

Research Article

A Literature Review and Analysis of Predecessors of Green Sigma and Environmental Factors Contributing to the Evolution of Green Sigma

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Abstract: The aim of study is disheartening to note that of late, the ecosystem has loomed large as a vital universal challenge. Triggered by the ever-zooming human and industrial adverse effects on the ecosystem, ecological problems have assumed mammoth proportions and exhibit a ballooning trend throughout the cosmos. This has squeezed the business sector to devote equal attention to both the eco-issues and the business goals. At this juncture, a green strategy plays a vital role in assisting the business magnates to arrive at significant decisions which have a telling effect on the ecosystem. The ethics which constitute the four pillars of a green strategy are expected to exert a positive impact on the business conglomerates to take effective decisions in accordance with sound business logic and excellent business sense. The doctrines of lean manufacturing which pave the way for the eradication of waste have extended a helping hand to the corporate and successfully addressed the ever-escalating needs of the client simultaneously conserving valuable resources for the posterity. Lean and green manufacturing are competent to exert a further pertinent and constructive influence on diverse dimensions of operational efficiency when executed simultaneously instead of separately. The growing thrust for carbon footprint diminution by the world community and the realization by the industrial magnates or high-profile IT entities on the unfavorable impact of their activities on the eco-system are the leading forces which ultimately trigger the fruition of the greening model. The performance advantages have been amazing, sustainable, optimistic economically and convenient to supplementary specialties.

Keywords: Carbon emission, energy-efficiency, environmental sustainability, environmental performance, green sigma, lean, productivity, six sigma, wastages elimination

INTRODUCTION

An well-integrated administration thinking is invested on incessantly fine-tuning the excellence of the quality and methods to usher in advanced client delight. In other words, they invest their blood and sweat on the integration of quality into outputs and procedures transforming the concept of heightened quality devotion and commitment for all the personnel in the institution (Karuppusami and Gandhinathan, 2006) It is pertinent to note that a lot of earnings have been invested by various investigators in the amazing arena of six sigma and lean sigma for the past several years. Therefore, it was high time a novel theory was green-signaled which blended the best of six and lean sigma with added attention aimed at preserving the eco-system. The innovative concept was devised and known as the Green Sigma, the fond name afforded to it by the research and development department of IBM Corporation, USA. Devibala *et al.* (2013) in fact Green Six Sigma represents a ground-breaking theory which is in childhood stages and hence the ins and outs of the new-fangled technique are in the process of being

hammered out. Nevertheless, the paramount objective of the green six sigma is to extend a helping hand to companies empowering them to plan for sustainability and decline in energy consumption, simultaneously keeping in view the maximization of profits. Fundamentally, advocates of the novel concept integrated with the experimented and true procedures of six sigma address the existing eco-concerns which plague all the businesses entities. Green Six Sigma invariably assists the companies not only to tackle the conservative problems within the manufacturing and non-manufacturing tasks, but it contributes its mite to the companies to scale down the eco-impact. It must be borne in mind that a country which is one of the signatories to the Kyoto Protocol, which restricts each country to its own CO₂ limitations, greenhouse gas-emissions trading is compulsory. In the United States, which is not a party to the environmental agreement, corporate participation is optional for the emission schemes. There is invariably a practice of supervising and fine-tuning ecological efficiency in the supply chain. These comprise blending eco-concerns into a supply chain administration, including product design,

material resourcing and choice, manufacturing procedure and the delivery of the final product to the ultimate client together with the perennial supervision of the product after its gainful life (Dheeraj and Vishal, 2012). Sustainable energy control has become a far-reaching notion that embraces all facets of the sector - from fuels and their mining, to energy production and the systems efficacies, energy allocation and energy utilization (as regards the quantity and effectiveness) and energy safety concerns and so on (Ürge-Vorsatz and Metz, 2009). The energy effectiveness invariably plays a vital part in checking the climate change together with energy preservation and in this regard, effectiveness plays only second fiddle, though it has also an incredible role in achieving climate stabilization. The significance of the energy effectiveness is decreased in comparison with the options symbolizing a de-carbonized energy supply, though it continues to play a very dominant role (Lela Ahmad *et al.*, 2013). It is significant that energy efficiency enhancements to the tune of 20-25% are characteristic and habitually can go up to 50% over the current scenario. This operational cost deduction generally paves the way for added advantages in the shape of enhanced consistency, tighter procedure management, reduced maintenance outlays and cutback waste (Yang *et al.*, 2013). Moreover, System optimization is also competent to usher in stepped up capacity to back up production without necessitating a considerable capital outlay by means of further efficient employment of the current device. The concept of Green Supply Chain Management (GSCM) is meant for dispensing with or reducing waste (energy, emissions, chemicals/hazardous, solid wastes) along supply chain challenge and for meeting with the stricter ecological conventions, rules and laws in shipping by bringing in GSCM-linked skills and capacity. Nonthaleerak and Hendry (2008) Six sigma has emerged as one of the superior quality enhancement techniques which have gained world-wide acclaim, though it is only an add-on project management device. In spite of this, it is established without any iota of doubt that it is highly essential for the elite academicians to proceed with the investigation of the six sigma phenomenon, especially in view of the zooming popularity it enjoys in the industry (Nonthaleerak and Hendry, 2008).

Six sigma: By pursuing the process of continuous and never-ending improvement the companies can outdistance their competitors by enticing the customers with high quality products at low price. TQM has culminated Six Sigma, which targets 99.99927% defect-free manufacturing. The Sigma represents a dimension of “variation about the average” in a procedure either in a manufacturing or service industry (Desai and Shrivastava, 2008). This embraces the Definition (D) and Measurement (M) of the challenge, data Analysis (A) to ascertain the fundamental reasons of the issue, improvement (I) of procedures to do away

with the vital reasons for the deficiencies and controlling (C) or supervising the procedures to keep in check the issue involved. Ferreira and Lopes (2010) The DMAIC technique proceeds through five define phases as follows: (1) define the objective of project, extent and procedure background for both interior and exterior clients. There is a host of diverse devices which are employed in define phase like SIPOC, Voice of Customer and Quality Function deployment. Prasad *et al.* (2012) In the course of the (2) Measure phase, the team generates a value stream mapping (VSM) of the procedure, (3) In the Analyze phase, the team has to gather and assess the data to realize the vital procedure input variables which have a greater impact on the objective of the project, regarding whether time utilized on existing activities is value added or not. (4) In the Improve phase, the team is entrusted with the task of planning and Carrying out Investigation (DOE) to a certain extent by employing a formal assessment procedure to locate and estimate the optimal or preferred options as against the traditional benchmarks. (6) In the Control phase, the team takes upon itself the task of normalizing and documenting the novel procedure to back up and maintain preferred enhancements (Kabir *et al.*, 2013). Before the initiation of the six sigma technique in an organization, it is highly essential to set up six sigma team configuration to carry out the entire phases of the technique. Soni *et al.* (2013b) the underlying aim behind the Six Sigma is intended to step up the profit margin, enhance financial strength by scaling down the deficiency pace of the product. It invariably leads to enhanced customer delight, retention and ends up with the generation of the superlative class product from the best procedure feat (Silva *et al.*, 2009). The Six sigma method is effectively employed to bring down the deviation in the product, whereas the FMEA document is devised to locate potential failure modes on the part of product production. Little wonder, a multitude of investigators have conducted relentless research and documented their scrutiny on six sigma application. It is a welcome fact that the execution of six sigma and kaizen effectively boosts the product quality enhancement endeavors by assessing the vital reasons for failure and furnish a substitute manufacturing procedure enrichment (Indrawati *et al.*, 2014). The devices and technology forming part of the Six Sigma effectively address the general outlays of quality, both tangible and intangible segments, honestly endeavoring to scale it down, simultaneously paving the way for the surge in the overall quality level and play their significant part towards the company business success and profitability. Soni *et al.* (2013a) the investigation for enhancing quality levels has materialized in the form of launching novel techniques for augmenting procedures like integration Lean Manufacturing (LM) and Six Sigma (SS), called Lean Six Sigma (LSS). The vital

enthusiasm of the LM technique is invested in bringing down the period of time between the demand of the client and delivery by doing away with the waste (Ansari *et al.*, 2009).

Lean six sigma: It is significant to note that Lean has surfaced as a novel philosophy and set of management methods invested on the incessant objective of “eliminating waste” so as to ensure that each and every single procedure, function or task invariably contributes to the process of “value adding” representing the actual output the customer has to opt for by sacrificing his scarce resources, from the standpoint of the enlightened client. When six sigma ideas are integrated with lean, it is renamed as Lean Six Sigma (Subramaniyam *et al.*, 2011). Incidentally, Lean generation is also known as lean manufacturing. In fact, it is an incorporated set of activities meant for realizing high-volume generation by employing nominal inventories of raw materials, work-in-process and finished goods. The segments which are received at the subsequent workstation “just in time” are finished and progress through the procedure rapidly (Sun, 2011). Lean creation was kick-started in Japan when SSM was efficiently experimented and the vantage points well-exhibited. The primary constraint arose because both the programmers functioned at diverse facets of a manufacturing concern with the identical objectives and hence it was a very difficult task to integrate both the techniques into a singular modernization technique (Kenneth Enoch, 2013). The diverse kinds of waste which bring down the effectiveness of the systems included such factors as Mistakes and Deficiencies, exhausted Motion/Unused Talent, Surplus Inventory Processing and Complication, Transport, Holdup and Protracted Time-frame, Overproduction. Arunagiri and Gnanavel Babu (2013) Generally, 80% of process delays are triggered by 20% time trap. Thus it is possible to keep aloof 80% of delay, by augmenting 20% of time trap. The lean is linked with swiftness, effectiveness and speeding up of process and the Process upgrade is intended for prioritizing issues and addressing only those problems which lead to universal outcomes (Habidin *et al.*, 2012) these issues have triggered the manufacturers towards their substantial development and production responsibilities with the objective of a sustainable environment for all. Since corporations are the vital organs of society, corporate interests tend to serve societal concerns. Meera and Chitramani (2014) Lean manufacturing helps to identify productive and nonproductive activities. Productive activities focus on any activity that customer is willing to pay for. Non productive activities describe those that the customer does not consider as adding value to his product. Islam *et al.* (2013) These tools can help the industry to eliminate waste, have better inventory control, better product quality and better overall

financial and operational procedure. The tools and techniques of lean manufacturing and six sigma have been widely applied in the discrete industry (Karim, 2013). The Lean Manufacturing is primarily entrusted with the duties of decline in waste and non value-added activities in production while Six Sigma takes upon itself the task of decline in process variation with both the techniques intended to incredibly cutback the waste. The amalgamation is expected to consider various features such as the strength, weaknesses and efficient features of each theory to give shape to a superior concept (Jie *et al.*, 2014). Lean thinking focuses on value-added lean and consists of best practices, tools and techniques from throughout industry with the aim of reducing waste and maximizing the flow and efficiency of the overall system to achieve the ultimate customer satisfaction.

Chakraborty and Paul (2011) Companies and organizations effectively using the lean devices usher in amazing gains in output and general efficiency. Lean Manufacturing tends to employ lesser quantity in contrast to the mass creation and it exhibits a unique tendency to function with the inter-related procedures. With the result, progress in one area is well-set to augment the progress of the entire mechanism (Furterer, 2011). It is from the lean six sigma theory that the green sigma conception is evolved with an eye on scaling down the waste in the form of carbon discharge and also ensuring greenhouse gas emission decline and the enhancement in the green energy utilization like solar energy and wind, to name a few. In the case of green sigma, the Green-minded companies are plagued by two types of priority-setting problems. The former challenge crops up while taking a decision on which sustainability project is to be taken into consideration at first. Lean Six Sigma is equipped with the capacity to furnish the companies the dimension, scrutiny, enhancement and management devices needed urgently to assess the project which is competent to incredibly contribute to eco- development and the probable outlay for accomplishing the same. Park and Linich (2008) For advanced developments in different industries Lean Six Sigma has shown to be a highly accurate technique. In the light of the urgency and the poor Copenhagen outputs, common decision making plan seems to be too sluggish to manage with global warming. Separately from any political agreement, companies, authorities and even private people can employ Green Sigma to economically lessen their own carbon footprint. The joint collision can considerably lessen climate gas releases. Industrial ecology comes out at a time when it is more and more clear that the conventional depollution move towards (end-of-pipe) is deficient. The pollution avoidance and cleaner making move towards it still think in terms of stopping and sinking ‘ wastes’ and thus, to a convinced extent, share a outlook similar to the end-of-pipe philosophy (Erkman, 1997).

Table 1: Related works

Author name	Applied	Result	Applications/Advantages
Miller <i>et al.</i> (2010)	Lean process with mathematical optimization and discrete event simulation	Reducing the number of miles driven, annual cost savings = \$100,000	It is used to avoid over or under production by using RCELL study
Boldt and Franchetti (2013)	Total Sustainability Assessments (TSA) with Lean Sigma	Annual cost savings = \$120,000, time reduced = 23.8%, 449,940 pounds of CO ₂	It is applied the field of simultaneous sustainability assessments related to solid waste, energy, and productivity
Trevor <i>et al.</i> (2011)	Grid energy-storage (GES) systems with Monte Carlo simulations	Annual cost savings = \$344260	Implement a grid energy storage system enabled energy arbitrage system and it helps to reduce carbon footprints.
White <i>et al.</i> (2009)	DMAI technique of Six sigma	Annual cost saving = \$300,000.00	Application of a technique used traditionally in manufacturing industries in a service process
Kane (2003)	Six sigma	Annual savings = \$250,000	Energy-related Six Sigma projects have covered all aspects of the energy value chain.
Vlahinos <i>et al.</i> (2003)	Six Sigma	Thermal energy efficiency = 43%	increased attention to battery thermal management, especially with regard to life and related warranty costs.
Falcón <i>et al.</i> (2012)	Six sigma	Energy saving=30% Annual savings=\$157000 year	Improving energy efficiency in a DU of a naphtha reforming plant.
Fischman (2010)	Lean six sigma rapid-cycle test with the Plan-Do-Study-Act approach.	94.5 minutes vs 103.5 minutes, P = .10, Wait time 15 minutes vs 18 minutes, P = .062	Fine-tuning of the interventions outlined and minimizes the patient wait time.
Robert <i>et al.</i> (2011)	Lean six sigma	improving on-time from 12% on time starts to 89%.Surgical process improvement Thoracic surgery (TS) 90%; Gyn sugery-77%; general and colorectal surgery (Gen/CRS) 90%	Surgical specialties and resulted in substantial and sustainable increases in OR efficiency and financial performance
Namdari <i>et al.</i> (2011)	failure mode and effects (FMEA)	Fuel consumption decreased at 16.4%	FMEA is highly recommended for improving process in agriculture
Hu <i>et al.</i> (2009)	Failure modes and effects analysis (FMEA)	green component risk priority number = 20% high risk green components improved and 46.2% within the GC-RPN between 9 and 10.	Green electronic products and risk evaluation of the Hazardous Substance.
Kuo and Chu (2013)	Failure mode and effects analysis (FMEA)	Highest potential risk Value (PRV) = 17.7.	Encounter significant challenges and risks in screening all the hazardous substance contained in received components as part of the green part approval management (GPAM) process.
Sahu and Sridhar (2013)	Six-sigma DMAIC	Overall Equipment Effectiveness(OEE) = 63%	to enhance productivity and quality performance and to make the process robust to quality variations
Mandahawi <i>et al.</i> (2012)	Lean Six Sigma methodology	Overall Equipment Effectiveness (OEE) = 21.6 % and 48.45%	Organizations must utilize all the available resources efficiently and effectively in order to cater their customers with high quality products at a low price
Anvari <i>et al.</i> (2010)	Overall Equipment Effectiveness-Market Based (OEE-MB)	Overall Equipment Effectiveness-Market Based (OEE-MB) = 85%	OEE monitors the actual performance of a machine relative to its performance capabilities under optimal manufacturing conditions.
Terro <i>et al.</i> (2014)	Six-sigma DMAIC methodology	Efficiency = 26%,34%	Recycled aggregates in civil works, financial savings are also incurred from reduction in transport and production energy costs.
Oludele <i>et al.</i> (2012)	Generic Green IT Model	Carbon reduction factor reduced from 0.43963136 (kgCO ₂ /kWh)	Reduction in waste landfills to reduce energy consumption, and to lower CO ₂ emissions

Table 1: Continue

Gopalakrishnan and Muruganandam (2013)	Factor analysis with Principal Components Analysis for green products	Kaiser-Meyer-Olkin (KMO) test of sampling adequacy produced coefficient = 0.749 (74.9%) and	It is a good sign for the companies to acknowledge the purchase preferences shift of consumer and capitalize this to market their products and services.
Peng and Pheng (2011)	lean production philosophy	Carbon emission=18.2900(kgCO ₂) Carbon Emission Value: 647.103 kg per column or 5.08%	to reduce construction duration and improve efficiency
Bilec <i>et al.</i> (2010)	life-cycle assessment (LCA)	CO ₂ emission reduction in the construction = 25%	Understanding the full spectrum of possible sources of environmental impacts from the life cycle of the built environment
Pendelberry <i>et al.</i> (2010)	Taguchi framework	CO ₂ emission reduction = 7% (96 Ton)	To reduce the carbon emission with the help of IT development
Torielli <i>et al.</i> (2011)	Implementing lean and green methodologies	VOC emission reduction = 75%,	Foundries can become economically and environmentally sustainable businesses with the systems approach offered by implementing lean and green methodologies.
Kumar and Singh (2014)	DMAIC of Six sigma	DM water leakage reduction = 0.1%	to find statistical as well as subjective solutions for minimizing DM water wastages or leakages.
O'Sullivan (2011)	Energy-Efficient Design (EED) Method with lean principle	Energy saving = 31%, carbon reduction = 0.6%	EED Methodology was developed to address the common barriers to achieving the best energy-efficient design, in projects ranging from new facility investments to smaller-scale new process designs.
Rahani and Al-Ashraf (2012)	Lean Production with Value Stream Mapping (VSM)	Total reduction of man time was at 15.99s or 16.9% and machine time reduced to 299.832s or 14.17%, Energy savings = 28%	Reduce the man and machine time for improving the production
Fernandes <i>et al.</i> (2013)	ASHRAE payback analysis		Dimmable lighting controls have long been promoted as a promising energy-efficiency measure for commercial buildings
Galasiu <i>et al.</i> (2007)	Individual dimming control	Energy savings = 47%	electrical energy use can be substantially reduced by using lighting control systems such as daylight-linked dimming and occupancy sensors

Increasing markets for pollution-prevention technologies and services tender company. s the ability that enhances the new foundations of revenues. Further the knowledge dispersal will aid governments all over the world to manage more competently the emission of air and water pollutants that outrage environmental assets. Quality-driven businesses have begun to learn that pollution deterrence is frequently far less costly than narrow compliance. Berry and Randinelli (1998) Lean constructs an equipped environment that is extremely favorable to waste minimization and pollution avoidance and that Lean can be leveraged to make even more environmental improvement (Found, 2009). Waste falling methods are the detailed business and construction progression practices connected with each developed system that affects the waste lessening. Business outputs are the assessable enhancements to the settled objectives of each developed system. Bergmiller and McCright (2009) Green Management Systems (GMS) with policies and events empowering workers to make decisions based on summary environmental

collision and it will hold an organizational culture that recognizes the sources of environmental wastes and employs the Green Waste Reduction Techniques (GWRT) intended to diminish the types and amounts of environmental wastes made by the company's operations. Bergmiller and McCright (2009) the application of Environmental Management System (EMS) and Lean within firms can help in overcoming the functioning challenges and enhancing business competence. Both systems are dissimilar in scope and approach but integrating the systems can help organizations realize brilliance in business performance and meet EMS objectives. Puvanasvaran *et al.* (2011) The objective of the study is green sigma and lean sigma based minimize the carbon emission, cost saving, carbon discharge decrease, efficiency enhancement and the presentation compensation have been astonishing, sustainable, cheerful economically and advantages have been amazing, sustainable are reviewed in Different papers (Table 1).

RESULTS AND DISCUSSION

Figure 1 illustrates the annual cost savings and energy savings of the various fields achieved by employing the six sigma and lean sigma techniques.

It is crystal from Fig. 1 that various authors have deployed the six sigma and Lean sigma techniques on various fields. In the long run, there is an amazing savings in the annual cost in the Hale *et al.* (2011) which amounts to a whopping \$344260 which is the maximum. In this document, the authors have been prudent enough to apply the Grid Energy-Storage (GES) systems with Monte Carlo simulations on the grid system. In this process, the carbon foot print is cut down to the bare minimum. In view of the fact that the renewable energy source is effectively employed to share the summit loads, pollution takes a beating to the desired pace. Miller *et al.* (2010) was pivotal in kick-starting the Lean and green manufacturing with Discrete-Event Simulation and the RCELL investigation duly indicated the green manufacturing procedure. Little wonder, it resulted in the cutback of the lead time from the present phase to the upcoming phase, dipping down waste by scaling down the inventories and processing interval. It was also noted that the considerable cutback in cost also paved the way for the eco-preservation with the slightest emission in the surroundings.

Figure 2 vividly depicts the energy saving graph which is launched by several authors. The energy savings is invariably dependent on the six sigma and lean sigma methods. Galasiu *et al.* (2007) amazingly advocated the direct-indirect system with integral occupancy which took the energy savings to the sky-high levels in this document. The energy saving, on the other hand, paved the way for preservation of the carbon emission of the ecosystem indirectly, in view of the fact that the lighting control leads to the scaling down of the emission, ultimately resulting in an amazing level of annual cost savings.

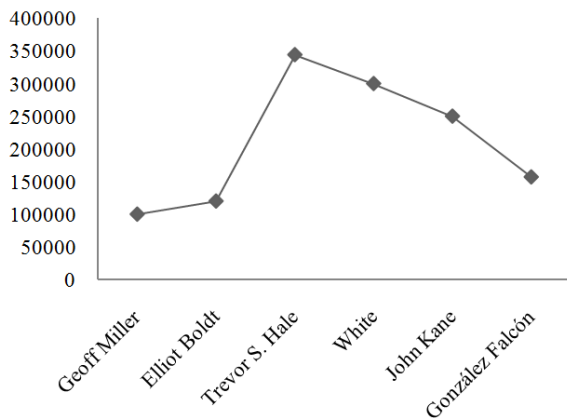


Fig. 1: Cost savings

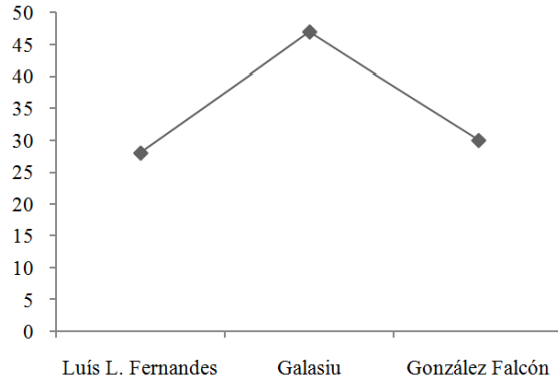


Fig. 2: Energy savings

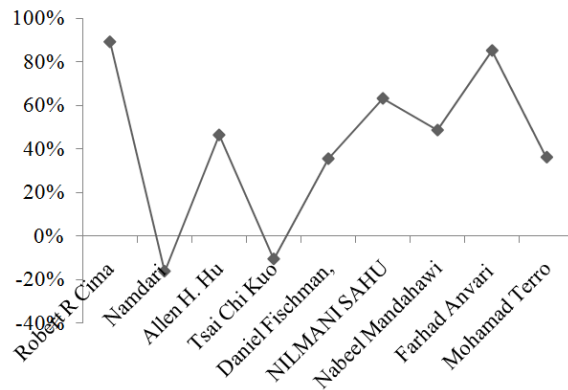


Fig. 3: Efficiency

Figure 3 depicts the graph dependent on the efficiency and the various techniques launched by several authors. Predominantly, it is the six sigma and lean sigma based techniques which are employed to fine-tune the efficiency along with the effective conservation of ecosystem. The efficiency, in turn, triggers an amazing augmentation in the machine performance which indirectly safeguards the machines from the consequences of overheating. Cima *et al.* (2011) was credited with green-signaling the six sigma technique to enhance the Lean and Six Sigma technologies which were designed in the manufacturing sector to scale up the effectiveness by doing away with the steps which fail to bring about value-addition. The Lean and Six Sigma techniques performed across an entire surgical suite to augment efficiency and Key performance metrics were gathered prior to and consequent to execution. The consequent results illustrate without any iota of doubt that the Process mapping, leadership support, staff engagement and sharing performance metrics are the vital parameters for stepping up efficiency. The accomplishment advantages were considerable, sustainable, positive economically and transferrable to other specialties. On the other hand, the defective side of the graph pointed out the utilization of the fuel and risklevel, to name a few. It

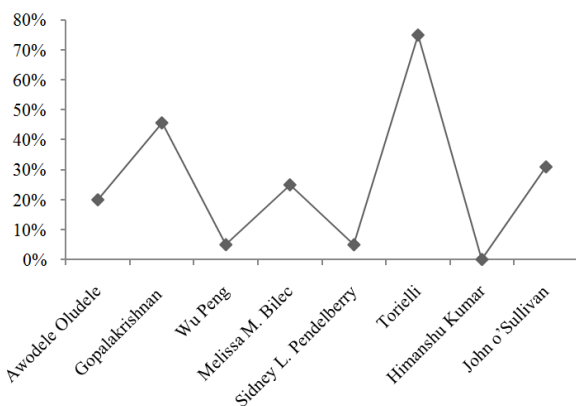


Fig. 4: Carbon emission

was at this stage that Namdari *et al.* (2011) came out with a ground-breaking Failure Mode and Effects Analysis (FMEA) technique which made a telling effect in the enhancement in efficiency and fuel consumption decrease. The fuel consumption, in turn, scaled down the carbon discharge and exploitation of the non-renewable energy resources. Hu *et al.* (2009) was instrumental in bringing to limelight the risk level management technique for employing the materials like plastic, PCB, metal. This method eventually resulted in the dip in the eco-discharge level.

The carbon emission level of the various fields applied by the diverse authors find them depicted in Fig. 4. Finally, the carbon decrease leads to the generation of green products and the consumption of green energy. In this regard, the Pendelberry *et al.* (2010) elegantly launched the power usage efficiency with the carbon discharge decrease. It employs the Taguchi-Based technique by effectively utilizing the sustainability performance which is evaluated with the help of the complete carbon discharge. The usual version of the Taguchi loss function punishes discouraging process trends and deviation corresponding to the performance. Peng and Pheng (2011) originated the lean theory to bring in sustainability in precast concrete factories. By employing suitable lean theories, the precast concrete industry is capable of inching closer to sustainability. It is also deployed in the arena of construction for generating the precast concrete. It may be effectively employed by premasters to usher in superb efficiency in certain sustainability parameters like energy consumption, carbon emissions in addition to production efficiency. It is competent to scale down the carbon emission to the tune of 5.02%. The peak carbon decrease is attained at 75% in the Lean manufacturing initiated in the domain of the foundry industry. This document, on its part, puts in a nutshell the method by which lean and green are able to furnish a pertinent structure for ecologically and financially sustainable foundries. It is evident from the cheering outcomes that

it is able to scale down the carbon discharge to the tune of a whopping 75%. Rahani and Al-Ashraf (2012), in his document, explains the method by making use of the Lean Manufacturing for bringing down aggregate of man utilization interval and the machine consumed period at 15.99s or 16.9% while the machine interval singly was decreased to 299.832s or 14.17% in relation to the original processing technique. From cycle period, it will have an effect on the capacity output of one machine and process interval.

Environmental Performance Index (EPI): It is cheering that this index takes upon itself the paramount task of evaluating the efficacy of national eco-safety measures cutting across a wide spectrum housing 132 nations. In total agreement with our conviction that on the-ground outcomes are the superlative methods to trace policy efficiency, EPI signals set their keen eyes on the assessable upshots like discharges or deforestation rates without relying on the policy inputs, represented by program budget expenditures. Each and every indicator is competent to be associated with the well-formulated policy objectives. The 2012 EPI has come out with flying colors in assessing the captioned 132 nations on the basis of 22 efficiency tools which ensnare the finest universal ecological data accessible on a country-to-country basis. It is horrifying to note that that India appears itself in the 125th place among the 132 nations as regards the 2012 Environmental Performance Index, which is deemed as the worst possible grade. Gardas and Narkhede (2013) it is alleged that grave data gaps have restricted .the skill to evaluate the efficiency on a multitude of significant parameters. On a close scrutiny of the policy drivers behind the 2010 ranking it is found that income has surfaced as a very pertinent factor in respect of ecological accomplishment.

CONCLUSION

This document earnestly endeavors to enlighten the effective pathway for achieving the related objective and brings to limelight the essential measures to be undertaken by business magnates to translate sustainable growth from a dream into a reality. The paramount aim behind the green sigma is delved deep into and the diverse dimensions are analyzed for greening like the annual cost saving, carbon discharge decrease, energy saving, efficiency enhancement. In respect of the entire parameters, the cutback of the pollution in the ecosystem is the ultimate goal which is attained through the six sigma and lean sigma for greening the ecology. Incidentally, eco-concerns have surfaced as a vital challenge for business and also the public entities, though fortunately it is tilted in favor of eco sustainability. Carbon discharges triggered by the waste of raw materials and finished products, improper production mechanism and capital facilities can be

considerably scaled down if similar non-value adding endeavors are eschewed. The improved Lean invariably does away with over production or under production, thus dispensing with irrelevant energy usage. When we take into account the significance of energy and the need for its optimization, the resultant savings in energy can be regarded as a highly triumphant activity and is well-set to usher in amazing improvement in energy utilization efficacy in the industrial development upgrade.

Future scope: It is hoped that the upcoming applications and investigations in green sigma can set the bar further higher on superlative change administration devices which are dead sure to usher in an amazing level of accountability and maintainability of the enhanced processes. Further avenues deserving intensive investigation embrace the superlative association of the elements of process organization, together with the daily management, planning and scrutiny to winning enhancement methods.

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