Class Topic Descriptions

These topics are available as both Multi Short-Topic Courses and Single Full-Topic Courses

Continuous Improvement - Kaizen is based on the theory that a series of small improvements can result in a radical positive change in business processes. It seeks improvements in productivity, production effectiveness, quality, safety, and waste reduction, while using inventory and employee skills more efficiently. Kaizen offers a scientific approach to continuous improvements by employing specialized tools, and it incorporates business values into improvements. Kaizen encourages the input and creativity of all employees in implementing changes.

Failure Mode Effect Analysis (FMEA) is designed to assist the manufacturer to improve product quality and reliability, provide for early identification and elimination of potential product/process failure modes, to document risk and take actions to reduce risk, prioritize product/process deficiencies, and minimize the need for late design and process changes which can be very costly.

Gauge Repeatability & Reproducibility (GR&R) is a study that determines if the precision of a measurement system being used is adequate to meet the customer's requirements as described in the product specification. The study also helps determine what needs to be corrected if the system is not trustworthy and provides information regarding where the issues are. Based on this information, efforts can be made in order to improve the system. Without a trustworthy measurement system, non-conforming product could be sent to the customer, while conforming product may be rejected and scrapped. Calibration is about equipment accuracy, while GR&R is about precision. Both methods are equally critical for production.

Overall Equipment Effectiveness (OEE) is a KPI measurement tool used worldwide, whose growth of usage has been exponential. OEE measures percentages of machine availability, throughput performance, production quality, and combines these metrics into one overall value, OEE. It is very important to know whether a production process is efficient or inefficient, and how it can be optimized. The OEE allows the quantification of efficiency and

the uncovering of the actual operation of the production processes. This information is crucial, because with it, one is able to take appropriate measures to obtain improvement. Only what is measured can be managed and improved. OEE is a very effective KPI metric to use in the pursuit of a lean six sigma manufacturing operation. By implementing an OEE process, manufacturers are provided with a system that alerts them of a decline in equipment availability, performance, and the quality of the parts produced.

Root Cause Analysis (RCA) utilizes resources and tools as efficiently and effectively as possible for problem solving and resolution. Companies can find themselves in an unending reactive state known as “firefighting” when RCA is not employed. Firefighting can appear useful in the short term because the “fire” is put out. It is, however, highly ineffective when it comes to preventing reoccurrence, since the source/root cause of the problem still requires elimination. Firstly, clearly identify the problem. Then employ RCA tools such as flow charts, brainstorming, 5-Whys, Fish-bone diagrams, and fault trees to assist to pinpoint factors (the basic causes) that contribute to the problem, and obtain the information necessary to find the actual cause (root cause) of the problem. The benefits of RCA are that the root cause itself is identified, and that tangible evidence of cause and effect are determined. From this, the subsequent corrective action can be formulated and executed to eliminate the issue.

Safety and Ergonomics program requires that an employer provide a safe and healthful workplace for employees by keeping it free from recognized hazards or provide the means to control such hazards that cannot be eliminated. The employees’ capabilities and physical limitations must be considered and matched with the right tools and equipment to provide safe working conditions. Ergonomics can prevent injuries related to work (headaches, eye strain, muscle aches, etc.) which also maximizes on productivity in addition to safety. Three levels of safety controls are: Engineering Controls that implements change to eliminate, substitute, or reduces the hazard; Administrative Controls that establish efficient processes or procedures to ensure safety, and Personal Protective Equipment (PPE) to provide protection from hazards when no other means is available.

Standard Work ensures that work is done according to the current state and simplifies and speeds training and on-boarding. Documented and clearly defined instruction provides consistency which is an essential ingredient of quality. Errors and unnecessary waste are often the results of work that is not done according a carefully constructed standard. Standard Work makes

results more predictable and measurable. When the process or task produces the same outcome every time, one can better predict results and control the flow of work and items through the value chain. Standard Work also makes it easier to determine how much a particular process costs, and therefore what the price point on the product should be. Standard Work documentation must be changed, however, as necessary, with such changes approved in a formal change process.

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Bill of Materials (BOM) is a comprehensive inventory of the raw materials, assemblies, subassemblies, parts, and components, as well as the quantities of each, needed to manufacture a product. It serves as the foundation of production planning systems, and the information in it provides the basic data for other business processes, such as manufacturing resource planning, product costing, **material** provision for production and plant maintenance. There are three main types of BOMs: Manufacturing BOM, an Engineering bill of materials, and a Sales BOM (SBOM) defines a product in the sales stage, meaning details of the product prior to assembly. Here, the finished product is managed as a sales item instead of an inventory item.

Change Requests and Orders can originate from a variety of sources including Continuous Improvement initiatives, issues discovered in the product design or production process, supply chain issues, safety issues, etc. An Engineering Change Request (ECR) is the initial document used to propose an authorized change related to component and assembly drawings, processes, work instructions and specifications. If approved, the ECR becomes an Engineering Change Order (ECO) to implement the change. A Manufacturing Change request (MCR) is the initial document specifying proposed modifications to the manufacturing process or equipment. If approved, the MCR becomes a Manufacturing Change Order (MCO) to implement modifications. Any type of change request, if not managed properly, can be slow to implement, contain errors, and lack in visibility.

Cross-Functional Meetings are comprised team members with differing functional expertise from various departments in the organization, depending on the nature of the issue. The team works together toward the common goal of solving a specific problem. It should include employees from various levels of an organization.

Debrief Meetings are structured processes to discuss and evaluate what occurred during a particular event and then reflecting on what went well, what went wrong, and what could be improved in the future. Effective debriefings typically include the following essential elements: active participation with more than just the passive receipt of feedback, developmental intent focused on learning and improvement discussion of specific events, and input from multiple sources. Properly conducted debriefings can help organizations realize significant individual and team performance improvements.

First Article Inspection (FAI) is a design verification and design history file and a formal method of providing a reported measurement for each manufactured feature of a part or assembly. Typically, the supplier performs the FAI and the purchaser reviews or approves the report. The evaluation report consists of assuring all the properties and features are compliant to its specifications. The inspected article may not necessarily be the 'first' produced, but an item or random sample of parts from the first lot. First article inspection is typically called for in a purchase order contract between the producer and buyer of a manufactured article.

Key Process Indicators (KPIs) are often used in industry in order to assess and measure critical processes. These criteria are used to measure success relative to a set of predetermined objectives that align with and support the overall strategic plan. In the manufacturing industry, KPIs are used to determine manufacturing process metrics in order to access how well the manufacturer is performing compared to their goals. Several examples of such KPIs are on-time delivery, schedule attainment, total cycle time, throughput, and overall equipment effectiveness.

Lessons Learned Session should be held upon completing a project. For the first step, the facilitator should have the participants complete a project survey containing three key questions: what went right, what went wrong, and what needs to be improved. This will help the participants to be better prepared to respond during the session. The project survey should also include specific questions for each category. The project survey should then be organized by category so key information is not missed and will help to focus the discussion. Standard categories for each project should be defined and additional categories specific to a project can be added. These responses will be used by the lessons learned facilitator to guide the discussion during the lessons learned session.*****

New Product Introduction (NPI) utilizes a structured and well-planned process that companies use to successfully define, develop, and launch new or improved products to the market. NPI processes affect many teams, product lines, and supply chain partners that are required to design, develop, produce, test, and ship products as teams move from early concepts to prototyping and volume production. NPI aids in bringing the correct resources together at the right time. This process is generally driven and managed by a cross-functional team that keeps a check on every aspect of the project.

Packaging, Shipping and Logistics of manufactured industrial products, are extremely important. An appropriate amount of planning time must be invested. Poorly packaged product or improper logistics can result in unnecessary delays or damage. When a product reaches the customers dock damaged, it can be of significant concern. Often, there are many factors and issues that may need to be addressed before a product can be shipped. Technologies associated to shipping containers are identification codes, bar codes, and electronic data interchange (EDI). Reusable packaging is encouraged. Returnable packaging has long been useful and economically viable for closed loop logistics systems. Additional input regarding the actual design of your product which may compliment and reduce packaging and labor costs as well.

Roles and Responsibilities of the manufacturing personnel are specific yet intertwined with each other in a manufacturing business. It is essential that each staff member not only fully understands their own functions and duties of not only themselves but also with all others that they interface with. This includes Operations Manager, Quality Assurance Manager, Manufacturing Engineer, Quality Engineer, Production Planner, Quality Inspector, Operations Personnel, and Shipping Personnel.

The **Stages of Proof of Concept (POC) through Full-Scale Production** are vital periods in the manufacturing process. The POC is an exercise to test the design assumptions and to verify the concept. The next stage, Prototyping, involves the set-up, programming, and the use of appropriate equipment allowing the innovator to visualize how a working model of the product will function. A test run allows time to adjust process to increase efficiency and decrease costs. Next, a Pilot Run, a small-scale production run, allows observation of the entire manufacturing process again allocating time to make for further process adjustments. This is followed by a First Article Run & Inspection which is a formal method of providing data for the manufacturing

process. This is followed by full-scale production where the complete order is produced.

Takt Time, Cycle Time, & Lead Time differences must be clearly understood. Confusion can cause significant problems. Takt Time is the rate at which the production process needs to be completed to fulfill the customer's order. Takt Time equals the time between starting to work on one unit and starting the next. Takt time is based on customer demand and has nothing to do with equipment or worker's speed. Lead Time is the time from the receipt of a customer's order to the time when it is delivered to the customer. Cycle Time is the average time it takes to complete a product, i.e., the time it takes to work on a unit from start to finish. Cycle time is calculated by the total production time divided by the units produced.

Process Capability (Cp) and Process Capability Index (Cpk) are important metrics since once the capability of a process is understood and documented, this information can be used for determining whether the process is capable of making parts to meet the customers' specification requirements, as well as providing data trends to facilitate continual improvement and prioritizing the order of process improvements to be made. While Cp shows if the manufacturing process is capable of making parts within specifications, the value of Cpk additionally indicates how your process is centered between the specification limits.

Statistical Process Control (SPC) regulates manufacturing processes through the use of charting statistical data obtained by making various measurements on parts in the production process. Once the process upper and lower control limits (UCL and LCL) and the process mean are determined, SPC charts are used to monitor manufacturing data through various production processes in order to be able to recognize when processes are going out of control. Adjustments to the processing can then be made to reduce process variation. A decrease in this variation will lead to better quality, lower costs through reduction of waste, scrap, rework, and warranty claims. Some additional key benefits derived from SPC are maximized productivity, increased operational efficiency, decreased manual inspections, and improved customer satisfaction.

Make - Buy Decision is the act of making a strategic choice which influences the strategic thrust of the organization between producing an item internally (in-house) or buying it externally (from an outside supplier). In turn, this can

affect a firm's competitive advantage, and modify the types of alternatives considered in the planning process. Outsourcing is different in that it involves the hiring a party outside a company to perform services and create goods that traditionally were performed in-house by the company's own employees and staff.

Manufacturing Production Processes is required when a manufacturing company begins production of a new material, it has a choice regarding the manufacturing process it will utilize. The type of process depends on the facility, the staff, and the information systems available. Each process has certain advantages when comparing the tasks that need to be performed. There are four basic manufacturing processes to select from: Production Line, Continuous Flow, Custom Manufacturing, and Fixed Position Manufacturing.

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Intro to Applied Statistics is about how statistics is utilized. From this course you will learn how to apply statistical tools for the purpose of data analysis and problem solving without the need to understand the mathematical derivation of statistical formulae. Engineering, Quality, and Operations personnel use statistical models to gain an understanding and control of nearly all aspects of manufacturing operations. Understanding the statistical methods that make up the various analytical tools employed in manufacturing is crucial for correctly applying, running, and analyzing the resulting data obtained.

Conflict Resolution is needed when there are two or more divergent needs or perspectives. Businesses utilize conflict resolution strategies to resolve internal and external issues that affect their operations. In conflict resolution you work toward the WIN-WIN scenario where opposing sides are satisfied. Traditionally there are five methods of conflict resolution to move forward to address and resolve a conflict: Competing, Avoiding, Accommodating, Compromising, and Collaborating. Additionally, an Interest-Based Approach can be very successful for an reaching an amiable long-term solution. Also, it is essential to communicate with the opposition, brainstorm possible solutions, and explore alternatives, while continuing to build positive energy and trust.

Lean Manufacturing is a methodology that focuses on minimizing waste within manufacturing systems while simultaneously maximizing productivity and product flow. Lean principles also include building-in quality,

creating knowledge, and making decisions only when sufficient data has been obtained. Several of the benefits of lean manufacturing include reduced lead times, reduced operating costs, improved product quality, all providing for more efficient and profitable business processes.

Metrology is the scientific study of measurements. It ensures confidence when comparing measurements made at different locations in the world. Metrology is divided into three basic overlapping activities, the first being the definition of units of measurement, second using instrumentation to produce these measurements, and lastly traceability which is linking measurements made in practice back to reference standards. The specified dimensional tolerance on the part to be measured drives the level of precision needed for the measurement, and therefore, the selection of the type of device to be used. Metrology also ensures the maintenance, quality assurance, and proper calibration of the instrumentation. Several types of measurement instrumentation include steel rules, calipers, micrometers, height gauges, bevel protractors, plug thread gauges, dial indicators, optical comparators, gauge blocks, surface plates, profilometers, and CMMs.

Non-destructive Testing (NDT) is a powerful analytical tool that is widely used in industry to examine materials, components, and structures during and after the manufacturing process. In this testing, an input is provided, and a resulting response is measured and evaluated. From this output it is determined whether or not the quality requirements of the manufactured product are being met. NDT involves the use of non-invasive techniques for testing without interfering in any way with the integrity of the product or its suitability for service. Typical uses for NDT are external and internal flaw detection, dimensional measurements, microstructure characterization, chemical analysis, estimation of mechanical and physical properties, and material sorting. This method not only locates a defect, but it can also be used to obtain defect information such as its size, shape, location, and orientation.

Quality Management Tools are used to make informed decisions based on data to drive process and product improvements. When used correctly, they can assist in identifying issues, trends, and root causes efficiently and effectively, and eliminate problems for the long term. Judgement and theories must be based on data and fact to implement effective management of quality. And utilization of the quality tools ensures that your customers are delighted with your high-quality level of service.

Statistical Process Control & Process Capability: Statistical Process Control (SPC) regulates manufacturing processes through charting statistical data obtained from measurements on parts in the production process. SPC charts are used to monitor manufacturing data through various production processes to recognize when processes are going out of control. Adjustments to the processing can then be made to reduce process variation leading to better quality, increased efficiency, and lower costs. Process Capability (Cp) is an important metric since once the capability of a process is understood and documented, is used to determine whether the process is capable of making parts to meet the customers' specification requirements, and provides data trends to facilitate continual improvement.

Fundamentals of Metallurgy: Metals and alloys are the most widely used class of materials. They fulfill the greatest variety of applications of all the engineering materials. For those not formally trained in the discipline of metallurgy or possess only peripheral knowledge of the subject, the lack of understanding of the basics of metals and their physical and mechanical properties can lead to a number of potential problems with manufactured components. This is why it is crucial to have knowledge that includes an understanding of a metal's sub-microscopic structure, microstructure, physical and mechanical properties as well as the relationship between the various metal and alloy processing procedures and their effect upon the resulting material properties. Metallurgical knowledge is necessary for the design, quality assurance and the reliability assessment of manufactured components. In addition, this understanding is vital for the analysis of components that have failed in service or do not meet the requirements of the relevant material or process specification.