Where am I at GSFC?

Mission Support Division, Code 320

Vacant, Chief
Michael Kelly, Acting Chief

SOFTWARE ASSURANCE
Sue Sekira
Isaac McGinnis
Grant Tregre
Saul Harris

Administrative Support
Celina Hanewich

MISSION SUPPORT SERVICES
Dave Smalts, CSO-New Business

Systems Safety Branch, Code 321
Bo Lewis, Branch Chief

PSM
Robert Dedalis*
William Conn
Paul Gibbons
Angela Melito*
Shandy McMillian
Carol Hamilton
Sue Pollard
Jana Rezac
Steve Leiter
Phillip Adkins
Michelle Perez

RE/PRM
Syed Aziz
Jacob Burke
John Evans
Luis Gallo
Orson John
Prince Kalia
Nasir Kashem
Nancy Lindsey
Paula Pruessner
Pietro Sparacino

Risk Analysis Branch, Code 322
Anthony DiVenti,

Integrated Risk Manager
Natesan Jambulingam

Systems Engineer
Mathew Samuel*

Assurance Branch, Code 323
Robert Sticka,
Branch Chief

Joseph Hall,

Daily Manager
John Blackwood
Teresa James
David Bogart
Roman Kilgore
Martin Born
Lydia Lee
Timothy Bowser
Belkacem Mansour
Dann Brown
Naveed Quraishi
Joseph Calabrese
Joe Radich
Robert Calvo

Mr. Bockorno

*Mathew Samuel is on Detail to GOES R Systems Engineering Team

*Angela Melito is Deputy CSO at AMES for LADEE

*Robert Dedalis is CSO for Satellite Servicing Mission.

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Purpose

The purpose is to share the LSS activities at NASA in general and at GSFC in particular on the following:

- Why Lean Six Sigma (LSS) at GSFC?
- What is LSS?
- How we are trained in LSS?
- Who is involved in a LSS Project Event?
Why Lean Six Sigma (LSS) at GSFC?
LSS Program Intent at NASA

The main intent of NASA’s Lean Six Sigma Program is to

1. Apply Lean principles and Six Sigma methodology to respective projects and work areas, to
   ✓ Remove non-value added activities from *existing* processes that create NASA products and services
   ✓ More effectively design *new* processes
   ✓ Increase understanding, communication, integration, and collaboration amongst work teams

2. Develop in-house Lean Six Sigma Green Belts and Black Belts to serve as facilitators and part time leaders of process improvement team activities.
Main Objectives

- Enhances Mission Success
- Focuses on Cost, Quality, and Schedule
- Reduces variability and “down time”
- Enables consistent, high quality products and services

May 26, 2010, Quote from NASA Administrator, Charlie Bolden, at the Hearing on "Review of the Proposed NASA Human Space Flight Plan" before the Committee on Science and Technology, United States House of Representatives: “private entities or the commercial entities are telling me they have learned through the years ways to be more efficient in their operations. They have in place programs like Lean and Six Sigma and other kinds of programs that have proven to be effective in bringing down cost. That's the way they make money. NASA is trying to drive those inefficiencies out by programs like Lean and Six Sigma and other programs.”
# Lean Six Sigma Training Builds In-House Capability

<table>
<thead>
<tr>
<th>Executive Overview</th>
<th>Champions Class</th>
<th>Green Belt</th>
<th>Black Belt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Who</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Half day overview for NASA Leaders</td>
<td>1-2 days class for NASA Leaders of improvement events provides guidance on who to send to the practitioner classes (Green/Black Belt)</td>
<td>One week class for NASA practitioners who carry out improvement events, and are part-time leaders/facilitators of simple events</td>
<td>Two week class for NASA practitioners who carry out more advanced improvement events, mentor Green Belts, and advise leadership in improvement activities</td>
</tr>
<tr>
<td>Training also benefits focus-area employees, contractors/suppliers, who have not attended more in-depth training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>What</strong></td>
<td><strong>What</strong></td>
<td><strong>What</strong></td>
<td><strong>What</strong></td>
</tr>
<tr>
<td>• Provides exposure to Lean and Six Sigma Principles</td>
<td>• Demonstrates how Lean and Six Sigma is applied to resolve improvement challenges</td>
<td>• Practitioners learn to apply principles/tools for application in improvement events</td>
<td>• Practitioners apply more advanced methods/tools/principles to complex improvement activities</td>
</tr>
<tr>
<td>• Participants will be able to recognize waste, begin to question sub-optimal processes, and initiate improvement activities</td>
<td>• Participants learn what happens during an improvement event, what type of results can be expected, and how to identify event candidates</td>
<td>• Practitioners learn to facilitate/lead teams through improvement event activities while under the guidance of a Black Belt</td>
<td>• Practitioners lead teams, facilitate events, mentor Green Belts, and advise Change Agent Leaders in competency of NASA continuous improvement</td>
</tr>
<tr>
<td>• No prerequisite for this training</td>
<td>• No prerequisite for this training</td>
<td>• No prerequisite for this training</td>
<td>• Prerequisite: Green Belt Training</td>
</tr>
</tbody>
</table>
Summary of Certification Requirements

- **Green Belt Certification**
  - Completion of Green Belt training
  - Successful completion of Green Belt exam (80% or higher)
  - Leading / facilitating one Kaizen event
  - Provide event summary to NASA Lean Six Sigma Management Office
  - Certification issued by Center Director

- **Black Belt Certification**
  - Completion of Black Belt training
  - Successful completion of Black Belt exams (80% or higher)
  - Leading / facilitating one Kaizen event
  - Leading / facilitating two additional improvement events
  - Provide event summary to NASA Lean Six Sigma Management Office
  - Mentoring two Green Belts to certification
  - Certification issued by Center Director
<table>
<thead>
<tr>
<th>Event</th>
<th>Duration</th>
<th>Scope of Change</th>
<th>Team Size</th>
<th>Time to Implement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaizen</td>
<td>3 or 4 days</td>
<td>Incremental change to an existing process</td>
<td>Team: 5 to 10 full time members</td>
<td>Short term: 0 to 6 months</td>
</tr>
<tr>
<td>Product or Process Development Kaizen</td>
<td>3 or 4 days</td>
<td>Pre-Production or Design development to a process that does not exist</td>
<td>Team: 5 to 10 full time members</td>
<td>Long term: 6 to 24 months</td>
</tr>
<tr>
<td>Value Stream Mapping</td>
<td>3 or 4 days</td>
<td>ID opportunities for improvements</td>
<td>Team: 5 to 15 full time members</td>
<td>Intermediate: 6 to 12 months</td>
</tr>
<tr>
<td>Just Do It</td>
<td>1 to 2 days</td>
<td>Solution is identified - ready to implement</td>
<td>Team: 1 to ??</td>
<td>NOW</td>
</tr>
<tr>
<td>Project</td>
<td>1 day to 6 months</td>
<td>Any difficult problem</td>
<td>Team Work on a Part time basis - not a full-time “event”</td>
<td>Intermediate: 6 to 12 months</td>
</tr>
</tbody>
</table>
NASA Lean Six Sigma Management Offices

Lean Six Sigma Management Offices are responsible for implementing NASA LSS at centres

- MSFC/Patty Fundum; patricia.s.fundum@nasa.gov
- LaRC/Al Motley; albert.e.motley@nasa.gov
- GRC/Michael Moxley; michael.e.moxley@nasa.gov
- JSC/Laurie Peterson; laurie.j.peterson@nasa.gov
- GSFC/Natesan Jambulingam; natesan.jambulingam@nasa.gov
- JPL/Marc Montgomery; marc.h.montgomery@nasa.gov
- DFRC/Paul Condon; paul.d.condon@nasa.gov
- KSC/Rey Diaz; rey.n.diaz@nasa.gov
- Agency (Contractor)/Mark Adrian (256) 532-4676; mark.adrian@adrian-tech.com

- Experts on the NASA Lean Six Sigma tool-set
- Provides for Lean Six Sigma training
- Internal consultants for NASA Lean Six Sigma improvement events
- Coordinates site activities
- Assists with locating Lean Six Sigma Green Belts and Black Belts
- Leverages outside resources
GSFC LSS Activities (through 2011)

Training & Certifications

- One Black Belt and two Green Belts (NASA certified) at GSFC
- 17 GSFC Managers have received Executive overview training
- 19 Green Belts trained in 2011
- Numerous Industry-trained Black Belts who only lack NASA approach training

Many projects at GSFC (one example given below)

- Lab Management Support (re: Mark Bollard)
  - Nonconformance Reports have been written stemming from internal and external audits
  - LSS Project seeks to provide a measureable assessment of the current state and define specific areas of improvement for twenty Labs in the following areas: Personnel Certifications, ESD Compliance, Calibration Compliance, Shelf-Life Compliance, GDMS Compliance, Clutter/Cleanliness, Assigned Roles & Responsibilities, and Safety
  - An overall score for each lab is captured before and after improvements to provide a measureable delta. And results are reported monthly to GSFC Management System Council.
GSFC LSS Goals for 2012

1. Integrate LSS into the existing continuous Improvement (CI) process at GSFC

2. Provide LSS Training
   a) Senior Management – One day in Apr/May
   b) Greenbelt – 4 Day in May/Jun
   c) Black Belt – 2 Weeks in Aug/Sep
   d) Facilitate Green Belt/Black Belt Projects in all Directorates
   e) Help programs, projects and institution to save money and resources
   f) Help LSS participants to graduate to help themselves on the job

3. Outside Partnership with other Government agencies, corporations and universities to bring in best practices
What is Lean Six Sigma (LSS)?
What is Lean Six Sigma?

Lean (basically) is the pursuit of waste elimination while Six Sigma pursues perfection in a process.

Typical Product / Service Flow

Value Added Tasks

Non-Value Added Tasks

Lean Focuses on Removing Waste

Six Sigma Focuses on Improving Quality

Source: Beyondlean.com
Lean Flow Goal

- **Lean Processes** should Flow without interruptions
- **Should continuously and progressively add Value in the eyes of the Customer**
  - Starts at receipt of customer request
  - Ends at delivery to customer
- **Should have the fewest number of process steps as possible, while**
  - Meeting required production time
  - Minimizing non-value added activities
“Six Sigma” is a Methodology and Tool Set

- We measure sigma levels to understand process performance. Higher sigma levels mean higher performance.
- It is a better way of approaching our entire business environment from planning through implementation.

We need to routinely:
- Measure our processes
- Make data driven decisions
- Reduce our process variation
- Predict performance
- Meet our customer requirements
Statistical Objective of Six Sigma

At $3\sigma$ a company spends $>25\%$ of revenues on internal and external repair.

At $4\sigma$ a company spends $>15\%$ of revenues on internal and external repair.

At $6\sigma$ a company spends $<1\%$ of revenues on internal and external repair.

Source: *The Six Sigma Way: How GE, Motorola, and Other Top Companies are Honing Their Performance* by Pande, Neuman, Cavanagh.
The Importance of Perfection

Process

-6σ-5σ-4σ-3σ-2σ-1σ  1σ  2σ  3σ  4σ  5σ  6σ

Process

-6σ-5σ-4σ-3σ-2σ-1σ  1σ  2σ  3σ  4σ  5σ  6σ

3.8σ = 99% Good

6σ = 99.99966% Good

Practical Examples

- 20,000 lost articles of mail per hour
- 5,000 incorrect surgical operations per week
- 200,000 wrong drug prescriptions each year
- No electricity for almost 7 hours each month

Variation has a major impact on the customer’s perception of quality

If we assume that many processes operate at 1σ these examples become:

- 636,000 lost articles of mail per hour
- 159,000 incorrect surgical operations per week
- 6,36M wrong drug prescriptions each year
- No electricity for approximately 2 days per week

7 lost articles of mail per hour
1.7 incorrect surgical operations per week
68 wrong drug prescriptions each year
1 hour without electricity every 34 yrs
### Using Lean Six Sigma to Achieve Perfection

#### SIX SIGMA

**OVERALL YIELD vs SIGMA**

(Distribution Shifted ±1.5σ)

<table>
<thead>
<tr>
<th># of Steps</th>
<th>±3σ</th>
<th>±4σ</th>
<th>±5σ</th>
<th>±6σ</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>93.32%</td>
<td>99.379%</td>
<td>99.9767%</td>
<td>99.99966%</td>
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<tr>
<td>7</td>
<td>61.63%</td>
<td>95.733%</td>
<td>99.839%</td>
<td>99.9976%</td>
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<tr>
<td>10</td>
<td>50.08%</td>
<td>99.36%</td>
<td>99.768%</td>
<td>99.9966%</td>
</tr>
<tr>
<td>20</td>
<td>25.06%</td>
<td>98.94%</td>
<td>99.536%</td>
<td>99.9932%</td>
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<tr>
<td>40</td>
<td>1.58%</td>
<td>68.18%</td>
<td>98.614%</td>
<td>99.9796%</td>
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<tr>
<td>60</td>
<td>0.40%</td>
<td>60.75%</td>
<td>98.156%</td>
<td>99.9728%</td>
</tr>
<tr>
<td>80</td>
<td>0.10%</td>
<td>53.64%</td>
<td>97.70%</td>
<td>99.966%</td>
</tr>
<tr>
<td>100</td>
<td>---</td>
<td>39.38%</td>
<td>96.61%</td>
<td>99.949%</td>
</tr>
<tr>
<td>150</td>
<td>---</td>
<td>28.77%</td>
<td>95.45%</td>
<td>99.932%</td>
</tr>
<tr>
<td>200</td>
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<td>15.43%</td>
<td>93.26%</td>
<td>99.898%</td>
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<tr>
<td>300</td>
<td>---</td>
<td>8.26%</td>
<td>91.11%</td>
<td>99.864%</td>
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<tr>
<td>400</td>
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<td>4.24%</td>
<td>89.02%</td>
<td>99.830%</td>
</tr>
<tr>
<td>500</td>
<td>---</td>
<td>2.38%</td>
<td>86.97%</td>
<td>99.796%</td>
</tr>
<tr>
<td>600</td>
<td>---</td>
<td>1.28%</td>
<td>84.97%</td>
<td>99.762%</td>
</tr>
<tr>
<td>700</td>
<td>---</td>
<td>0.69%</td>
<td>83.02%</td>
<td>99.729%</td>
</tr>
<tr>
<td>800</td>
<td>---</td>
<td>0.37%</td>
<td>81.11%</td>
<td>99.695%</td>
</tr>
<tr>
<td>900</td>
<td>---</td>
<td>0.20%</td>
<td>79.24%</td>
<td>99.661%</td>
</tr>
<tr>
<td>1000</td>
<td>---</td>
<td>0.06%</td>
<td>75.88%</td>
<td>99.593%</td>
</tr>
<tr>
<td>1200</td>
<td>---</td>
<td>---</td>
<td>50.15%</td>
<td>98.985%</td>
</tr>
<tr>
<td>150000</td>
<td>---</td>
<td>---</td>
<td>1.91%</td>
<td>94.384%</td>
</tr>
<tr>
<td>300000</td>
<td>---</td>
<td>---</td>
<td>0.01%</td>
<td>87.880%</td>
</tr>
<tr>
<td>700000</td>
<td>---</td>
<td>---</td>
<td>78.820%</td>
<td>60.000%</td>
</tr>
</tbody>
</table>

Source: SIX SIGMA RESEARCH INSTITUTE
Motorola University Motorola, Inc.
LSS Training at NASA/GSFC
Materials Covered

Lean Principles
NASA DMAICC Roadmap to Success
Event Roles and Approaches
Class Project (Statapult) – Baseline
Project Selection
Writing Charters
NASA Event Management
Team Dynamics
Documenting the Process
Introduction to Process Measuring
Introduction to Facilitation
Facilitator Intervention Techniques
Materials Covered – Cont.

Brainstorming
Error Proofing
Into FMEA
NASA Flow & Pull
Sustaining Improvement
Understanding Process Data
Class Project (Statapult) – Lean Improvements
Easy Analysis Tools
Introduction to SPC and Performance Measures
6S (Sort, Set-in-oredr, Shine, Standardize, Sustain, Safety)
Class Project (Statapult) – Variation Reduction (6σ)
Event Closure
How Do We Achieve Rapid Process (DMAIC) Improvement at NASA?

<table>
<thead>
<tr>
<th>Focus on the Customer and the Value Customers receive from NASA Products and Services</th>
</tr>
</thead>
</table>

- Define Scope and Problem
- Determine Goals / Objectives
- Create Charter
- Gather As-Is Process data
- Define As-Is Process
- Identify Potential Causes
- Perform Gap Analysis from what Customer really wants
- Generate Potential Solutions
- Develop Implementation Plan
- Create and Execute Monitoring Plan
- Status Team & Sponsors
- Teams’ Solutions are fully implemented
- Celebrate Success!
Class Project (Statapult) - Baseline

1. We established teams
2. Team members were teams
3. We learned the process
4. Took data to establish the baseline
Class Project (Statapult) – Lean Improvements

1. Defined the Charter
2. Mapped the AS-IS Process
3. Visually identified each step in the process as:
   - Value-Added ( )
   - Required - Non Value Added ( )
   - Non-Value Added - Waste ( )
4. Reviewed Waste areas for improvement opportunities on the mapped process
   - Brainstormed
   - Cause & Effect Analysis
5. Ran Process – Took data
6. Mapped Ideal State
1. Mapped the Ideal-State
2. Brainstormed
3. PICK Chart – Big/Small Payoff, Easy/Hard to Implement
   - Possible
   - Implement
   - Challenge
   - Kill
4. Ran Process – Took Data
Who is involved?
# Key Roles In LSS Events

<table>
<thead>
<tr>
<th>Roles</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Champion</td>
<td>- Provides resources and business guidance, project selection assistance, removes roadblocks</td>
</tr>
<tr>
<td>Sponsor</td>
<td>- Project selection assistance, actively supports and encourages project teams, participates in event kick-offs and out-briefs</td>
</tr>
<tr>
<td>Team Lead</td>
<td>- Responsible for ensuring Implementation Plan happens and tracks activities for Sponsor</td>
</tr>
<tr>
<td>Team Members</td>
<td>- NTE 10 members, which include Today’s Subject Matter Experts and Today’s Customers</td>
</tr>
<tr>
<td>Black Belt</td>
<td>- Facilitator &amp; Mentor of team and Green Belt candidates on LSS methodology and tool set as well as team dynamics &amp; change management</td>
</tr>
<tr>
<td>Green Belt</td>
<td>- Participates in Lean Six Sigma events, collects data, provides process expertise, completes improvement tasks and communicates change</td>
</tr>
</tbody>
</table>
NASA’s DMAICC Approach Roadmap

1. Define
2. Measure
3. Analyze
4. Improve
5. Control
6. Celebrate

Using Lean Six Sigma for Product and Service Excellence

Success
Define - Step 1

**Activities**
- Identify Opportunity
- Develop Charter
- Validate Problem Statement
- Gather Voice of the Customer
- Develop CTCs
- Perform Gemba Walk
- Validate Goal Statement
- Validate Business Case
- Validate Project Scope
- Select and Launch Team
- Develop Project Schedule
- Team Training

**Tools**
- Value Stream Map
- Project Selection Tools
- Project Charter
- Various Financial Analysis
- Effective Meeting Skills
- Stakeholder Analysis
- Communication Plan
- SIPOC Map
- High-Level Process Map
- Project Management Tools
- VOC and Kano Analysis
- RACI and Quad Charts
- QFD

**Who’s Involved**

<table>
<thead>
<tr>
<th>Role</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Champion</td>
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</tr>
<tr>
<td>Sponsor</td>
<td>100%</td>
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<tr>
<td>Black Belt</td>
<td>100%</td>
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<tr>
<td>Green Belt</td>
<td>0%</td>
</tr>
<tr>
<td>Team Lead</td>
<td>0%</td>
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<tr>
<td>Team</td>
<td>0%</td>
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</tbody>
</table>
# Measure - Step 2

## Activities
- Appropriately Map Process
- Identify Key Input, Process and Output Metrics
- Develop Operational Definitions
- Develop Data Collection Plan
- Validate Measurement System
- Collect Baseline Data
- Determine Process Performance/Capability

## Who's Involved

<table>
<thead>
<tr>
<th>Role</th>
<th>Involvement</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Black Belt</td>
<td>100%</td>
</tr>
<tr>
<td>Green Belt</td>
<td>100%</td>
</tr>
<tr>
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<td>100%</td>
</tr>
<tr>
<td>Team</td>
<td>100%</td>
</tr>
</tbody>
</table>

## Tools
- Process Mapping
- Process Cycle Efficiency
- Operational Definitions
- Data Collection Plan
- Statistical Sampling
- Measurement System
- Analysis
  - TPM
  - Generic Pull
  - Setup Reduction
  - Control Charts
  - Histograms
  - Constraint Identification
  - Process Capability
Analyze - Step 3

**Activities**
- Identify Potential Root Causes
- Reduce List of Potential Root Causes
- Confirm Root Cause to Output Relationship
- Estimate Impact of Root Causes on Key Outputs
- Prioritize Root Causes

**Tools**
- Value Analysis
- Process Constraint ID
- Takt Time Analysis
- Cause and Effect Analysis
- FMEA
- Hypothesis Tests
- Correlation Analysis
- Simple and Multiple Regression
- ANOVA
- Sources of Variation
- Conquering Product and Process Complexity
- Queuing Theory

**Who’s Involved**

<table>
<thead>
<tr>
<th>Role</th>
<th>0 %</th>
<th>100 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Champion</td>
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</tr>
<tr>
<td>Team</td>
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</tbody>
</table>
Improve - Step 4

**Activities**
- Develop Potential Solutions
- Develop Evaluation Criteria
- Select Best Solutions
- Develop ‘To-Be’ Process Map(s)
  - Develop Pilot Plan
  - Pilot Solution
  - Develop Full Scale Implementation Plan

**Who’s Involved**

<table>
<thead>
<tr>
<th>Role</th>
<th>% Involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Champion</td>
<td>0 %</td>
</tr>
<tr>
<td>Sponsor</td>
<td>100 %</td>
</tr>
<tr>
<td>Black Belt</td>
<td>60 %</td>
</tr>
<tr>
<td>Green Belt</td>
<td>40 %</td>
</tr>
<tr>
<td>Team Lead</td>
<td>100 %</td>
</tr>
<tr>
<td>Team</td>
<td>100 %</td>
</tr>
</tbody>
</table>

**Tools**
- Brainstorming
- Replenishment Pull/Kanban
- Stocking Strategy
- Process Flow Improvement
- Process Balancing
- Analytical Batch Sizing
- Total Productive Maintenance
- Design of Experiments (DOE)
- Solution Selection Matrix
- ‘To-Be’ Process Mapping
- Poka-Yoke
Control - Step 5

**Activities**
- Implement Mistake Proofing
- Develop SOP’s, Training Plan and Process Controls
- Implement Solution and Ongoing Process Measurements
- Identify Project Replication Opportunities
- Transition Project to Sponsor

**Who’s Involved**
- **Champion**: 0% to 100%
- **Sponsor**: 0% to 100%
- **Black Belt**: 0% to 100%
- **Green Belt**: 0% to 100%
- **Team Lead**: 0% to 100%
- **Team**: 0% to 100%

**Tools**
- Control Charts & SPC
- Standard Operating Procedures (SOP’s)
- Training Plan
- Communication Plan
- Implementation Plan
- Process Control Plans
- Visual Process Control Tools
- Project Replication
- Follow on Projects
- Team Feedback Session
## Celebrate - Step 6

### Activities
- Celebrate Success
- Center Website Populated
- Lessons Learned
- Completed

### Who's Involved

<table>
<thead>
<tr>
<th>Role</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Champion</td>
<td>0%</td>
</tr>
<tr>
<td>Sponsor</td>
<td></td>
</tr>
<tr>
<td>Black Belt</td>
<td>100%</td>
</tr>
<tr>
<td>Green Belt</td>
<td></td>
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<tr>
<td>Team Lead</td>
<td></td>
</tr>
<tr>
<td>Team</td>
<td></td>
</tr>
</tbody>
</table>

### Tools
- Suggestion Program
- Migration of Best Practice
- Web Page
- Newsletters
- Story Boards
- Awards
- Incentives
- Giveaways
Issue Statement:
The current Purchase Requisition process span time is not in line with efficient and effective operations. The average PR takes xx Calendar days whereas the required metric is x business days which leads to overall customer dissatisfaction and lack of confidence in the current process.

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- Analyze process data
- Secure team members
- Write Charter
- Brief Champion & Sponsor

**LSS Kickoff (1st Day)**

**Document Reality**
- Map As-Is or Current State process
- Value determinations (w/RYG)
- ID Touch time, Wait time, & Rework loops
- Determine main areas for improvements
- Perform Cause & Effect Analysis

**Ideal State (2nd Day)**
- Brainstorm attributes of Ideal State
- Map Ideal State
- Pick Chart what it will take to get from the Current State to the Ideal State

**Future State (2nd Day)**
- Map Future State using ideas from PICK
- ID improved Touch time and Wait time

**Implementation of Solutions (3rd Day)**
- Implementation Plan & Schedule
- OWI / MPR updates
- Action Item Closeout

**Out-Brief (3rd Day)**

**Measure & Sustain**
Examples of LSS Project Events
# NASA LSS Candidates

<table>
<thead>
<tr>
<th>Ctr</th>
<th>Date</th>
<th>Project Type</th>
<th>Title</th>
<th>Description</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSFC</td>
<td>Feb-08</td>
<td>1 VSM</td>
<td>Integrated MSFC PPBE09 and WIMS</td>
<td>Develop structure for integrated Financial and Workforce Planning process for MSFC.</td>
<td>Developed a streamlined, single, flexible, process flow for Financial and Workforce planning that meets partners needs with clear lines of communication. 1,400 labor hours saved.</td>
</tr>
<tr>
<td>LaRC</td>
<td>Jul-09</td>
<td>Kaizen</td>
<td>Center Hiring Process</td>
<td>The Team will improve the current Center Hiring process; understand barriers and/or mitigate challenges associated with internal and external hiring.</td>
<td>Developed a streamlined process that standardizes PDs, reduces process steps from 71 to 29 (60% reduction) and span time from 138 days to 77 days (45% improvement) 1,760 labor hours saved</td>
</tr>
<tr>
<td>HQ</td>
<td>Aug-08</td>
<td>1 VSM</td>
<td>Agency Desktop Software Delivery</td>
<td>Reduce software delivery time from 24 months by 25%, or 18 months.</td>
<td>All testing has been collapsed and integrated into a single set of tests/time period prior to Agency CCB approval, minimizing rework and wait times; reduced span time from 305 work days to 187 work days (61% improvement) and approvals from 78 to 33 (58% improvement)</td>
</tr>
<tr>
<td>JPL</td>
<td>Feb-09</td>
<td>Kaizen</td>
<td>Evaluating Purchase Requisition to Purchase Order Process Cycle Time</td>
<td>Reduce the 7 day cycle time from Purchase Requisition Approval to Purchase Order Placement to 4 days, to be able to give valuable manufacturing days back to the projects.</td>
<td>Cycle time savings is 2.3 days average cycle time; 2.3 days = 18.4 hours x 100 purchase orders per year = 1,840 labor hours saved</td>
</tr>
<tr>
<td>JSC</td>
<td>Jun-09</td>
<td>1 VSM</td>
<td>Pre-Solicitation Phase of JSC's Source Selection Process</td>
<td>Optimize all activities required to perform the pre-solicitation phase of JSC's Source Selection Process</td>
<td>Reduced presolition phase labor hours by 43% (13,334 hours to 7,536 hours)</td>
</tr>
</tbody>
</table>
Day 1
Current State of several GSFC Offices processes will be mapped and analyzed on what each Office does to create a product or service

Day 2
An Ideal Map will be created that integrates across the Offices

Day 3
A Plan will be created on what it will take to achieve the Ideal State, and an Out-Brief will be created for the GSFC Champions & Sponsors
Typical Candidates For Improvement

Processes that have:

- High customer problems / complaints
- High-cost
- Schedule delays
- Tailored processes within orgs causing variation
- Communication and Integration issues
- High rework / mistake rates
- Employees are constantly fire-fighting
- Confusion over who does what
- Too many approvals / reviews
- Lots of “walking the paperwork through” to expedite
Excessive Processing

Definition

- Effort which adds no Value to a product or service
  - Work that can be combined with other processes
  - Enhancements that are transparent to the customer

Examples:

- Unnecessary sign-offs
- Data fields that aren’t used
- Too many iterations
- Review cycles
- Reformatting
- Duplicate data entry

AUTHORIZING SIGNATURES

Lead Test Engineer _____________________   Date __________
Test Conductor ________________________    Date __________
Mechanical Engineer ____________________   Date __________
Quality Engineer _______________________    Date __________
Safety Engineer _______________________     Date __________
Example Process Areas for GSFC LSS

- Traveler Process
- Training Process
- On-boarding Process
- Equipment sharing Process
- Reimbursable Process
- Project Baselining Process
- Returning Unused Funds Process
- Property Accounting Process interaction with facilities and logistics
- and so on...
Summary & Next Steps

Summary

• LSS program is an agency effort endorsed by HQ
• LSS is being implemented by all centers to focus on cost, quality, schedule and consistency (Agency’s ROI/Cost avoidance over the past four years is $1.3M in budgets and 670K labor hours)
• NASA trained over 1000 executives and 1500 technical personnel in LSS
• GSFC has done many LSS type project events in an informal way by industry standard with the help of corporate Black Belt professionals and is now doing it in a formal way using NASA LSS

Next Steps

• To identify and prioritize potential projects at GSFC for process improvement through LSS process
• To get management support to form the team to work on LSS projects
### Event Management Agenda for Facilitators

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Facilitator #1</th>
<th>Facilitator #2</th>
<th>Facilitator #1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Kick-Off: 8 to 9am</strong>&lt;br&gt; - Team Introductions and Rules of Kaizen (use chart 2)&lt;br&gt; - Charter (use charts 3 &amp; 4)&lt;br&gt; - Kick-Off is conducted by the Sponsor and/or Champion (Sponsor meets with team and explains why this event is taking place – they may refer to the Charter - notes for Sponsor is attached separately to this email)&lt;br&gt; - Ground rules (use chart 5) show team this chart and create a separate sheet for this team to come up with their Ground rules for this event&lt;br&gt; - Thumb Voting (use chart 6) make sure team knows consensus must be achieved on all aspects of the new process</td>
<td><strong>Current State Map: 9 to 12noon</strong>&lt;br&gt; - Explain example “Logical Process Map” (use chart 7 and 8)&lt;br&gt; - Have team hang roll of paper and add swim lanes via post-it notes (explain swim lanes represent process functional responsibilities)&lt;br&gt; - Have team capture actual process steps on the wall for each swim lane (reinforce post-it notes with tape as they may fall off over night)&lt;br&gt; - Have team review all process steps to assure correct step sequence&lt;br&gt; - Have team link steps with arrows&lt;br&gt; - Have team add touch-times and wait times to each post-it note. Have team add up times of each process step by swim lane – post times totals at the end of each lane</td>
<td><strong>ID Problems with Current process: 1 to 3pm</strong>&lt;br&gt; - Have team identify re-work loops, inventory, wasted steps, cancellations, redundancy, and efficiencies that can be gained by doing things concurrently&lt;br&gt; - anything else?</td>
<td><strong>Customer &amp; Value Statement: 3 to 4:30pm</strong>&lt;br&gt; - Have team identify who the Customer is; the product or service being provided; and what the customer values in this process (use chart 9)</td>
</tr>
</tbody>
</table>

**NOTE:** If there is time available, forge on to the brainstorming activity, first mentioned on Day 2 (see chart 10)
Team Introductions & Rules of Kaizen

1. Each Team Member explains their role in this process

2. Rules
   - Rely on the Wisdom of the Team
   - No Grandma’s Hams
   - Ask Why, Why, Why, Why, Why?
   - Can’t Say “Can’t”
   - Use Brains, Not Money
   - Experiment
   - Make Change Happen!

*Enjoy This Opportunity!!!*
**Example Charter (Page 1): Purchase Requisition Process**

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- Action Item Closeout

**Out-Brief (3rd Day)**

**Measure & Sustain**
Ground Rules

- Be active, timely, and present
- Cell phones and PDA’s turned off
- Everyone is responsible for our success
- One person speaks at a time
- Be respectful and supportive of all ideas
- Think process, not personality
- Vegas Rules apply
Rules For Brainstorming

- No premature decisions or evaluations
- "Wild" or "bad" ideas are welcome
- No "judgment" of ideas (positive or negative)
- Don’t sit on ideas -- express them
- Quantity over quality
- Piggyback on the ideas of others
- Everyone participants
Thumb Voting is Used to Gain Consensus

- **Thumbs Up** indicates team member agrees with specific idea and will support it through implementation when the event is over.

- **Sideways Thumb** indicates team member may not like the specific idea but will support it through implementation when the event is over.

- **Thumbs Down** indicates team member does not like the specific idea and will not support it through implementation when the event is over.
Functional Process Map (AS-IS or Current Reality)

- Shows not only the linear sequence of activities, but also the responsible functions for each activity
Process Rework Loops (AS-IS or Current Reality)

<table>
<thead>
<tr>
<th>Dept D</th>
<th>Dept C</th>
<th>Dept B</th>
<th>Dept M</th>
<th>Dept S</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="Diagram" /></td>
</tr>
</tbody>
</table>

- Dept D: 10%
- Dept C: 25%
- Dept B: 10%
- Dept M: 40%
- Dept S: 54%
Current State Process Map

- A “map” which defines all actions currently required to deliver the product/service
- Visually identifies areas for improvement opportunities
- Integrate separate process flows into one combined process map
Customer, Product & Value Definitions

- Who is the Customer?
- What is the Product being created?
- What does the Customer value in this process?
# Event Management Agenda for Facilitators

<table>
<thead>
<tr>
<th>Day 2</th>
<th>Facilitator #2</th>
<th>Facilitator #1</th>
<th>Facilitator #2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brainstorming: 8 to 10:00am</strong></td>
<td></td>
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<tr>
<td>- Recap Current State map</td>
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<tr>
<td>- Have team brainstorm ways to eliminate non-value added process steps and rework in the Current process</td>
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<tr>
<td>- Review ideas for clarity and have team agree with combining duplicates, if necessary</td>
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</tr>
<tr>
<td><strong>Cause and Effect Analysis: 10 to 12noon</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>- Explain Fishbone (cause &amp; effect) analyses to determine root cause (use chart 11)</td>
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</tr>
<tr>
<td>- Have team split up into sub-teams (i.e. 3 people each) to create Fishbones to analyze those brainstormed items that capture what is wrong with Current process</td>
<td></td>
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</tr>
<tr>
<td>- Have team create SOV Matrices with actions for each Fishbone (use chart 12) that explain what they can do about the eliminating the problem in their new process</td>
<td></td>
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<tr>
<td>- Have sub-teams out-brief their Fishbones/SOVs to the rest of the team</td>
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</tr>
<tr>
<td><strong>Ideal Process Activity: 1 to 3pm</strong></td>
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<tr>
<td>- Have team map an Ideal process (works right the first time, plenty of budget, no politics, etc.)</td>
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<tr>
<td>- Have team brainstorm what it will take to get from the Current process to the Ideal Process. Have team capture their brainstormed ideas on post-its so they can be added to the PICK Chart</td>
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<tr>
<td><strong>PICK Chart: 3 to 4:30pm</strong></td>
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<tr>
<td>- Have team PICK chart their improvements ideas (use chart 13). Team must agree via consensus, on which quadrant each idea is to be placed</td>
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</tr>
</tbody>
</table>
These diagrams are used to isolate one specific defect, problem, or undesirable condition and determine the potential causes.

Excellent tool for determining root cause.

For every entry on the fishbone, determine if it is:

- **C** = Controllable ⇒ requires Mistake Proofing and Standard Operating Procedures (SOPs),
- **N** = Noise, or
- **X** = Experimental
Major Cause Categories

Four P’s for Service
- Policies
- Procedures
- People
- Plant/technology

Six M’s for Manufacturing
- Machinery
- Methodology
- Materials
- Measurement
- Mother Nature (environment)
- Manpower (People)

Process Steps - Consider using each major step in the process as a cause category. For example:
- Prepare Materials
- Process Materials
- Process Rejects
- Ship Product
Brainstorming Causes

- Multifunctional team of experts brainstorm specific causes based on major categories.
- Attach each one to the cause arrow that leads to the centerline arrow.
Next Steps

Once you have completed the diagram you should classify each variable as:

- **C** - Controllable (Needs control mechanism, SOP)
- **N** - Noise (Can not be controlled easily)
- **X** – Experiments needed to determine effect (do not use for this exercise)

The final Cause and Effect diagram may contain many potential factors

- The team should prioritize which factors are the most significant causes
- Seek data to confirm relationships

Note: Cause and Effect is a living document that should be saved for future reference
Ideal State

Team will develop an “Ideal State” Map where ideal conditions exist for this process ►

During this activity, team will capture

♦ List of possible obstacles to the Ideal State
♦ list of key projects to make this happen

♦ No politics
♦ No bureaucracy
♦ Funding is not a problem
♦ Everyone shares ideas and tools
♦ The Customer defines a job well done
♦ Everyone wants to provide the Customer with the BEST product

Note that IDEAL processes contain very few process steps because they are “Ideal”
PICK Chart

- Easy to Implement
  - Small Pay-off
  - Possible Implement
  - Possible Challenge
  - Kill
  - Item
- Hard to Implement
  - Big Pay-off
  - Possible Implement
  - Possible Challenge
  - Kill
  - Item
Shows not only the linear sequence of activities, but also the responsible functions for each activity.
<table>
<thead>
<tr>
<th>Event Management Agenda</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day 3</strong></td>
</tr>
<tr>
<td><strong>Facilitator</strong></td>
</tr>
<tr>
<td><strong>Future Process Map: 8 to 12noon</strong></td>
</tr>
<tr>
<td>- Review objectives and how team meets those in Ideal process</td>
</tr>
<tr>
<td>- Have team Map new Future process on the wall with post-it notes reinforced by tape</td>
</tr>
<tr>
<td>- Have team review all process steps and assure correct step sequence</td>
</tr>
<tr>
<td>- Have team link steps with arrows</td>
</tr>
<tr>
<td>- Have team add touch-times to post-it notes and calculate times of new process</td>
</tr>
<tr>
<td><strong>Take Team Picture: 12noon</strong></td>
</tr>
<tr>
<td>- Have team include team picture on Out-Brief Completion Report</td>
</tr>
<tr>
<td><strong>Sub-Team Work: 1 to 3:00pm</strong></td>
</tr>
<tr>
<td>- Have a sub-team review action items and develop an Implementation plan – this may include ISO document updates (may need to split the team into sub-teams) (use chart 17)</td>
</tr>
<tr>
<td>- Have a sub-team document the improvements they have made (before and after of: time, reduced process steps, reduced labor, etc.) and calculate the savings to include on Out-Brief Completion report (use chart 18)</td>
</tr>
<tr>
<td><strong>Sub-Team Work: 3 to 4:00pm</strong></td>
</tr>
<tr>
<td>- Team is briefed on sub-team activities and results, and obtains consensus to include charts in Out-Brief (tweaks are usually required)</td>
</tr>
<tr>
<td><strong>Prep for Out-Brief: 4 to 4:30pm</strong></td>
</tr>
<tr>
<td>- Facilitators and Team prepares for the Out-Brief</td>
</tr>
<tr>
<td>- Team prepares for Champion and Sponsor Out-Brief (each team member will select an event activity to brief (show chart 19 as example agenda)</td>
</tr>
</tbody>
</table>
### Event Management Agenda

<table>
<thead>
<tr>
<th>OUT-Brief</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out-Brief is usually scheduled for an hour</td>
</tr>
<tr>
<td>- Ask the Team to keep their presentations to about 5 minutes each, so that the presentation part of the Out-Brief will only last about a half-hour</td>
</tr>
<tr>
<td>- The remaining half-hour will permit the Champions and Sponsors to ask questions to gain clarity on the new process and their role in rolling it out at the center</td>
</tr>
<tr>
<td>- Team Lead introduces team and briefly recaps the Charter (make sure the Charter is up-to-date, sometimes team members change…)</td>
</tr>
<tr>
<td>- Each team member briefs some aspect of event activity – all activities are presented at a high-level to the Sponsor – so each person speaks for only about 5 minutes</td>
</tr>
<tr>
<td>- Team Lead briefs Completion Report and asks for questions/comments from the Champions and Sponsors</td>
</tr>
<tr>
<td>- Champions &amp; Sponsors should praise the team for their efforts!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Room Clean-up (1/2 hour):</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Facilitators have team restore room to original order</td>
</tr>
<tr>
<td>- Typically the Team Lead keeps the paper on the walls as the Team Lead is responsible for implementation of the Team’s new process</td>
</tr>
</tbody>
</table>

**Adjourn**
# Implementation Plan

TEAM: ______________________________________________________ DATE: ___________________

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Problem – Issue – Opportunity</th>
<th>Action Required</th>
<th>Person(s) Responsible</th>
<th>Due Date</th>
<th>Status</th>
</tr>
</thead>
<tbody>
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</table>
Completion Report - Event Title

*Event Title*

date event completed

The way we used to do it...
- 
- 
- 

The changes we made...
- 
- 
- 

The way we do it now...
- 
- 
- 

Results

<table>
<thead>
<tr>
<th>Category</th>
<th>Before</th>
<th>After</th>
<th>Improvement</th>
</tr>
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<tbody>
<tr>
<td></td>
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Picture/Graphic

Change Leader Name/Level:
Team Members:

Completion Report - Event Title

*Event Title*

date event completed

The way we used to do it...
- 
- 
- 

The changes we made...
- 
- 
- 

The way we do it now...
- 
- 
- 

Results

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Picture/Graphic

Change Leader Name/Level:
Team Members:
Out-Brief to Champions/Sponsors:

- Integrated Current state
- Main areas for improvement
- Cause & Effect Analyses
- Ideal State
- PICK Chart
- Future State
- Implementation Plan
- Other items?
- Completion Report
Value Added versus Non-Value Added

**Value-added Activities**

- Activities which change the form, fit or function and usability of the product/service and
- Activities which, when asked, the customer is willing to pay for and
- Activities done right the first time

**Non Value-added (Waste) Activities**

- Activities that consume resources but create no Value in the eyes of the Customer Required (regulatory, customer mandate, legal)
- Pure Waste
- If you can’t get rid of it turns yellow

**Non Value-added – Required Activities**

- Activities causing no value to be created but which cannot be eliminated based on current state of technology or thinking
- Required (Required internal or external customer mandate)
- Necessary (due to non-robustness of process, currently required)
NASA Reduces Non-Value Added Activities

PRIOR TO LEAN SIX SIGMA RAPID PROCESS IMPROVEMENT

TRADITIONAL PROCESS IMPROVEMENT

AFTER LEAN SIX SIGMA RAPID PROCESS IMPROVEMENT

Time and Labor

NON VALUE ADDED ACTIVITIES (NVA)

VA

NVA
A Focused / Prioritized Approach in Applying Lean Six Sigma

Strategic Plans…
Program Project Plans…

Hot Issues…
Low Hanging Fruit…
Benchmarking…

Mission changes, redirection, new enabling technologies are all reasons to …

…Focus efforts on those activities that will provide the most benefit
When Do We Start Applying Lean Six Sigma?

Key to success: start early

More Savings When Applied Early in Life Cycle

% Influence On Total Costs

Design

70%

Tremendous Opportunities Exist By Focusing on Design

20%

5%

5%
### Typical Kaizen Event Results - NASA

<table>
<thead>
<tr>
<th>Cost Drivers</th>
<th>Targeted Improvement Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rework</td>
<td>30 – 80%</td>
</tr>
<tr>
<td>Span Time</td>
<td>30 – 80%</td>
</tr>
<tr>
<td>Labor</td>
<td>30 – 70%</td>
</tr>
<tr>
<td>Costs</td>
<td>30 – 70%</td>
</tr>
<tr>
<td>Inventory</td>
<td>30 – 80%</td>
</tr>
<tr>
<td>Variation</td>
<td>30 – 90%</td>
</tr>
</tbody>
</table>

You can ALWAYS reduce waste by at least 30%
How Do We Achieve Rapid Process Improvement at NASA?

By focusing on the Customer & what the Customer Values in the Products and Services they are using

- Define Scope and Problem
- Determine Goals / Objectives
- Create Charter
- Gather As-Is Process data
- Define As-Is Process
- Identify Potential Causes
- Perform Gap Analysis from what Customer really wants
- Generate Potential Solutions
- Develop Implementation Plan
- Create and Execute Monitoring Plan
- Status Team & Sponsors
- Teams’ Solutions are fully implemented
- Celebrate Success
Customer Value

Value is specified from the Customer’s perspective

- Value is activity which the customer is willing to pay for
- Value is only meaningful when expressed in terms of a specific product or service which meets...
  - The customers needs
  - At a specific price
  - And at a specific time

Have you asked your Customer what they Value?
Your “Value” Responsibility

- Know your Customers
  - **Internal** (those that create the product / service)
  - **External** (End Users)
- Know exactly what your Customers **value** in your product or service
- Stay **close** enough to your Customer to know if they are satisfied or not
- Ensure that your Customer Satisfaction **recovery actions** are swift, effective, and lasting
Typical Doctor Visit
Forms of Waste = DOWNTIME

When a Value Stream stops flowing you have downtime...

- When you have DOWNTIME you encounter one of the 8 forms of Waste.

- **D** – Defects
- **O** – Over Producing
- **W** – Waiting
- **N** – No Injuries
- **T** – Transportation
- **I** – Inventory
- **M** – Motion
- **E** – Excessive Processing
Session Summary

- Measuring is important to **understand** how well we are or are not performing

- **Follow the five step approach to establishing good process measurements**
  - Determine what to measure
    - **Always** select measurements which have a purpose
  - Determine how to measure
  - Determine measurement / data source
    - Be aware of potential pitfalls in manual data collection
  - Determine data collection / sampling plan
    - Use tools such as surveys to gather data quickly
  - Determine how to maintain the measurement