Green Manufacturing Index Applicability, An Approach to Acquire Industrial Gain.

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Abstract: The paper focuses on the requirement of fitness of lean and green concept utilization in an industry. Manufacturing plays the most prominent role in the development of economy of any country. The base of green manufacturing is its preference for sustainability and economical benefits. The main agenda of Green Manufacturing deals with conserving natural wealth for future generation and recycling of material by improvements in production process, it traverse the estimation and involvement of its index. Green constitutes bionomical durability and includes various attributes such as recycling from scrap and waste, pollution of land water and air, usage of energy and prescription. Green Growth is the effective and proper utilization of resources available by nature, reduction of pollution and impact of environment and strong towards bad effects, focusing on global durability and endangered into profitable from efficient, clean and pliant growth. Green assembling is a framework that incorporates item and procedure configuration issues with issues of assembling, arranging and control in such a way as to recognize, measure, test and deal with the progression of natural waste with the objective of diminishing and eventually limiting ecological effect while likewise attempting to expand asset effectiveness. The primary target of this exploration work is meant to examine viability of Green assembling. The strategy has been planned by sub ordering the machining rehearses dependent on their impediments, financial and ecological effects on keep up an economical assembling standard for businesses. The proposed strategy would be pertinent to any assembling procedure in industry. The intension is to minimise the gap of involvement of lean and green approach to contribute crucially as regarding expandable manufacturing.

1. Introduction
Now a day’s Power of flexibly request are the issues looked by assembling ventures. Significant number of decades numerous industrialists are continually consistently searching for an elective alternative to find some kind of harmony among activity and ecological execution. Additionally, the expansion in worldwide rivalry among the assembling business has driven the makers to extend and hotspot for elective approaches to improve another way to enhance green Manufacturing. For future advancement, it plays significant role. The interest of manufacturing would be expanded in future and...
improvement in vitality productive assembling procedures would become considerable component for businesses to receive and stay as top producer regardless of monetary downturn. While the act of vitality proficient and ecological cordial assembling procedure would take huge significance, Green creation is turning into a piece of different ventures that incorporates new or changed procedures, strategies, practices or frameworks a normalized deliberate ordering instrument is required for estimating the green assembling rate-per-part of non-customary assembling forms engaged with any enterprises[3]. To assess a green assembling procedure and item, one needs to recognize the potential wellsprings of contamination and pollution, which to be utilized as ordering boundaries[4]. Ozone depleting substances, destructive discharges produced by material preparing and waste removal are critical piece of making natural contamination that may prompt hurtful results to our future. Every one of these variables is set as Green Manufacturing Index boundary for a reasonable assembling. Furthermore, deciding the presentation of green assembling process, the GMI will assist with keeping up the nature of green modern items by estimating distinctive green assembling rate/division at different periods of creation.

2. Background of Machining Process and Its Classification
Manufacturing has been begun from a little scope creation line in 1800s. Its development to huge scope from past century since the interest of vitality has expanded whiles natural worries to change over greener has become a huge theme in the examination field to grow more reasonable items locally and for worldwide social orders [2]. Since 2011, explores in endeavor of finding the arrangements concerning the green assembling in different fields have been taking spots. It has been recommended to embrace Added substance Assembling (AM) forms like 3D printing to rehearse green procedure as it spares materials and diminishes creation steps. In their recognition the green assembling can be rehearsed by, decreasing the expense of crude material, that is by utilizing less vitality and reusing squanders rather than purchasing new materials for creation. There are numerous sorts of manufacturing forms accessible in the industries to create a few kinds of parts by casting, framing and different molding form. The most significant procedures is a Machining that is used to create finished products such as turning boring drilling with high precision and surface quality. Machining forms further can be isolated into two classifications relying on the technique for tool utilized for cutting of material. The traditional machining process is mostly used for the removal of materials by using tools. With nontraditional machining, ceramic production and composites can be machined with less harm, more intricate shapes can make, low-inflexibility structure can be delivered, small scale machined parts with tight resistances and fine surface quality with minimal effort can be acquired.

3. Traditional and Non Traditional Manufacturing Process
Machining is a procedure that is utilized to deliver completed items with a serious extent of exactness and surface quality. There are numerous sorts of assembling forms accessible in the manufacturing to deliver a few and complex kinds of parts through throwing, machining framing trim, molding and joining process. Machining forms further can be ordered basically into two classes relying on the technique for apparatus utilized for cutting or for and its grouping is appeared in [Figs1]. The customary machining process is for the most part utilized for the expulsion of materials by utilizing apparatuses. For instance in granulating machining process there is high volume of crushing wheel worn per unit of volume metal expelled, there is confinement in pounding process as its evacuation of material per unit of volume can't be reached out after a specific breaking point. Accordingly so as to satisfy the imperative need of market for profoundly mechanical and progressed designed material items nontraditional machining procedures are obtained. Traditional manufacturing process includes turning milling planning, shaping. And in non-traditional process involves chemical machining, electrochemical machining, laser beam machining.[Fig.1]
4. Principles of Green manufacturing
To reach up to the good environmental stage in manufacturing, it is necessary to provide the right attitude to get most important thing for both principles accentuate the estimation of the manufacturing based on product life cycle and measures[5] In green manufacturing the aspects can be taken into consideration that, both principles exhibits a strong significance on energy and environmental emission issue

5. Generating Green Manufacturing Index (GMI)
By improving the manufacturing processes we can enhanced the production cycle due to environmental impact. in order to save the environment following factors must be taken into account like 3R (Reduce, Reuse, Recycle)[8] and saving of material or by replacing the materials for a longer term. From last decades it has been observed that there are lot of stress on environment and also due to use of harmful products it has been studied that in order to have sustainable future one must be able to look beyond some other alternative and here comes the fundamentals of GMI which is now a days gaining popularity among the industries[9]. Following are some of the important objectives of GMI:
1. The primary goal of green Manufacturing is to prevent pollution & conserve energy. This can be possible only by reducing or completely eliminate the hazardous products used during manufacturing processes.
2. Every industrial units when it comes to GMI should be conserving natural resources for future generations.
3. By taking concrete steps we can think upon some policies on GMI and determine the product value based on GMI
4. Overall the conclusion is based on the product cost its different process and the life span.

Figure 1. Classification of Machining Process
From C.Y. Jian, "The Role of Green Manufacturing in Reducing Carbon Dioxide Emissions"
6. Concept of Applying Green Manufacturing Index in an Industry

The following fig[2] shows the conceptual development of GMI. In such Model examples fundamental elements that causing impacts for benefit of industry can be made also adverse environmental impacts can be reduced. The essential recipe of, A Grouping Technology strategy can be utilized to create a special record number given to each broad g-code type. By realizing this list number of g-codes utilized in any machining procedure the Green Manufacturing Index can be distinguished by contrasting the outcomes and yield of machine. The GMI centers around impacts brought about by machining process and can be created by figuring significant information sources and its yield result given to a machine. Numerical mastery are required to comprehend the bigger framework information which includes a ton of upstream and downstream procedure information that makes the general framework hard to coordinate. In this manner, a simple widespread strategy is created, known as Green Manufacturing Index (GMI) that can be actualized into any assembling plant or procedures to recognize how much the green creation cycle is included.[11] The general two significant sources of info given to a machining procedure are: Water/Oil and Power (Electricity); and the two general yields of a machining procedure are: Waste and CO2 outflows. While by changing over these information/yield of machine into the applied model of GMI; Water/Oil, Waste, Energy and CO2 outflows assumes a significant job to drive the list bar.

| Table 1. Principles elaborating green manufacturing |
|---------------------------------------------------|
| Definition of Principles | Elaborations |
| 1. The intrinsic non-hazardous rather than circumstantial | Aim is to insure that input and output of the energy and all material constitutionally non dangerous |
| 2. Prevention is Better than cure | Waste is nothing but the improper use of process and energy, it is better to avoid production of waste rather than retreat or clean up waste after its generation. |
| 3. Design for separation | More amount of material and energy is utilizes for product purification and separation. So while designing it is considered that less amount of material and energy should be utilized |
| 4. Output-pull | Consumption of material and energy should where there is a demand from customer. If no customer demand is there, no production. |
| 5. Expandmass,vitality, existenceA process is considered to be more efficient when there is a maximum utilization of resources like energy, space and time to get more efficiency. To avoid waste, space and time can be used with mass and energy. Design of process, product and system should be in such a way that there should be maximum efficiency from mass, energy, space and time. |
| 6. Meet need, minimize excess | The system should not be overdesign it increases material and energy cost. Design should be proper to avoid design flaw and unnecessary capability |
Durability rather than immortality

To avoid environmental problem, product life should not be beyond its commercial life. Expected lifespan should be considered for product design. For product design Durability must be targeted rather than immortality.

Conserve complexity

To avoid reuse, design should be simple. Without changing available manufacturing process, the material used is having complexity benefit. The point of view of complexity and embedded entropy is an investment when making design choices on recycle, reuse, or beneficial disposition.

Coordinate neighborhood material And vitality stream

This is pivoted on recovery of existing process on heat and material. Products, processes, and systems design must include integration and interconnectivity with available energy and materials flows.

Minimize material diversity

To promote disassembly and value retention material diversity should be minimum material diversity in multi component products.

Renewable rather than depleting

Recycle/renewable source is nothing but the utilization of waste product as a feedstock from process. For recycling, renewable resources are used. Material and energy inputs should be renewable rather than depleting.

Design for commercial “afterlife”.

The recycle elements enables the current products to utilized in next generation product which is recycling element and integrated into product design. Products, processes, and systems should be designed for performance in a commercial “afterlife”.

7. Simplifying Green Manufacturing Principles to Motivate GMI

Table 2. Optimize GMI Principles

| Principles | Description |
|------------|-------------|
| To evaluate and improve the production process from a green perspective, a comprehensive approach to the systems must be used. | Principle 1 takes into account the environmental effects, since the effects could have arisen from the process itself. |
The system should be perceived completely in both vertical and horizontal directions. Vertical alludes to framework differing level of detail starting from the enterprise to the procedure while flat alludes to the framework at a similar degree of detail. This methodology is significant as ecological effect can happen contingent upon the degree of detail.

Noxious machine input and output to the atmosphere and humans should be minimized or removed. Distinguish hurtful info and yield to be supplanted with material that has a lower sway. An elective path is to actualize reuse, reuse and reproduction to decrease destructive info required.

Effective use of capital will be reduced. Utilization of net resources should be less or nearly zero so that rate of refilling in the environment should be equal as that of resources used.

Temporary impact on the framework also to be remembered. Time based effect is nothing but the temporal effect. In design stage it is necessary to consider environment impact to allow better ability to consider for an alternative in reducing the future effect.
Figure 2. Concept of Applicability of GMI in Industries
(W. Thurner and V. Roud, "Greening strategies in Russia's manufacturing from compliance to opportunity," Journal of Cleaner Production (Elsevier))

8. Economic policies in the form of the financial analysis and the effect on society
The effect of Economy attributable to assembling procedure in the setting with money related viewpoint and cultural perspective can decide the zones of benefit achievement or progression for organizations to seek after. This is especially valid for those nations trying to additionally build their creation forte. This would be material to the individuals who have just done well in large scale manufacturing. Green assembling list application examines the disturbance in assembling brought about by the new assembling and structure openings. The paper centers the monetary status encompassing GMI, including the set up and transformed financial models that help various advances in current condition. Beforehand organizations have consumed on the fruitful technique for diminishing inconstancy in configuration, to amplify on the monotonous creation of exchangeable parts, following the DFM advantage offered by conventional assembling strategies going back to the 1990s. The fast improvement in transportation brought about by the presentation and progression of advanced advances, brought low-wage nations, for example, China, onto the world phase of serious assembling. Then again, GMI offers adaptability which empowers makers to make an ideal structure for lean creation, offering creation adaptability, to sum up, the audit states GMI is savvy for low-volume/little bunch producing with proceeded with brought together assembling instead of circulated fabricating. At present, research models reason that while there is a costly beginning speculation for
machine and individual costs, circulated creation. In any case, GMI created can be received procedure with expanded robotization and diminished machine costs, disseminated creation may turn out to be increasingly doable.

9. Quality Control and Quality Assurance Owing To Green Manufacturing Index
Quality Control and Quality Assurance are two key purposes of accuracy fabricating Standardization of the items. A significant adaptability of GMI offers is the kind of item which will be utilized that is fit for reason the intricate geometry, inner grid structure, surface completion, layer direction and geography advancement, all add to the mechanical inclination of a GMI part. Quality is measured and qualified distinctively relying upon the part delivered. The primary discovering is to Check and Inspect Mechanical Material Deliveries On the place of work according to Consultants Specification and material Submittal Approval, To present all investigation documentation, To produce a Checklist for the Inspection of Mechanical Installations with the General Contractor and Consultant, To check the Workmanship of the Installation as indicated by Standard Methods, To check the General Mechanical Plans, Comments from Consultant on the Mechanical Shop Drawings, Mechanical Revisions and Additional Site Instructions from the General Contractor, To organize with the Mechanical CAD Designer, Supervisors, Foreman and Project Manager in regards to the Site Implementation and Mechanical Material Sample Submittals, To submit month to month Progress Report Photos of every single Mechanical Installation to the General Contractor according to site conditions, To assess the Quality of Mechanical Equipment according to the Specification to be introduced nearby, To review the Quality of Mechanical Methodologies to be utilized during Testing and Commissioning, To dissect the Input for the Submission of Operation and Maintenance Manuals, To break down the Input for the Submission of Mechanical As-assembled drawings and Project Close-out Punch list.

10. Advantages of Applying Green Manufacturing Index
1. The obvious benefit of applying GMI in terms of environmental effects is that material and resources quality are less expended
2. With this also reusing the scrap for proper utilization of resources
3. Cost effectiveness in terms of optimized process
4. By Applying this, there will be minimum emission of harmful gases in the air
5. Definitely it will require less maintenance so one don’t have to involve a lot of investment to operate it.
6. Can slow the impacts of a dangerous atmospheric deviation by decreasing CO2 discharges.
7. Renewable means it will never run-out.

11. Discussion
Green Manufacturing innovation infers to a framework that utilizes inventive techniques to make condition neighborly items. Primarily, it contains different ordinary cleaning items, vitality sources, creations, reuse and reuse squander. Practicing environmental safety and utilizing innovations that are inviting to the earth is among the numerous ways that nations are investigating so as to prod monetary development and improve the lives of its residents. Green innovation utilizes sustainable characteristic assets that never exhaust uses new and creative vitality age procedures. The paper discusses the capacity of Green Manufacturing innovation and producing GMI to contend or add to build up customary assembling advances. Items are being reconfigured to utilize less dangerous substances, require less transportation material, and work on less vitality and advance finish of-life reusing. So as far as natural maintainability, the innovation enterprises are grasping change henceforth an attempt for changing to dodge negative outcomes of conventional manufacturing or to fulfill green need or to accomplish both is been done hence efforts for moving toward green has been accomplished.

12. Conclusion
A developing number of market members and clients interest for green innovation. Strong waste and the emanation of ozone depleting substances are the principle worries as a feature of conversation, this
require the ascent for building up the green assembling list. The benefits of proposed GMI philosophy incorporates the framework that can be actualized in any production line from small to huge scope particularly for those enterprises running with old age hardware; the introduced GMI is adaptable to be embedded on these old machines and the GMI structure is adaptable to receive by both the customary and non-conventional machining forms, the individual measured GMI structures can be executed at any procedure industry like development, mining, food, building the board and so forth.

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