey were the type of raw material, annual sales, size of pallet, customers and price.

HDPE is the most widely used plastic in the plastic pallet industry, which directly correlate to the high consumption of HDPE in India. Another important aspect of this finding also points towards the availability of HDPE waste generate from the Industries including the pallet industry, which can be used as the source of raw material. Further, both wooden and plastics pallets industries are serving a wide range of customers such as engineering firms, pharmaceutical firms, textile firms, food and beverages industries, electronic firms etc. Thus any new firm thinking of entering into the market will have a huge variety of customer base to cater only if they can provide the product at competitive price and decent quality.

In terms of annual sales, wood industry still dominates with all the response stating over 1Mn annual sales however the plastic pallet industry is growing rapidly with few already achieved 1Mn annual sales. Thus, this clearly shows the potential in the Indian Pallet industry and the rate at which it is growing. These signs are quite encouraging for a new firm either local or foreign who wants to establish a base in India. However, the price of the product will always be a big issue for the India customers thus any new firms entering into the market must have competitive prices in order to sustain in the market. With

wooden pallet are much cheaper in comparison with plastic pallets, prices for WPC pallet should be define in such a way that the firm can compete with both types of pallets and also ensuring that the investment is profitable over long term.

The profitability of the investment for both size of pallet is done separately with some assumptions such as no tax structure is considered, annual sales were considered at 600,000 etc. For the cost calculations, HDPE prices are selected because of its easily available and provide better strength. The gross profit margin in 600x400 mm size pallet was 64.75 % and for 800x600 mm size was 57.75 %. Furthermore, the ROI for 600x400 mm size pallet was 147.06% and for 800x600 mm size was 122.53 % thus signifying the high return potential on the investment.

The profitability analysis for both size pallet shows that the breakeven will achieved in quater6. Furthermore, a sensitivity analysis of parameters such as annual sales, material cost and selling price is done to see how much affect any change in these parameters can caused severe changes in the profitability of the investment. However, not much changes in the profitability was noticed with the breakeven point reaching at maximum in quarter in certain scenarios. Therefore, ensuring the stability of the investment with high rate of returns.

## 8 CONCLUSION

The purpose of this research was to understand the Indian Pallet Market and its growth potential. This aspect of research was done by literature review and also conducting a market survey where 22 companies from both wood and plastic pallet industry took participation. A thorough literature review was done to understand the procedure for a foreign firm to enter into India and starts its manufacturing operation. Furthermore, the research includes designing and analysing different process compatible size pallet which can manufactured from WPC material for the Indian market. The developing of WPC pallet is done according to the requirements of IS, however it is not an obligation to follow the design requirements prescribed by BIS. Lastly, an economic evaluation is done to check the profitability of the investment and identifying when the breakeven point will be achieved if a foreign firm decides to starts its operation in India. The research question taken into consideration are:

### **What is the current scenario of Indian pallet market?**

Currently Indian pallet industry is valued at Euro 858.3 Mn and is projected to grow at a CAGR of 13.9 % during the period of 2016-2024. Indian pallet industry is dominated by wooden pallet which contributes to approximately 80-85 % of the total pallet in circulation. However, the future growth of plastic industry is predicted to be much higher than wooden pallets. This growth in demand is mainly because of high growth in manufacturing sector due to favourable government policies related to manufacturing sector such as new GST structure and new initiatives such as Make in India.

According to the market survey, every wooden pallet producing firm has an annual sales over 1Mn but at the same time plastic pallet industries have also grown rapidly in the annual sales reaching almost 1Mn also. But one thing is to be kept in mind that the growth of plastic pallet in India doesn't have any negative effect on the market share of wooden pallet. The plastic pallet market is dominated with pallet produced by HDPE material because of the easy availability of material and its high strength.

Though the market is dominated by large size pallet such as 1200x800 mm, 1200x1000 mm and 1200x1200 mm there is still a significant portion of share for smaller size pallet such as 800x600 mm and 600x400 mm. In terms of prices, the wooden pallet range in between Euro 6.9 – 20.7 and the plastic pallet in between Euro 13.8 – 55.2 depending on the size. The prime customer for the pallet industries are automotive industries and their supplier, pharmaceutical companies, electronic firms, food and beverages etc.

### **What is the potential of WPC pallet in India?**

In order for a firm producing WPC material pallet to compete in India it must be able to compete on price and at the same time provide decent quality to the customer. The manufacturing cost of WPC material is relatively quite small mainly because of the availability of raw material is abundant and at a cheap price. The manufacturing cost for a 800x600 mm WPC pallet is about 4.37 € and it can easily compete on prices even with against the wooden pallet in India which are sold at minimum range of 6.9 €. Further, these pallet also provide a decent amount of load bearing capacity as per the IS therefore these pallets are not only cheaper but steadier also.

However, currently the only issue is the size of pallet due to process incapability it is right now suitable for smaller size pallets only. Though with further improvement in the process capability large size WPC pallet can be produce and they can also compete with their larger wooden and plastic counterparts. This is required because of dominance of large pallets in market al.so, WPC pallets being an environmental friendly option for both wood and plastics pallet because of being made from waste material provide additional value to the product itself and thus can creates its own market share and can also penetrate into either wooden or plastic pallet market.

### **What is the correct procedure a foreign firm need to follow to enter in Indian market?**

With introduction of new FDI programmes it is quite easier for a foreign firm to starts its operations in India. Now government had open most of the sectors for FDI and have certain on investment caps. The two common route for FDI are government route which require approval from government and automatic route where no approval is needed. The

pallet industry falls under the category of automatic route therefore all foreign firm has to do is to open a business venture in India.

Earlier most of the firms opt to form a company in India either WOS or JV but now with option of LLP being available many are opting for that route. LLP is a much better option because the process of forming a LLP is simpler than a company and the handling the operations of LLP is also quite simple and involve less documents and audit work. Further, in case of winding up LLP can be closed swiftly without any legal obligations.

### **How much profitable this investment will be?**

The total investment estimated in this research in 1Mn Euros which include equipment and machinery cost and other auxiliary cost required initially in establishing a production unit. The profitability analysis for both 800x600 mm and 600x400 mm size pallet predict high profit returns on the investment considering the assumption used for calculations. The ROI for 600x400 mm size pallet is predicted at 147.06 % and for 800x600 mm size is predicted at 122.53 % with both size pallet reaching breakeven in quarter 6, therefore meaning the return of entire investment in less than 2 years. Further, even the sensitivity analysis of crucial parameters predicts the achievement on breakeven point at maximum by quarter 8.

### **8.1 Further Research**

For future research, the focus can be given on developing different size of pallets especially large size pallet once the process become capable enough to produce such large-scale products. The main plastic used for analysis and calculations was HDPE and combined alongside wood to produce WPC but a different material can be taken into consideration for the process. Furthermore, the cost calculation can be done more concretely taking into consideration the tax rate in India for firms. Also, the market survey for pallet industry, material availability and suppliers can be further expanded to cover entire India instead of just relying on the results only from north and western region of India.

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## **APPENDICES**

APPENDIX 1: FDI Prohibited sectors, government route sectors and automatic route sectors

APPENDIX 2: E-mail Interview (from BIS)

APPENDIX 3: Material properties

APPENDIX 4: Figures and Technical drawings

APPENDIX 5: Tables

APPENDIX 6: Calculations

APPENDIX 7: Survey

## APPENDIX 1,1

FDI Prohibited sectors, government route sectors and automatic route sectors

*Table 1: The following are the sectors where FDI is prohibited in India (mod. India Legal help 2016).*

<b>Sr No.</b>	<b>Sectors</b>
1	Lottery Business – Government, private, online etc.
2	Gambling and Betting including casinos etc.
3	Chit Funds
4	Nidhi Company
5	Trading in Transferable Development Rights
6	Real Estate Business or Construction of Farm Houses
7	Manufacturing of Cigars, cheroots, cigarillos and cigarettes, of tobacco or of tobacco substitutes
8	Sectors not open to private investment e.g. Atomic Energy and Railway Transport
9	Foreign Technology collaboration in any form for Lottery Business and Gambling and Betting activities such as licensing for franchise, trademark, brand name, management contract

*Table 2: Sectors requiring central government approval for FDI (mod. Makeinindia 2016; DIPP 2016).*

<b>Sr. No.</b>	<b>Sectors</b>	<b>Cap</b>	<b>Government Approval</b>
1	Mining and mineral separation of titanium bearing minerals and ores	100%	Upto 100%
2	Defence	100%	Beyond 49%
3	Publishing/printing of scientific and technical magazines/specialty journals/ periodicals	100%	Upto 100%
4	Publication of facsimile edition of foreign newspapers	100%	Upto 100%

<b>Sr. No.</b>	<b>Sectors</b>	<b>Cap</b>	<b>Government Approval</b>
5	Print Media - Publishing of newspaper and periodicals dealing with news and current affairs	26%	Upto 26%
6	Print Media - Publication of Indian editions of foreign magazines dealing with news and current affairs	26%	Upto 26%
7	Air Transport Service - Scheduled, and Regional Air Transport Service	100%	Beyond 49%
8	Investment by foreign airlines	49%	Upto 49%
9	Satellites – establishment and operation	100%	Upto 100%
10	Telecom Services	100%	Beyond 49%
11	Trading – Single Brand Retail Trading	100%	Beyond 49%
12	Pharma – Brownfield	100%	Beyond 74%
13	Banking – Private Sector	74%	Beyond 49%
14	Banking – Public Sector	20%	Upto 20%
15	Private Security Agencies	74%	Beyond 49%
16	Broadcasting Content Service such as FM radio, uplinking of ‘News & Current Affairs’ Tv Channels	49%	Upto 49%
17	Trading - Multi Brand Retail Trading	51%	Upto 51%

*Table 3: Sectors Under Automatic Route with Conditions (mod. Makeinindia 2016; DIPP 2016).*

<b>Sr. No.</b>	<b>Sector</b>	<b>Cap</b>
1	Agriculture	100%
2	Plantation Sector	100%

## APPENDIX 1,3

<b>Sr. No.</b>	<b>Sector</b>	<b>Cap</b>
3	Mining of metal and non-metal ores	100%
4	Mining – Coal & Lignite	100%
5	Manufacturing	100%
6	Food product retail trading	100%
7	Broadcasting Carriage Services (Teleports, DTH, Cable Networks, Mobile TV, HITS)	100%
8	Broadcasting Content Service - Up-linking of Non-‘News & Current Affairs’ TV Channels/ Down-linking of TV Channels	100%
9	Airports – Greenfield	100%
10	Airports – Brownfield	100%
11	Air Transport Service – Non-Scheduled	100%
12	Air Transport Service – Helicopter Services/ Seaplane Services	100%
13	Ground Handling Services	100%
14	Maintenance and Repair organizations; flying training institutes; and technical training institutions	100%
15	Construction Development	100%
16	Industrial Parks – new and existing	100%
17	Trading – Wholesale	100%
18	Trading – B2B E-commerce	100%
19	Duty Free Shops	100%
20	Railway Infrastructure*	100%
21	Asset Reconstruction Companies	100%
22	Credit Information Companies	100%
23	White Label ATM Operations	100%
24	Non-Banking Finance Companies	100%
25	Pharma – Greenfield	100%

## APPENDIX 1,4

<b>Sr. No.</b>	<b>Sector</b>	<b>Cap</b>
26	Petroleum & Natural Gas - Exploration activities of oil and natural gas fields	100%
27	Petroleum refining by PSUs	49%
28	Infrastructure Company in the Securities Market	49%
29	Commodity Exchanges	49%
30	Insurance	49%
31	Pension	49%
32	Power Exchanges	49%

\*Proposals involving FDI beyond 49% in sensitive areas from security point of view, to be brought by the Ministry of Railways before the Cabinet Committee on Security for consideration on a case-to-case basis.

## Email Interview

**Vardaan Chauhan**

---

From: ted@bis.gov.in on behalf of TED <ted@bis.gov.in>  
Sent: Tuesday, May 9, 2017 9:57 AM  
To: Vardaan Chauhan  
Subject: Re: Query for Wood Plastic Composite Pallet

Dear Sir,  
This is in response to your preceding mails. To date, we do not have any existing standard that certifies the type or the dimensions of the pallets manufactured by you. However, we do have a standard that lays down general guidelines for selection of wood as packaging material which is as follows:

[IS 10106\(Part 2/Sec 5\):1990](#) [Packaging code: Part 2 Packaging materials, Section 5 Wood and plywood](#)

If you wish to sell your products in the Indian market, you may choose to do so without the BIS standard mark, as pallets and packaging materials are not covered in the list of products under mandatory certification.

Also, if you wish to propose any revision in the existing standards, or wish a new standard under any subject to be formulated by BIS, you may write to us, and your proposal would be put before the concerned Sectional Committee, i.e; TRANSPORT PACKAGES, PACKAGING CODES, FREIGHT CONTAINERS & PALLETS , TED 24, if the proposal seems relevant for the industry.

For any further queries, kindly get back to us.

Regards,  
Tushit Kamal  
Sc-B (TED)  
Bureau of Indian Standards  
New Delhi

On 04/18/17 04:58 AM, Vardaan Chauhan <Vardaan.Chauhan@student.lut.fi> wrote:

Hello Sir,

In reference to IS 16058, which states tests for top member, tests for bottom section, tests for assembled pallets states tests such as drop, handling, hammer and load bearing. However in our case, we do not have any assembly in the pallets, or any separate top or bottom part because the pallets are produced by press forming process, thus needing no assembly.

So I need to know do we have to perform all these tests? Or Are there any other specific tests related to our product?

Also if, we have to perform these tests are there specific limits for deflection, expansion, cracks or other visual / concrete observations especially in case for tests for top and bottom part? Because I saw IS 6219

which specify test methods for assembled parts and IS 13546 which specify the performance value or maximum permitted deflection.

Thanks and Regards,

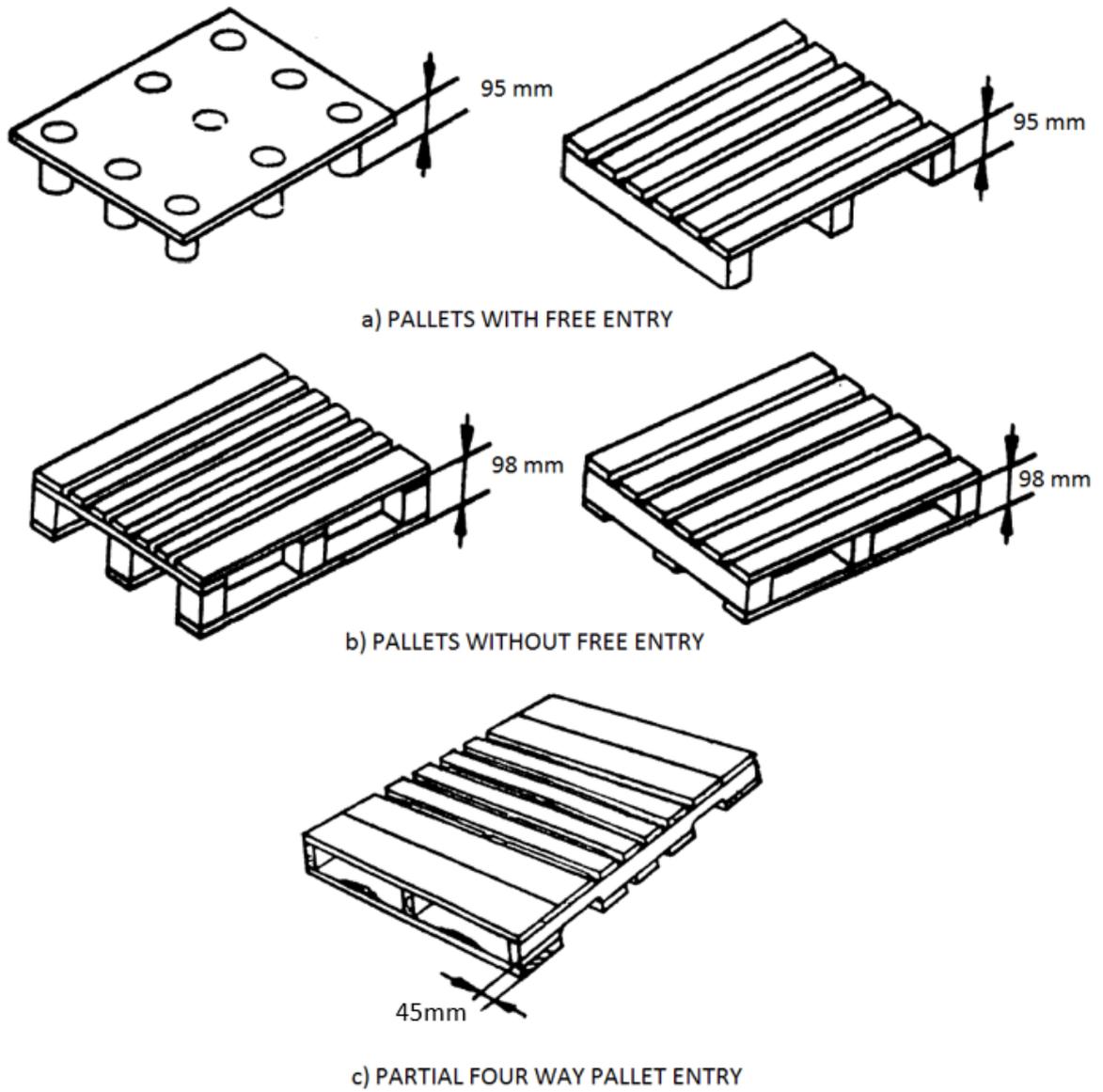
VARDAAN CHAUHAN

## Material Properties

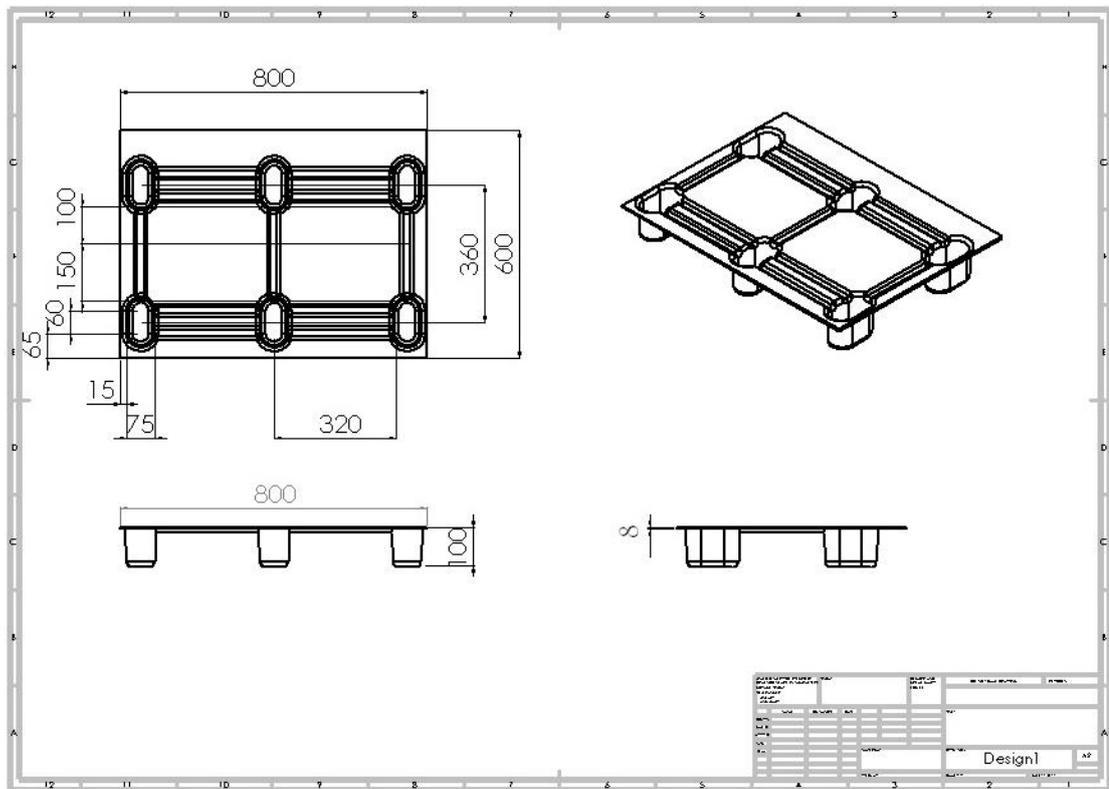
Table 1: Mechanical Properties of LDPE and HDPE (mod. AZoM 2011a; AZoM 2011b).

<b>Property</b>	<b>LDPE</b>	<b>HDPE</b>
<b>Density (g/cm<sup>3</sup>)</b>	0.92	0.96
<b>Surface Hardness</b>	SD48	SD68
<b>Tensile Strength (MPa)</b>	10	32
<b>Flexural Modulus (GPa)</b>	0.25	1.25
<b>Elongation at Break (%)</b>	400	150
<b>Strain at Yield (%)</b>	19	15
<b>Max. Operating Temp (°C)</b>	50	55
<b>Water Absorption (%)</b>	0.01	0.02
<b>Oxygen Index (%)</b>	17	17
<b>Melting Temp. Range (°C)</b>	220-260	220-310
<b>Mould Shrinkage (%)</b>	3	3
<b>Mould Temp. Range (°C)</b>	20-40	30-70

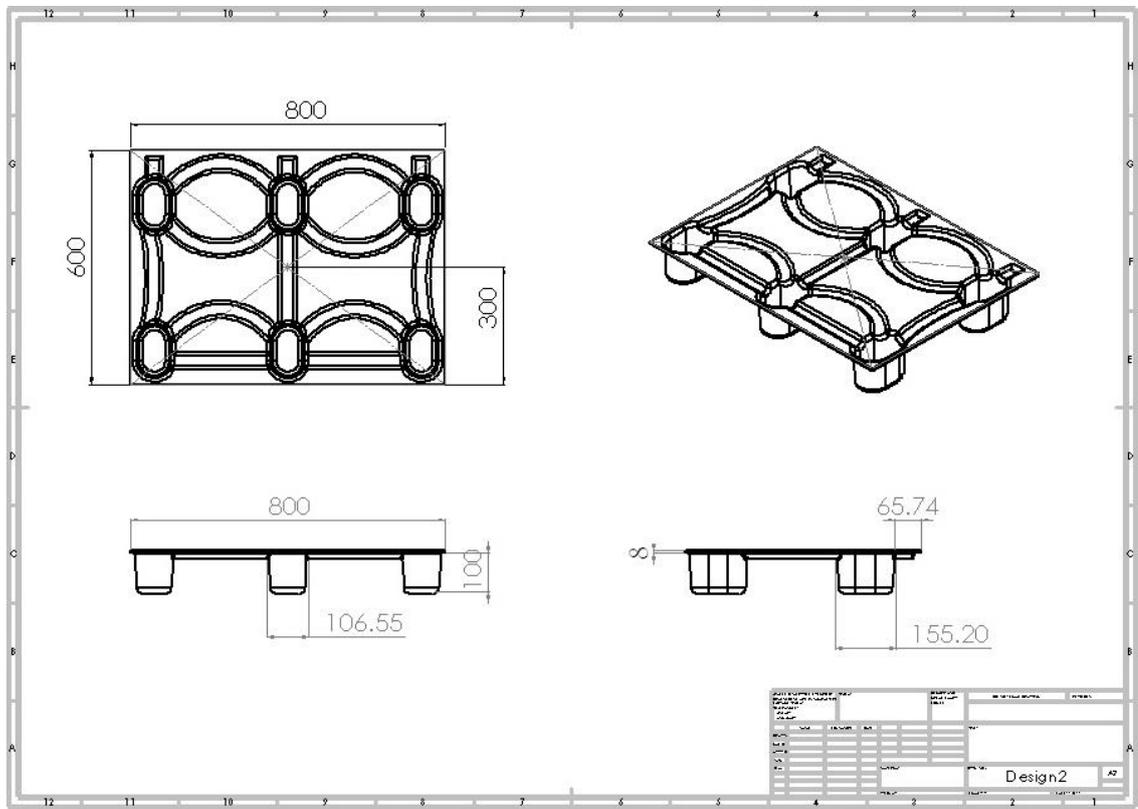
## Figures and Technical Drawings



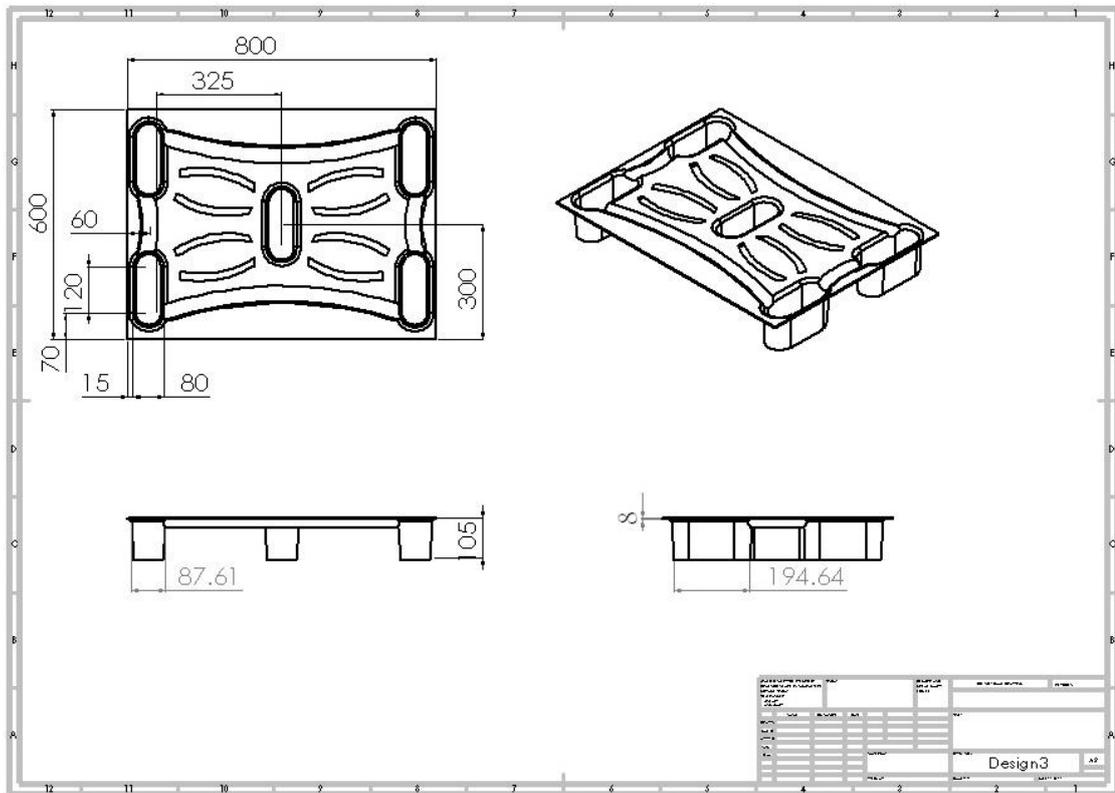
**Figure 1:** Vertical dimensions for the entry of lifting equipment (mod. IS 7276 1989, p. 5-6).



**Figure 2:** Drawing of design 1 (800X600mm)



**Figure 3:** Drawing of design 2 (800X600mm)



**Figure 4:** Drawing of design 3 (800X600mm)

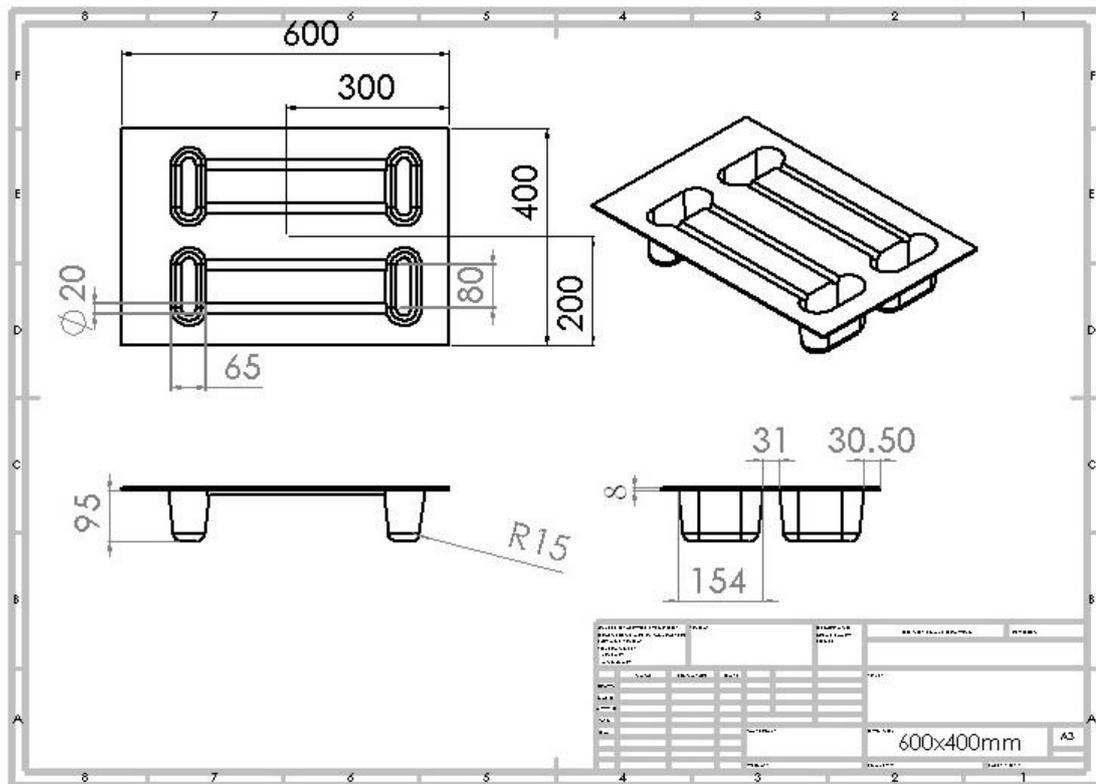


Figure 5: Drawing of design 4 (600X400mm)

## Tables

Table 1: Rating and Safe working load relationship with different types of payload (mod. I 11982 1987, p. 2).

Severity of Load on the Pallets	Example of Goods on the Pallet	Formula* for Maximum bending Moment in Deckboards	Area of Deck Under Load (A = Area of Pallet Deck)	SWL as a Fraction of Rating ¶	Example of SWL on a 1000 kg R Pallet
Point load	Electric motor	$\frac{wl}{4}$	Less than 0.3A	0.6R	600 kg
Patch or concentrated load	Large case-plan dimensions smaller than pallet	$\frac{wl}{ka}$ ¶	Greater than 0.3A and less than 0.85A	0.9R	900 kg
Uniformly distributed load	Cold flowing butyl rubber in sacks	$\frac{wl}{8}$	Greater than 0.85A	1.0R	1000 kg
Unbonded uniformly placed load	Non-interlocked cases	$\frac{wl}{kb}$ ¶	Greater than 0.85A	1.0R	1000 kg
Bonded uniformly placed load	Interlocked cases in regular pattern	$\frac{wl}{kc}$ ¶	Greater than 0.85A	1.1R to 1.9R	1100 to 1900 kg
Solid load	Horizontal paving slabs	zero ¶	Greater than 0.85A	2.25R	2250 kg

\*Standard mathematical formula for boards in simple bending.

¶  $ka$ ,  $kb$ , and  $kc$  and fraction of R are determined by laboratory test given the particular shape, size, pattern and nature of goods stacked on the pallet.

† Limit for solid incompressible loads is the compression strength of pallet blocks and height of stacking.

*Table 2: Pallet load rating with appropriate codes (mod. IS 11983 1987, p.1).*

<b>LOAD RATING</b>	<b>CODE</b>
250 KG	A
500 KG	B
750 KG	C
1000 KG	D
1250 KG	E
1500 KG	F
1750 KG	G



APPENDIX 6,2

**Total Manufacturing Cost**

Size of Pallet	Number of workers	Total VC	Annual VC	Overhead on VC (60%)	Annual Overhead	VC Overhead +	Annual operating expenses	FC /piece	Total COST
600 X 400mm pallet	3	€ 1.44	€ 862,700.00	€ 0.86	€ 517,620.00	€ 2.30	€ 1,380,320.00	€ 0.44	€ 2.74
	5	€ 1.44	€ 866,012.00	€ 0.87	€ 519,607.20	€ 2.31	<b>€ 1,385,619.20</b>	€ 0.44	€ 2.75
800 X 400mm pallet	3	€ 2.84	€ 1,701,932.00	€ 1.70	€ 1,021,159.20	€ 4.54	€ 2,723,091.20	€ 0.44	€ 4.98
	5	€ 2.84	€ 1,705,244.00	€ 1.71	€ 1,023,146.40	€ 4.55	<b>€ 2,728,390.40</b>	€ 0.44	€ 4.99

APPENDIX 6,3

**Profitability Calculation 800x600mm**

		Year1				Year2				Year3				Year4				Year5				Year6				Year7
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
<b>Total Investment</b>	1,000,000.00 €	250000	500000	750000	1000000																					
<b>Annual Fixed Cost</b>	263,667.60 €	65916.9	131834	197751	263667.6	329584.5	395501.4	461418.3	527335.2	593252.1	659169	725085.9	791002.8	856919.7	922836.6	988753.5	1054670	1120587	1186504	1252421	1318338	1384255	1450172	1516089	1582006	1647923
<b>Annual Variable Cost</b>	1,705,244.00 €				426311	852622	1278933	1705244	2131555	2557866	2984177	3410488	3836799	4263110	4689421	5115732	5542043	5968354	6394665	6820976	7247287	7673598	8099909	8526220	8952531	
<b>Overhead Cost/Year</b>	1,023,146.40 €				255786.6	511573.2	767359.8	1023146.4	1278933	1534720	1790506	2046293	2302079	2557866	2813653	3069439	3325226	3581012	3836799	4092586	4348372	4604159	4859945	5115732	5371519	5627305
<b>Production Volume</b>	600000					150000	300000	450000	600000	750000	900000	1050000	1200000	1350000	1500000	1650000	1800000	1950000	2100000	2250000	2400000	2550000	2700000	2850000	3000000	
<b>Unit Variable Cost</b>	2.84 €					2.8420733	2.8420733	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	2.842073	
<b>Sales Revenue (€)</b>	6,204,000.00 €					1551000	3102000	4653000	6204000	7755000	9306000	10857000	12408000	13959000	15510000	17061000	18612000	20163000	21714000	23265000	24816000	26367000	27918000	29469000	31020000	
<b>Sales Volume</b>	600000					150000	300000	450000	600000	750000	900000	1050000	1200000	1350000	1500000	1650000	1800000	1950000	2100000	2250000	2400000	2550000	2700000	2850000	3000000	
<b>Unit Price</b>	10.34 €					10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	
<b>Period Cash Flow</b>		-315917	-631834	-947751	-1519454	-1267469	-464483.2	338502.3	1141488	1944473	2747459	3550444	4353430	5156415	5959401	6762386	7565372	8368357	9171343	9974328	10777314	11580299	12383285	13186270	13989256	14792241

APPENDIX 6,3

**Profitability Calculation 600x400mm**

		Year1				Year2				Year3				Year4				Year5				Year6				Year7
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
<b>Total Investment</b>	1,000,000.00 €	250000	500000	750000	1000000																					
<b>Annual Fixed Cost</b>	263,667.60 €	65916.9	131833.8	197750.7	263667.6	329584.5	395501.4	461418.3	527335.2	593252.1	659169	725085.9	791002.8	856919.7	922836.6	988753.5	1054670	1120587	1186504	1252421	1318338	1384255	1450172	1516089	1582006	1647923
<b>Annual Variable Cost</b>	866,012.00 €					216503	433006	649509	866012	1082515	1299018	1515521	1732024	1948527	2165030	2381533	2598036	2814539	3031042	3247545	3464048	3680551	3897054	4113557	4330060	4546563
<b>Overhead Cost/Year</b>	519,607.20 €				129901.8	259803.6	389705.4	519607.2	649509	779410.8	909312.6	1039214	1169116	1299018	1428920	1558822	1688723	1818625	1948527	2078429	2208331	2338232	2468134	2598036	2727938	2857840
<b>Production Volume</b>	600000						150000	300000	450000	600000	750000	900000	1050000	1200000	1350000	1500000	1650000	1800000	1950000	2100000	2250000	2400000	2550000	2700000	2850000	3000000
<b>Unit Variable Cost</b>	1.44 €						1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353	1.443353
<b>Sales Revenue (€)</b>	4,140,000.00 €						1035000	2070000	3105000	4140000	5175000	6210000	7245000	8280000	9315000	10350000	11385000	12420000	13455000	14490000	15525000	16560000	17595000	18630000	19665000	20700000
<b>Sales Volume</b>	600000						150000	300000	450000	600000	750000	900000	1050000	1200000	1350000	1500000	1650000	1800000	1950000	2100000	2250000	2400000	2550000	2700000	2850000	3000000
<b>Unit Price</b>	6.90 €						6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
<b>Period Cash Flow</b>		-315917	-631834	-947751	-1393569	-805891.1	-183213	439465.5	1062144	1684822	2307500	2930179	3552857	4175535	4798214	5420892	6043570	6666249	7288927	7911605	8534283	9156962	9779640	10402318	11024997	11647675

## Survey

## Plastic Pallet Industry Survey

## Plastic Pallets Market Research - India

\* Required

## 1. Name

---

## 2. Company name \*

---

3. Please provide email address if you want to have a summary of the research work ?  
(Optional)

---

## 4. Contact Number (Optional)

---

## 5. Which scale of plastic pallets the company provides? \*

*Mark only one oval.*

- Small (below 1000 X 1000 mm)    *Skip to question 6.*
- Large (above 1000 X 1000 mm)    *Skip to question 23.*
- Both    *Skip to question 40.*

## Small Size Pallets

## 6. General Dimensions of Plastic Pallets (Small)

*Check all that apply.*

- 600 X 400 mm
- 800 X 600 mm
- 800 X 800 mm
- 900 X 900 mm
- Other: \_\_\_\_\_

## 7. Application \*

*Mark only one oval.*

- Industrial    *Skip to question 8.*
- Commercial such as malls, stores    *Skip to question 13.*
- Both    *Skip to question 18.*

## Industrial Application - Small Size Pallets

**8. Major Buyers (Industrial)**

*Check all that apply.*

- Engineering Industries
- Pharmaceutical Industries
- Chemical Industries
- Textile Industries
- Agriculture Industries
- Electronic Industries
- Logistics Industries
- Food Industries
- Other: \_\_\_\_\_

**9. Design**

*Check all that apply.*

- Four way Entry
- Two way Entry
- Other: \_\_\_\_\_

**10. Type of Material**

*Check all that apply.*

- HDPE
- LDPE
- PP
- PE
- PS
- PET
- PC
- ABS
- Other: \_\_\_\_\_

**11. Price per piece \***

*Check all that apply.*

- Less than INR 1000
- INR 1000 - INR 2000
- INR 2000 - INR 3000
- INR 3000 - INR 4000
- INR 4000 +
- Other: \_\_\_\_\_

**12. Estimate Annual Sales \***

*Check all that apply.*

- Less than 50000
- 50000 - 1 lacs
- 1 lacs - 2 lacs
- 2 lacs - 5 lacs
- 5 lacs - 7 lacs
- 7 lacs - 10 lacs
- 10 lacs +
- Other: \_\_\_\_\_

*Stop filling out this form.*

**Commercial Application - Small Size Pallets**

**13. Major Buyers (Commercial)**

*Check all that apply.*

- Shopping mall
- Grocery stores
- Retail market
- Other: \_\_\_\_\_

**14. Design**

*Check all that apply.*

- Four way Entry
- Two way Entry
- Other: \_\_\_\_\_

**15. Type of Material**

*Check all that apply.*

- HDPE
- LDPE
- PP
- PE
- PS
- PET
- PC
- ABS
- Other: \_\_\_\_\_

**16. Price per piece \***

*Check all that apply.*

- Less than INR 1000
- INR 1000 - INR 2000
- INR 2000 - INR 3000
- INR 3000 - INR 4000
- INR 4000 +
- Other: \_\_\_\_\_

**17. Estimate Annual Sales \***

*Check all that apply.*

- Less than 50000
- 50000 - 1 lacs
- 1 lacs - 2 lacs
- 2 lacs - 5 lacs
- 5 lacs - 7 lacs
- 7 lacs - 10 lacs
- 10 lacs +
- Other: \_\_\_\_\_

*Stop filling out this form.*

## **Industrial and Commercial Application - Small Size Pallets**

**18. Major Buyers (Industrial and Commercial)**

*Check all that apply.*

- Engineering Industries
- Pharmaceutical Industries
- Chemical Industries
- Textile Industries
- Agriculture Industries
- Electronic Industries
- Logistics Industries
- Shopping Centres
- Retail Market
- Grocery Stores
- Other: \_\_\_\_\_

**19. Design**

*Check all that apply.*

- Four way Entry
- Two way Entry
- Other: \_\_\_\_\_

**20. Type of Material**

*Check all that apply.*

- HDPE
- LDPE
- PP
- PE
- PS
- PET
- PC
- ABS
- Other: \_\_\_\_\_

**21. Price per piece \***

*Check all that apply.*

- Less than INR 1000
- INR 1000 - INR 2000
- INR 2000 - INR 3000
- INR 3000 - INR 4000
- INR 4000 +
- Other: \_\_\_\_\_

**22. Estimate Annual Sales \***

*Check all that apply.*

- Less than 50000
- 50000 - 1 lacs
- 1 lacs - 2 lacs
- 2 lacs - 5 lacs
- 5 lacs - 7 lacs
- 7 lacs - 10 lacs
- 10 lacs +
- Other: \_\_\_\_\_

*Stop filling out this form.*

## Large Size Pallets

**23. General Dimensions of Plastic Pallets (Large)**

*Check all that apply.*

- 1000 X 1000 mm
- 1200 X 800 mm
- 1200 X 1000 mm
- 1200 X 1200 mm
- Other: \_\_\_\_\_

**24. Application \***

*Mark only one oval.*

- Industrial      *Skip to question 25.*
- Commercial such as malls, stores      *Skip to question 30.*
- Both

**Industrial Application - Large Size Pallets**

**25. Major Buyers (Industrial)**

*Check all that apply.*

- Engineering Industries
- Pharmaceutical Industries
- Chemical Industries
- Textile Industries
- Agriculture Industries
- Electronic Industries
- Logistics Industries
- Food Industries
- Other: \_\_\_\_\_

**26. Design**

*Check all that apply.*

- Four way Entry
- Two way Entry
- Other: \_\_\_\_\_

**27. Type of Material**

*Check all that apply.*

- HDPE
- LDPE
- PP
- PE
- PS
- PET
- PC
- ABS
- Other: \_\_\_\_\_

**28. Price per piece \***

*Check all that apply.*

- Less than INR 1000
- INR 1000 - INR 2000
- INR 2000 - INR 3000
- INR 3000 - INR 4000
- INR 4000 +
- Other: \_\_\_\_\_

**29. Estimate Annual Sales \***

*Check all that apply.*

- Less than 50000
- 50000 - 1 lacs
- 1 lacs - 2 lacs
- 2 lacs - 5 lacs
- 5 lacs - 7 lacs
- 7 lacs - 10 lacs
- 10 lacs +
- Other: \_\_\_\_\_

*Stop filling out this form.*

## **Commercial Application - Large Size Pallets**

**30. Major Buyers (Commercial)**

*Check all that apply.*

- Shopping Malls
- Grocery Stores
- Retail Market
- Other: \_\_\_\_\_

**31. Design**

*Check all that apply.*

- Four way Entry
- Two way Entry
- Other: \_\_\_\_\_

**32. Type of Material**

*Check all that apply.*

- HDPE
- LDPE
- PP
- PE
- PS
- PET
- PC
- ABS
- Other: \_\_\_\_\_

**33. Price per piece \***

*Check all that apply.*

- Less than INR 1000
- INR 1000 - INR 2000
- INR 2000 - INR 3000
- INR 3000 - INR 4000
- INR 4000 +
- Other: \_\_\_\_\_

**34. Estimate Annual Sales \***

*Check all that apply.*

- Less than 50000
- 50000 - 1 lacs
- 1 lacs - 2 lacs
- 2 lacs - 5 lacs
- 5 lacs - 7 lacs
- 7 lacs - 10 lacs
- 10 lacs +
- Other: \_\_\_\_\_

*Stop filling out this form.*

**Industrial and Commercial Application - Large Size Pallets**

**35. Major Buyers (Industrial and Commercial)**

*Check all that apply.*

- Engineering Industries
- Pharmaceutical Industries
- Chemical Industries
- Textile Industries
- Agriculture Industries
- Electronic Industries
- Logistics Industries
- Food Industries
- Shopping Malls
- Grocery Stores
- Retail Market
- Other: \_\_\_\_\_

**36. Design**

*Check all that apply.*

- Four way Entry
- Two way Entry
- Other: \_\_\_\_\_

**37. Type of Material**

*Check all that apply.*

- HDPE
- LDPE
- PP
- PE
- PS
- PET
- PC
- ABS
- Other: \_\_\_\_\_

**38. Price per piece \***

*Check all that apply.*

- Less than INR 1000
- INR 1000 - INR 2000
- INR 2000 - INR 3000
- INR 3000 - INR 4000
- INR 4000 +
- Other: \_\_\_\_\_

**39. Estimate Annual Sales \***

*Check all that apply.*

- Less than 50000
- 50000 - 1 lacs
- 1 lacs - 2 lacs
- 2 lacs - 5 lacs
- 5 lacs - 7 lacs
- 7 lacs - 10 lacs
- 10 lacs +
- Other: \_\_\_\_\_

*Stop filling out this form.*

**Both Small and Large Scale of Pallets**

**40. General Dimensions of Plastic Pallets**

*Check all that apply.*

- 600 x 400 mm
- 800 X 600 mm
- 800 X 800 mm
- 900 X 900 mm
- 1000 X 1000 mm
- 1200 X 800 mm
- 1200 X 1000 mm
- 1200 X 1200 mm
- Other: \_\_\_\_\_

**41. Application Area \***

*Mark only one oval.*

- Industrial     *Skip to question 42.*
- Commercial such as malls, stores     *Skip to question 47.*
- Both     *Skip to question 52.*

**Industrial Application - Both Small and Large Scale of Pallets**

**42. Major Buyers (Industrial)**

*Check all that apply.*

- Engineering Industries
- Pharmaceutical Industries
- Chemical Industries
- Textile Industries
- Agriculture Industries
- Electronic Industries
- Logistics Industries
- Food Industries
- Other: \_\_\_\_\_

**43. Design**

*Check all that apply.*

- Four way Entry
- Two way Entry
- Other: \_\_\_\_\_

**44. Type of Material**

*Check all that apply.*

- HDPE
- LDPE
- PP
- PE
- PS
- PET
- PC
- ABS
- Other: \_\_\_\_\_

**45. Price per piece \***

*Check all that apply.*

- Less than INR 1000
- INR 1000 - INR 2000
- INR 2000 - INR 3000
- INR 3000 - INR 4000
- INR 4000 +
- Other: \_\_\_\_\_

**46. Estimate Annual Sales \***

*Check all that apply.*

- Less than 50000
- 50000 - 1 lacs
- 1 lacs - 2 lacs
- 2 lacs - 5 lacs
- 5 lacs - 7 lacs
- 7 lacs - 10 lacs
- 10 lacs +
- Other: \_\_\_\_\_

*Stop filling out this form.*

**Commercial Application - Both Small and Large Scale of Pallets**

**47. Major Buyers (Commercial)**

*Check all that apply.*

- Shopping Malls
- Grocery Stores
- Retail Market
- Other: \_\_\_\_\_

**48. Design**

*Check all that apply.*

- Four way Entry
- Two way Entry
- Other: \_\_\_\_\_

**49. Type of Material**

*Check all that apply.*

- HDPE
- LDPE
- PP
- PE
- PS
- PET
- PC
- ABS
- Other: \_\_\_\_\_

**50. Price per piece \***

*Check all that apply.*

- Less than INR 1000
- INR 1000 - INR 2000
- INR 2000 - INR 3000
- INR 3000 - INR 4000
- INR 4000 +
- Other: \_\_\_\_\_

**51. Estimate Annual Sales \***

*Check all that apply.*

- Less than 50000
- 50000 - 1 lacs
- 1 lacs - 2 lacs
- 2 lacs - 5 lacs
- 5 lacs - 7 lacs
- 7 lacs - 10 lacs
- 10 lacs +
- Other: \_\_\_\_\_

*Stop filling out this form.*

**Industrial and Commercial Application - Both Small and Large Scale of Pallets**

**52. Major Buyers (Industrial and Commercial)**

*Check all that apply.*

- Engineering Industries
- Pharmaceutical Industries
- Chemical Industries
- Textile Industries
- Agriculture Industries
- Electronic Industries
- Logistics Industries
- Food Industries
- Shopping Malls
- Grocery Stores
- Retail Market
- Other: \_\_\_\_\_

**53. Design**

*Check all that apply.*

- Four way Entry
- Two way Entry
- Other: \_\_\_\_\_

**54. Type of Material**

*Check all that apply.*

- HDPE
- LDPE
- PP
- PE
- PS
- PET
- PC
- ABS
- Other: \_\_\_\_\_

**55. Price per piece \***

*Check all that apply.*

- Less than INR 1000
- INR 1000 - INR 2000
- INR 2000 - INR 3000
- INR 3000 - INR 4000
- INR 4000 +
- Other: \_\_\_\_\_

**56. Estimate Annual Sales \***

*Check all that apply.*

- Less than 50000
  - 50000 - 1 lacs
  - 1 lacs - 2 lacs
  - 2 lacs - 5 lacs
  - 5 lacs - 7 lacs
  - 7 lacs - 10 lacs
  - 10 lacs +
  - Other: \_\_\_\_\_
-

## Wooden Pallet Industry Survey

### Pallet Market Research - India

\* Required

**1. Name \***

\_\_\_\_\_

**2. Company Name \***

\_\_\_\_\_

**3. Email Address (Optional)**

\_\_\_\_\_

**4. Type of wood material \***

*Check all that apply.*

- New Wood
- Composite Wood
- Recycled Wood
- Used Wood
- Other: \_\_\_\_\_

**5. Structural Design**

*Check all that apply.*

- Block Pallet
- Stringer Pallet
- Other: \_\_\_\_\_

**6. Industry Standards**

*Check all that apply.*

- ISO Standards
- Euro Pallet
- Four-way Entry
- Two-way Entry
- Other: \_\_\_\_\_



**10. Estimate Annual Sales \***

*Check all that apply.*

- Below 50000
- 50000 - 1Lacs
- 1Lacs - 2Lacs
- 2Lacs - 5Lacs
- 5Lacs - 7Lacs
- 7Lacs - 10Lacs
- 10Lacs +

**Plastic Scrap Suppliers Survey**

**Plastic Scrap Supplier**

\* Required

**1. Name \***

---

**2. Company Name \***

---

**3. Type of Material Available \***

*Check all that apply.*

- HDPE
- LDPE
- PP
- PET
- ABS
- PS
- PC
- PU
- Other: \_\_\_\_\_

**4. Price Range per Kg \***

*Check all that apply.*

	HDPE	LDPE	PP	PET	ABS	PS	PC	PU
INR 10-20	<input type="checkbox"/>							
INR 20-30	<input type="checkbox"/>							
INR 30-40	<input type="checkbox"/>							
INR 40-50	<input type="checkbox"/>							
INR 50-60	<input type="checkbox"/>							
INR 60-70	<input type="checkbox"/>							
INR 70-80	<input type="checkbox"/>							

**5. Additional Information**