

# Applying Concepts of Sustainability in Warehousing Industry

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## ABSTRACT

Sustainability is one of the latest industrial buzzwords. The idea of sustainability has been deeply engrained in the business world and in minds of peoples due to which tactics of business is been changed worldwide, from the fashion industry to the healthcare industry and now even the logistics industry. Sustainability in reference of supply chain logistics can be termed as an optimization of logistics network by improving environmental impact and reducing business risks. Also, it is considered as the backbone of the economy. The industry is now into end-to-end solutions to the clients rather than just service provider. The warehouse is an essential component for sustainable supply chains and logistics to be efficient. 13-17% of India's Gross Domestic Product (GDP) accounts for logistics cost which is double compared to developed countries (U.S., France and Hong Kong) logistics cost i.e. (6-9%) to GDP ratio. Additionally, COVID -19 and the resultant lockdowns have accelerated the transition of retail to online and adoption of e-commerce globally. With more sustained behavioural shifts and increasing confidence in the e-commerce story, there will be a definite need for warehousing to cater to the back end of this transition. Currently, the function identified for warehouse logistics is changed from just a mere storage of raw materials and finished goods irrespective of the industry serving. The main aim here is to identify indirect parameters among environment, economic, social & technology affecting warehouse sustainability and comparison by implementing better techniques, technologies, materials etc. to improve the effectiveness.

**KEYWORDS:** Sustainable Warehousing, Logistics Management, Warehouse Management System (WMS)

## INTRODUCTION

Sustainability trend is global due to the fact that many countries sign international agreements such as the Paris Protocol signed in December 2015, the UN Sustainable Development Goals and others. At national level, many countries also take individual measures to limit their carbon footprint and is widely discussed today in various areas of business activities. On the field of logistics, there are many researches considered in particular the sustainable supply chain management or sustainable transport system. In efficient management of Supply chain network, Warehouses play a critical role, a place where material is stored and kept ready for shipping to customers. In a typical warehouse, main operations include, receiving, put-away, picking and finally shipping. To provide value to their

customers, warehouses, nowadays, involve into various activities including labeling, customization in addition to their business-as-usual activities as well as kitting. Rise and improvements in material handling transportation as well as advances in global supply chain network not only had significant impact on environment and society but also have prominent influence on economic growth. In order to create a system equipped with appropriate organizational and technological solutions, some studies are being conducted in the context of sustainable warehousing, which allows to achieve the lower cost of its functioning reduce the negative impact on the environment and operate maintaining the high standards of work. These assumptions are compatible with the considerations

**How to cite this paper:** Vivek Patel | Deep Patel "Applying Concepts of Sustainability in Warehousing Industry" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-5, August 2021, pp.238-248, URL: [www.ijtsrd.com/papers/ijtsrd43804.pdf](http://www.ijtsrd.com/papers/ijtsrd43804.pdf)



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of sustainable warehouse given by Żuchowski, which requires "a set of organizational and technological solutions whose aim is to efficiently execute warehouse processes, by taking financial effectiveness into account, with the lowest possible environmental impact and with the highest social standards met". However this definition indicates different dimensions of sustainability concerning the building design, application of advanced technology to support the warehouse processes and application of social policy to ensure higher standards of work, nowadays the problem of sustainability of warehouse is measured taking into account the existing building certification standards: LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Methodology), DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen), HQE (Haute Qualité Environnementale). LEED takes into account of categories such as: location and transportation, application of innovative technologies to reduce energy consumption, material resources & recycling, indoor environment quality etc. BREEAM distinguishes the following categories: management, energy, health and wellbeing, materials, transport, waste etc. The reduction of CO<sub>2</sub> during production/manufacturing has garnered more attention than reducing the carbon footprint in terms of decarbonizing warehousing activities. Nevertheless, warehousing does have its own environmental impact in form of energy consumption and produced emissions for lighting, heating, cooling, air conditioning and material handling. Logistic buildings account for approximately 10% of logistic and transport sector CO<sub>2</sub> emissions. The global greenhouse gas (GHG) emissions, which is cause of climate change and the major indicator of environmental damage gets affected by global logistics activities, annually, by around 5.5% (0.5% by logistics facilities and 5% by transportation), according to the World Economic Forum. As compared to transportation, logistics facilities cause relatively lower GHG emission. Around 13% of total emission in supply chain is caused by logistics facilities which generate more GHG emissions than rail freight and airfreight. And this has led to emergence of sustainable warehousing concept so as to alleviate social and environmental impacts while leading to sustainable economic growth.

### Methodology

The current scenario of warehousing industry was studied and its impact on nation's economy. The need for sustainability in warehousing identified

and compared with the traditional warehousing facility and different indirect parameters assessed under Economic, Social, Environment & Technology. The major aim here is to find the sustainable idea which can be implemented as successful business model in warehousing sector. At certain point comparison is done at international level to understand the practicability in a deeper concept. The data was extracted from various government and private agencies reports & surveys, blogs, and research papers.

### Literature Review

On the agenda of many businesses sustainability in supply chain is at high level like by reducing pollution and waste, increasing energy efficiency and creating safe working environments. Traditional logistics operations are leading to creating noise disturbance, impairing air quality and producing greenhouse gases which is resulting in pollution of the environment thus in logistics, Sustainability is a necessary requirement. Globally, logistics operations produce around 8% of GHGs and the amount is likely to get doubled by 2050. Warehousing as an industry integrates various different parts and even if any one of the parts fails to act promptly or fails to act altogether then the entire chain is affected and at the times there are even instances when an entire business has come to halt. Sometimes, delivery times are delayed and due to which these industries lose customers or critical projects gets affected. One of the major solutions to this is investment in sustainability/ sustainable operations to prevent such expensive delays.

Following steps are essential to implement sustainability:

To ensure a long-term use- Use packaging materials which are eco-friendly.

The maximum efficiency of a single box should be utilized during the packing.

Using route optimization/ no. of distribution centers required to optimize travel costs, time or distance.

How implementation of Warehouse Management System can improve warehouse operations efficiency.

Importance of Human Resource Management and its overall impact in terms of economic and social aspects.

### Results & Discussions

#### Packaging Material

Trees are only source for manufacturing the paper causing much energy consumption while manufacturing and impacting environment by releasing 3.5 times more greenhouse gases compared to plastic. More and more paper bags production

causes to tress to be harvest resulting into less trees to absorb the produced greenhouse gases by paper. During the production of paper bags, at least 25 times more water is required than plastic bags and generating more than 7 times solid waste. Paper bags consumes 3.4 times more energy compared to plastics during production process. Also, approximate 1183 trucks are needed to deal with paper bags compared to only 145 trucks in case of plastic bags. So, it is most important to consider life cycle impact on environment while selecting among plastic or paper [1].

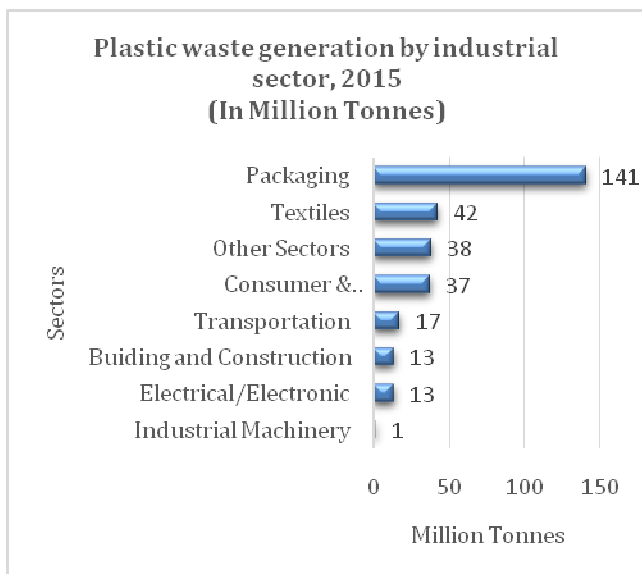
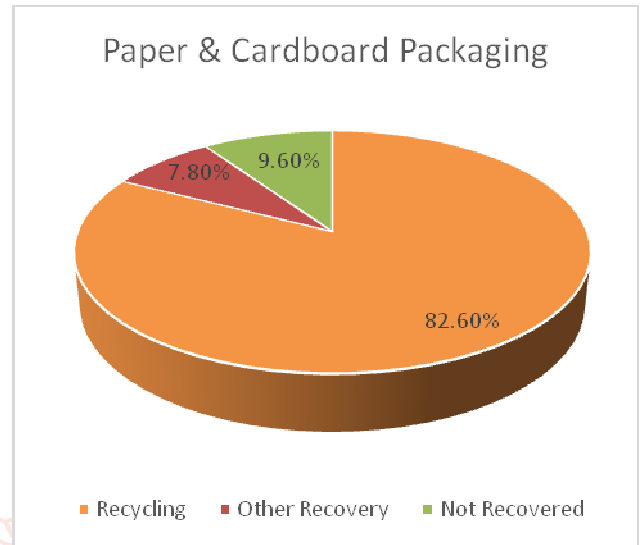
A study done by Franklin Associates, A Division of Eastern Research Group (ERG) back in 2014 for the American Chemistry Council (ACC) and the Canadian Plastics Industry Association (CPIA) is as following:

The different categories analysed for plastic packaging are: soft drinks canes, bottle caps and closures, carry bags, other outer hard & flexible packaging for logistics purpose, thin film and shrink wrapping for small goods and food packaging.

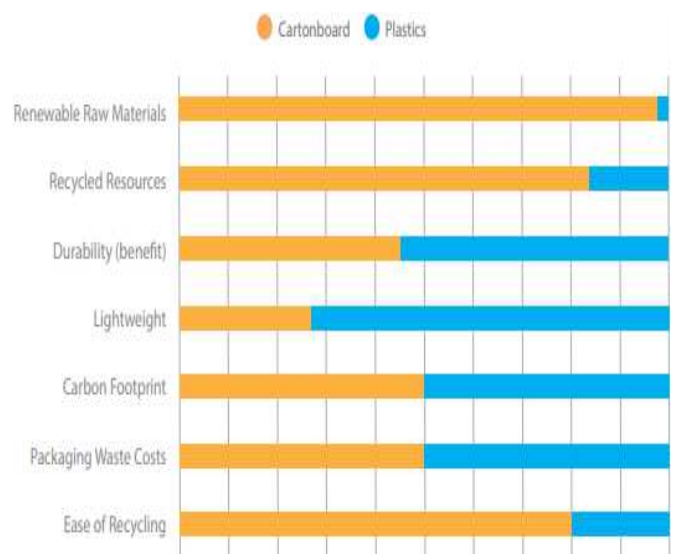
- Approximate 78% of weight savings can be achieved by using plastic packaging compared to substitute packaging.
- In 2010, the usage of plastic packaging was 14.4 million metric tons and to replace it, 64 million metric tons of alternate packaging would be required.
- The alternate packaging consumes at least 80 percent more energy and impacting global warming more than 130 percent which is same as the addition of 15.7 million vehicles on the roads [2].

The above chart clearly depicts that major share in plastic waste is from the packaging sector and need to find solution at the earliest. An attempt is made in following section to address this issue.

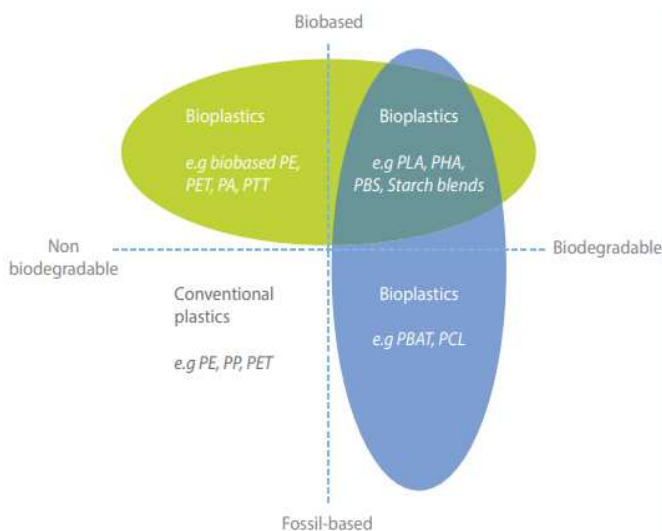
Relative Benefit of Cartonboard and Plastics [4]



[3]



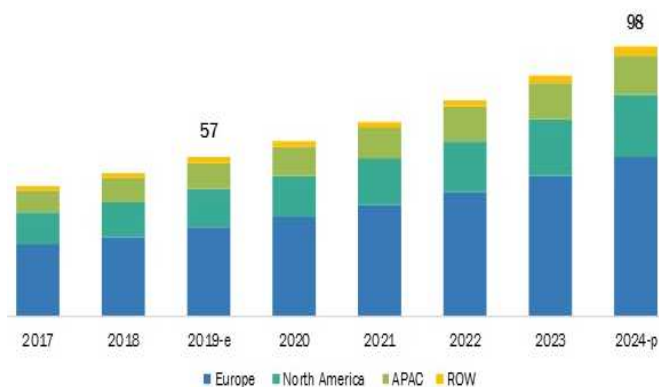
Below is the solution to the debate between plastic and paper.



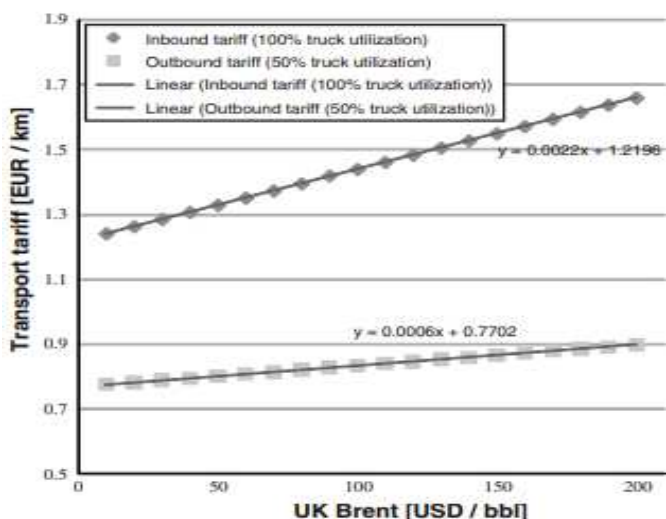
PHA= Polyhydroxy Alkanoate	PLA= Polylactic Acid
PE= Polyethylene	PBS= Polybutylene Succinate
PP= Polypropylene	PET= Polyethylene Terephthalate
PBAT= Polybutylene adipate terephthalate	PCL= Polycaprolactone

**Global Market of Bio Plastics (PHA)**

- Configuring hybrid polymers to take advantage of both fossil based and biodegradable plastics. For e.g., Bio-On (Italy), Danimer Scientific (US), Shenzen Ecoman (China), Ecolife (India), Truegreen (India), Plastobag (India)
- The global market size of polyhydroxyalkanoate (PHA) is expected to hit USD 98 by 2024, growing at an average growth rate of 11.2%
- Energy consumption reduced by 48% and 62% lower CO2 emissions compared to traditional plastics



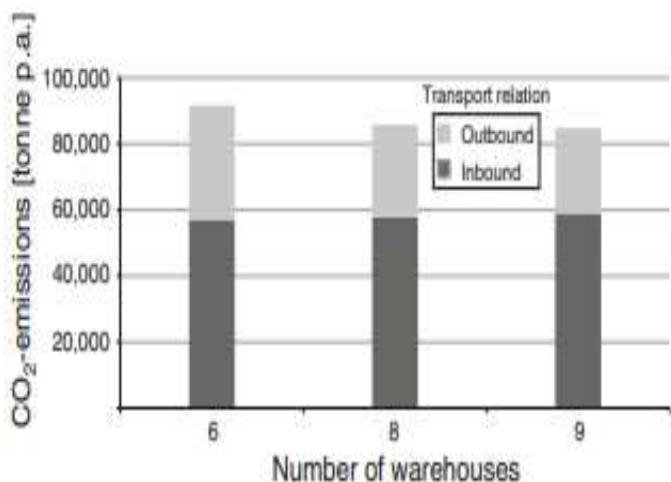
**Emissions**



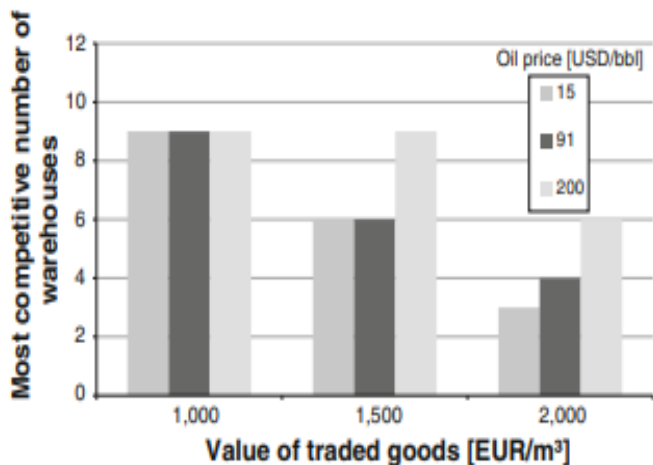
**Oil price–dependent transport tariffs**

**Impact on CO2 emissions**

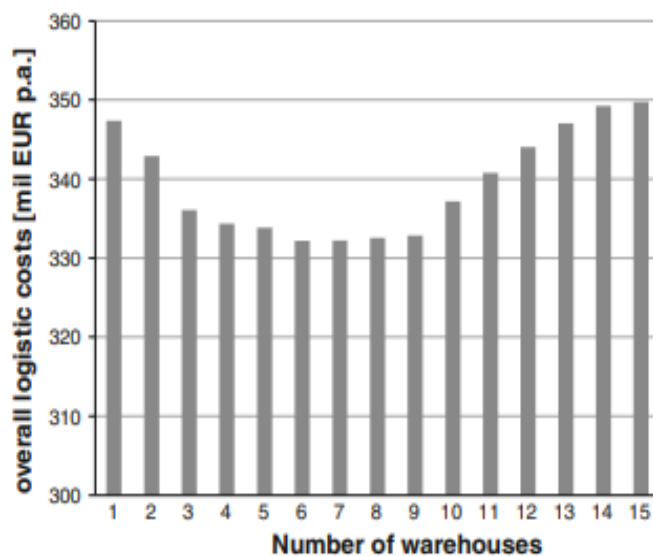
The number of warehouses should be six for the most optimum network structure at low and moderate low oil prices and value of goods to be 1,500 EUR/m<sup>3</sup> Yearly GHG emissions accounts 91,632 tons for this network structure. The number of warehouses is 8 and 9 for the most optimum network structure at high and very high prices of oil respectively i.e., above 150 USD/bbl. Yearly emissions of greenhouse gases accounts 85,799 and 84,783 tons for traditional and decentralized network structures respectively. Calculations for GHG emissions is done individually for inbound and outbound logistics as there is significant variation in the values depending on the means of carriage and use. Traditional distribution network and decentralized structure can save 5,833 tons or 6.4% and 6,849 tons or 7.5% greenhouse gases respectively. The major contributor in this GHG reduction is outbound logistics, while the difference in savings of the network structure is very less in case of inbound logistics [5].



**CO2 emissions depending on number of warehouses**



**Optimal number of warehouses depending on value of traded goods**



**Overall logistic costs with varied numbers of warehouses at an oil price of 91 USD/bbl**

Companies tend to opt for decentralization strategy with increasing number of warehouses to create an optimum network structure having oil prices above 150 USD/bbl. Most optimum number of warehouses with these conditions is up to nine. In the model applied, a typical consolidated nine warehouses logistics network represents a stable state at oil prices between USD 180 and 200 / bbl [5].

### Introducing Electric Trucks

#### Cost-effectiveness

According to The Verge, the purchase cost of tesla truck is around \$200,000, a quite expensive compared to an average diesel truck of class 8 costing \$120,000. After the initial higher purchase cost of tesla truck, the operating cost is only \$1.26 which is much lower as compared to diesel truck costing \$1.51 resulting into 20% savings [6].

#### Higher efficiency

In 2019, production of semi-truck is expected to start which would be quite efficient than traditional petrol/diesel fueled trucks. This semi-truck is expected

to run 500 miles in single battery charge attaining a maximum speed of 60 miles/hr. which is thrice the speed of normal truck when fully loaded, as claimed by Tesla. As per an ICTT study, efficiency of electric truck can be increased up to 43% having a potential to improve supply chain. Also, the weight of EV batteries gets lowered at 7% per year due to increase in energy density of lithium-ion cell.

The battery of Tesla semi-truck is so designed that it can take 1 million miles of charging cycles i.e. If charged at every 500 miles and 200 then 2000 cycles and 5000 cycles respectively. Also, the design of drive motors is such that it can to run up to 1 million miles. Tesla claimed that its semi-truck owners can save \$200,000 over life span in fuel cost.

### Electric Truck in India

Infraprime Logistics Technology (IPLT) (Gurgaon, India)

#### Rhino 5536

The first electric truck which is made in India, which has the load carrying capacity of up to 60 tonne is manufactured by a startup name Infraprime Logistics, based out of New Delhi. The medium haul truck is designed to transport the rough materials like the material used in construction. If the truck is not loaded than it can run up to 400km and at the optimum load capacity it can run up to 200km. The truck can be easily taken on a slope having gradient up to 20 degrees, this is much higher than the diesel engine truck. The running cost of the truck designed by IPLT is Rs10/km, which is almost one third of the running cost of the diesel truck. Above the running cost if lower EV tax and lower maintenance cost is added than an electric vehicle has a potential to increase the profit by almost 3 times, compare to diesel truck. The more important is this truck is available at 1/3rd price of Tesla’s semi-truck, which cost 2 cr [7].

#### What About Charging?

The company has planned to set up its own charging stations, which is supposed to be designed by the team currently working on this project. They have also informed that a 30-member team has created two samples of 160 kWh fast chargers, it can charge the electric truck in 90 minutes.

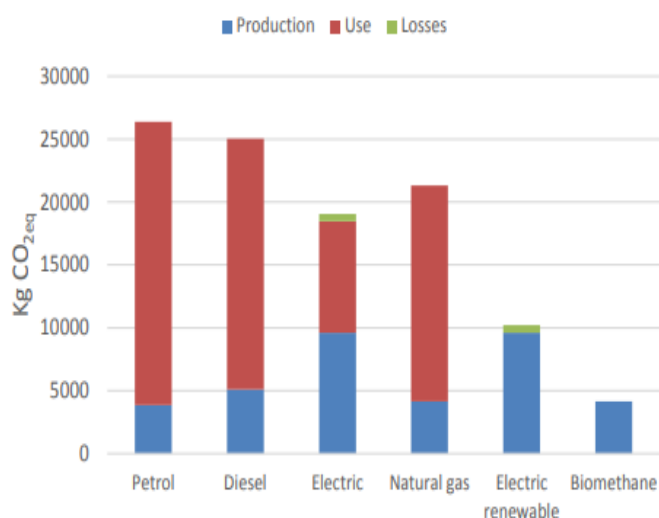
Initiative taken by Government of India to remove the obstacle for adoption of EVs:

The biggest obstacle in adoption of EV is the lack of charging infrastructure. To eradicate this issue, Government of India, on 14 December 2018 came up with a proposal to establish a charging infrastructure in 70 cities and 20% of highway. The cost of this project is considered as 5,000 crores and will be

completed by 2025. A company name Energy Efficiency Services Limited (EESL) is given the responsibility of procuring electric vehicle and establishing charging stations across the length and breadth of the country. EESL is at the forefront in promoting the adoption of EVs and have install EV chargers in the country.

### Status of EV Infrastructure

According to the survey done by the Market Watch, there are around 250 electric charging stations operating in India. Due to the initiative taken by GOI, this number can see an exponential growth. As forecasted in the Kenneth Research, for the time 2019-2025 the Indian EV infrastructure will witness CAGR of 40%. The target set by Government of India is to set up 2636 charging station in 62 cities across 24 states and UT by the end of 2023.



Source: SNAM (2018) Thinkstep (2017)

For this survey the calculation takes into account the assumed average annual distance of 15000km and the operating useful life of vehicle is considered as 10 years. The production cost of vehicle is also incorporated by SNAM to calculate the GHG emission reduction cost of €1.11/kgCO<sub>2</sub>eq for electric vehicles and €0.44/kg CO<sub>2</sub> eq for CNG vehicles compared to the diesel alternative [8].

### Human Resource and Corporate Training

#### 1. We Need to Invest More in Training.

The finding of the U.S Bureau of Labor Statistics says that a company having employees less than 100 gives managerial training of 12 minutes every six months. The scenario is even worse in the company of size 100-500 employees where managerial training is given for just 6 minutes.

#### 2. Employees Want More Training.

A research project undertaken by a well-known Middlesex University on work-based learning showed that from a sample of 4300 employees, 74% felt that

they are not able to realize their full potential due to lack of opportunities.

#### 3. Convert Beliefs into Practice!

The same research of Middlesex University also showed that 56% of human resource managers believe that training the employee regularly and giving them essential opportunity to grow is an essential thing in running business successfully. These two points are conflicting with each other. The HR managers believe that training and development is necessary but are not able to deliver on their belief.

#### 4. Employees needs to be engaged at work! They are isolated.

A research found that 33% of people leave their company within the 1st year of joining. It shows a turnover of 22% of staff in the first 6 weeks of employment.

Also, the research done by the Gallup's in 2014 only 13% of employees are "highly engaged" and 26% are "actively disengaged". So, the disengaged people are double than the engaged people.

#### 5. Invest in On boarding Early On.

The estimation done by PwC says that the cost of losing an employee in the first year of its joining can be almost 3 times the salary of the employee who has left the organization. The accumulated figure in UK itself is \$63.3bn. This is a huge amount, but the take away for organization from this is that they need to invest more into the on-boarding exercise so that they contribute less to the above-mentioned figure and have a lower employee turnover.

#### 6. Make Retaining Your Employees a Priority.

In a survey done in 2015 shows that 70% of respondents admit that job-related training and opportunities for development has a direct impact on their decision of staying with the company. The key takes away for HR managers is that they need to invest in retaining the employees, because the cost of retaining the present employees is much less than replacing them. This investment should be in the direction of the expanding the knowledge, offering more training options etc.

#### 7. Knowledge transfer must be increased.

A survey shows that only 12% of the employees who got training admit that they apply the upgraded skills into their jobs. This shows that how inefficient is the training program designed and it does not match with the skills of employee.

#### 8. Take Learner Needs into Consideration.

ATD research study in 2015 shows that only 2/5th of the managers believe that their training program meet their needs. Therefore, before designing a training

program also consider the needs of the employee so that they don't get frustrated with the program and can learn efficiently from the program.

9. Workplace training must joyful.

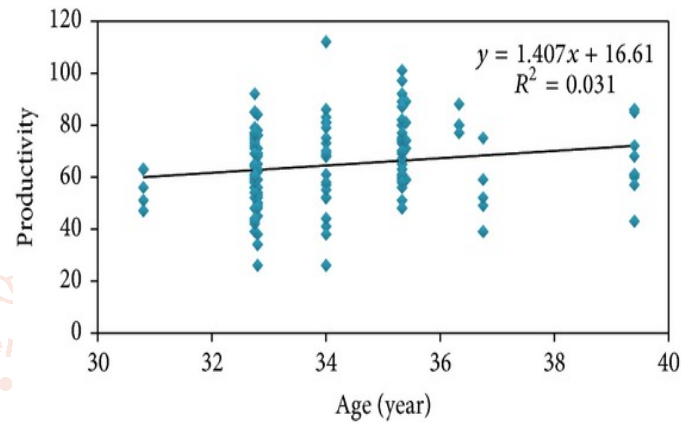
1/3rd of the employees believe that uninspiring and boring content of the program is a barrier to learning. The program should be so designed that the employees also get fun while learning. It is more efficient in showing the result after training.

10. Ineffective Training Costs Money.

Given the statistics above, what is the total loss to a business from ineffective training? It's staggering: \$13.5m per year, per 1,000 employees. So, considering all the data given above the total loss to business from ineffective training is \$13.5million per year per 1000 employees [9].

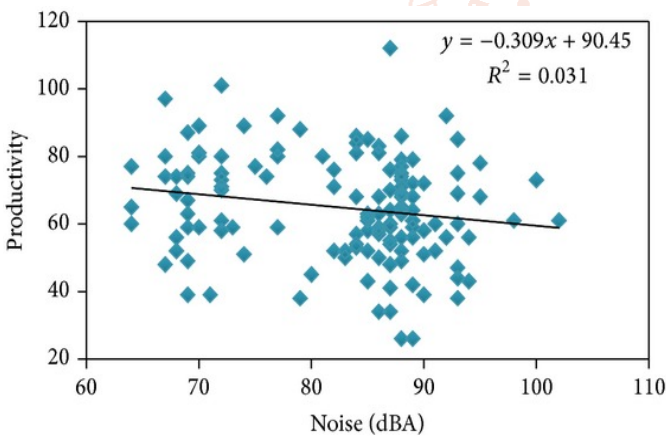
The result obtained from performing Pearson correlation co-efficient between the level of noise and the level of productivity shows that there is a significant relationship between noise level and productivity ( $P = 0.935, r = -0.178$ ), whereas the same method shows that there is not much of a relationship between the lighting intensity and productivity level ( $P = 0.753, r = 0.027$ ).

The result of Pearson correlation coefficient between demographic factors and productivity showed that only age has a significant relationship with human productivity ( $P = 0.035, r = 0.177$ ). Other variables like occupational background, sex, BMI, height, and weight do not have a significant relationship. When the correlation factor between demographic factors and productivity level is calculated using Pearson method that it shows that only age has a significant relationship ( $P = 0.035, r = 0.177$ ), whereas other factors like sex, height, weight does not have a strong relationship [10].

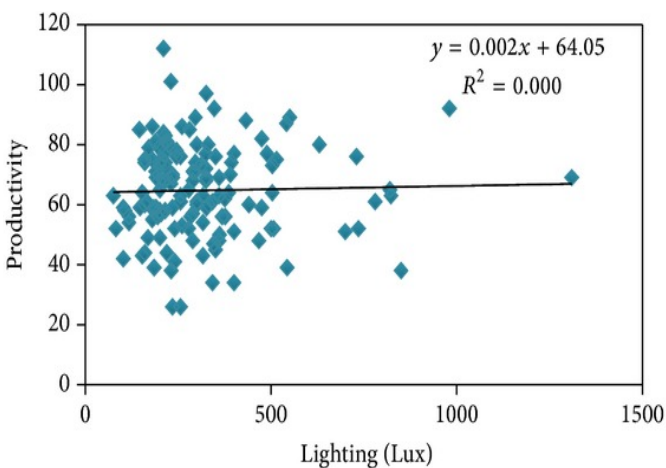


How Noise can be Reduced?

- Acoustic Foam: It is an open celled foam used to absorb sound in its air pockets and can be directly applied to machines, walls or flooring. For e.g., Polyurethane, Wood Wool, Steel etc.
- It can help to reduce up to 20 decibels of noise in the premise. Companies Dealing in this: ZAK Acoustics, MMTacoustix, Acoustical Surfaces



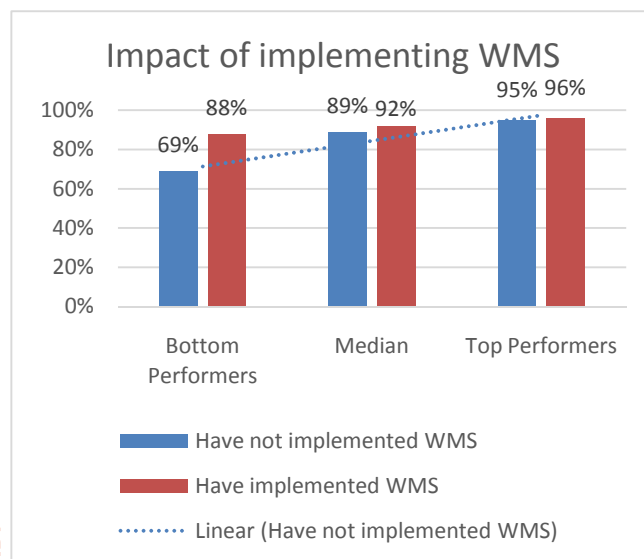
Scatter plot between noise level (dBA) and productivity level in automotive industry



Scatter plot between lighting (LUX) and productivity level in automotive industry



and derived that companies using WMS are more efficient in handling the warehouse operation and have a greater visibility of inventory present in the warehouse. The following result also shows that using WMS also reduced the logistic cost [11].



### Technology

A software named Warehouse management system (WMS) blend all the various activities of the warehouse and provide greater efficiency in handling the warehouse operations. This is also proved in the results from APQC’s Open Standard Benchmarking

### Logistics Costs

APQC’s data reveals the costs of the logistics process as a whole and the costs of operating warehousing per \$1,000 in revenue for both groups of organizations.

Performance Measure	Top Performer	Median	Bottom Performer
<b>Total Cost of Logistics</b>			
Organizations that have not implemented WMS	\$26.56	\$52.75	\$105.89
Organizations that have implemented WMS	\$21.59	\$49.12	\$89.74
<b>Total cost of the process operates warehousing</b>			
Organizations that have not implemented WMS	\$3.02	\$6.74	\$17.95
Organizations that have implemented WMS	\$4.93	\$10.13	\$21.82

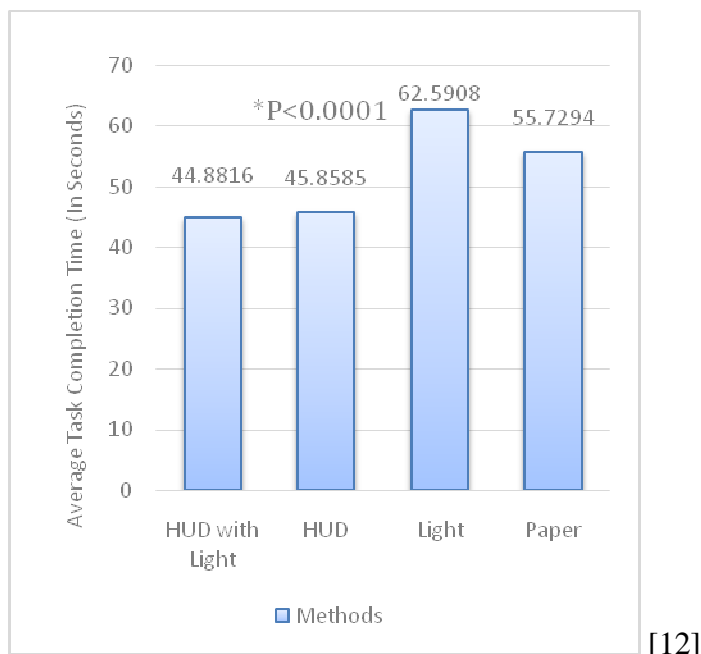
So, from the above table it can be derived that for every \$1000 in revenue organizations who used WMS for warehouse management spend \$3.63 less than the organizations which does not used WMS. This mean that is the revenue is \$5 billion than the difference will be of almost \$18 million in that year. From the above data it depicts that there is much gain involved for bottom performers.

### Order Picking Methods

Over \$150 billion is spent in warehouse operation out of which picking order account for more than 50% in United States of America. Only 20% of the order picking is perform in an automatic method. The comparison is done between unassisted paper list picking and the other three techniques blend with weight checking.

The methods are pick-by-light, pick by HUD (head up display) and the third method is the combination of the first two, that is HUD+light. It is found that the 3rd method has the highest picking rate (19% faster than paper) and minimum errors (67% fewer than paper).





- Using sorters and conveyors, the pick rate can be increased up to 300 pics/ hr. compared to 60-80 pics/hr. by traditional order picker.
- The data published by International Federation of Logistics is used to analyzed the use of robots designed for 14 industries in 17 countries in the time frame of 1993 and 2007. Use of robots showed that the manufacturing growth was seen as a 0.36 of GDP and the labor productivity seen a growth of 0.37 of the GDP. This might look like a small amount but it consists of 10% of total GDP growth and 16% of labor productivity growth over that time.

**Cost savings at different levels**

Surcharges can be minimized by checking the compliance with the freight contractors. Negotiation should be done on the rates provided by Freight forwarders. The contract should be designed in such a way that the risk and benefits should be shared with their freight forwarding partners. Customer breakpoints should be recognized and then can ask customer to select the cost-effective options by giving incentive.

Levers	Rationale	FTE savings potential per lever
Compliance with contracted price	Ensure payment terms are correctly with no hidden overcharging	2-5 %
Negotiated price	Understand the lowest possible cost (clean sheets) and available alternatives (benchmark from different suppliers for similar weight and distance conditions)	10-15 %
Contract terms	Achieve better payment terms link rates to external indices (e.g., fuel)	2-5 %
Customer breakpoints and behavioral changes	Understand the cost value to customers for different service levels	5-10 %

**Source: McKinsey**

**Conclusions and Recommendations**

After assessing the above environment, social and technological aspects thoroughly, it can be concluded that sustainability in warehousing can be achieved at an ease with minor improvisation in current traditional practice. Further, the government incentives and policies are in support which eases to implement and practice sustainability. The newer technology will not only help to reduce time but at a reduced cost with

higher accuracy and higher safety. This would cause to make supply chain more efficient and to provide customers end to end solutions as fast as possible. Currently this is must in case of food industry as in this type of pandemic situation, food must be reach to end consumer as fast as possible without degradation of food item. This also reduces the storage of additional inventory to cope up with demand fluctuations resulting into less dead investment. Eco-friendly innovation in packaging

like use of PHA and other bio plastics will definitely reduce the global warming impact as packaging industry worldwide contributes 42% of the plastics usage alone especially developing countries as share in mismanaged plastic waste is much higher at global level. The major recommendation is that peoples need to accept these different sustainability approach rather than continuing traditional methods as still many peoples think that paper bags is environment friendly but research proves it wrong. Researchers, Government, Educational institutes needs to take charge and arrange seminars, advertisements, change in educational syllabus etc. to create awareness and stepping stone towards a sustainable world.

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