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Lean Collaboration Environments and Engineering Work Cells at Sandia National Laboratories

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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
- Neutron Generator Center Lean Journey
- 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

- The Neutron Generator Center is part of the Nuclear Weapons Business Unit at Sandia.
- Our mission is to build Neutron Generators, a non-nuclear component of a nuclear weapon, 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

Environment:

- 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 Center Responsibilities:

- Science and Technology
- Product and Process Development
- Continuous Production
- Stewardship
- Retirement

Burning Platform

- Sandia started building NGs in 1994 – no lean thinking

- 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.
- The Neutron Generator Center was the first Sandia organization to implement the program.

Lean Journey

- Trained 3 Black Belts to start the transformation – currently have 16
- Have a goal of 100% Green Belt trained - currently at 80%
- 6S'd all production areas and starting to 6S R&D Labs
- Re-organized Center into Value Streams
- Implemented pull throughout the production line
- Implemented three production work cells
- Mistake proofed key process on the production floor
- Implemented use of Vertical Value Streams for major projects
- Held numerous kaizen events that have led to significant reductions in span time and increases in yield
- Established SMART metrics to identify areas for improvement
- Integrated all the departments for the Neutron Generator Value Stream (life cycle of the product) to become more efficient
- Implemented Hoshin- Kanri Strategy Deployment
- Implemented a Portfolio Management Board to prioritize and authorize work in the Center

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
Transformation Team – an enterprise redesign example	Engineering Change Order Work Cell
	Incoming Materials Receiving Work Cell

Lean Collaboration Environments

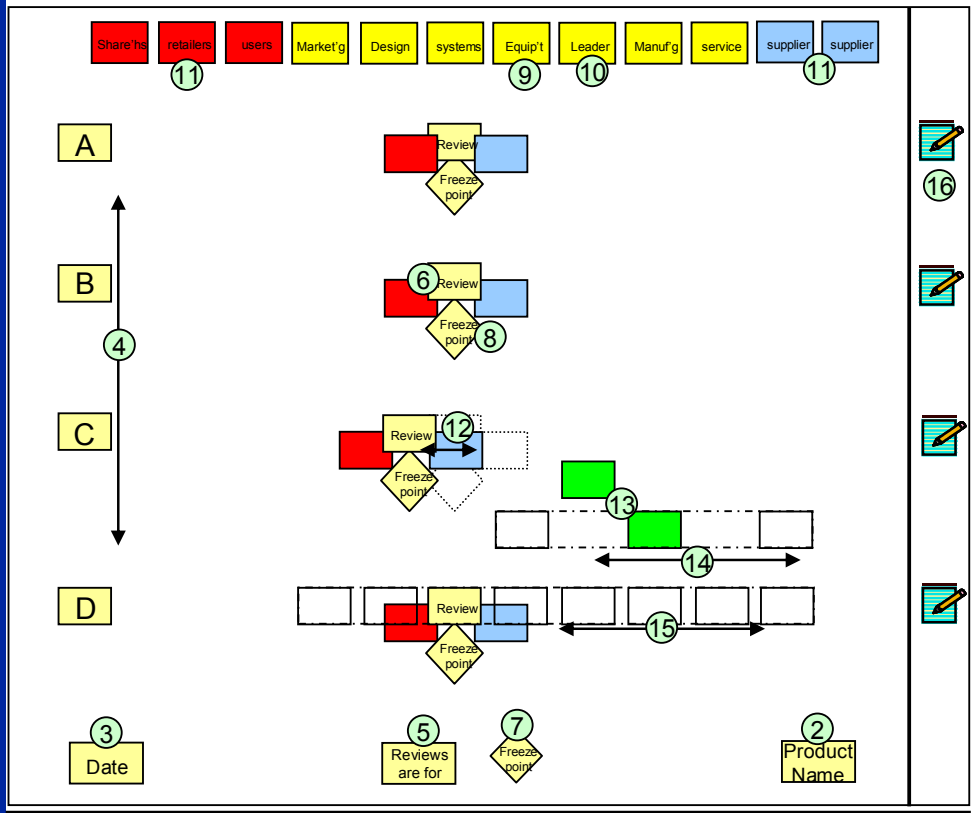
A Lean Project Plan (VVS)

A Dedicated Team

A Designated Teaming Area

Vertical Value Stream Map Recipe Card

VERTICAL VALUE STREAM MAP



Before starting……please remember :

- Main goal is to improve quality, cost, and delivery by eliminating waste
- Goal two is to make job's easier, faster, less stressful & more fun
- Every Map is different because we must always ask;

*What does the **PRODUCT** want?*
*What does the **PROCESS** want?*
*What does the **BUSINESS** want?*

Post- it rules - No acronyms, make the words clearly describe what you are recording.

Step 1 Assemble the appropriate team
- Select people for their relevant expertise / function & bring diaries

Step 2 Describe the end product to be delivered
- Write on a yellow post-it & place in bottom R/H corner

Step 3 Decide the end date (e.g. product launch)
- Write the date (and why?) on a yellow post-it & place in the bottom L/H corner

Step 4 Describe the major phases this project will move through (no more than 5)
- Write on a yellow post-it & place in a time- line down L/H side of chart

Step 5 Discuss/ agree the purpose of 'phase reviews'
- Decide if formal / informal, & whether to have separate business / technical
- Write your team definition on a yellow post-it & place in middle at foot of chart

Step 6 Name each phase review & agree 'input' & 'exit' criteria
- Name each review on a yellow post-it & place in time-line down centre of chart
- List inputs on red post-its to the left of the review and exit criteria on a blue post-it to the right of the review
- Each review must confirm that enough cross discipline activity has taken place to progress with 'least waste' to the next phase

Step 7 Discuss / agree the purpose of 'Freeze Points'
- Agree a definition & place on a yellow post-it and place at bottom in the middle

Step 8 Place freeze points under each phase review
- Decide as a team what gets locked at each freeze point
- Decide the circumstances (if any) under which you could unfreeze them
- Write on an angled yellow post-it under each review

Step 9 List the full time core team by discipline (max 10)
- Use a yellow post-it for each & align along the top in rough value add sequence

Step 10 Discuss / agree the required leadership style
- Decide how the team will make decisions (consensus, majority, team ldr…)

Step 11 List the customers and suppliers for this project
- Customers to the left on red post its / Suppliers to the right on blue post
- Where do management fit ?

Step 12 Align each review under the appropriate lead discipline

Step 13 List the 'value adding' tasks within each phase
- In order to satisfy the review criteria
- Position in time sequence (real dates) in each phase on smaller green post-its

Step 14 Stretch each task to show required team- working
- Maximise up-front involvement to minimise re- work & waste
- How do we ensure the right level of cross discipline working ?

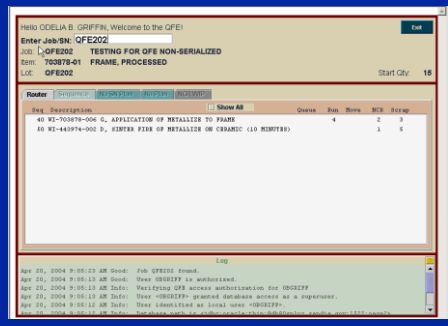
Step 15 Stretch each review to show attendees required
- When all tasks are listed calculate "Pulse Time" (Available Time/# of Activities)

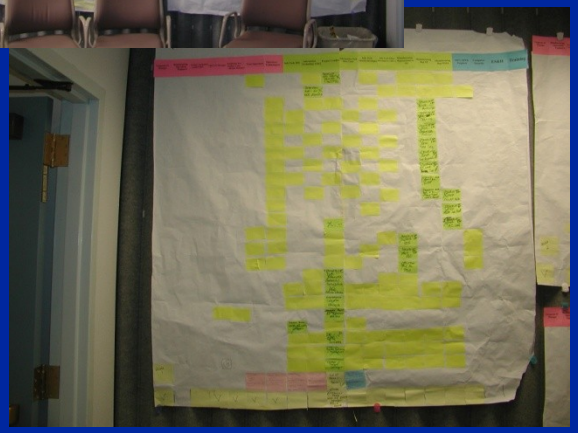
Step 16 Identify standard operating procedures to be used for each activity
- List standard operating procedures down R/H side of chart
- If no standard operating procedures exist see step 17 below

Step 17 Run 'events' for required for each standard operation
- Classify these events as either:- Events, Projects or do-its
- Use the SBS methods to create standard work, 3P, Voice of Customer, etc.

Quality Front End (QFE)

Software Development





Process

- Project team was formed and participated in a week long Vertical Value Stream (VVS) Event
- Used QFD to prioritize customer requirements
- Project Team Room was created
- Team tracked their performance to takt time of 1 task per day
- Tasks done collaboratively in room, including reviews, prototyping, testing, training.

Results

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

Transformation Team

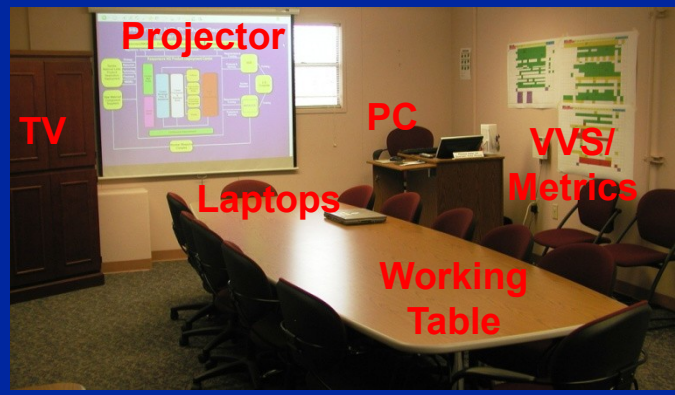
Enterprise Redesign

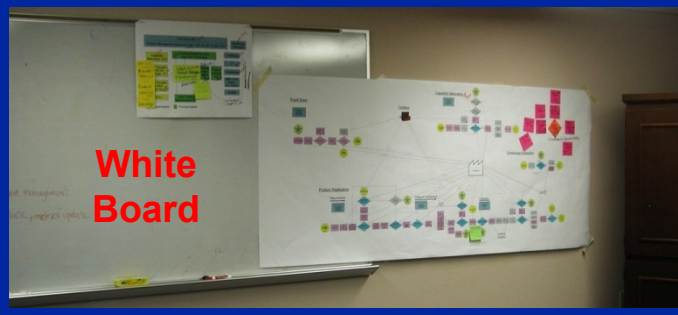
Enterprise Value Stream

- Objective: Reduce Neutron Generator Center costs by 25% in 3 years.
- 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

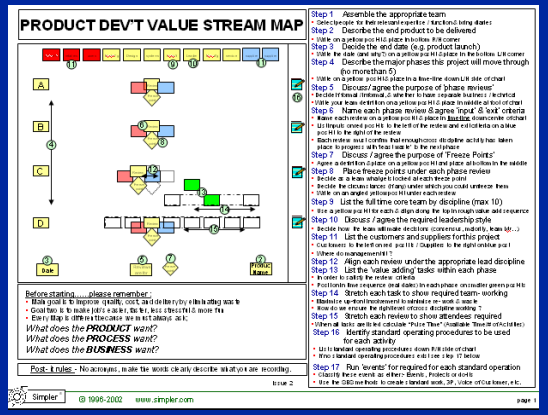




Transformation Team

Process

- Plan Project
  - Week long VVS event
  - Calculate takt time
- Execute Project
  - Teaming activity
  - Daily morning meetings
  - Daily wrap up meetings
  - Tasks executed as collaborative activities
  - Hold VVS Reviews
  - Weekly meetings with stakeholders
  - Planned communications with staff
- Deliver Project
  - Documentation
  - Performance evaluation of team members
  - Customer surveys
  - Lessons learned



Results

- New process to do work better in our organization and reduce cost:
  - Enterprise Value Stream Map
  - Standard Work
  - System to prioritize work
  - Elimination of non-value added activities
  - Re-defined roles and responsibilities
- Project was accomplished in a fraction of the time
- Initial positive feedback from partners and customers

Transformation Team

Lessons Learned:

- **100% dedicated team to effort was critical for success**
- **Dedicated team space enabled efficient team work**
- **Upfront teaming activity was valuable**
- **Use of collaborative IT tools made work and communication easier**
- **Understanding and staying within scope is critical**
- **Frequent communication with champions is critical**
- **Strong project lead is key**

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.

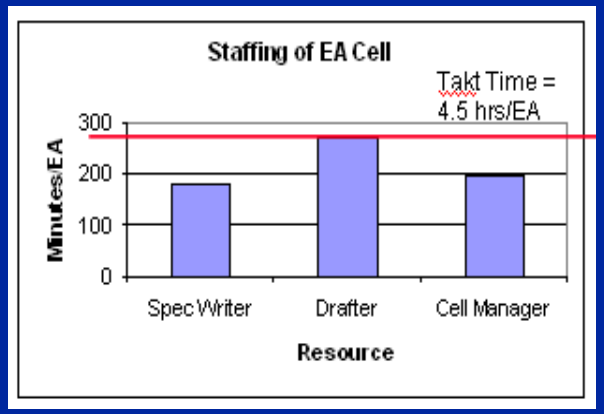
Engineering Work Cells

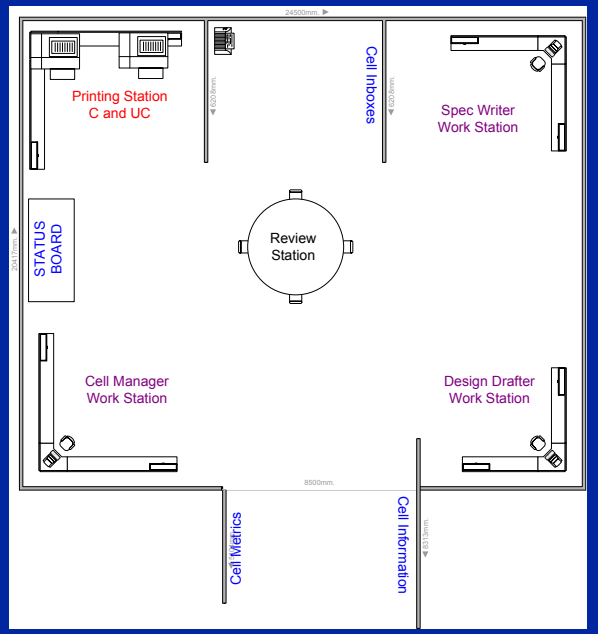
Engineering Change Order Work Cell

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
  - Calculated takt and 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							

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

Engineering work cell for the product acceptance process

Current State:

Long process, many hand-offs, ineffective communication, lots of rework, no good feedback on errors.

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
- Cell Rules:
  - Meet once a week
  - Dedicated and negotiated resources on call

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

Incoming Material:

- **Arrival and unpacking of raw material, chemicals, and shop supplies.**
- **Logging items into the inventory system and placing in appropriate location in the warehouse.**

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.**

Incoming Material Receiving Work Cell

Results:

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

- Standard work for Inspection process created
- Optimized work area physical flow with no facilities purchases
- Single-piece-flow (one owner per “box” start to finish)
- Eliminated an ASA position (re-assigned to staff another work cell)
- Clearly delineated formerly mixed up roles (Engineer, Tech, Material Handler, ASA). People are more satisfied with their work.
- Increased Materials Department capacity
- Can now cross-train with standard work

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?