Critical Path Tooling

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Good morning. We’re the Critical Path Tooling Team. My name is Ron Gill. With me today are: Don Woullard, Andy Moehn, Mike Caldarera, and Daniel Munoz, our presentation driver.

We represent two of Boeing’s C17 Program sites…Long Beach, California, and St Louis, Missouri.
Early 2009, a major supplier announced their heat-treat facility would close in six months. Critical to fabrication of C17 skin panels, their unique furnace and quench tank would no longer be available. This challenge brought opportunity to improve quality as well. These exterior skin panels became C17 Program “Critical Path” items.
The C-17 program embraces Lean Manufacturing and Technology Integration, so data and tools used to select our project centered on process improvement.

First…we created a value stream map, focusing on heat-treat and forming for team member understanding of the current process…stimulate brainstorming … and answer the question…“Where are we now?”

A proven effective quality tool, brainstorming allowed team members to contribute ideas for quick action and improvement. This helped us compile a list of recommendations and possible solutions in a short time, as time was critical.

We used proprietary risk analysis software focusing on risk identification, exposure, assessment, and reporting.

We used Fishbone diagrams to capture and organize probable cause and effect information.
The C17 Program manages data and processes using a 7-Step, Continuous Improvement Model…our Process Based Management System, or PBM. Continuous, in that improvements are incorporated at Step 7, re-validated in Step 3, and repeated through the model.
Section 1A.b... This project was selected because our supplier deemed the panels affected as “un producible” without replacing the lost furnace capacity.

Losing heat-treat capacity would adversely impact production schedules in Long Beach, St Louis, and our Macon, Georgia facility...which was not an option.

Upper-management issued directive to team Subject-Matter Experts (SME’s) to develop and implement resolution producing a quality product without disrupting schedule.
Seen here, we validated our project selection using Process Failure Modes and Effects Analysis (PFMEA), a step-by-step approach to identifying possible failures associated with heat-treat and forming processes.

- Span time challenges
- Opportunity for improving process
- To prevent disruption in C17 production
- Sole heat treat supplier closing down
- To prevent financial impact
**Section 1A.c**… Potential stakeholder involvement in project selection depended on impact to that stakeholder group, and their probable influence on resolution and benefits.

SME’s from internal disciplines such as Engineering, Supplier Management, and Tooling, as well as external fabrication and heat-treat suppliers, were briefed on risks and potential program impacts, then brought onboard to map the value stream and brainstorm project direction and selection.

For example, Supplier Management feedback included a list of approved heat-treat suppliers. While Quality provided prior performance and capability history.
Section 1B.a... Organizational goals affected by this project are customer satisfaction, product quality, timely delivery, affordability, and business growth.

Performance metrics affected are...Quality, timeliness, and efficiency.

The C-17 program fosters the use of Lean Manufacturing and Technology Integration as continuous improvement strategic initiatives...and, Risk Management as a strategic methodology to mitigate risk factors...ensuring organizational goals and metrics are positively impacted.
Section 1B.b... Types of project impact on organizational goals and measures are:

- Preserves customer satisfaction as quality, our primary concern, is enhanced and defects are reduced.

- Prevents schedule disruptions and mitigates negative cost factors.

- ...and, positively impacts C17 program reputation for on-time delivery and dependability...promoting business growth.

Boeing's Strategic Objectives to eliminate waste and optimize production, encourage process redesign to prevent defects and inefficiencies. Our project goals were selected to meet these objectives.
### Section 1B.c...

The degree of impact on goals and performance metrics was determined through team consensus and analysis of potential impact and outcome.

Based on ability to satisfy organizational goals, improve performance, and enhance lean value, impact was quantified and rated high, medium, or low.

This matrix shows the correlation between the degree of impact on goals, strategies, and performance. For example, the degree of impact on cycle time was high since avoiding production disruptions was...
Section 1C.a... Potential stakeholders were identified when reviewing value stream and process flow maps for panel acquisition, fabrication, and installation. Customers and process owners for each of these maps were immediately identifiable and listed as potential stakeholders.

Boeing Production, Support staff, and Supplier Management in charge of acquisition, were listed as internal stakeholders.

Suppliers for fabrication, heat-treat processes, and tooling...all outside of our internal processes...made up our external stakeholder group. Although, both stakeholder groups worked together to determine process changes.
Section 1C.b... We determined potential impact on stakeholders through program-level meetings, brainstorming, and face-to-face feedback from internal production teams and external customer-site visits.

Cause and Effect diagrams, and value stream analysis, identified potential road blocks and impact within the process. For example, timely delivery of quality parts processed by a new heat-treat supplier would positively impact internal production.

Critical to stakeholders was the potential impact of having no parts, causing a chain reaction of “negative consequences” to production requirements and program schedule.
Section 1C.c… The degree of impact on stakeholders depended on the expected change to their overall environment.

The team agreed on a simple matrix to determine the degree of potential impact on stakeholders. Impact… positive of negative… having 10 or greater expected change to the stakeholder and our project goals rated high…5 to 9 medium…and, 0 to 4, low.
For example, impact to program-level stakeholders ranked high since our delivery and reliability record to facilitate future business growth was threatened.

Impact to production ranked high from the immediate and direct effect on their performance.

Impact to Support personnel ranked high since project success relied heavily on their ability to implement.

Next up, Don, with the analysis of our current situation…
Thank you Ron...
Methods and tools to identify potential improvement opportunities were...

- Brainstorming at the program level to digest the issue and propose potential solutions.

- Process and Value Stream Mapping to identify steps associated with panel procurement through final installation...to pinpoint process improvement opportunities that resolve supply chain and fabrication issues.

- Stakeholder interviews for opportunities not easily seen in process mapping...such as safety enhancements.

- Benchmarking other aerospace skin panel eat-treat and skin forming projects. This helped identify potential cost and lead-time hazards.
...and, we reviewed part quality history which showed the Process Capability Index, or Cpk, for these parts was less than C-17 program
**Section 2A.b...** Analysis of data to identify potential improvement opportunities began with a review of SME input during initial brainstorming.

These proposals, inserted into our process map, revealed new complexities, areas of potential part damage, and handling challenges.

We explored alternate sources of supply and product redesign identified during data gathering and project selection.
For example, heat treat distortion was a root cause of part Cpk being below the minimum program level of 1.0. This became an achievable improvement opportunity by redesigning the heat treat process.
Section 2A.c... Potential impact was so extreme that stakeholders became involved in identifying potential solutions and improvement opportunities right after the closure notice was issued.

Internal and external stakeholders proposed solutions, design challenges, opportunities for implementing process improvements, new documentation, and updating tooling.
For example, Production stakeholders conducted a supplier “on-site” process evaluation... reviewed schedules... provided feedback on critical issues... and... established “no-later-than” dates that would impact schedule.
Section 2B.a... Methods and tools used to identify final improvement opportunities were the “5 Why’s”, brainstorming, and Cause and Effect diagrams...proven industry tools for problem solving and solution identification.

Using our list of potential improvement opportunities, we applied the “5 Why’s” to each item for structured responses to populate and define our Cause and Effect diagram...providing a systematic way to arrange...
For example, our Cause and Effect diagram, a result of supplier site visits and face-to-face interviews, was instrumental in identifying new heat-treat process challenges.

Heat circulation, quench solution, and using dry ice for temper retention were highlighted as potential sources of variation throughout the diagram. The resulting defect is heat-treat distortion.
Section 2B.b... Our method to analyze data for selecting final improvement opportunities was to identify common characteristics from one area in our Cause and Effect diagram to another.

We applied the “5 Why’s” to our potential improvement of eliminating heat-treat distortion, then inserted the answers into our Cause and Effect diagram.

This method helped to identify final improvement opportunities with the
Seen here, potential improvements were given a risk analysis where...

- SME’s identified threats and opportunities
- Estimated cost
- Determined feasibility for success, and consequences of failure
- …and, used proprietary risk analysis software to analyze inputs and assign matrix likelihood and consequences data.

The “Likelihood and Consequences” make this option unacceptable.
Shown here, this chart shows a “go-forward” option.

Note that the “Likelihood and Consequences” moved from “moderate” to “low” risk as the team addressed each element of risk.
Section 2B.c... This chart shows our final list of improvement opportunities after analysis of performance trend data, implementation costs, and subject-matter-expertise.
For example, one opportunity is a redesigned heat-treat process to eliminate distortion, the primary source of skin panel defects.

• Typical example of an aluminum heat treat distortion improvement opportunity
This chart shows the validation tools used on our improvement opportunities.

- Value Stream Mapping of part fabrication, heat-treat, and forming dependent processes
- Performance Trend Analysis - the total part process perspective
- Stakeholder Feedback providing transparency of all project risks
- …and, One-on-One Interviews with process SME’s
Seen here, our improvement opportunity of relocating existing heat-treat furnaces was prohibitive due to high cost and unavailability of local environmental agency permits.
Finally, the team revisited the heat-treat value stream to validate challenges associated with a new heat-treat supplier.

Support stakeholders performed a Trend Analysis, concluding that the heat-treat process must be redesigned.

Then, we surveyed stakeholders, such as Supplier Management, for their feedback. We held “one-on-one” interviews and a “hands-on” walk-thru with production personnel for their input, validation, and concurrence.

Now, Andy with our Solution Development.
Thank you Don...
Methods and tools used in development of potential solutions

<table>
<thead>
<tr>
<th>Tools / Methods</th>
<th>Why?</th>
<th>Anticipated Benefits for Solution Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brainstorming</td>
<td>Proven effective tool to gather many ideas and suggestions quickly.</td>
<td>Subject-Matter Expert (SME) best practice recommendations</td>
</tr>
<tr>
<td></td>
<td>(Time is of the essence)</td>
<td></td>
</tr>
<tr>
<td>Benchmarking</td>
<td>Past successes from Boeing 747 &amp; 777 that can be leveraged through</td>
<td>Leveraging core competencies to minimize research, testing, and cost of prototyping</td>
</tr>
<tr>
<td></td>
<td>Knowledge management / transfer</td>
<td></td>
</tr>
<tr>
<td>Process Flow and Value Stream</td>
<td>Re-mapping of process and value stream as new data and ideas are</td>
<td>Robust process with minimal roadblocks and risk</td>
</tr>
<tr>
<td>Mapping</td>
<td>gathered</td>
<td></td>
</tr>
<tr>
<td>On-Site Fabrication Observation</td>
<td>Visual inspection of actual process and future capabilities validating</td>
<td>Validation of part productivity and impact assessment</td>
</tr>
<tr>
<td></td>
<td>Process Flow and Value Stream Map accuracy</td>
<td></td>
</tr>
<tr>
<td>Computer Simulation</td>
<td>Boeing Best-Practices using Stress Strain data fed into Finite Element</td>
<td>Predictable outcomes of material behavior minimizes risk, and enhances probability of solution success</td>
</tr>
<tr>
<td></td>
<td>Modeling as a cost effective and quick way of prototyping</td>
<td></td>
</tr>
</tbody>
</table>

Section 3A.a... Methods and tools to develop potential solutions addressed SME best-practice recommendations from brainstorming sessions and benchmarked certified heat-treat suppliers, and tooling processes used on Boeing 747 & 777 programs.

As a result, engineering test requirements for both heat-treat and forming were established.

Value stream mapping allowed team assessment of potential impact on each solution before implementation.

On-site observation of the process was used to validate consistency between actual work done and our value stream and process flow maps.

We also used computer modeling simulations, which enabled us to predict material behavior during forming.
Section 3A.b... Data analysis to develop potential solutions began as SME and stakeholder recommendations. These were then analyzed and engineering test parameter requirements for heat treat were created. Test parameters clarified and identified process requirement challenges. Historical quality data was integrated at this phase of the project.
This graphic illustrates the stress of stretch forming on a panel as predicted through Finite Element Modeling computer simulation.
This analysis resulted in a list of Potential Feasible Solutions:

- Redesign parts to eliminate heat-treat
- Redesign heat-treat process
- Reconfigure existing tooling
- Redesign and purchase new tooling
- Invest in spring-back tooling technology

We then inserted the potential solutions into our current Value Stream to identify benefits if implemented, and conducted a thorough risk analysis.
Redesigning the heat-treat and forming processes reduced span times and provided opportunity to reduce part cost while enhancing quality by improving heat-treat related distortion issues.
Section 3A.c... Criteria used to select a final solution was a combination of adhering to program funding requirements and meeting project goals.

Risk analysis of all options identified the best use of company assets.

Computer simulation increased accuracy...provided insight into critical parameters... providing a faster, less expensive design with increased productivity and return-on-investment.

Use of proprietary tooling technology to implement a proven, benchmarked solution with 350 successful applications.

Choosing a redesign of heat-treat and forming processes satisfies program and project goals of improving part quality with no impact to schedule.
Potential solutions were evaluated for their capacity to improve the process in each criteria category.

In the end, redesigning heat-treat and form processes, and form tooling, provided the “cleanest” handoff solution.
Section 3B.a... Methods and tools to select our final solution were:

- Review of redesign documentation by entire project team

- …and, Value Stream Maps as our foundational Lean tool to identify waste, reduce cycle time, and implement process improvement.

We inserted each potential solution into our Value Stream Map process to validate flow, adherence to project goals, and projected cost and cycle time data.

A Program level presentation outlined cost and risk factors associated with all recommended solutions.

Ultimately, program leadership approved our Lean process/tooling solution for funding to satisfy project requirements.
Section 3B.b... The analysis of data to select our final solution was based on data gathered from historical quality sources.

Due to project time constraints, analysis recommendations were predicated on the knowledge and hands-on experience of project team members.
Here we used value stream maps of current heat-treat and forming processes to compare and analyze each potential solution for adherence to program and project goals. This brought tangible evidence to cost and schedule factors, as well as making potential roadblocks visual for each solution.
We also used risk analysis software to obtain objective potential solution capability and ability to adhere to program requirements.

Finally, we conducted additional computer simulation analysis to re-validate predictable outcomes that would satisfy all challenges, program directives, and project goals.
Involvement of stakeholders in selection of the final solution

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Stakeholder Disciplines</th>
<th>Process Roles</th>
<th>Involvement in Final Solution Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-17 Production</td>
<td>Assembly Mechanics Production Engineers Production Managers</td>
<td>Subject Matter Experts Assembly Process Ownership</td>
<td>Brainstorming, Goal Identification, Potential Solution Evaluation and Down-Select Value Stream Validation</td>
</tr>
<tr>
<td>Long Beach, CA</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Final Assembly</td>
<td></td>
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<tr>
<td>Mason, GA</td>
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<tr>
<td>St. Louis, MO</td>
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<tr>
<td>Support (Supplier</td>
<td>Contracts, Procurement, Site Monitoring and Product Verification</td>
<td>Contracts and Quality Subject Matter Experts</td>
<td>Brainstorming, Potential Solution Evaluation and Down-Select</td>
</tr>
<tr>
<td>Quality / Management)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Part Supplier</td>
<td>Supplier Management Part Manufacturer Contracts</td>
<td>Manufacturing and tooling expertise Process design</td>
<td>Brainstorming, Goal Identification, Statistical Data Acquisition and Distribution, Solution Design Adaptation and Verification of Ability to Perform Task</td>
</tr>
<tr>
<td>Host Treat Supplier</td>
<td>Heat Treatment of Aluminum Metallurgy</td>
<td>Heat treat and tooling expertise Process design</td>
<td>Brainstorming, Goal Identification, Statistical Data Acquisition and Distribution, Solution Design Adaptation and Verification of Ability to Perform Task</td>
</tr>
<tr>
<td>Advanced Tooling Technology Supplier</td>
<td>Gate Keepers of Boeing Tooling Technology</td>
<td>Finite Element Analysis Electronic Tool Models Process Consultants</td>
<td>Finite Element Method and Process Simulation Models of the Redesigned Tooling</td>
</tr>
</tbody>
</table>

**Section 3B.c...** Involvement of stakeholders varied depending on discipline and process role.

Stakeholders participated in brainstorming, goal identification, value-stream mapping, potential evaluation, and final consensus.

By aligning project objectives to requirements and expectations, and providing regular status, we were able to satisfy all stakeholders.

Because of process role and expertise, the majority of direct involvement came from production, support personnel, and supplier stakeholders….due to their knowledge of the existing process, prior Lean training, and any influence they could have on the final solution.
Section 3C.a... Our final solution was a combination of two elements... a part fabrication process redesign, and current tooling upgrades using the latest metallic forming technologies, allowing parts to be formed in optimal temper condition, a key to quality improvement.
Validation of both solutions came from value stream mapping our potential solutions, and from computer simulation data that graphically demonstrated the differential stresses encountered during the forming process. This analysis proved to be a fast, accurate and economic alternative to design prototyping, and brought team consensus and confidence in this solution’s success.

Data gathered at that time showed significant reductions in fabrication span time and quality defects.
Another point of validation came in the form of employee safety improvements at both the heat-treat and part suppliers as the shipping container was designed by both the employees and an ergonomics specialist.
3C.b... Expected Tangible benefits were determined through benchmarking results from similar projects, and computer simulation data of our final solution...

- Elimination of build cycle disruption through implementation of Lean Principles
- Improvements in Employee safety
- ...and, reductions in part defects and takt time through use of Advanced Technologies.
Expected intangible benefits were determined from stakeholder-surveyed feedback:

- Knowledge benefits from incorporating Lean principles and advanced tooling technology
- Improved supplier relations and employee morale
- Greater customer satisfaction and higher confidence in our ability to meet deliveries.
- …and, reinforced customer confidence in project team member capabilities for continuous improvement.
Section 3C.c... Data used to justify implementation of our final solution came from our Cost and Benefits Analysis. This document is required to fulfill organizational goals for corporate funding. It includes regulatory and contractual information, cost savings, assumptions, and risk assessment...all part of the project’s main objectives to preventing a production line shutdown while preserving customer confidence in our ability to deliver on time, supporting the benefits of additional orders and market share increase.

Now, Mike with our Project Implementation and Results.
Thank you Andy…
### Section 4A.a...

Stakeholder involvement in implementation consisted of three phases...”After Okay To Proceed”... ”Production Readiness”...and, “In Production”.

Once funding was validated and “Ok to Proceed” was given, Supplier Management and the project manager down-selected tooling sources, then placed purchase orders to revise forming tools.

Boeing and Part Supplier stakeholders planned and implemented a heat-treat and forming engineering test.

Boeing and Supplier production, along with support personnel, began revising process documentation.

During the “Production-Readiness” phase, reviews were conducted at Boeing and Part Supplier sites.

And, during the “In-Production” phase, support personnel successfully completed their process validation.
Section 4A.b... We identified resistance during team meetings, on-site visits, and one-on-one interface.

For example, our supplier maintained the parts could not be produced in a smaller heat-treat furnace. Engineering successfully conducted a test, which disproved and mitigated the concern.

Our supplier questioned springback technology, which was mitigated by sharing lessons learned and benefits from a previous redesign project.
Skepticism over project risks was addressed by reviewing the risk assessment, and creating a robust contingency plan.

Frustration over the unexpected challenge of the heat-treat facility closure diminished through project leader one-on-one interface and full team collaboration.
Section 4A.c... Communication and collaboration were fundamental to stakeholder buy-in.

All internal and external supplier stakeholders were actively engaged throughout project conception, solution development, and implementation.

The result was consensus buy-in from all project team members throughout all phases of the project.
We ensured C17 program stakeholder buy-in by adhering to corporate funding requirements of documenting risk assessment, cost and benefits, and executive leadership briefings.

Once the responsibility for new tooling technology was assumed, project benefits understood, and supporting implementation data was available, full buy-in by all stakeholders was achieved.
Section 4B.a... The plan to implement our final solution started with the creation of high-level task requirements.

High-level actions, like obtaining funding approval, were scheduled and setup to track through to completion.

Each action item, along with its beginning and end dates, was entered into a project management software where completion percentages could be tracked, statused, and updated by the entire team during weekly progress meetings.

The resource assignment software creates specific reports, establishes critical path, and helps assignees prevent unrealistic time commitments.
Action Items included:

A “Production Readiness Review” to verify completion of any required documentation.

A stakeholder “process walk-thru” validating first use of the new process.

…and, stakeholder briefings for implementation results.
Section 4B.b... To implement our solution, the project drove tool design and part fabrication changes to production procedures.

Skin panel production is governed and standardized using electronic planning “build-to” systems.

Work accomplished by these standards is audited for accuracy and maintainability, ensuring sustainability of solution results.

For example… recording time and temperature of heat-treated material was added to planning documentation.

Prescribed and actual elongation of forming measurements are now captured and recorded in planning documentation, ensuring process stability.
Section 4B.c... The C-17 uses a common system for measuring and sustaining results found in our PBM database.

To measure results, PBM captures production data from C-17 facilities concerning hours charged, cycle time, and rework and repair. This data is then charted as our performance metrics.

When the system identifies problem areas or negative trends, the process owner receives a corrective, preventive action notification, or CPAS. This forces immediate response to rectify the situation.

CPAS requires root cause analysis, solution development, and implementation phases to sustain results.

CPK data is tracked in a monthly report created by the part supplier, then sent to Boeing Supplier Quality.
Section 4C.a… Tangible benefits realized include…

- Reduced fabrication process steps from 2 to 1

- Improved quality by controlling forming temper and eliminating heat-treat distortion

- On-time delivery of all parts to production

- 40% reduction of takt time resulting in renegotiation of pricing

- Nearly 600 thousand dollars, the project was 5% under estimates, with up to 8.4 million dollars in cost avoidance when compared to other options.
Including a redesigned forming process that…

• Reduces flow time

• Ensures process repeatability

• Mistake proof set-up

• …and prevents wasted efforts, inefficiencies and defects
Intangible benefits include...

- Improved part quality enhancing mechanic efficiency and workmanship.

- Greater employee morale, evident through sustained results and positive performance trends.

- ...and, the user-friendly process eliminating wasted efforts, and promoting greater mechanic confidence in support staff capabilities.

These overall benefits gave us the best quality, lowest cost, and quickest turn-around...meeting all project, performance and organizational goals.
Section 4C.b... We linked our project goals with organizational goals and performance metrics from the onset to give us the best opportunity to meet or surpass program objectives.
For example, redesigning tooling, heat-treat and forming processes, met our project goal of maintaining production levels and eliminating schedule disruption, resulting in positive performance metric trends due to higher quality with less rework and repair…contributing factors to organizational goals of quality, schedule and Lean Implementation.
Section 4C.c... Sharing results with stakeholders was a team effort.

During frequently scheduled production team meetings, team members briefed peers and production management on Intangible Results and “Before and After” trend data.
Project management shared results with internal stakeholders at departmental and program levels by verbal communication or our weekly 5-15 report...5 minutes to read, 15 to prepare. This documented reporting allows for immediate feedback of misunderstood verbal flow down.

Information is passed on by our leadership team to the corporate level via intranet and direct reporting methods.

Team members briefed external stakeholders through face-to-face meetings and direct interface with external support groups.

Stakeholder understanding of project results was verified by formal team recognition as a recipient of the 2010 Boeing Silver Eagle Award.

Now, Ron with Team Management.
Thank you Mike…
Team members were selected and involved throughout the project based on pre-assigned responsibility, expertise, process ownership, and relative need. Communication skills and their ability to interact in a team-based structure were also considered.

Some team members were pre-assigned because of their daily support and awareness of the production team’s structure and requirements. While other members were assigned by management, or selected specifically for their expertise.
All team members attended regular meetings, directly or through teleconferencing for brainstorming and statusing action items and project needs.

After implementation, team members gathered related data, and began briefing stakeholder groups on project results.
Their involvement ranged from selecting a project manager, identifying “need” dates, and ensuring conformance... to identifying potential suppliers, and predicting material behavior through computer analysis.
Section 5B... The team was prepared to work together through a team-based employee involvement training focusing on team formation... building... collaboration... and performance.

During our project kick-off meeting, team members were made aware of the urgency of the situation. Project management briefed team members on meeting guidelines, expectations, and protocol to keep meeting focus aligned with project direction and schedule.
A certified lean representative was brought in to familiarize the team on the use of lean and problem solving tools, such as Value Stream Mapping to identify process waste, and Fishbone Diagrams to identify causes of variation.

This included how to determine which tools best suit our project needs…and what data to enter and expect in return.
Section 5C... The team managed performance and ensured effectiveness by establishing a Team Charter and Mission Statement to maintain focus during discussions.

We created a “war” room with virtual-conference access for brainstorming and statusing, providing team members the latest updated information.

We used “off-the-shelf” project management software for tracking and statusing action items, milestones, and delays in progress.
We held accountability meetings to assess risk indicators, then briefed Stakeholder groups to ensure expeditious constraint mitigation.

We addressed conflict resolution using pre-established team protocol and open communication.

We created “work-around” plans to maintain quality and schedule if problems surfaced during implementation.

In addition to optimizing team performance and efficiency, these tools and methods ensured our project goals of reducing production disruption time, lowering cost, creating a lean solution, and promoting first-time quality were all met.
On behalf of our team...Thank you.