

Sustainable Manufacturing & Green Manufacturing Reduces the Waste and Emission from Manufacturing Industry As Well As Save the Resources for the Future

Gaushiya Bano¹ Aniruddh Mishra²

^{1,2}M. Tech Student

^{1,2}Department of Mechanical Engineering

^{1,2}ABSS Institute of technology, Meerut, Uttar Pradesh, 250001, India

Abstract— This research paper deals about the Sustainable manufacturing, which is the backbone for Green Manufacturing because the goal of both manufacturing have same which has been explained in the comparison of the Sustainable Manufacturing and Green Manufacturing. The objective of this paper to create awareness among the manufacturer and research manufacturing company has competition with each other in this modern manufacturing world. As, we can see that almost all the industry wants to earn money that's why they are increasing their manufacturing day by day without thinking about the environment. From manufacturing industries wastage emission like SO₂, CO, NO₂, which destroying the natural environment. The solid waste which are coming out of manufacturing industries which damped into the land which harm to our agricultural land, human being and land animals also as well goes to underwater destroy to aquatic animal and plants. Sustainable manufacturing & Green manufacturing such that both helps in reducing the waste or removing the waste from the environment. Green Manufacturing helps in supporting the renewable energy uses because of using recycled, reuse and remanufacturing. The Sustainable manufacturing very much supports the present resources like coal, petroleum, natural gases, etc. Natural resources which are available precious for our earth like coal, oil, natural gas available for a limited time in the future if they are using continuous by the manufacturing company and human being. Therefore, GM and SM helps for recycling, reuse, and re manufacturing also support the use of renewable energy resources.

Keywords: Sustainable Manufacturing (SM), Green Manufacturing (GM), Reduces CO₂, Minimize Wastage, Reduces non-renewable sources

I. INTRODUCTION

As we know that now a day the environmental pressure continuously increases by the Manufacturing companies and manufacturing business. Because the pressure is that conservation of business and move to the circular economy. The main challenge is that reduces the material uses and increases recycle as well as reuse. The digital technology has come in the fourth industrial revolution (4IR) and industrial internet of things that enabling the companies for reducing waste cut costs as well as extend machine lifetimes. Therefore, in the future around 2050 the population will increase half of the present population, such that the demand of agricultural land, cereal crops and animal products. From these we can consider that 85% increase for water crowd and 100% more required for manufacturing companies. The manufacturing companies have aimed to reduce environmental footprint and reduce impact

considering the competitive and profitable. Such that in this direction SM is most preferable manufacturing. According to the United States Environmental Agency to the SM means that it is a creation of manufacturing products through which minimize the negative environmental impact as well as conserving natural resources and energy. SM also enhances the employee, product and community safety. We can say that SM is the path of future manufacturing, which impact on the society and the environment.

Now, there is a helping hand SM is GM, which is most important manufacturing for reducing Pollution and wastage. The GM word was highlighted by Teddy Roosevelt and John Meir in 1903. But it was implemented in 1970s after 2nd world war. During this period two policy made for an environment that is the name was given The Earth Day and Environmental policy act. From 1970-1990s during two decades, there were lots of toxic waste and wastage increases during this period as well as cutting of forest also increased. Therefore, in the 1990s the people come outcome the protection of trees. The title of protection was the trees were Hungry Tree. The main aim was that manufacturing plant usage the resources fewer, CO₂ liquefy to protect the environment, reduce wastage.

Sustainable development is defined as fulfilling the demand of present without considering the Future generation meet their demand or not. Therefore, it is a simple way to define the SM. Such that, it is a new paradigm which is used to transform material into economical valuable products [1].

Green Manufacturing is an important Paradigm that is followed green strategies and also eco-friendly. According to this the products also apply the system which is manufactured for energy saving. It uses input product is renewable or non-renewable, non-toxic or toxic, and reducing unwanted wastage for recycling. Therefore, this is the best paradigm for eco-friendly environment. [2].

The main aim to go under the green production for Green. But, all we have to do within the sustainability community which is interpretations of ideas and method associated with the green. The green technology, green production types and the role of green production can help for the competitive strategy of a manufacturing [4].

SM is a widely accepted idea required little guidance implementation. Sustainability is the keeping, preserving or maintaining. It is related to the three dimensions: environmental, economical & social. It is a new approach for product life cycle considering environment [5].

As we all aware that there is two important challenges for 21st century that change the environment and decrease of resource as well as energy. The chance of the Greenhouse gas increase day by day due to emissions of

CO₂ gases we have seen in 2013 400 ppm which closer to 315ppm in 1958. These greenhouse gas effect can affect world best cities like Shanghai, Miami & New York due to ice melt. Another energy and resource consumption by transportation 33% and heating/cooling by 28-29%, there is one journal that is IJPEM-GT has come for resource saving and give support to GM. The journal had selected. This journal basically deals renewable energy devices, waste reduction, energy saving, Green manufacturing design and products [7].

The word emphasis that moving towards Green and Sustainable Manufacturing. Companies feels that sustainability is the best strategy for the both business that is GM and SM. Because it helps in saving energy and resources. It is very responsive to customer demand and competitiveness. Because demand increases day by day such that it is needed that energy & environment aware consumer, energy supply alternatives, less uses the energy by machine tools and production equipment. At higher level social responsibility toward SM, therefore use more green production technology. Now one key for the utilization of resources and increases resource productivity [8].

As we can see that for the environmental imbalance globally resource and population responsible. The ISO proposed quality and environmental management system for minimizing the damage such that it required Sustainable development for helping GM. Another aim for ISO is that reduce cost of energy and resources for manufacturing. But if the company face fluctuation of price than customer also faces according to the quality of products. Off price, therefore, within the large price of resources and energy companies aim is to produce well. There should be strategies for the customer that can face the fluctuation of the price due to the improvement of the product. Therefore company should start the practicing GM and also try that improve the organization and product efficiency [13].

GM is the new trend of manufacturing for saving resource and energy because as we know that traditional manufacturing utilized high energy, high resources high input and high emission. But the GM is helpful for solving the problem of manufacturing industries by reduce emission, recycling and ecological system is clean. The innovation of GM is weak because not structure clear. GM is the main focus of every country therefore, for their policy and strategy such that it converts manufacturing industries into Green Manufacturing [14].

SM is used in manufacturing because it does not harm in the manufacturing process. It focusses that if it is used do not harm the environment or consumers, employees, or other member of the community. SM is used for recycling, conservation of resources, waste management and variety of environment related issues. Therefore, SM has also given different name that is environmentally responsible manufacturing and GM. SM is helpful for designing and deliver a product which gives less impact on the environment [15].

Any country of the world depends on the industry. Because it generates more revenue for the country. Therefore, the workers and staff such that Engineers & technicians, handling tools and machine, handling material

and equipment have knowledge and skill modern concept of manufacturing. Further, prepare themselves for facing competition as well as research and development, according to CIM (Computer Integrated Manufacturing) and Automation. The government makes the rule and regulation to follow GM for making environment eco-friendly [16].

As we know that most of manufacturer convert themselves for GM managing natural resources. The government of every country has to make policy for GM and provide a favorable market for manufacturer [17].

SM is defined as the integration of systems and processes which is capable of produce high quality services and products using more and less energy resources. It should be safer for the customer employees and committees surrounding and abilities to mitigate social and environmental impact through the whole life cycle [19].

From this above introduction, we conclude that SM is related to GM. Because, as we know that GM or SM goal reduce pollution, minimize the wastage, zero pollution, reduce the change of Greenhouse gas effect and make the environment eco-friendly. Therefore, both the manufacturing help for saving the natural resource which is non-renewable in the nature for the future generation. As we know that if the use of non-renewable resources reduces if come goes to the Sustainable manufacturing then the company automatically started the use of Green product, Green design, Green Technology, Green Packing Therefore, in the near future the GM and SM both can help reducing the waste. The company gets profit from this and stand them for more and more business development.

II. LITERATURE REVIEWS

The paper explains that SM can take place clearly in the industries. The researcher tries to improvement in the design technology, supply chain and waste rejection activities. The paper also emphasis that more paper has to be published in this area of SM [1].

The paper explores about innovation of SM which help in solving problem of the environment. The main aim of GM is that follow 4Rs (Recycle, Reuse, Reduce, Remanufacturing), reduce pollution, minimize resource and waste, design of product concepts, no impact environment. At last researcher made universal framework as well as 4Rs model [3].

The paper focuses on the meaning of green production, that is, it is just like an umbrella, then after it covers the topics under it ethical, environmentally-conscious, organic and fair trade production. Then after in this research paper researcher explains the definition of green production. The forms of green production also explore that is green products, green processes, green use, green end of life management. Therefore, lastly the researcher focuses that are greener production apply, then it can give excellent growth potential, maintain production locally as well as environmental issues [4].

This paper introduces sustainability into process and product development. In this paper improved models, metrics, framework and optimization technique has taken. The framework is considered with main pillars interlinked

relationship with each other. The pillars are Technology, Education, Ethics, accountability, economy, society and the environment. The combination of above pillar known as proposed framework [5].

This paper emphasizes on the corporate sustainability performance and eco-product innovation. This tells that eco-product innovation is not giving effect result in improving company performance. The Eco-process has a positive effect on sustainability performance. GM leads to lower raw material costs, reduced environment, production efficiency gain, safe occupational, and improve corporate image [6].

The paper researcher explains that GM is important for present and future. The researcher has taken two important parameters that is H-index and web of science that was the number of papers after finding result by the stage of technology vs technical journal. The journal IJPEM-GT helps for this continuously monitored and verified in the future [7].

The research emphasis that in this paper that step towards GM and SM. Because, it will be best for achieving the sustainability in the future. Such that increases the values of products reduces as well as the impacts of environments. The components of these types of manufacturing is machine, process, system, factory and enterprises. For the systematic approach tool and analysis reviewed also offer opportunity for the manufacture and design [8].

The researcher helps to understand the benefits of SM that is reducing the cost, reduce the social and environmental issues as well as benefits to the company. We can be seen limited to only a few companies, but regarding in this direction researcher will have to be worked in the future [9].

The studied of this paper focus for implementation of GM required Green technology, design can be changed according to technology, as well as for the manufacturing process specification, tolerance, quality control, evaluating, monitoring, justifying, organizing Classification of factor and sub factors such that Green manufacturing, Green Design, Green purchasing, Green distribution as well as Employee training and involvement and customer awareness program. These will give company to competitive advantages. For reducing the CO₂ and waste such that it is necessary for appropriate methodology should be made for smaller and larger industries in adopting GM [10].

The researcher, interaction to the manufacturer and researcher that GM is used for reducing the waste we want to reduce wastage then should start Green Manufacturing system, development of product, energy conservation. The main aim is that reduction of cost, safe environment, reuse of product as well as the use of sustainable product by SM. Another aim is reducing wastage, reduce pollution, energy conservation and product development. The researcher studies about a Green operation that is a product and process orientation as well as improve the performance that's why it is the best tool [11].

The researcher explains that GM is Green design, minimized waste and no harm to the environment. GM is

helping for improving the competitive capacity and firm performance as well. As give support to SM [12].

The paper focuses on at the operational level SM as well as organizational level GM can be utilized. Therefore, if work is done well then the productivity of resources also increases [13].

The research studies about that environment faces new challenges day by day due to new technology, new development ,such that pay attention toward GM as well as the use of sustainable energy. Green operation is tool for green image and improve performance of industries [14].

This paper explained the major researcher provides the paper qualitative thematic analysis and quantitate descriptive analysis for the SM. This paper finds out the six plus publishers has reviewed over 24 years. The paper also emphasis that 78% key research paper has reviewed [15].

This paper explores about the foundry & sugar cane factories of their problem in manufacturing and working. The paper mainly deals that GM helps to recycle of the material improve and conservation of natural resources as well reduction of pollution and waste generation. Applying the GM then reduces resource utilization but increases economic growth as well as quality improves and reduce emission. Therefore, GM of the companies reduces waste, less impact on the environment, increase profit and quality. Such that more and more work in the field of SM and GM [16].

This paper researcher explains that GM is the path of innovation for the environment such that the path is system, dimension and dimension space. GM is the key for combination several elements which is interdependence and interaction. The dimension depends on the 3D space which is gotten from technology, internet and structure reform [17].

The researcher focusses that present day a lot of technology available for replacing old technology, but barriers also available for implementing. The stakeholder should take steps betterment of society as well as aware about the new technology. Because it can give better results in the future also if industries want to stand in the international market than they have to standardize the product [18].

This paper topic industry 4.0 research helps to the SM and also gives positive impacts on all the sustainability dimensions. The industry 4.0 agenda also deals with aspects: Sustainable developing business, models, circular and sustainable production system. Sustainable product [19]. GM practice 73% mechanical experts want to replace the existing methodology by GM [20].

III. PRINCIPLE OF SUSTAINABLE MANUFACTURING RELATED TO GREEN MANUFACTURING

The principle of Sustainable manufacturing, which help for Sustainability and Green Manufacturing are explained in the Fig 1. The main principle on which Sustainable works which are more and more supports the Green manufacturing because the principle of Sustainable manufacturing is very much helpful for the saving the environment. As per the principle rule for the GM principle has explained in the Fig

2, which has related to the SM. The main aim of SM is that is that saving the resources which are available in nature reduces the wastage, eliminate the unnecessary waste from the environment, individual safety not harm to the environment and ecosystem. Most recycle and reuse means help to reduce the wastage. We can say that SM is the one type of saving elimination of non-renewable resource by creating a renewable source like that recycling and reuses. Therefore, GM is also supporting the use of renewable source of energy reduces the use of non-renewable sources of energy which are available for only for a few decades. Therefore, both the manufacturing that is a SM and GM both principles are supporting the use of renewable sources and reduces the use of non-renewable sources.



Fig. 1: Principle of Sustainable Manufacturing

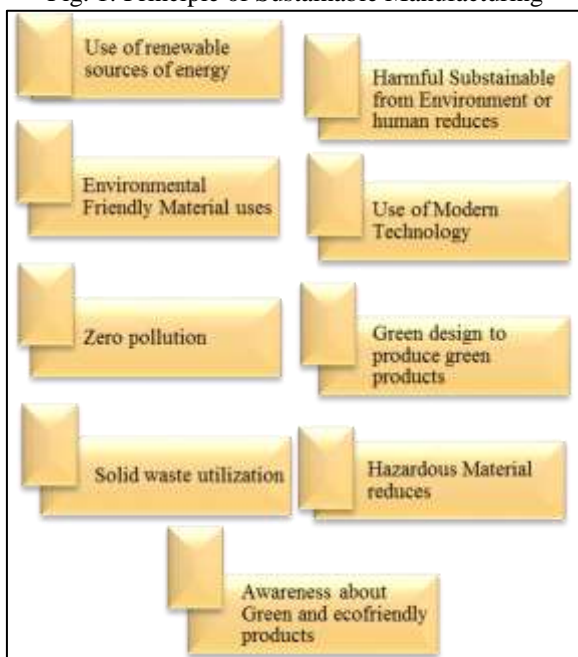


Fig. 2: Principle of Green Manufacturing.

IV. COMPARISON OF SM AND GM MOST IMPORTANT ASPECTS

This is the most important point we have taken for this research paper that is compared between SM and GM because as we know that SM is supported. That's why we have taken this topic for our research paper because as we know that we have to understand the most important aspects which is closest to SM and GM. Now, we have taken for the comparison of the SM and GM, which has been shown in the Figure 3. These are aspects we have taken for comparison are;-

- 1) Concepts
- 2) Purpose
- 3) Objective
- 4) Elements
- 5) Goal
- 6) Characteristics
- 7) Area of application

S.NO	COMPARISON OF SM & GM		
	Aspects	Sustainable Manufacturing	Green Manufacturing
	Concepts	<ul style="list-style-type: none"> •Minimize the use of natural resources which are non-renewable. •Employees and individual safety. 	<ul style="list-style-type: none"> •Improvements of products and processes. •Recycle and reuse.
	Purpose	Minimize waste as well as environmental impacts	Minimize waste and environmental impact.
	Objective	<ul style="list-style-type: none"> •Deals about social economics and environment related operations in industries. •Resource saves for the present. 	<ul style="list-style-type: none"> •Reduce the cost and save the environment achieve sustainability •Resource save for the future
		<ul style="list-style-type: none"> •Green technology •Green Chemistry •Green Plastics (Bio-degradable) 	<ul style="list-style-type: none"> •Energy consumption management •Waste management •Environment certification or ISO 14001 •Green design, Green manufacturing, green labelling.
	Goal	<ul style="list-style-type: none"> •Optimize the life cycle of products and system •Works on the 6Rs 	<ul style="list-style-type: none"> •Works on the 6Rs •Conserve resources and reduces pollution
	Characteristics	•Recovery of	•Use of

		composite material for recycling and reuse •Reducing the footprint of carbon	renewable energy. •Reduces the waste
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Table 1: Comparison of SM and GM

V. ADVANTAGE, DISADVANTAGES AND LIMITATIONS OF THE SM AND GM

In this research paper, we have considered this topic because the manufacturer, business, stakeholder, questionaries' should understand the value and importance of these two manufacturing techniques for manufacturing industries. Because if the company takes step in direction Sustainable Manufacturing then they should also understand that they will achieve the GM in the future and vice versa. Now, the most important manufacturer and business company understand that advantage is important for implementing these two manufacturing techniques, but as we know that if there is an advantage then disadvantage and limitation also available but that is nothing in front of advantage so company as well as more and more research work on the SM and GM. The mainly advantage both the manufacturing techniques have mainly the advantages of SM and GM is that eliminate wastage, reduce pollution, encourages for a 6R, less impact on the environment and many more advantages, disadvantage and limitation has been in the Table 2 and Table 3.

SUSTAINABLE MANUFACTURING			
S.No.	Advantages	Disadvantages	Limitations
1	Innovation promotes.	Unemployment for people.	Small scale not service
2	An edge to the business.	Starting cost is high.	Establishing the SM company or industries manufacturing cost is high.
3	Aware to the customer.	Uncertainty constant by renewable or organic farming.	Create huge amount of unemployment
4	Cost reduction.	Less cooperation.	Fully categories of recycling and reuse all products not categories.
5	Profit Margin increases.	Developing area manufacturing not helpful.	The Cost is high
6	Positive impact on the Environment.	Entry requirement high for small industries.	Less cooperation between government

			and manufacturer.
7	To meet environmental regulation by material testing.	Development of water and energy footprint is very high.	Sustainable manufacturing more practices towards GM
8	Recycling and reuse	Change of mass destruction.	Employer training required.

Table 2: SM advantages, disadvantages and limitations.

The detail discussion as per our table of advantage of SM has explained: -

1) *Innovation promotes*

If the company goes for the sustainability, then they have no any option in spite of that they go for the environmentally friendly options. Therefore, this is very challenging, but this can give best for long term business.

2) *An edge to the business*

It provides the company to stand out at the unique selling point. Therefore, it is very easy for the company to target the audience from around the crowd competitors. Therefore, if the business company gets the tag USP then can stand their company to environmentally conscious business and make a profit to the company.

3) *Aware to the customer, attract toward environmentally*

As we know that target audience always looking for SM. Because they want eco-friendly product, which is safer for life as well as for some audience reduce environmental impact. Such type of audience, a manufacturing company can give their products to try. This will increase our sales and revenues.

4) *Cost Reduction*

Some of manufacturer's things that if they change their manufacturing method then they have to spend money and if they will not get a return than their money lost. But it is not true if they will have to pay up front then they will get benefit in the future.

5) *Profit Margin increases*

The manufacturing company goes towards Sustainable then they will attract to the customer. Therefore, the demand of the product increases day by day. It will give a huge profit margin.

Positive impact on environment

SM helps for the advantages of nature by conserving non-renewable resources and earth nature, therefore improve the state of the environment.

6) *To meet environmental regulation by material testing*

This is very much important for the manufacturers should understand the material certification of ISO 14001 and BS OHSAS 18001.

7) *Recycling and reuse of material*

Recycling and reuse help for saving energy, natural resources, money and also keep away harmful plastic from nature. The plastic allowed for the recycling to reuse is Nylon, PE, PP, USHEP, and styrene mainly.

GREEN MANUFACTURING			
S.No.	Advantages	Disadvantages	Limitations
1	Reduces	The initial cost	Implementation

	harmful waste & emission.	is high.	cost is high.
2	Less cost for maintenance.	Companies are not fully familiar with GM.	Skilled labour required.
3	Green manufacturing technology conscious.	Instalment or implement of GT affect due to lack of skilled human resources.	Work with the renewable energy sources.
4	Encourage Renewable energy.	Most country policies, not finalized for GM.	Fully knowledge of Green technology required.
5	Reduction of CO2	Lack of information in the area of GM and their technology.	Directly benefit to GM company.
6	Tax credits and incentive credits	No knowledge about alternative raw material or chemical input.	Implementation policy best required.
7	Promote healthy environment	Lack of knowledge alternative process technology.	Green certification required which is very hard and costly.
8	Business Growth.	Renewable energy sources are not all working Condition.	Only limited options available for green.

Table 3: GM advantages, disadvantages and limitations.

The detail discussion as per our table of advantage of GM has explained: -

8) *Reduce harmful waste & emission*

GM helps in reducing the wastage into the environment, it makes for eco-friendly nature.

9) *Less cost for maintenance*

GM reduces the less cost of maintenance because it reduces the operating and overall cost.

10) *Green manufacturing technology conscious*

The technology, which is innovative for green is very conscious about the environment. It will be the best technology for helping investors in the future.

11) *Encourage Renewable energy*

GM is mainly focused on the renewable sources of energy for the generating electricity, making food, reduce use of non- renewable energy sources.

12) *Reduction of CO2*

It reduces the chance of global warming by reducing CO2.

13) *Tax credits and incentive credits*

The company who is adopting GM. They get the benefit of tax credit and incentive according to their state level in the world.

14) *Promote a healthy environment*

GM is more promoted healthy environment for the survival of human being, birds and animals.

15) *Business Growth*

There are competitions between manufacturing companies for government contract bids. But the government company has limited contract therefore only limited gets the benefits.

VI. COUNTRY INDEX ABOUT SUSTAINABLE AND GREEN ALSO THEIR MANUFACTURING

We have taken for our research paper that country index about Sustainable and Green. Therefore, according to this the countries around the world has also done their manufacturing. Because it very necessary for the researcher, manufacturer, engineer, scientist as well customer should have to understand that best countries come under Sustainable and Green. We have taken top 10 countries in our research paper for Sustainable and Green countries which are practicing manufacturing according to their categories. Therefore, as we know that Sustainable performance index represent the competitiveness of countries in an integrated way. It calculates from quantities, measurable which has got it from World Bank, different UN agencies and IMF. These are categories into the group that is resource efficiency & intensity, Natural capital, intellectual capital, social cohesion and Governance Efficiency. The country ranks and the index has shown in the Fig 3. Now, as we know that some of the manufacturing working hard for the Green also gaining the best economy from it. Such that, we know that the world is advancement toward a green that is environmentally conscious nation. Because, day by day increases of product industries, residential developments and expansion of modern transport. All these things create the risk to the environment. Such that, we have taken top 10 countries according to their performance index for green as well as GM. The top green performance index is shown in the Fig 4. These are countries which have taken environment very seriously as well as they has invested in its Sustainability. The first country that come under Green is that Iceland. The Iceland has forefront for implementation of the program that is eco-friendly. The performance index is 93.5% and their rank 1. Therefore, the performance index has explained.

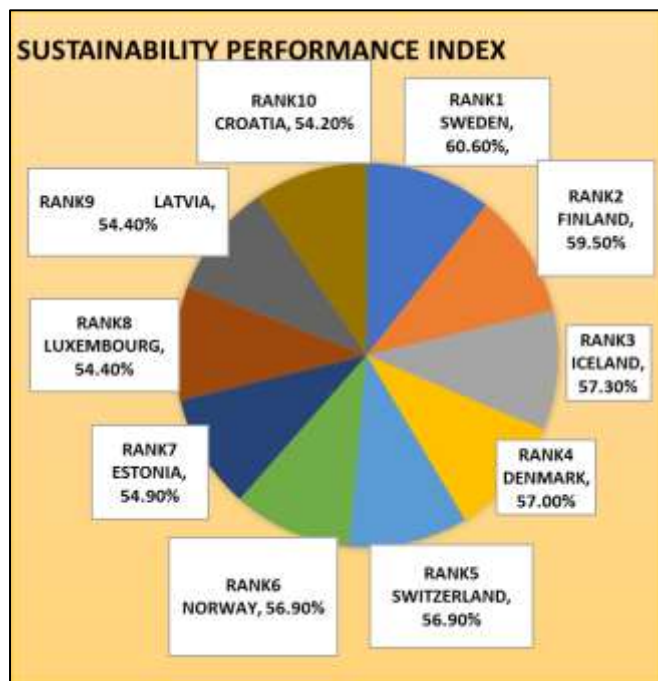


Fig. 3: Top 10 Sustainable Manufacturing performance Index

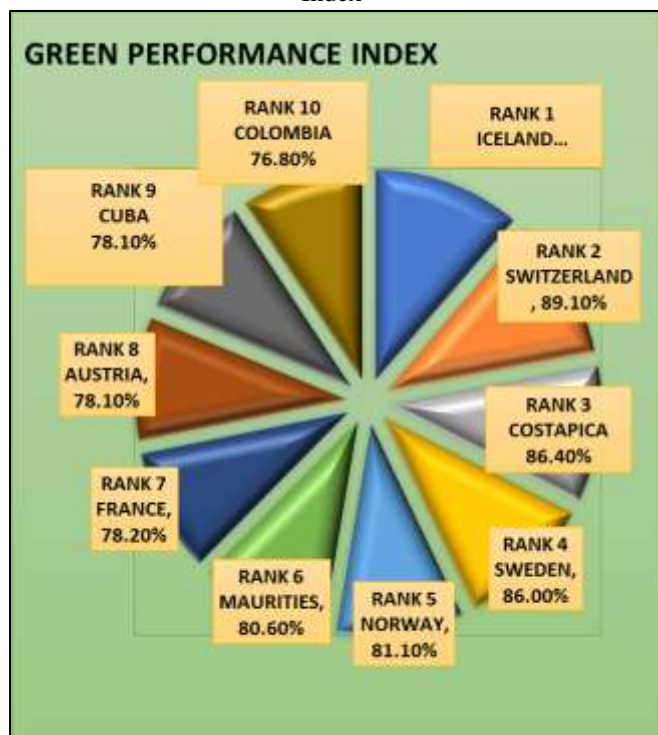


Fig. 4: Green Manufacturing Performance Country Index

VII. BARRIERS FOR IMPLEMENTATION OF SM AND GM

We have to understand the most that is a barrier which is more responsible for the Sustainable manufacturing and Green manufacturing not implemented in the small-Scale and large-scale industries for their manufacturing of a product. The main reason finds out from research paper, article, questionnaires and manufacturer that is, there are many issues arising during implementation in the industries. The Sustainable manufacturing is that cost are main reason

for the factories and industries not go for the Sustainable manufacturing because as we know that almost of middle and small scale manufacturing industries has financial weak, therefore, if the company or industries not moves towards SM such that they are lack towards Green manufacturing. Because, as we know that almost all the implementation works which is common as per research analysis and articles. The barriers we have explained for implementation SM and GM is also vary from the company to company, industries to industries, organization to organization and business to business. But the most issues we have taken for the research paper is common for not the successful implementation SM and GM in the manufacturing world. This is also creates the weak point for the industry and their manufacturing. The main is that today's world market most of the manufacturers for stand themselves and give completion to the other company globally.

Now for the Sustainable manufacturing the barrier is classified as shown in the Table 4. Such that the barriers issues are broadly classified are as follows: -

- 1) Environment awareness issues,
- 2) Government related issues,
- 3) Customer support issues,
- 4) Knowledge issues,
- 5) Business environment issues,
- 6) Organizational issues,
- 7) Technology issues.

Now if we have researched the barriers of the GM is almost equal to SM but the GM industries for manufacturing little bit is different than their working conditions also different therefore, there barriers are different within the same classification has explained in Table 5.

S.no.	Barriers Aspects	Sustainable Manufacturing
	Environment awareness issues of SM	Lack of awareness among managements in the industry. Lack of political decision makers. Lack of awareness, energy resources consumption.
	Government related issues of SM	Lack of government interest. Lack of local regulation support. Lack of interest of government agencies. Formal document is made for organisation. Lack of support by the government for recycling.
	Low Customer Support	Low demand of product and practices. Cheap price, product required by customer. Not environment awareness a part.
	Knowledge issues	Lack of experts and professional support and plan.

		Lack of policies of construction management. Lack of policies and plan for waste management. Lack of incentive
	Business Environment issues	Lack of experts and professional. Complication between employees about SM. Lack of employees training and skill about the SM.
	Organizational issues	Lack of maintenance and repair issue in organization. Lack of sewage problem. Sewage waste on the road Lack of road maintenance.
	Technology issues	Poor infrastructure. Poor evaluation and monitoring system. New technology challenges

Table 4. Sustainable manufacturing Barriers

S.no.	Barriers Aspects	Green Manufacturing
	Environment awareness issues	Lack of Knowledge of GM. Lack of access to external GM. For potential improvement, obtaining information difficult.
	Government issues	Lack of environmental program for GM. Lack of training program by the government. Lack of consultancy is provided by the government
	Customer support issues	Cheap product required, not environmentally conscious. Price sensitive customer. Lowest price first choice. Lack of knowledge of Green product. Less use of customer renewable of energy. Less attract toward renewable
	Knowledge issues	Lack of proper knowledge of GM. Lack of proper management system. Difficulties in bonding between customer band manufacturers about the product.
	Business Environment issues	Lack of effective measurable. Lack of experienced. Lack of awareness of GM. Weak market position. Less completeness.
	Organizational Issues	Hesitation towards convert's new technology always practices traditional. Weak organization support Limited resources Undeveloped organizational

		culture. Management has resistance to GM. Improper communication structure. Lack of awareness about benefit of GM. Lack of technical expertise. Difficult transforming positive GM attitude. Lack of corporation between owners, manager, leadership.
	Technology issues	Not available infrastructure No alternative solution for GM. Design complex Improper use of R&D, testing & design within the organization. Lack of flexibility of manufacturing process.
	Financial issues	Initial cost is high. Limited resource. Financial capital acquires less. Bad financial performance. Cost is high for certification/verification.
	Suppliers issues	Lack of conscious about supplier. Lack of awareness of GM. Supply less raw material.

Table 5. Green Manufacturing Barriers

VIII. METHODOLOGY

The methodology we have applied for this research paper is that we have studied the most important research paper that approx. 60 which shows that the Sustainable manufacturing and their other correlated manufacturing that is Green manufacturing give benefit in the future for the environment and reduce the change of greenhouse gases as well as safe the ecological system. The step we have followed for our research paper has shown in the Fig 5.

A. Introduction.

We have studied the meaning of the SM and GM. From this we have concluded that both meanings are common because both deals about the reduces the use of available non-renewable energy which are limited in the nature, then after their meaning explain the wastage from manufacturing industries in any form.

B. Literature Review.

We have taken it from published research I the field of SM and GM. This part we have written the different author finds the result and conclusion after study the 60 research papers and 40 articles.

C. Principle of SM and GM.

This is the base for our research paper because of this we have understood that SM principle works on that it helps in reducing the waste, save the resources which is non-renewable in nature, environmental safety as well as

personal safety. Now the principle on which GM works that promoting the use of renewable source of that's why by saving non-renewable source of energy as well as recycle and reuse.

D. Comparison of SM and GM.

In this part we have taken seven elements for comparison between SM and GM

- 1) Concepts
- 2) Purpose
- 3) Objective
- 4) Elements
- 5) Goal
- 6) Characteristics
- 7) Area of application

After their comparison, we have found out that their motive is that save the available resources for present and future.

E. Advantages, Disadvantage Limitations of SM and GM.

This is the most important part because when the researcher and manufacturer for green they have to understand that SM and GM advantages, disadvantage and limitations because as we know this is the area on which further study have to do. Limitation is that manufacturing does not want to give up their old traditional working condition and not to adopt new technology because of cost. So there should be work out on the cost.

F. Understand the Country performance index about SM and GM.

We have this topic for the research because researcher, manufacturer, engineer and scientist as well customer should have to understand that best countries come under Sustainable and Green. We have taken 10 ten countries which come under Green and Sustainability such that they do their manufacturing according to that.

G. Barriers of implementation of SM and GM.

The reason for not successfully implementation Sustainable and Green obstacle we have mentioned in the manufacturing industries that is mainly are: -

- 1) Environment awareness issues,
- 2) Government related issues,
- 3) Customer support issues,
- 4) Knowledge issues,
- 5) Business environment issues,
- 6) Organizational issues,
- 7) Technology issues

H. Future works

The future works research works that works for the mainly limitation, reduction of barriers as well as old traditional ways to convert new technology.

I. Conclusions.

From this part we get the result that SM and GM will be most beneficial in the future if steps can take in this direction.

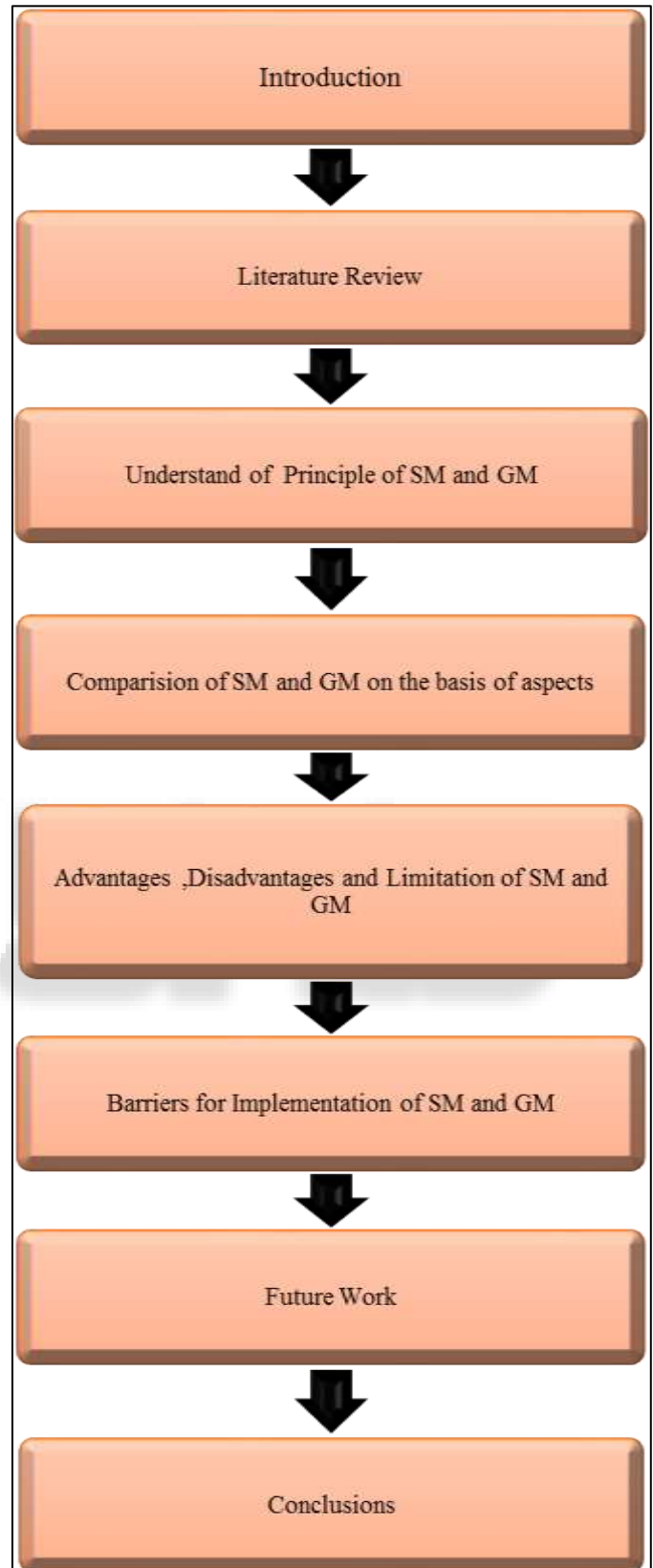


Fig. 5: Methodology of SM and GM

IX. FUTURE WORK

We have studied in this research paper that manufacturer is not much conscious about the limited resources which are

available, they are at the age of scarcity for the future uses. Another most important thing for a manufacturer of the manufacturing only wants to raise their business, but they are not thinking about the climate change as well of increasing energy resources. Consequently, duty companies to decrease/remove the production of non-environmentally friendly pollutant. Global noise for invention in technological development and plans to bring future products and services obtained by companies today expression to travel sustainability ideas within the scope of conventional performs, and well-organized and actual performances. Therefore, it is hard work for researchers to understand the Sustainable manufacturing, but researcher should try to simple ways the benefits that is, it can business collaborating and innovating to build resilient, competitive green enterprises as which are prepared for the Future challenges. Now the most important area, we have to find out more and works have to do that is an Environment energy resource, Flexibility & business leadership. There are some are area more works have to do that is the barriers are as we know that lack of awareness of the environment because as per of our research that Customer and the manufacturer not fully aware about the environment. So, we have to work that customer and manufacturer get benefits in term of cost saving and maintenance ecological balance. Another barrier is government because government agencies have the low interest in the direction of SM as well as formal document only made for follow the Sustainability. If the manufacturer will not follow the rule and regulation then the percentage of CO₂ and harmful gases will increase day by day. Therefore, in the nearer there should be ruled to make each and every industry show the Sustainable percentage and there should be criteria also more than 50%. This rule and regulation will have to follow strictly. In this direction researcher will do best and best their research paper and articles because they can attract government view towards their work for environment conscious.

As we know that manufacturing company is leading one industry, therefore more, consumption of energy, pollute planets and carbon footprints all the problem same as that of problem with Sustainable manufacturing. This manufacturing is also dealing with reduced the consumption of energy or resources, reduces the pollution as well safe the environment from natural hazards. In this direction encourage use of renewable of energy on strict level should have to follow because the resources are only for a few decades in the future. Therefore, Green manufacturing is the best concept such that researchers and government have to access and monitor about the industry. Research work look out the industry reduces the energy consumption, which is coming from non-renewable. The work should try that from different ways to attract of the manufacturer about the renewable energy sources. Such that manufacturing companies should fundamentally structure of GM and initiative of sustainability case on ABC paint manufacturing company. Also, companies can reduce the cost if they go to GM and SM Fundamental structure and sustainability case whatever the company apply after following. Lastly, GM can increase their business and

efficiency both. On the other way, that economic growth, adopting the GM.

Therefore, further work for researcher to reduces the obstacles or barrier SM or GM, easy way of implementation of SM or GM complexity reduces as well as work out on the saving money.

X. CONCLUSIONS

The manufacturing that Sustainable and Green is the most important aspects for the industries, Manufacturer, businessman, engineers, scientist and R&D. These are the area manufacturing can be benefited by adopting of SM and GM because their major principle deals that is using environmentally friendly materials, reduce the use of resource utilization in the process, reduces the waste, increases recycle and reuse of materials as well as self-recovery capability of the earth. We have found out the conclusion after comparison of advantages, disadvantages and limitations of both the manufacturing process that disadvantage is very much less than the advantage, because present world most important issues for the scientist, researcher and engineers that how they take action against the environment depletion day by day. Because, there has to save the earth from any natural hazards as well as clean environment and also saves the resources which are available in the present for the future by using renewable sources of energy. We have taken data of top 10 countries which they are coming under Sustainable and Green they are following the all the norms of Sustainability and greenest such that they are practicing Sustainable manufacturing and Green manufacturing they also getting benefits from it. The countries come under Sustainable and Green is make themselves eco-friendly, economy rises country as well as stand themselves for the global in the international markets.

We have got the results that if we adapt the GM in the future, then it will give the very good business. It gets revolutionary advance to the manufacturer in productivity and efficiency by reducing waste or pollution. Economic growth may be doubled by environmental if the industries will be conscious about the thinking of the nature as well take an oath to themselves save the earth and the life of the people. The Green mission will be possible when the entire industry should start to adopt the GM and reduce the lower carbon emission. If the manufacturing industries go for the Green then they also move towards Sustainability. The advantage environments can get by reducing the pollution and wastage as well as reduces of carbon footprints. As, we have seen that resources which are non-renewable are available in the nature for the short period in the future. Such that, for that of work manufacturer and the customer both have to think about not go for a cheap product and cost less. Eco-friendly products are different from not eco-friendly products cost only a little bit.. Therefore, Future works more than the present work for SM and GM. The Government should be active in this direction of implementation of SM and GM on the large scale and strict action also have to take.

Lastly, manufacturer should apply at the fundamental structure of GM and sustainability initiative

which has been included in this research paper to reduce the wastage and emission as well as save the resources for future. Therefore, overall, we have research that in this paper SM and GM can give more advantage for the environment in the future if they have to follow well manner according to rule and regulation.

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