BY ORDER OF THE COMMANDER
AIR FORCE MATERIAL COMMAND

AFMC INSTRUCTION 21-137

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Maintenance

DEPOT MAINTENANCE PROCESS IMPROVEMENT

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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This instruction establishes policies and procedures for process improvement within all maintenance divisions at the Air Logistics Centers (ALCs). It also applies to the Aerospace Maintenance and Regeneration Center (AMARC). This instruction does not apply to United States Air Force (USAF) Reserve or Air National Guard (ANG) members.

Process improvement within AFMC is vital to becoming "World Class Depots providing the world's best warfighter support." Leveraging process improvement initiatives across the command requires standardized guidance, integration and tracking. Utilizing appropriate process improvement technique(s) in specific areas will ultimately result in an overall level of improvement that leads to "World Class" distinction. This process improvement instruction establishes a standard methodology by which Oklahoma City Air Logistics Center (OC-ALC), Ogden Air Logistics Center (OO-ALC), Warner Robins Air Logistics Center (WR-ALC), and Aerospace Maintenance and Regeneration Center (AMARC) will accomplish process improvement and become "World Class." This instruction applies to administrative as well as production processes.

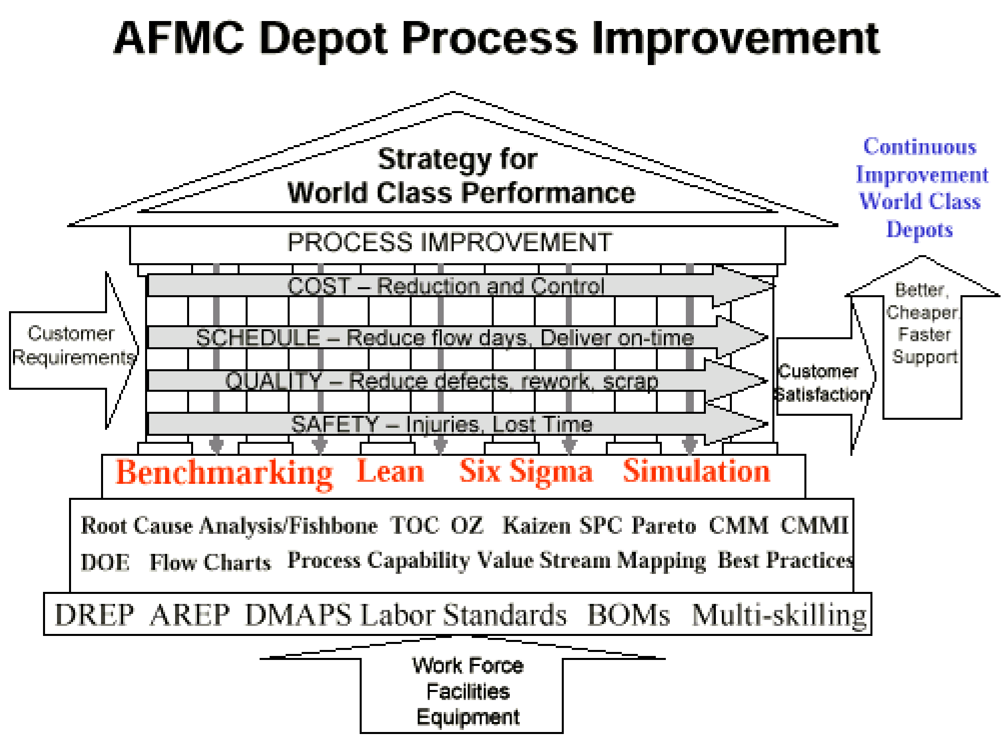
The purpose of this instruction is to document and implement a shared, standard process improvement program to continuously measure, analyze, and improve AFMC depot maintenance processes.

Chapter 1

OVERVIEW AND RULES OF ENGAGEMENT

1.1. Overview. The diagram below illustrates the AFMC process improvement strategy. The strategy begins with the input of customer requirements to the organization. Foundational support originates from the AFMC resources of work force, facilities, and equipment. Additional foundational support is provided by basic AFMC programs and processes such as Depot Repair Enhancement Program (DREP) and Bills of Material (BOMs). The core methods include Benchmarking, Lean, Six Sigma, and Simulation/Modeling. The tools that support these methodologies (such as Object Czar Depot Maintenance Analysis System, Pareto, etc.) are used to improve depot business processes in the areas of safety, schedule, quality, and cost . The output of this process improvement construct is better customer satisfaction made possible by better, faster, cheaper depot support. The end result is a "World Class" depot organization. **Attachment 1** for a list of definitions and for a list of reference material.

Figure 1.1. AFMC Depot Process Improvement.



1.2. Rules:

1.2.1. **Rules of Engagement.** This AFMC instruction provides a common approach and rules of engagement for process improvement. Depot organizations will implement process improvement initiatives under the guidelines of this instruction. Six Sigma, Lean, Benchmarking, and Simulation/Modeling methodologies are emphasized in this document as providing the core techniques available in the toolbox, utilizing the Process Improvement Model (**paragraph 2.1.**). The use of any method is authorized, however, as long as it is effective as measured in process improvement results. The selection of a process to be improved will be a natural function of depot leadership, based on leading metrics, recognized performance gaps, new technology, new requirements, customer inputs, etc. Benchmarking is one methodology that all Centers must utilize in addition to any other methodology or techniques they may be employing, in order to achieve the intent of "World Class". The goal is to meet or exceed customer requirements for schedule, cost, quality, and safety by becoming "World Class". See **Attachment 3** for information on process improvement methodology strengths and weaknesses. Center Operating Instructions (OIs) for process improvement are allowed and encouraged providing they comply with this instruction. Instructions should not be workload specific and should not drive singular application of one methodology over another. The core methodologies are complementary, and parallel use of more than one methodology to accomplish project goals is encouraged.

1.2.2. **Capital Investments.** Process improvement resource requirements will be rolled up at the ALC and HQ AFMC level to facilitate Program Objective Memorandum (POM) and budget exercises, as well as provide a reporting mechanism. Process improvement initiatives and/or studies that result in the recommendation of capital investments (investments in facilities and equipment costing $100K or greater FY03 and $250K starting in FY04, reference AFMCI 21-109) must be justified. Complete documentation to support costs and benefits is required using a formal business case analysis and/or economic analysis.

1.2.3. **Benefits and Savings.** Process improvement results must be tracked and recorded in the Command corporate repository on the LGP Web Page (**paragraph 1.2.6.**). Metrics will be tracked and entered indicating the effect of the process improvement on the applicable business process.

1.2.4. **Building the Improvement Team.** Process improvement team members must have a thorough understanding of the process being studied and the tool being applied to improve it. Some members, such as facilitators skilled in various process improvement tools, move from project to project. Other team members, such as process owners, are considered core team members, and must remain with the improvement project team until completion. Process owners are considered to be the managers responsible for the process implementation and sustainment of the agreed process improvement plan. Leadership is the foundation of a healthy and functioning continuous process improvement system. Senior leadership support is absolutely necessary to ensure successful implementation of continuous process improvement. The team should have a champion, usually in management, who is empowered to make decisions. The team must be empowered and supported by management in order to be provided the time to conduct the study, build an implementation plan for change, and effect the change. Many factors may affect implementation; therefore, management must follow up on the results with immediate action, a plan of action, or justification why the result should not be acted upon.

1.2.5. **Baselining.** It is critical that key processes are analyzed/measured as a prerequisite to process improvement. Process selection can be made using customer interviews and feedback, metrics, quality assurance documentation, statistical process control (SPC) data, value stream mapping, etc. The optimum target process is one that is truly significant, will provide a worthwhile return on investment, and is achievable in a short period of time. The process should also be stable and not undergoing change from another effort. Once a process is selected, current operations must be baselined and documented so that the effects of change can be assessed (See **paragraph 1.2.3.**). SPC , process capability analysis, and value stream mapping are important tools for determining process stability, capability, and documenting the baseline flow and performance measures. The process baseline document must be maintained as future changes are made. It is also very important to have completed sufficient baseline analysis to ensure that all aspects of a process are within the span of control to change. If a critical portion of the process belongs to another organization, effecting change will be more difficult. In those cases where more than one process owner is involved in a study, and each or all may be responsible for poor performance of the initial process, each sub-process or portion of a process affecting that poor performance should be considered for improvement. See **Attachment 2**.

1.2.6. **Process Improvement Web Page and Tracking System.** A Web Page is located at **https://www.afmc-mil.wpafb.af.mil/HQ-AFMC/LG/lgp/lgpq/benchmark/index.htm**. The web page is a source for policy memos, training material, trip reports, briefings, POC phone numbers, best practice links, OZ DMAS link, and the corporate data repository of process improvement projects. Tracking and documenting change is essential.

1.2.6.1. Repository. A standard Command database exists at the web site to document all process improvement studies and external benchmarking projects. The database has standardized data fields and metrics input forms to ensure data is entered in a consistent manner. Instructions are provided at the web site. Each process improvement team at the ALCs and AMARC is responsible for ensuring that data collection is accomplished and the data is reflected in the Command process improvement web page database. The team enters the data, and the MAPs provide support, with monthly reviews to assist and ensure that the database is valid. This will facilitate cross-flow of information across the ALCs, aggregate business case assessments, provide lessons learned, provide opportunities for internal benchmarking, and ensure a standardized reporting system. The vision is to have a common entry portal so Centers can add and update project information in the database.

1.2.6.2. Web Page Links. The Command web page is linked to the ALC process improvement web pages. Each ALC will implement a process improvement web page. The center web pages shall be linked to the AFMC Process Improvement web site. Current Headquarters and ALC POCs are provided at the website. The AFMC approved Process Improvement CONOP and related policy memos are available for downloading. Best practice trip reports, studies, and database links are available. The latest training material and briefings are loaded for ALC use and information. A hyperlink is available to access the OZ DMAS data system. The website will be maintained by HQ AFMC/LGP.

1.2.7. **Education and Training.** Education and training are essential to the implementation of process improvement. Before use of a particular process improvement tool, education and training on the use of that particular tool is required. There are five main areas of training that will be targeted: Benchmarking, Six Sigma, Lean, Simulation/Modeling and OZ DMAS. Senior leadership will be provided an executive overview course, and all main areas will be covered, with particular emphasis on Benchmarking, Lean, and Six Sigma. The intent is to provide enough training to ensure knowledge of what the work force is using and why. All center employees must have rudimentary understanding of process improvement and of the Command's objectives. Each ALC will develop a core team of training managers, instructor(s), and mentors in process improvement methodologies. A limited core number of personnel may require extensive training in several areas, in order to recognize when and how to apply the different tools and techniques. Team members will require more targeted training, specific to their team responsibilities, and timely to a pending process improvement initiative. Training will be centrally managed and funded by HQ AFMC/LG. Training will be provided to the centers, which will supply personnel to be trained. ALCs may continue to provide their own training, in addition to the standard training provided.

1.2.7.1. Benchmarking, Lean, and Six Sigma training objectives are as follows:

1.2.7.1.1. Train the workforce and change the culture through standardized training.

1.2.7.1.2. Inform depot maintenance employees within AFMC of the necessity to improve our depot maintenance operations and performance in the areas of cost, quality, and schedule.

1.2.7.1.3. Inform depot maintenance employees that process improvement tools and procedures are standardized for the command, and that the primary methodologies, for which standardized training is being provided, are Benchmarking, Lean, and Six Sigma.

1.2.7.1.4. Provide overview training to depot maintenance employees about how these process improvement tools work and when they should be applied.

1.2.7.1.5. Provide more in-depth training on the processes/tools of each of the improvement methodologies to a limited number of depot maintenance executives, managers, and supervisors on an initial and ongoing basis. This training will cover all three methodologies.

1.2.7.1.6. Provide extensive training on each of the improvement methodologies to a limited number of depot maintenance practitioners on an initial and ongoing basis. This training will cover all three methodologies.

1.2.7.2. Benchmarking, Lean, and Six Sigma training will accomplish these objectives through tailored training courses that will address overall process improvement, executive, team member, and process owner training.

1.2.7.3. OZ DMAS. The OZ DMAS training will enable OZ DMAS users to employ the process improvement and tutorial support that is resident in the system. The training approach will be to provide on-site training by the system developer.

1.2.7.4. Simulation/Modeling. Training in Simulation and any associated software will be a depot requirement in compliance with AFMCI 21-109. Except in the overview and executive level training, no specific training will be provided by HQ AFMC.

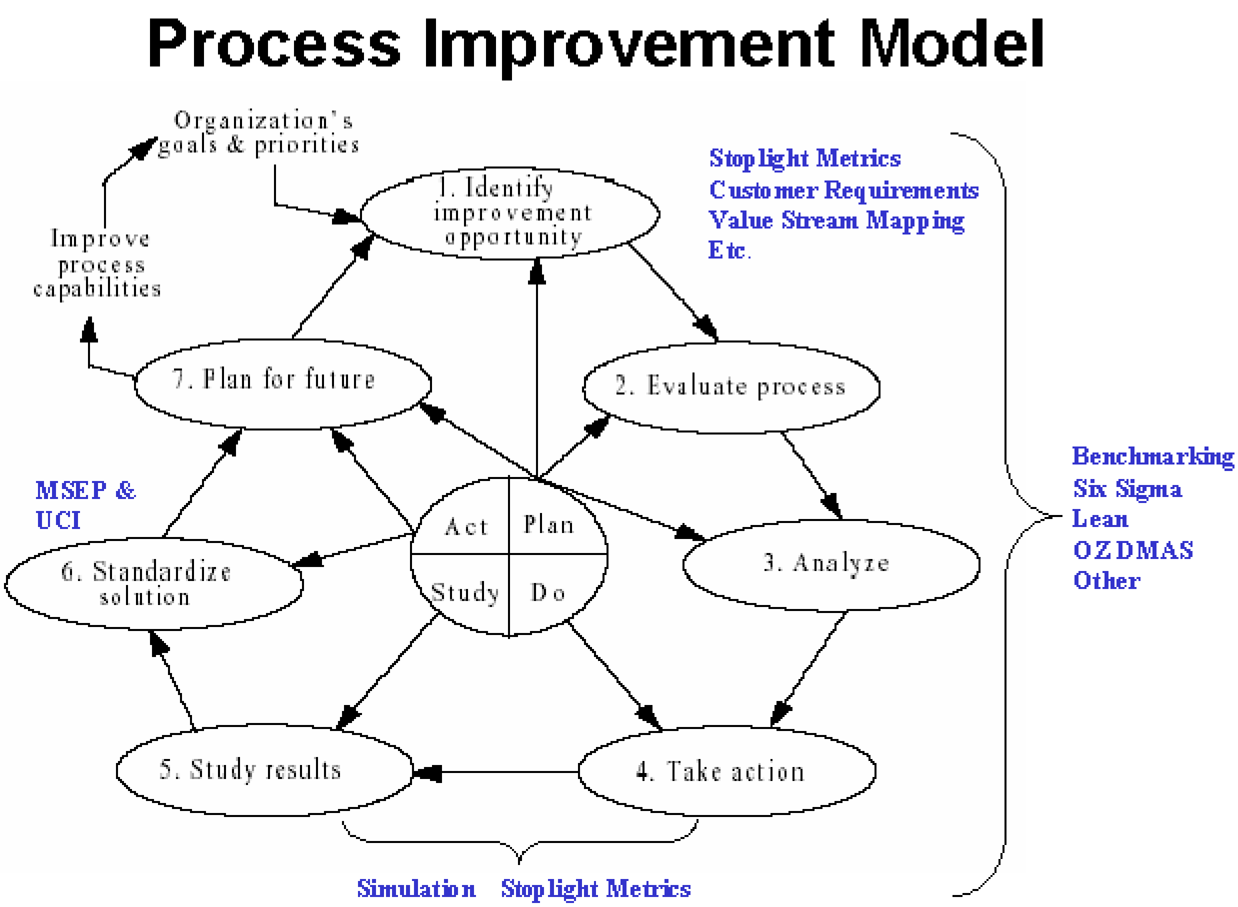
1.2.8. **Metrics.** Command mandated depot maintenance shop floor metrics shall be displayed on the shop floor. Metrics may be displayed with any media. (Reference: AFMC Manual, 21-XXX, Depot Maintenance Metrics)

Chapter 2

PROCESS IMPROVEMENT

2.1. Model. The model is borrowed from AF Handbook 90-502, The Quality Approach, with slight modifications. The model covers generic process improvement from baseline, stabilization, and improvement using the Plan, Do, Study, and Act cycle.

Figure 2.1. Process Improvement Model



Every process improvement effort should start with the recognition that a problem exists that needs/deserves fixing. The process model in 2.1. will help in getting started and guide you through the improvement effort.

2.1.1. **Step 1. Identifying Improvement Opportunity.** Select the appropriate process for improvement that impacts the organization's mission and is linked to its key processes. Customer requirements, regulatory requirements, and other factors provide the framework for building and defining processes. Does a problem exist that needs attention? When metrics analysis indicates an opportunity for improvement in a process, it should be selected for further review.

2.1.2. **Step 2. Evaluate the Process and Select and Improvement Opportunity.** Is the process under consideration for change worth the time, cost and effort? If there is more than one that needs attention, have they been prioritized? Is this one in the top 20 percent of processes that, if improved, will affect 80 percent of output? Ensure you spend your limited resources on the most important process to your customer and you. Label the problem (e.g., low quality, quantity, safety; high cost, flow time, rework).

2.1.3. **Step 3. Analyze.** This step covers all efforts required to determine the cause of the problem. Use analytical tools to explore data, and identify and verify the root causes of the problems. Has the problem and root cause been clearly identified, or only the symptoms? If only symptoms are fixed, the root cause will continue to trouble you. Ensure that the root cause has been identified before acting. OZ DMAS analysis tools are very useful for root cause analysis. Refer to **Attachment 2** for detailed internal process improvement logic flow.

2.1.4. **Step 4.** Take Action. Plan and implement actions that correct root causes. Develop and evaluate possible actions; ensure cost beneficial; develop action plan; test actions before fully implementing (simulate); get the cooperation and approval needed; and implement.

2.1.5. **Step 5. Study Results.** Once you have implemented a solution, verify that the problem is resolved. Study results and confirm that the actions taken achieved their target results. If the problem persists, repeat the cycle until the problem is solved. Metrics should be tracked to see if the improvement has had a measurable impact on the process. Determine if the improvement can be standardized.

2.1.6. **Step 6. Standardize.** Where appropriate, standardize the improvement into the organization's daily operations and take steps to monitor and control. Training, publishing revised methods, Unit Compliance Inspections (UCI), Maintenance Standardization Evaluation Program (MSEP), and ALC management reviews are methods to continually monitor that processes conform to standards.

2.1.7. **Step 7. Plan for the Future.** Seek out the next process improvement opportunity and utilize lessons learned.

Chapter 3

METHODOLOGIES

3.1. Methods and Tools. AFMC process improvement is based on using the applicable/appropriate improvement tools/concepts at each of the steps in the 7-Step Improvement model. The Lean, Six Sigma, Benchmarking, and Simulation methodologies provide the core tools in the AFMC toolbox. Other methodologies (drawers) with other tools may be utilized to complement these core methods. Practitioners and team members should be trained on each methodology prior to participation on a process improvement project in order to efficiently and effectively utilize them. This section provides an overview of each methodology.

3.1.1. **Lean.** Lean thinking is the systematic elimination of waste. Waste is considered to be in the form of defects, inventory, overproduction, waiting time, motion, transportation, or unnecessary processing. Traditional process improvement efforts focus on process or touch time. In most companies, process or touch time expended toward adding value to a product accounts for around 5% of the total time expended towards the production of a product. Lean is a systematic approach to identifying the waste or non-value added components of a process, and focuses process improvement efforts upon elimination of that waste. Production goals of Lean are to meet the customer's requirements on demand, defect-free, at lowest cost. Lean tools apply to both administrative and production environments.

3.1.1.1. Lean utilizes a set of tools developed and implemented by Henry Ford, which inspired Taiichi Ohno to create the Toyota Production System to identify and eliminate waste. Lean transformation is achieved through a systematic process (e.g., kaizen events), in which a process-focused team applies Lean principles and tools. Lean is implemented by first creating a high-level value stream map of current processes. Each task in the current state value stream is identified as either waste or value added. An ideal state map is then generated assuming no barriers or limitations. A future state map is developed from the current and ideal state maps. An action plan is developed to include projects, events, and "do-its" required to achieve the future state condition. Rapid-improvement events focus on a specific topic with clear measurements and targets. Management reviews progress periodically. After the current operations in the value stream have undergone a Lean conversion, a second pass of the operations is conducted to refine the process, in the continued pursuit of a waste-free operation and the continuous pursuit of excellence.

LEAN STEPS

- Identify the AS IS or current state (use tools, i.e., spaghetti diagram, walk the value stream, calculate manual task time, both value and non-value)
- Identify the ideal state
- Identify future state to move from AS IS to ideal
- Map out action plan (Events, Projects, and Do-Its)
- Prioritize and begin implementation
- Follow up

3.1.1.2. The tenets of Lean are value, value stream, flow, pull, and perfection. Value is what the customer is willing to pay for. The value stream is the series of steps required to deliver that value to the customer. Flow focuses on organizing the value stream to be continuous. Pull is setting up the process to respond to a downstream customer demand. Perfection is the relentless pursuit of process improvement through the elimination of waste. Lean uses the following tools to identify waste: Takt time calculations, time observations, bar charts, spaghetti diagrams, flow diagrams, standard work sheets, production control boards, and standard work in process (WIP). Lean organizes the work required or value stream into a series of cells. Cells are designed to have a common continuous one-piece flow rather than batch & queue. Standard work is identified for each cell in the process. Pull systems are setup to link the cells together and to link customers and suppliers to the cells.

3.1.1.3. The "6S" concept is a visual management system and is just one of the many tools that can be applied in an area to help Lean a process. The 6S elements are straighten (organize for efficiency and production), sort (have what you need, where you need it), scrub (a clean and organized work area is more efficient), standardize (once you find the best way to do it, have everyone do it that way), sustain (don't slip back into the old rut), and safety (safety seriously affects performance).

3.1.2. **Six Sigma.** Six Sigma is a philosophy of doing business with a focus on eliminating defects through fundamental process knowledge. The Six Sigma methodology identifies processes that are off target (from the goal), and/or have a high degree of variation, and corrects them. Improving product/ service quality is the focus of Six Sigma; however, it also applies to process effectiveness and efficiency. The core concepts are:

- **Customer:** Define the customer and determine what attributes the customer considers to be important, sometimes referred to as the *voice of the customer*.

- **Process:** Identify the processes and key characteristics that deliver these attributes.

- **Capability:** Measure what your process is delivering for each of these characteristics.

- **Entitlement:** Determine the best performance that you can reasonably expect from your process, i.e., what's possible.

- **Defect:** Any shortfall in delivering what the customer wants (quality, cost, delivery) is a defect.

- **Variation:** Difference between capability and entitlement. The concept of Six Sigma is to either shrink the process variation so that it "fits" within your specification limits, or center it between the specification limits (if its width is already within the spec limits). Stabilizing the process, by eliminating variations in the customer's experience, maintains customer satisfaction.

3.1.2.1. Six Sigma projects are used to close the gap between capability and entitlement for a given process. If a required parameter exceeds the entitlement of a given process, a search for a new process is in order, using reengineering, or other similar techniques.

3.1.2.2. While Six Sigma can be utilized as a stand-alone technique to achieve improved product or service quality, successful adherents of Six Sigma (a systematic improvement methodology) use it in conjunction with the tools/techniques of Lean and Benchmarking, when necessary, to achieve the objective of the improvement project.

3.1.2.3. Six Sigma is an improvement methodology that "packages" tried and true statistical tools with well-established Quality (TQM) tools in order to provide a structured, systematic model for process/product improvement. Six Sigma applies statistical tools (such as hypothesis testing and regression analysis) to raw data to provide information that leads to process improvements impacting the bottom line. The fact that it supports the heavy use of statistics is its main distinguishing characteristic from other improvement methodologies. Everything an organization does is done through processes. The products that customers receive are outputs from production and administrative processes. Six Sigma brings the voice of the customer and the voice of the process into harmony, through a discipline that removes variation.

3.1.2.4. Six Sigma methods integrate principles of business, statistics and engineering to achieve tangible results. The steps in Six Sigma vary from five to seven steps, but all include the basic steps of defining, measuring, analyzing, improving, and controlling. For the purposes of this instruction, a seven-step Six Sigma process is provided:

Step 1: Identify a problem.

Step 2: Form a team with the required skills.

Step 3: Define the project goals and boundaries, and identify issues that need to be addressed to achieve the higher (better) sigma level.

Step 4: Measure the current situation to obtain baseline data on current process performance, and identify problem areas.

Step 5: Analyze the root causes of quality problems, and confirm those causes using the appropriate data analysis tools.

Step 6: Improve by implementing solutions that address the problems (root causes) identified during the previous (Analyze) phase.

Step 7: Control the process by evaluating and monitoring the results of the previous phase.

3.1.2.5. Six Sigma project leaders are called Black Belts. They are typically formally trained in Six Sigma principles and techniques and act as the experts who lead improvement teams. Black Belts mentor Green Belts.

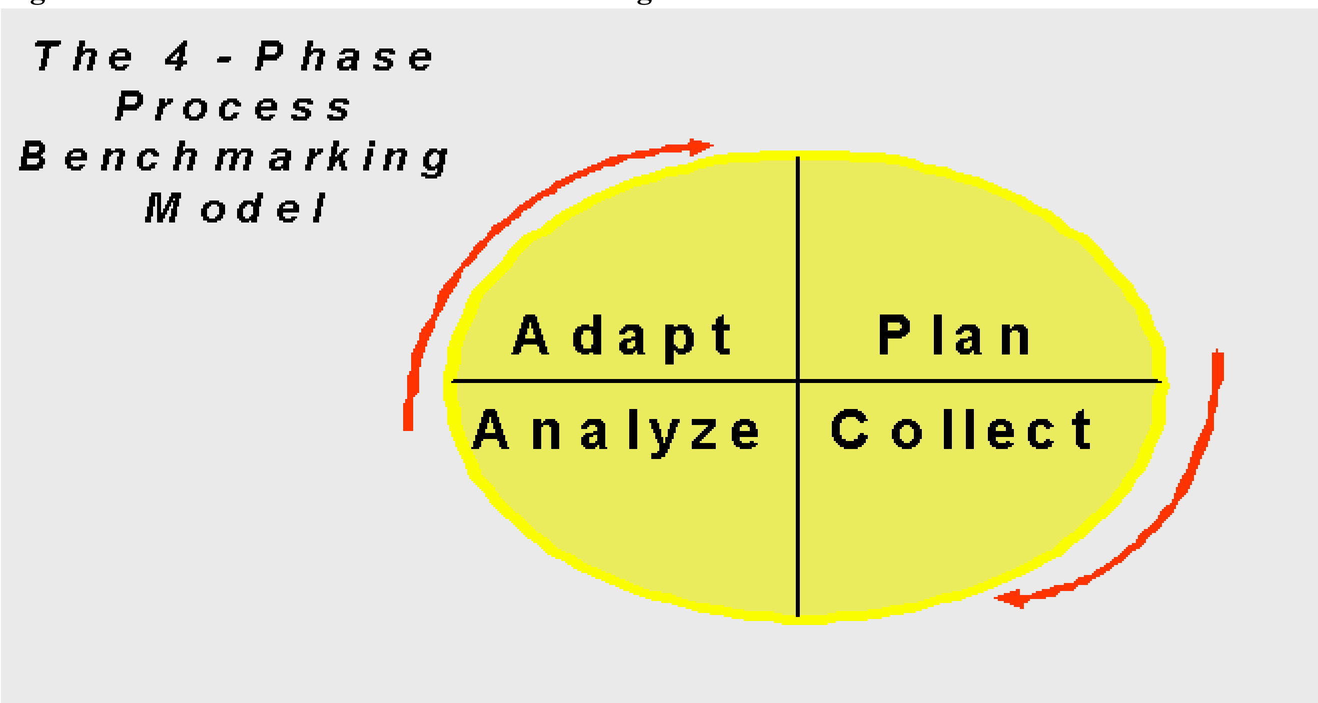
3.1.2.6. Green Belts are fully trained individuals who use Six Sigma skills to complete projects in their job areas, participate on teams being lead by Black Belts; and, in some cases, lead their own teams.

3.1.2.7. Master Black Belts are fully trained, full-time leaders who are responsible for Six Sigma strategy, training, mentoring, deployment, and results.

3.1.3. **Benchmarking.** Benchmarking is the process of comparing to and measuring against others to improve performance. Internal benchmarking is the continuous measurement and improvement of a process capability against internal center specifications, requirements or standards by comparing similar business units or business processes. Internal benchmarking can be done with any process, product, or service within a center. If internal process improvement alternatives and internal benchmarking efforts have been exhausted without achieving the desired result, or if the desire is to move acceptable processes to a new level of excellence by identifying and implementing industry best practices, the product/process becomes a candidate for external benchmarking. External benchmarking is similar to internal benchmarking, except the focus is moved to partnering with external organizations in the pursuit of "World Class" status.

3.1.3.1. 4-Phase Benchmarking Model. The Air Force benchmarking model, described in the Benchmarking Guidebook published by Air Force Manpower and Innovation Agency (AFMIA), 31 Jan 01, recognizes a 4-step continuous process: 1. Plan, 2. Collect, 3. Analyze, 4. Adapt.

Figure 3.1. The 4-Phase Process Benchmarking Model.



Step 1: Plan. The planning stage consists of forming the benchmarking team, documenting the process (identify focus area, identify the essential mission factors for the area, and develop measures for the essential mission factors), establishing the scope of the study, developing final purpose statement, brainstorming criteria for selecting the benchmarking partners, developing a benchmarking partner questionnaire, formulating options for data collection, and communicating findings. This stage normally composes about 30 percent of the total study effort.

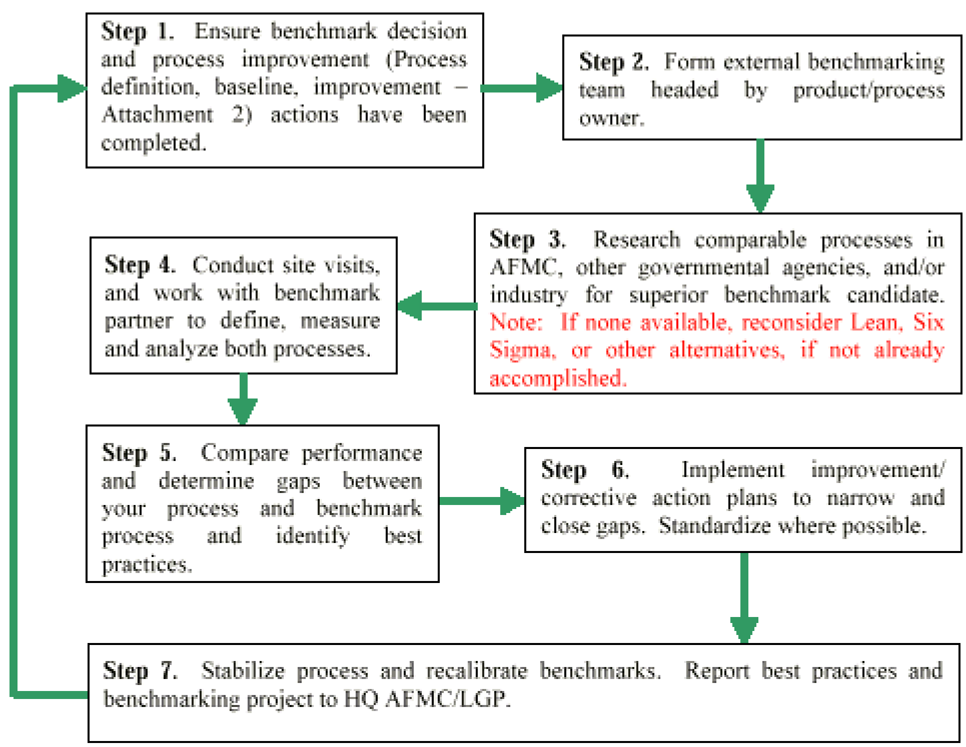
Step 2: Collect. Collecting data during a benchmarking effort is very significant for the success of the study. Data collection begins with secondary research using the following resources: libraries, APQC's information services, associations and professional organizations, and online databases. The secondary research should uncover data that indicates best practices and potential partners. The next step of data collection is to evaluate results and identify potential partners. A partner profile is developed and screening survey sent to potential partners. The screening survey is used to qualify the interest of a potential benchmarking partner. After the benchmarking partners are selected, a detailed survey is designed to collect more details about the study topic from the benchmarking partner. The last step in data collection is the primary research or site visit. Site visits further verify the data collected during surveys. Site visits are extremely advantageous to clarify question responses, allow face-to-face discussions about the partner's process, and allow actual viewing of the partner's operation. A typical site visit should be one day or less. This stage normally composes about 50 percent of the total study effort.

Step 3: Analyze. The analysis phase of benchmarking involves simply analyzing the data that has been collected. Based on your external benchmarking partner's operations, gaps in performance are defined, and the team may begin to form a strategy to close the gaps. This is done by identifying the gaps and formulating an implementation strategy. This stage normally composes about 20 percent of the total study effort.

Step 4: Adapt. The final phase of the benchmarking model is adapting. Without adapting, a benchmarking study is merely comparative analysis. This phase of benchmarking involves adapting what has been learned from the entire benchmarking study. An action plan must be built based on the implementation strategy.

3.1.3.2. External Benchmarking. External benchmarking is characterized by focusing on external organizations and partnering in the pursuit of "World Class" status. External benchmarking can be conducted with another ALC, another governmental agency or an industry source. Candidate processes can be identified through the metrics system and the internal process improvement efforts, or when they are designated as a special benchmark project. Special projects are considered critical, such as high dollar and/or chronically broken, or management has targeted them as needing improvement to reach a higher level of performance. The following diagram illustrates the flow of an external benchmarking program.

Figure 3.2. Illustration of External Benchmarking Program.

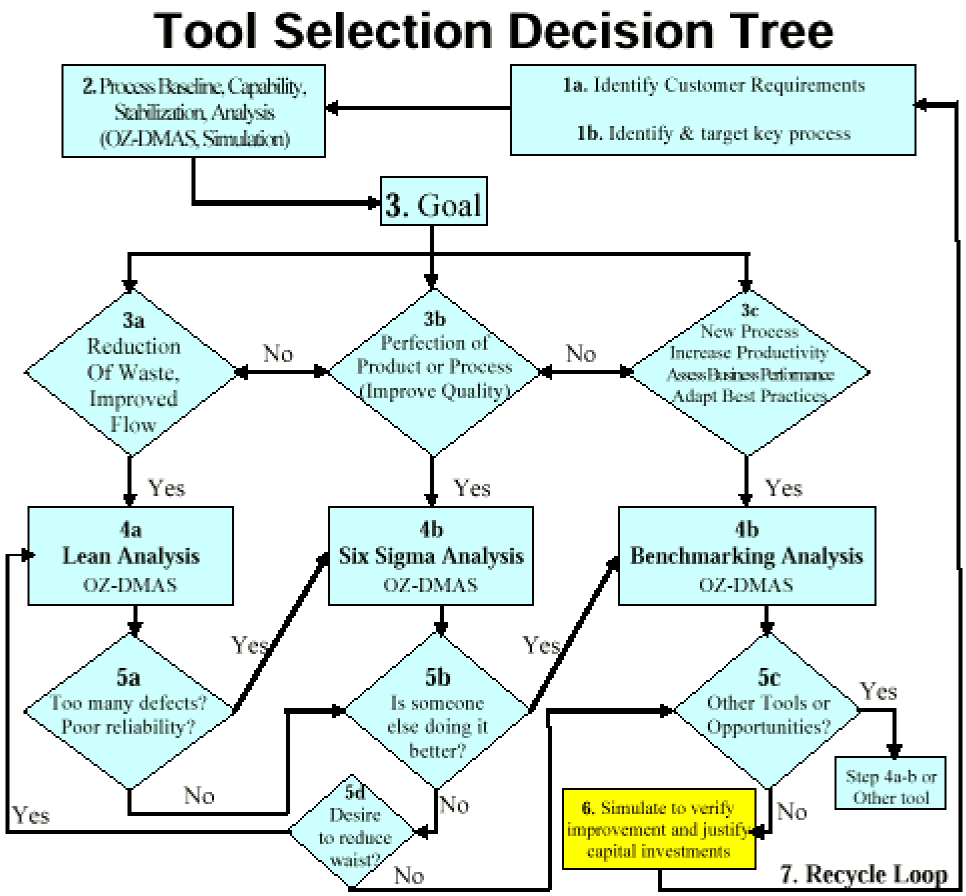


3.1.4. **Simulation/Modeling.** Simulation is an important tool for verifying and validating the expected results of process changes recommended through Lean, Six Sigma, and Benchmarking studies. Computer simulation is the process of designing a mathematically logical model of a real system or process, and experimenting with this model on a computer. Simulation encompasses a model building process, as well as the design and implementation of an appropriate experiment involving that model. Simulation/Modeling allows analysts to predict the performance of existing or proposed systems under different configurations or operating policies. Simulation/Modeling is most effective when used in conjunction with classical process improvement tools. It can be used at any stage in the process improvement model. PC-based commercial software is readily available; however, hand simulations are effective tools as well. There are many applications where hand simulations utilizing models serve as excellent visual models for decision making, without the investment and time required to support computer driven simulations. Value and scope of Simulation/Modeling is determined relative to each process improvement initiative, and must be evaluated for applicability.

3.1.5. **Object Czar (Oz) Depot Maintenance Analysis System (DMAS).** OZ DMAS provides a comprehensive stoplight alerting metrics system and on-line analytical process improvement tools. OZ DMAS is capable of assessing performance at all organizational levels. OZ DMAS extracts designated data from existing systems, and performs requisite mathematical and statistical computations (formulas embedded in software). It displays the selected data elements in the form of analytical metrics in the red, yellow, and green stoplight format for each indicator. Performance standards (thresholds) are established for each metric, showing the status as red (unacceptable), yellow (marginal), or green (acceptable). Process improvement analysis tools included in OZ DMAS are Pareto, SPC, value added analysis (flow charting), root-cause analysis (Cause – Effect Diagrams), and external benchmarking. OZ DMAS analysis tools can be used to support Lean, Six Sigma, Benchmarking, and Simulation efforts. As the process is improved over time, the standard and thresholds will be updated in OZ DMAS. The OZ DMAS tool can be found at the following internet address **https://137.245.165.124/dmas/main.aspx**. Please note that users must apply for a user ID and password.

3.2. Method Selection. The Process Improvement Model in **paragraph 2.1.** should be used to get started, select the best tool(s), and conduct the process improvement project. What to use and when depends on the objective, scope, and complexity of the improvement project. Decision tree analysis will guide correct tool selection and application. The intent is for users to utilize all tools, depending on the goal and purpose of the process improvement project. Complimentary application of the tools is often necessary and preferred in order to achieve program goals. Relying on one tool or technique to solve all process improvement problems is inefficient and not advised. The following diagram defines the selection criteria for determining the appropriate methodology to use in a process improvement project. The decision tree does not include an exhaustive list of every tool, technique, and program. The tree is intended to address the four main methodologies and techniques currently endorsed by AFMC. They are Benchmarking, Lean, Six Sigma, and Simulation/Modeling. Other tools may also be used. The decision tree is a guide to assist in the selection of the most effective methodology within the Process Improvement Model (**Paragraph 2.1.**).

Figure 3.3. Tool Selection Decision Tree.



3.2.1. **Step 1:** Identify a customer requirement, if possible, that relates to the output of a key business process. See Process Improvement Model, **paragraph 2.1.**, step 1.

3.2.2. **Step 2:** Baseline the process and ensure it is stable, capable, and meets customer requirements. OZ DMAS analysis tools and Simulation/Modeling are good tools at this stage. After you ensure the process is baselined, stable, and capable, you will identify the goal of the process improvement effort in the next step. See Process Improvement Model, **paragraph 2.1.**, step 2.

3.2.3. **Step 3:** Determine the goal. Determining the goal of the improvement effort will lead you down the path of Lean, Six Sigma, or Benchmarking. If the goal is general reduction of waste, go to step 3a (Lean). If the goal is general quality improvements, go to step 3b (Six Sigma), if the goal is generally to adapt industry best practices and benchmark against the competition, go to step 3c (Benchmarking). See Process Improvement Model, **paragraph 2.1.**, step 3.

3.2.4. **Step 4:** Lean Analysis, Six Sigma Analysis, or Benchmarking Analysis is conducted (steps 4a, 4b, 4c). Note that OZ DMAS analysis tools may prove effective with each technique. Note also that Lean, Six Sigma, and Benchmarking can be done in parallel or complementary manner, if desired.

3.2.5. **Step 5:** Ask additional questions (steps 5a, 5b, 5c, and 5d) that will lead the improvement effort to possible follow-on process improvement initiatives using alternative techniques.

3.2.6. **Step 6:** Simulation. Simulation/Modeling can be used to verify improvement efforts. Simulation/Modeling can also be used to justify capital expenditures greater than $500,000 that a process improvement project may recommend (Reference AFMCI 21-109).

3.2.7. **Step 7:** The countinuous recycle loop.

Chapter 4

RESPONSIBILITIES

4.1. HQ AFMC Process Improvement Responsibilities. Senior steering oversight for the AFMC depot process improvement program is the Logistics Business Board (LBB). The Office of Primary Responsibility (OPR) for the process improvement program is HQ AFMC/LGP. The primary purpose of the AFMC Process Improvement Working Group is to establish and revise program requirements to ensure integration of the process improvement program and its requirements into center operations. Headquarters has the lead role for process improvement. Responsibilities are as follows:

4.1.1. Roll-up and advocate the Program Objective Memorandum (POM) process.

4.1.2. Provide long-term vision and policy.

4.1.3. Ensure a common approach is being utilized by all depot maintenance organizations by publishing, maintaining, and enforcing an AFMCI for process improvement.

4.1.3.1. Establish criteria for Maintenance Standardization Evaluation Program (MSEP) audits of ALC compliance with this instruction.

4.1.3.2. Conduct staff assistance visits and internal audits as required.

4.1.4. Support ALC and AMARC process improvement initiatives as required.

4.1.5. Build and maintain Command Web Page for Process Improvement. Ensure linkage to ALC web pages.

4.1.6. Build and maintain corporate repository of process improvement project data including Lean, Six Sigma, and Benchmarking to allow cross-flow of information between AFMC sites.

4.1.7. Facilitate semi-annual senior leader process improvement meetings, preceded by working level meetings alternating between centers. Meetings will facilitate cross-talk and provide opportunities to experience improvements at each center.

4.1.8. Ensure education and training is provided in a cohesive and standardized manner by acting as a Command training focal point. HQ AFMC/LG will design, fund, and provide appropriate training for implementation of this instruction.

4.1.9. Address any union issues from a Command standpoint.

4.1.10. Formulate and evaluate employee incentive programs.

4.1.11. HQ AFMC/LGP has lead integration responsibilities.

4.2. ALC Responsibilities. The ALCs and AMARC will appoint an OPR to coordinate and integrate depot maintenance efforts. The MA OPRs will serve as the primary members of the AFMC Process Improvement Working Group, with HQ AFMC/LGP serving as the chair. Each ALC and AMARC will establish a process improvement organization responsible for local integration of process improvement and implementation of directed taskings including compliance with this instruction. The common responsibilities at each ALC and AMARC are as follows:

4.2.1. Integrate process improvement into all functional areas. Ensure training on all tools and improvement methodologies is provided, so they can be used as required.

4.2.2. Integrate policy, guidance, and information coming into and going out of the ALC regarding process improvement – single entry/exit.

4.2.3. Ensure an enterprise approach and recommend priorities to the Command section when return on investment decisions have to be made.

4.2.4. Be the conduit to HQ AFMC/LGP and contribute to policy development.

4.2.5. Conduct periodic process improvement program reviews.

4.2.6. Communicate success stories through newspapers (base and local), professional journals, tours, other media, CC calls, and director calls.

4.2.7. Roll-up resource requirements for manpower, contractor support, equipment, IT tools, etc.

4.2.8. ALCs will support HQ AFMC/LGP in developing a command standard training plan and standard courses.

4.2.9. Train and coordinate facilitators to support improvement teams. Initial support may come from contractor support.

4.2.10. Maintain a reporting structure to keep senior leadership informed.

4.2.11. Coordinate and run pilot projects as needed to support process improvement, including information technology and capital investments. Promote the use of Simulation/Modeling as a verification and validation tool.

4.2.12. Each ALC and AMARC will build a process improvement web page. The purpose will be to share common elements across the ALCs. The web pages will be linked to the HQ AFMC Command web page. Process improvement data will be collected and archived into a corporate repository. This repository will be maintained by HQ AFMC/LGP from ALC-provided information. It will be updated quarterly at a minimum.

4.2.12.1. Track costs/benefits. Ensure costs and benefits are tracked and entered into the Command corporate repository of process improvement projects. Ensure business process improvements are tracked and entered into corporate repository.

4.2.13. Support periodic process improvement meetings with AFMC and the other ALCs.

4.2.14. Address local union issues from a center perspective.

4.2.15. Work with HQ AFMC/LGP on formulating and evaluating employee incentive options.

4.2.16. Assure mandatory support and involvement from all levels of management.

DEBRA K. WALKER
Deputy Director, Directorate of Logistics

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

To ensure consistency in application across the Command in areas of process improvement, the following references should be used:

Air Force Manpower and Innovation Agency (AFMIA), "Benchmarking Guidebook" and training material.

HQ AFMC/LGP Process Improvement Website:
https://www.afmc-mil.wpafb.af.mil/HQ-AFMC/LG/lgp/lgpq/benchmark/index.htm

AF Handbook 38-210, "Air Force Best Practices Clearinghouse"

AF Manual 38-208, Volume 2, "Air Force Management Engineering Program (MFP) Quantification Tools"

AFMC Benchmarking CONOPs, 8 Jan 02 (Available on HQ AFMC/LGP Process Improvement Website)

ASQC, "Principles of Quality Costs"

GOAL/QPC "The Memory Jogger, A Pocket Guide of Tools for Continuous Improvement"

Carnegie Mellon University, Software Engineering Institute, "The Capability Maturity Model: Guidelines for Improving the Software Process"

Carnegie Mellon University, Software Engineering Institute, "Capability Maturity Model Integration"

W. Edwards Deming, "Out of the Crisis"

Eli Goldratt, "The Haystack Syndrome", "The Goal", "The Race", "Theory of Constraints"

Dr. Michael Hammer, "The Reengineering Revolution"

Masaaki Imai, "Kaizen"

J.M. Juran, "A History of Managing for Quality"

McNair and Leibfried, "Benchmarking: A Tool for Continuous Improvement".

Kazuo Ozeki and Tetsuichi Asaka, "Handbook of Quality Tools, The Japanese Approach"

James Womack, "Lean Thinking" (with Daniel Jones) and "The Machine that Changed the World"

Terms

Baselining—Determining a measure for comparisons. A baseline is a reference position for measuring progress in process improvement. The baseline is usually used to differentiate between a current and a future representation.

Benchmarking—The systematic and continuous process of finding and adapting best practices to improve your organizational performance in order to meet customer requirements. Benchmarking can be internal or external.

Best Practice—A superior method or innovative practice that contributes to improved performance. Best practice is a relative term and usually indicates innovative or interesting business practices identified as contributing to improved performance at leading organizations.

Capability Maturity Model (CMM)—A model that is a description of the stages through which software organizations evolve as they define, implement, measure, control, and improve their software processes. This model provides a guide for selecting process improvement strategies by facilitating the determination of current process capabilities and the identification of the issues most critical to software and process improvement.

Capability Maturity Model Integration (CMMI)—A model that contains the essential elements of effective processes for two or more disciplines. It also describes an evolutionary improvement path from ad hoc, immature processes to disciplined, mature processes with improved quality and effectiveness.

Capital Investment—Facility and equipment investments costing $100,000 ($250K starting in FY04) or more, with a useful life of at least 2 years. Reference AFMCI 21-109.

Cause/Effect Analysis—Cause and effect analysis allows a team to identify, explore, and graphically display (Ishikawa diagram) all possible causes for a specific problem or effect in increasing detail.

Continuous Process Improvement—The philosophy that quality management and improvement is necessarily a continuous activity to ensure ongoing customer satisfaction and improved efficiency.

External Benchmarking—The process of comparing against industry's best organizations anywhere in the world to gain information on philosophies, processes, policies, practices, and measures that will help an organization improve its own operations.

Flow Chart Analysis—Compares/contrasts the actual versus the ideal flow of a process to identify improvement opportunities. Flow chart analysis shows unexpected complexity, problem areas, redundancy and waste, and is used to identify simplification and standardization opportunities.

Hand Simulation—Simulating a process or system using a small model made of paper, Lego blocks, or similar material. This process enables the user to determine bottlenecks in the process flow and evaluate alternatives without physically changing the actual process.

Internal Benchmarking—The comparison and improvement of a process capability against internal center specifications, requirements, or standards by comparing similar business units or business processes.

Kaizen—Kaizen means improvement. When applied in the workplace, Kaizen means continuing incremental improvement involving everyone – managers and workers alike. Kaizen is a key tool for creating cultural change through the participation of the workforce and management in continuous, systematic, incremental process improvements.

Lean—A systematic approach to identifying waste and focusing activities on elimination of that waste, thereby freeing resources to focus on meeting customer requirements. Lean is a methodology with enterprise wide applications, including administrative and industrial operations.

Object Czar (OZ) Depot Maintenance Analysis System (DMAS)—A user-friendly, web-enabled software tool that provides statistical analysis, process analysis capabilities, and support for analyzing metrics and performing entire internal and external benchmarking studies. OZ DMAS relies on embedded and packaged statistical software to process raw data and present numerous process improvement displays, charts, etc.

Project—A planned set of events or actions that will produce or improve a product, process, service or outcome, which is managed by objectives and goals and has a completion point. A project should be clearly connected to business priorities, be of major importance to the organization, have a reasonable scope and a clear quantitative measure of success, and have the support and approval of management.

Reengineering—The radical redesign of business processes, organizational structures, management systems, and values of an organization to achieve breakthroughs in performance.

Simulation/Modeling—An Operational Research technique that provides a decision maker with the equivalent of a "flight simulator" of their factory or other system. It accomplishes this by modeling every significant resource and event in the factory or system, and moves with "simulated time", enabling the client to test out different ways of operating the system, without experimenting with the actual system. Simulation is used to help with the design or modification of complex systems by experimenting with alternative combinations of resources and with alternative operating policies. It can be used to test out plans or to gain insights into what alternatives are worthwhile under a number of different assumptions about the operating environment.

Six Sigma—Six Sigma achieves dramatic improvement in business performance through a precise understanding of customer requirements and the elimination of defects, errors, etc., from existing processes, products, or services. Sigma is a measure of the amount of variation resulting from the inherent factors affecting an undisturbed process in statistical control. The Six Sigma name is derived from the goal of having six standard deviations of process variation fit within the customer specification limits. Six Sigma equates to 3.4 defects (internal and external rejects), errors, occurrences for waste/scrap, etc., per one million opportunities.

Statistical Process Control (SPC)—The application of statistical methods to analyze and control the variation of a process. Most often used for (but not limited to) manufacturing processes, the intent of SPC is to monitor product quality and maintain processes to fixed targets. Six Sigma techniques employ SPC.

Takt Time—Takt is a German word for pace. Takt time is the rate at which the customer requires the product. Takt time defines the manufacturing line speed and the cycle times for all manufacturing operations. Takt time is computed as: Available work time per day / Daily required demand (parts/day).

Theory of Constraints (TOC)—A set of management principles that help to identify impediments to goal(s) and effect the changes necessary to remove them. TOC recognizes that the output of any system that consists of multiple steps, where the output of one step depends on the output of one or more previous steps, will be limited (or constrained) by the least productive steps.

Value Stream Mapping—Value Stream Mapping depicts the steps of a process and makes a determination whether they are value-adding, necessary waste, or unnecessary waste, in order to assist efforts to "lean" the process.

Warfighter Support—The support provided to AFMC customers, defined as the users of our products. These include all operators and maintainers of weapon systems and end items (engines, exchangeables, etc.) repaired by AFMC depot maintenance.

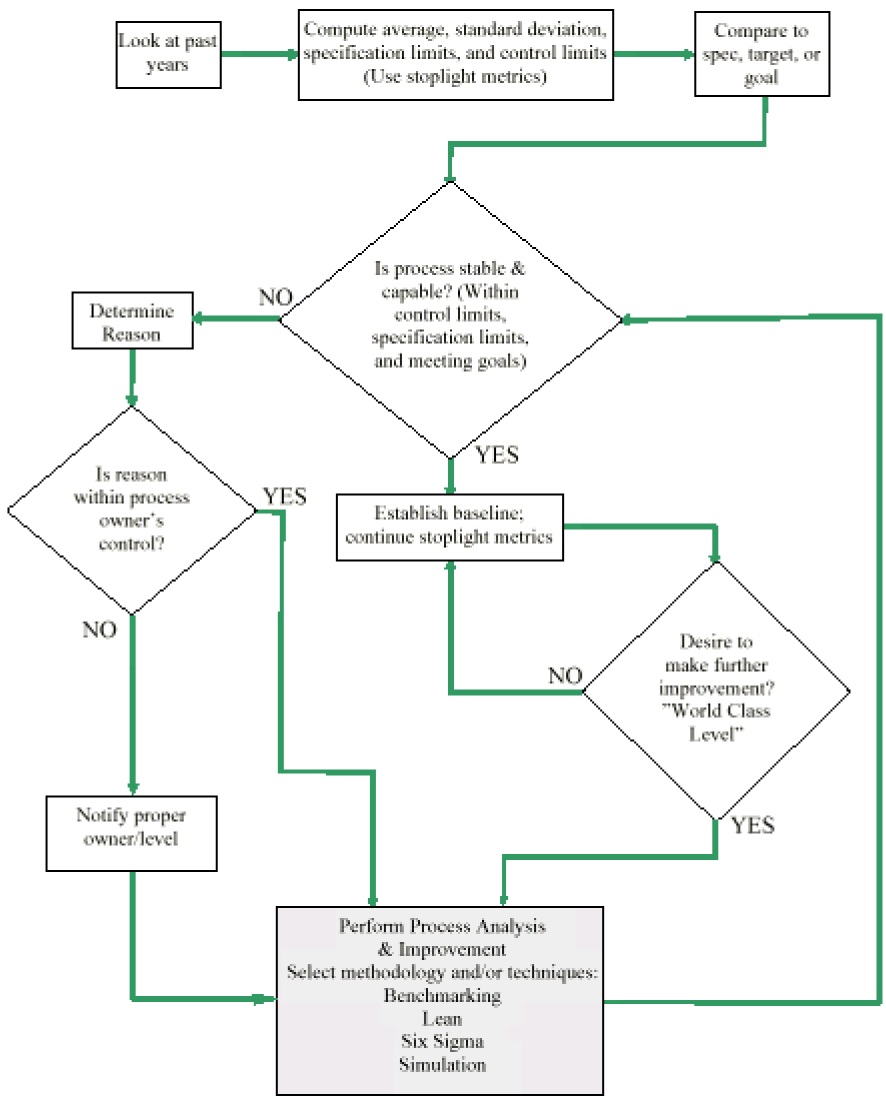
World Class—Being the best, or nearly the best, in the world for a particular process, function, organization, product, etc. A world class depot would be comparable or better than any industry standard in the world.

Attachment 2

PROCESS IMPROVEMENT LOGIC FLOW

(Process Definition, Baseline, and Improvement)

Figure A2.1. Process Improvement Logic Flow.



Attachment 3

PROCESS IMPROVEMENT METHODOLOGY AND TOOL SUMMARY SHEET

Teams are encouraged to use any one or a combination of these tools as dictated by the process that is being improved.

Figure A3.1. Process Improvement Logic Flow.

METHOD	STRONG POINTS	WEAK POINTS	ANALYTICAL APPROACH	SKILLS NEEDED	DECISION MAKING TOOL	PROBLEM ANALYSIS TOOL	OZ-DMAS*
Internal Benchmarking **(IB)**	Ad Hoc Team, Best Process Through Breakthrough Process Improvements	Assuming Processes are Identical, Stable, and Capable, and Data Accuracy	Process Definition/Base lining, Process Stability to Internal Improvement	Process Understanding and Statistics	✓	✓	•
External Benchmarking **(EB)**	Ad Hoc Team, "World Class" Process Improvement Through External Comparison	Assuming Processes are Identical, Stable, and Capable, and Data Accuracy	Process Definition/Base lining, Process Stability to Internal Improvement to External Comparison	Process Understanding and Statistics	✓	✓	•
Lean (L)	Leads to Efficient Manufacturing Process through radical improvements with Focus on Cost, Quality, and Schedule	Data Accuracy, Incremental Improvement, Dedicated Team, No External Comparison	Uses Kaizen	Process Understanding and Statistics	✓	✓	••
Six Sigma (SS)	Nearly Infinite Quality Improvement	Data Accuracy, Dedicated Team, Extensive Math Tng., No External Comparison	Statistical	Process Understanding and Statistics	✓	✓	•
Simulation/ Modeling (SM)	Visual, Leads to Efficient Manufacturing Process	Requires thorough understanding of process.	Models every significant resource and event in the factory or system	Process Understanding	✓	✓	•
6S	Visual	Not Data Oriented	Sort, straighten, scrub, standardize, sustain and safety.	Process Understanding		L	
Brainstorming	Generates multiple ideas. Works well in groups of all sizes.	Number of ideas may overwhelm process.	Defining a problem or idea and coming up anything related to the topic, usually performed by a group.	Open mind		IB, EB, L, SM, SS	
Cause and Effect	Verbal to Visual	Not Data Oriented, Possibly Self-fulfilling	Broad Categories to Specific Problems/Solutions	Basic and Brainstorming	✓	L, SS	•
Design of Experiments	Robust Product Design	Data Accuracy Expensive	Statistical	Engineering, Statistics, and Process Understanding	✓	SS	•

*** • The OZ-DMAS system includes all mathematical formulas / analytical tools and displays required by these techniques.**
•• The OZ-DMAS system will include all mathematical formulas / analytical tools and displays required by these techniques.

METHOD	STRONG POINTS	WEAK POINTS	ANALYTICAL APPROACH	SKILLS NEEDED	DECISION MAKING TOOL	PROBLEM ANALYSIS TOOL	OZ-DMAS*
Simple Flowcharting	Visual	Not Data Oriented	Process Diagram	Process Understanding	✓	IB, EB, L, SM, SS	•
Advanced Flowcharting	Visual	"Best" Process May Be Self-fulfilling	Theoretical, Actual, and Best Process Charting	Process Understanding	✓	IB, EB, L, SM, SS	•
Kaizen	Process Oriented, team based, results focused	Most suitable for simple problems	Incremental Process Changes	Process Understanding		L, SS	
Pareto	Visual	Data Accuracy	Separates Problems and Prioritizes	Process Understanding and Mathematics	✓	IB, EB, L, SS	•
Spaghetti Diagram	Identifies inefficient processes	Can be difficult to understand	Maps the flow chart data on a floor plan of the workplace, and gives a visual overview of the process "geography".	Process Understanding		L, SM	••
Statistical Process Control (SPC)	Process Stability Definition	Data Accuracy Dedicated Team, Extensive Math Tng., No External Comparison	Statistical	Process Understanding and Statistics	✓	IB, EB, L, SS	•
Takt Time	Eliminates excess inventory	May cause late shipments, if problems arise.	The rate at which the customer requires the product.	Understanding of process and customer demand		L	••
Value Stream Mapping	Identifies bottlenecks in process	May introduce new problems due to narrow scope	Depicts the steps of a process and makes a determination whether they are value-adding, necessary waste, or unnecessary waste, in order to assist efforts to "lean" the process.	Process Understanding	✓	L, SM	••

*** • The OZ-DMAS system includes all mathematical formulas / analytical tools and displays required by these techniques.**
•• The OZ-DMAS system will include all mathematical formulas / analytical tools and displays required by these techniques.