SAND2007-6456C

# Lean Collaboration Environments and Engineering Work Cells at Sandia National Laboratories

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**October 11, 2007**

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

# Agenda

- About Sandia
- Lean Collaboration Environments
- Engineering Workcells
- Questions

# Background

**Sandia is a multiprogram engineering and science laboratory managed by Lockheed Martin for the U.S. Department of Energy's National Nuclear Security Administration.**

**We design all non-nuclear components for the nation's nuclear weapons, perform a wide variety of energy research and development projects, and work on assignments that respond to national security threats, both military and economic. We encourage and seek partnerships with appropriate U.S. industry and government groups to collaborate on emerging technologies that support our mission.**

# Facility

**Sandia has two primary facilities, a large laboratory and headquarters in Albuquerque (about 7,500 employees) and a smaller laboratory in Livermore, California (about 900 employees).**

# Primary Responsibilities

- Nuclear weapons
- Nonproliferation and assessments
- Military technologies and applications
- Energy and infrastructures assurance
- Homeland security




# Responsive Neutron Generator Product Deployment Center

- Our mission is to build neutron generators, now and in the future, to meet the nation's deterrence by shipping quality product on time within the resource constraints defined.
- NG Production Facility consists of 280 employees and 100,000 sq feet of production space.

# Responsive Neutron Generator Product Deployment Center

- Government R&D environment
- Manage to a decreasing budget
- Low volume, low mix, high reliability, specialty product
  - 75 piece parts
  - 100 unique processes
  - 3769 engineering drawings
- Neutron Generator Responsibilities
  - Science and Technology
  - Product and Process Development
  - Continuous Production
  - Stewardship
  - Retirement

# Burning Platform

- Multiple products coming online
- Increasing production requirements
- Low yields
- Large span times
- High WIP
- No clear vision – are we R&D or are we production?

# Lean/Six Sigma Conversion

- The organization embraced Lean Six Sigma in December of 2000 .
- Lockheed Martin launched a corporation wide program, LM21.
- Neutron Generator Production Facility was the first Sandia organization to implement the program.

# Lean Journey

- 80% of the workforce is greenbelt trained
- Four full time black belts and twelve part-time black belts
- 6S in all production areas
- Re-organized into value streams
- Implemented pull throughout the production line
- Implemented three production work cells
- Mistake proofing on key process on the production floor
- Vertical value streams for major projects
- Numerous kaizen events that have led to significant reductions in span time and increases in yield
- Metrics are in place and reviewed to identify areas for improvement
- Integrated all the departments for the Neutron Generator Value Stream (life cycle of the product) to become more efficient
- Hoshin- Kanri Strategy Deployment
- Portfolio Management Board

- Shingo Public Sector 2006 Bronze Recipient

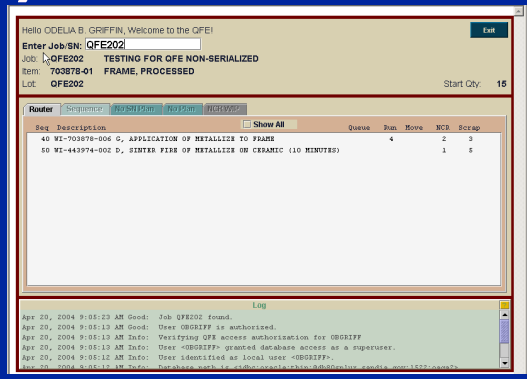
# Best Practices: Lean Collaboration Environments and Engineering Work Cells

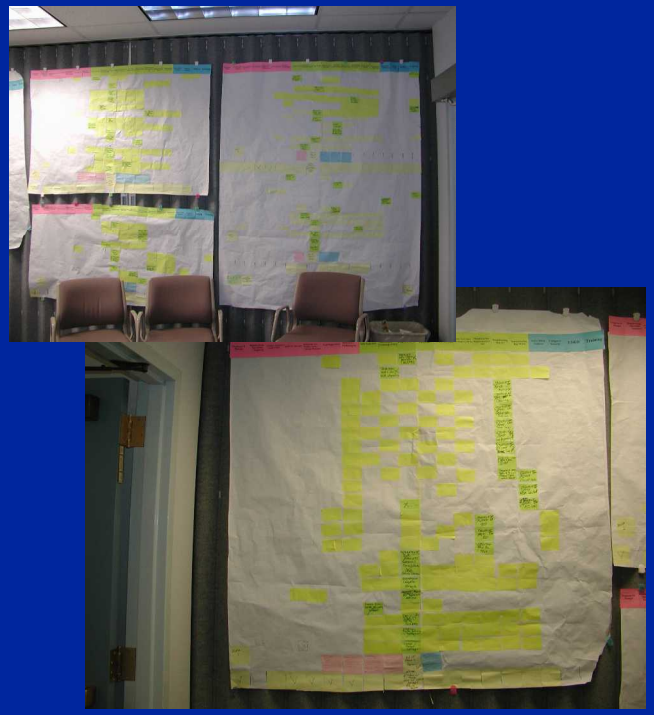
| Lean Collaboration Environments | Engineering Work Cells |
|---|---|
| QFE – a software example | Product Acceptance Work Cell |
| Small Tube and Generator – a product development example | Engineering Change Order Work Cell |
| Transformation Team – an enterprise redesign example | Incoming Materials Receiving Work Cell |

# Lean Collaboration Environments

# Quality Front End (QFE)

## Software Development



### Process

- Project team was formed and participated in a week long Vertical Value Stream (VVS) Event
- Project Team Room was created
- Team tracked their performance to takt time of 1 task per day

### Results

- Project span time was 8 months
- Delivered 4 months ahead of original schedule
- Customers were satisfied

# Small Tube and Generator Development

## New Product Development

### Process

- Product Realization Teams conducted a week long VVS event to create the project plan
- Teams are executing tasks in a collaborative environment, but did not have a dedicated teaming space
- Teams are tracking progress to takt time

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|---|---|---|

| | TAKT | Goal | Actual | Complete | Comments |
|---|---|---|---|---|---|
| | Small Tube | 2.6d | 2.5d | 70% | |
| | Small Generator | 4.5d | 7.8d | 30% | Team is struggling with embracing the VVS techniques & continues to manage projects via traditional planning methods. It has been>1 year and are still struggling. |
| | Tube Flow | | | 100% | Successfully utilized tool |

| Date | Event | Project Affected | Status |
|---|---|---|---|
| **Aug04** | **Problem Analysis on G:M** | **Project A** | **50%** |
| **Sept04** | **Welding Kaizens** | **Project B** | **35%** |
| **Sept04** | **Diffusion Bonder Decision Analysis** | **Project C** | **80%** |
| **Oct04** | **Problem Analysis on Product B HVBs** | **Project B** | **50%** |
| **Nov04** | **Problem Analysis on Product B Header Braze** | **Project B** | **40%** |

### Results

- Neutron Tube Project is on track thus far
- Neutron Generator Project is not meeting takt time

# Transformation Team

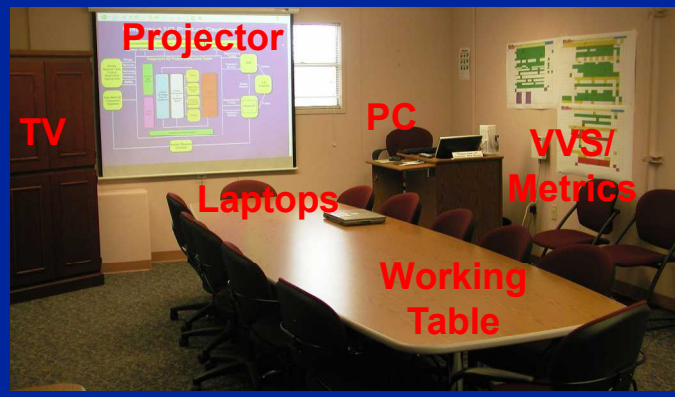
## Enterprise Redesign

### Enterprise Value Stream

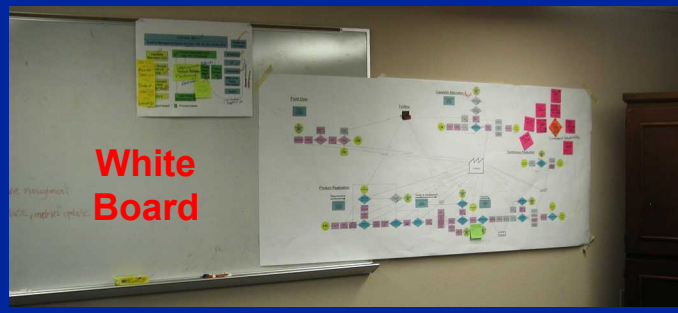
- Objective:  Reduce Neutron Generator Center costs by 25%
- Transformation Action Plan draft (VVS)

### Getting Started

- Form cross-functional team and identify team leader
- Reserve teaming area
- Obtain all hardware/software needs for teaming area
- Have project kickoff and obtain direction from management



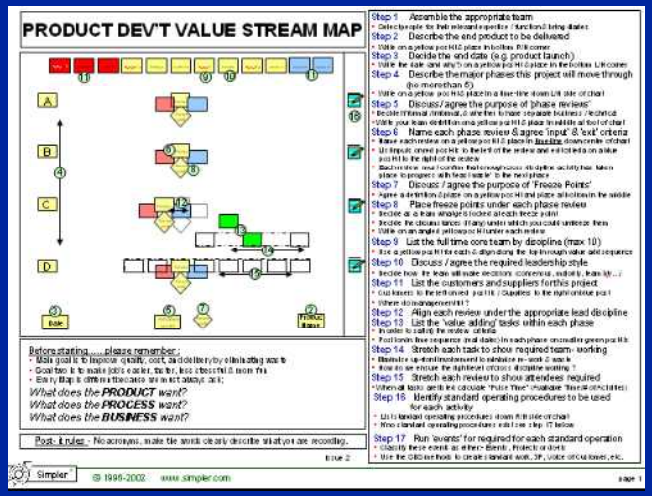




# Transformation Team

## Process

- Week long VVS event
- Daily morning meetings
- Daily wrap up meetings
- Tasks executed as collaborative activities
- Weekly meetings with stakeholders
- Planned communications with staff
- Project closeout
  - Documentation
  - Performance evaluation of team members
  - Customer surveys
  - Lessons learned




## Results

- New process to better do work in our organization and reduce cost by 25%
  - Enterprise Value Stream
  - Standard Work
  - Management System
  - Implementation Plan
- Project was accomplished in a fraction of the time
- Initial positive feedback from partners and customers

# Lean Collaboration Environments Conclusions

- Project span time has decreased since this methodology was adopted
- Reduced project rework
- Better teaming and better communication
- Team members develop a better empathy for the roles and responsibilities of the other members and are more willing to work to a common solution or compromise. More efficient way of doing work leading to better results
- Tracking the rate of completion of tasks rather than tracking the slack on a project plan, has helped us determine actual progress and encourages continuous progress and eliminates the bow wave at the end of the project.
- Recognizes that multitasking is inherently unrealistic, since a resource can really only work on one thing at a time.

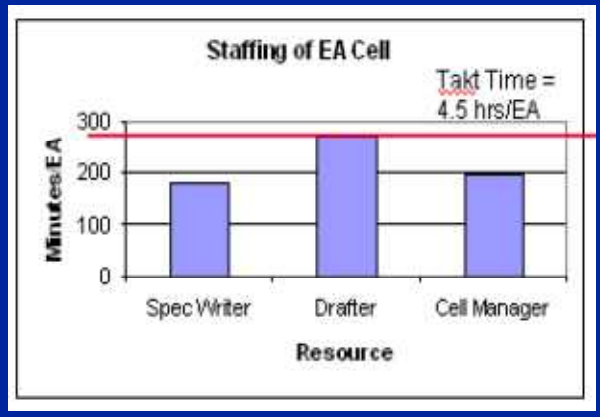
# Engineering Work Cells

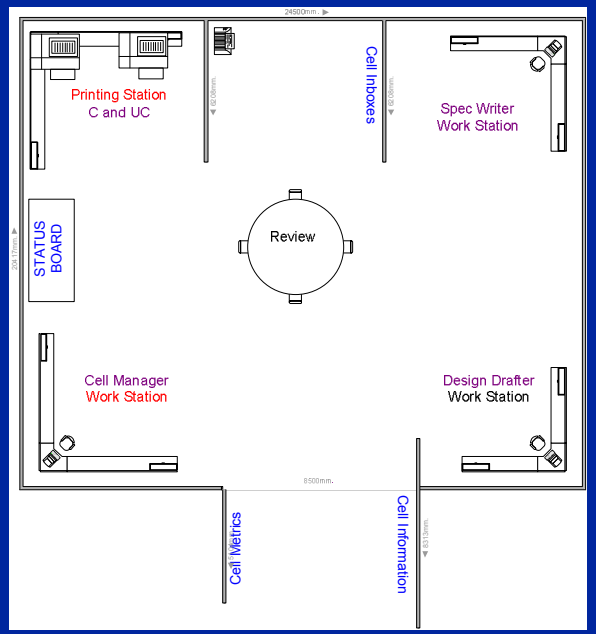
# Engineering Change Order Work Cell

***The process by which changes are made to design specs and product drawings had large span times and multiple rework loops***

## Process

- Kaizen event held to design the work cell
  - 1 piece flow, 6S, standard work, and pull
  - Simulated the cell
- Set up the location of the cell and staffed
- Conducted successful pilot
- Implemented full scale




**14400 EA Cell Status Board**

| Station1 | Station 2A | Station 2B | Station 2C | Station 3 | Station 4 | Station 5 | Station 6 |
|---|---|---|---|---|---|---|---|
| | | | | | | FCO # 12349 Dwg # A127 | |
| | | | | | FCO # 12348 Dwg # A126 | | |
| | | | FCO # 12346 Dwg # A124 | | | | |
| | FCO # 12347 Dwg # A125 | | | | | | |
| FCO # 12345 Dwg # A123 | | | | | | | |
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# Engineering Change Order Work Cell Results

| Metric | Before | After |
|---|---|---|
| Span Time | 33 days | 2.5 days |
| Cycle Time | 13.2 hours | 10.5 hours |
| Hand Offs | 11 | 2 |
| Number of Steps in the Process | 58 | 10 |
| Resources Required in the Process (people) | 8 | 3 |
| % Rework (Rejections) | 17.5% | 0% |
| Time to Rework | 8 minutes/EA | 0 minutes/EA |

- **Annual savings: $38,300**
- **Capacity gain for the Engineering Management Systems Organization: 12% (or 6 weeks per year)**
- **Customer satisfaction increased**
- **Exceeded initial goals**

# Product Acceptance Work Cell

***Collaborative work cell for the product acceptance process***

**Process**

- **A kaizen event was held to design the work cell**
  - **Determined the process**
  - **Established cell rules**
  - **Developed standard work**
  - **Simulated the work cell**
- **Implemented the work cell**

**Results**

- **WIP reduced by 83%**
- **Distance traveled reduced by 61%**
- **Span time reduced by 50%**
- **Hand-offs reduced by 63%**

# Incoming Material Receiving Work Cell

## Process:

**Kaizen Event to design and implement work cell**

- **Current State: One big area where three people worked on top of each other to accomplish the process with 23 handoffs in between.**
- **Future State: Two parallel flows where one person works each side to process an entire lot through completion.**

**Before**

**After**


## Results:

| Metric | Before | After |
|---|---|---|
| Handoffs | 23 | 5 |
| Cycle Time | 4.6 days | 1.5 days |
| Number of Resources | 3 | 2 |

# Engineering Work Cells Conclusions

- Same principles that apply to manufacturing can be applied to admin/engineering areas.
- Collaboration, dedicated resources, and co-location enable a highly efficient environment where quality work happens.
- Cost savings / capacity increases were achieved in every work cell implemented.
- Having all required functions in one location facilitate the quick resolution of issues.
- Clear roles and responsibilities in an engineering work cell can improve worker satisfaction.

# Questions