SMART MANUFACTURING: A BOON FOR INDUSTRIAL PERSPECTIVE
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Abstract: In this developing digital technology of manufacturing industries, the approach of Smart Manufacturing fosters the concepts of traditional industrial systems. The world is confronting a huge fourth industrial revolution with being overwhelmed by the infiltration of web advances into smart manufacturing conditions and change in perspective from hierarchic creation to self-association and self-improvement on the assembling floor, progressive adjustments done in quality control. In last years, several reference models had described the concepts of smart factories but had gaps in their research. This paper focuses the concepts and understanding of Industrial Revolution 4.0 or Smart Manufacturing and quality management practices and promotes for future research.

Keywords: Smart Manufacturing, Industrial Revolution 4.0, Business Transformation, Intelligent Manufacturing System

Introduction
The beginning of the original Industrial Revolution have started around 1760 nearly 260 years earlier. The hierarchy of the industrial revolution was developed in the form of steam power and the power loom in the first revolution; the assembly line contributed as the second industrial revolution; and the automation and data enhanced automation came onto existence during the third industrial revolution during 1970s. Recently through the fusion of physical, biological and digital world, a new revolution came into existence which is known as fourth industrial revolution. The latest iteration of this process, the fourth industrial revolution, has been called "smart manufacturing" in the United States, while in Europe it's known as "Industry 4.0. In addition to this, there exist numerous technologies that aids enabling smart manufacturing which includes:

- Machine learning/ Artificial intelligence (AI) – It authorizes automatic decision-making based on the heap of information that manufacturing companies collect through interpretation of information.
- Driverless vehicles/Drones – It increases productivity by decreasing the needed worker's number to move vehicles across a facility.
- Blockchain – Blockchain’s benefits a pace and capacitive way to record and store data, including immutability, traceability and disintermediation.
- Edge computing – Helps manufacturers turn massive amounts of machine-generated data into actionable data to gain insights to improve decision-making. To accomplish this, it uses resources connected to a network, such as alarms or temperature sensors, enabling data analytics to happen at the datasource.
- Predictive analytics – For improving forecasting, companies analyzes the data collected from all their data sources to anticipate problems.
- Digital twins – To boost efficiency and productivity, company uses digital twins to replicate their processes, networks and machines in a virtual environment, then use them to predict problems.

Smart Manufacturing is a paradigm for promoting the traditional manufacturing of HDD towards smart manufacturing with advanced IT technology, consequently there is a tremendous interest of experts with mastery in IoT, Big Data, Cloud Computing, and Cyber Security to keep refreshing their representative's information level inside the quality administration territory to coordinate with the speed of innovation advancement.

Moreover, by having different information in the actual innovation will give a huge effect on the enterprises which upheld by Kang, Lee et al. (2016) that referenced, "it is an assortment and a worldview of different advances that can advance an essential development of the current assembling industry through the combination of people, innovation, and data". Savvy producing makes processing plants more canny, adaptable, and dynamically outfitting fabricating with sensors, entertainers, and self-sufficient frameworks (Roblek et al. 2016). They recommended that "machines and hardware will accomplish undeniable degrees of self-streamlining and automation. Moreover, the assembling interaction has the ability to satisfy more intricate and qualified norms and prerequisites of items, true to form" (Roblek et al. 2016). Hence, clever production lines and savvy fabricating are the significant objectives of Smart assembling (Sanders et al. 2016). Savvy fabricating makes esteem added reconciliation happen evenly and vertically in the assembling interaction (Shafiq et al., 2016; Stock and Seliger, 2016). The even method is incorporated with the steam creation modules from the material stream to the coordination of the
item life cycle, while the vertical strategy incorporates the item, hardware, and human requirements with various total levels of the worth creation and assembly frameworks. They incorporate knowledge and digitization from the crude material securing to the assembling framework, item use, and the finish of item life. Lasi et al. (2014) tracked down that Smart assembling drives fabricating in two ways: the application-pull methodology and the innovation push strategy. The previous instigates dynamic changes brought about by another age of modern framework. The last requires the more significant level automation, digitalization and systems administration, and scaling down. An investigation directed by Albers et al. (2016) broke down quality-related creation with a keen condition checking based quality control framework and built up a thorough spellbinding model. To accomplish straightforwardness and profitability of large information, Lee et al. (2014) address the patterns of assembling administration change and the preparation of savvy prescient informatics apparatuses. The prognostics-observing 162AStudyofQualityToolsandTechniquesforSmartManufacturingsmartassemblyinMalaysiaframework is a pattern of the brilliant assembling and modern huge information climate (Lee et al. 2014; kumar et al.2015). Cuihua et al. (2016) present a novel way to deal with improving on the booking issue of occupation shop planning by utilizing RFID to gather constant assembling information. Thus, Scheuermann et al. (2015) portray a spry plant model that moves nimble computer programming strategies to the space of assembling; they additionally propose a framework that portrays the effect and possibility of client changes during get together time. Paelope(2014) presents an enlarged reality framework that upholds human laborers in a quickly changing creation climate.

S. Wang et al. (2016) analyze the connection between lean creation and wise assembling and propose a lean insightful creation framework (LIIPS) to improve item quality and productivity and to decrease costs, in Industry Albeit few analysts showed no critical contrast related with apparatuses and strategies between assembling businesses (Fotopoulos and Psomas, 2009; Sousa et al., 2005), a few different investigations uncovered the distinction between the two enterprises dependent on the need determination of various instruments and methods (Antony et al., 2007; Antony and Banuels, 2002; Nicols, 2006). An illustration of this, an examination led by Yau (2000) uncovered that “the assembling business regularly utilized the seven fundamental quality control instruments, acknowledgment testing, and interaction ability, though the help business utilized benchmarking, Gantt diagrams, and quality circles the frequently”. Reliably, an investigation led in the Saudi food industry by Alsaleh (2007), backed that see by calling attention to that control outlines, histograms, and run graphs were apparatuses and methods utilized regularly. All in all, fabricating associations all the more frequently apply quality improvement apparatuses and methods (TariandSabater, 2004). Thusly, Burchercetal.(2006) asserted that “albeit quality directors in Britain and Australia have extremely restricted abilities in numerous quality apparatuses and methods, they don't pay a significant exertion to improve their insight in that space. They don't utilize the most current quality instruments and procedures, and they are maybe not even mindful of them. Quality chiefs in these two nations for the most part utilized an exceptionally thin assortment of instruments and strategies, which comprised of conceptualizing, control outlines, and Pareto examination”. The more encountered an association partner with happily the quality administration, the more propensity it needs to utilize diverse quality apparatus and procedures, the better exhibition it gains, paying little heed to its size (Ahmed and Hassan, 2003).

Smart Manufacturing (SM) is a technology driven methodology that uses Internet-associated apparatus to monitor the production process. The objective of Smart Manufacturing is to recognize openings for computerizing activities and use information investigation to improve fabricating execution. Smart Manufacturing is a particular application of the Industrial Internet of Things (IIoT). Organizations include implanting sensors in assembling machines to gather information on their operational status and execution. Previously, that data regularly was kept in nearby dataset on singular gadgets and utilized uniquely to evaluate the reason for a failure that happened. Presently, by investigating the information gushing off a whole processing plant of machines, or even across different offices, producing architects and information experts can search for signs that specific parts may fail, empowering preventive support to keep away from unplanned downtime gadgets. Producers can likewise investigate patterns in the information to attempt to spot steps in their cycles where creation eases back down or is wasteful in their utilization of materials. What's more, information researchers and different experts can utilize the information to run recreations of various cycles with an end goal to distinguish the most effective methods of getting things done. As brilliant assembling turns out to be more normal and more machines become arranged through the Internet of Things, they will be better ready to speak with one another, conceivably supporting more prominent degrees of automation. An absence of principles and interoperability are the greatest difficulties keeping down the more noteworthy reception of smart manufacturing. Specialized norms for sensor information still can't seem to be comprehensively embraced, which restrains various types of machines from imparting information and conveying to one another adequately.
Advantages of Smart Manufacturing

Smart manufacturing offers various advantages, including improved efficiency, expanded productivity and long haul cost investment funds. In a smart industry, efficiency is constantly improved. On the off chance that a machine is hindering creation, for instance, the information will feature it, and the man-made reasoning frameworks will attempt to determine the issue. These incredibly versatile frameworks empower more noteworthy adaptability. As far as effectiveness, one of the primary investment funds comes from the decrease underway personal time. Current machines are regularly outfitted with distant sensors and diagnostics to make administrators aware of issues as they occur. Precisely, innovation can feature issues before they happen and find ways to moderate the monetary expenses. An all-around planned smart plant incorporates mechanization just as human-machine cooperation, includes that empower operational productivity. Brilliant assembling, then again, is a community oriented, completely incorporated assembling framework that reacts progressively to meet changing the conditions and requests in the manufacturing plant, in the stock organization, and in the necessities of the clients. The objective of smart manufacturing is to enhance the assembling cycle utilizing an innovation driven methodology that uses Internet-associated apparatus to screen the creation interaction. Smart manufacturing empowers associations to recognize openings for robotizing activities and use information examination to improve fabricating execution. Then again, it likewise significantly affects quality execution in the Industrial Revolution.

The key elements recognized, to be specific, information on quality instruments and methods, industry 4.0, climate, consumer loyalty, ceaseless improvement, and provider association. The climate of Industry 4.0 assumes a significant part in conveying the assistance and organizing information. For smart manufacturing approach in industries balancing of the Assembly Line is a major factor which needs to consider. To optimize the assignment, Assembly Line balancing is used as a tool to assign operations to workstation, everyone is doing the same amount of work, No one overburdened, No one waiting. Everyone working together in a BALANCED fashion. Line balancing is the most important thing to ramp up the production. Line balancing mainly depends on 3M (Muda, Mura and Muri).

- **MUDA-Waste**
- **MURA-Inconsistency**
- **MURI-Overburden**

Importance of Line Balancing

When line is not balance then production rate reduces as well as there is reduction in quality. It simply shows a couple of examples of when a line is not balanced – highlighting the overburden by some operators and the waiting of others. We can also point out how inventory is being built up. Large batch quantities create inventory and waiting which leads to longer process creating an imbalance which then creates waiting and inventory.

There are three broad types of waste: Muda, Muri and Mura. This list can be reduced only to first waste type for lean implementations with corresponding reduced benefits. To illustrate this thinking, Shigeo Shingo observed that only the last turn of a bolt tightens it—there is just movement. To establish this thinking, Shigeo Shingo observed that only the last turn of a bolt tightens it—there is just movement. To establish distinctions between value-adding activity, waste and non-value-adding work very fine clarification is required. Non-value adding work is waste that should be done under the present work conditions. To exemplify the change effects achieved and the movement towards the goal, one key way is to measure, or estimate the size of these waste. All irrational work that management inflict upon workers and machines due to impoverished organization such as carrying heavy weights, moving things around, dangerous tasks, even working significantly faster than usual comes under Muri. It is pushing a person or a machine beyond its natural limits. This method asking a higher level of performance from processes it cannot handle without taking shortcuts and informally modifying decision criteria. Unreasonable work is almost always a cause of multiplications.
An easy way to remember the 7 wastes is TIMWOOD:
- T: Transportation
- I: Inventory
- M: Motion
- W: Wait
- O: Over-processing
- O: Over-production
- D: Defect

The 5 ‘S’ Methodology

5S is Seiri, Seiton, Seiso, Seiketsu, and Shitsuke are Japanese words used in organisation. Transliterated or translated into English, they all start with the letter “S”. The list describes how to organize a work space for efficiency and effectiveness by

1. **Seiri** (Sort)
   - Remove unnecessary items and dispose of them properly
   - Eliminating obstacles to make work easier
   - Reduce chance of disturbing with unnecessary items
   - Prevent collection of unnecessary items
   - Estimate requisite items with regard to dept./cost/other factors.

2. **Seiton** (Straighten or Streamline)
   - Arrange all necessary items for easy picking for use
   - Avert loss of time
   - To ease finding and picking up necessary items
   - Ensure first-come-first-serve basis
   - Smooth and easy flow of work.
   - Can also be translated as “set in order”

3. **Seiso** (Shine)
   - Immaculate your workplace fully.
   - Use cleaning as inspection.
   - Prevent machinery and equipment waning.
   - Keep workplace easy and safe to work
   - Can also be translated as “sweep”

4. **Seiketsu** (Standardize)
   - Maintain high standards at workplace organization all times.
   - Maintain cleanliness and orderliness
   - Maintain everything in order and as per its standard.

5. **Shitsuke** (Sustain)
   - To keep in working order
   - Also translates to “Self-Discipline” meaning to do without being told.
References


