SAND2008-2348P

SHINGO
PUBLIC SECTOR
ACHIEVEMENT REPORT

Responsive
Neutron Generator
Product Deployment Center
(2700)

April 2008

Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DEAC04-94AL85000.

SAND Number: 2008-2348 P

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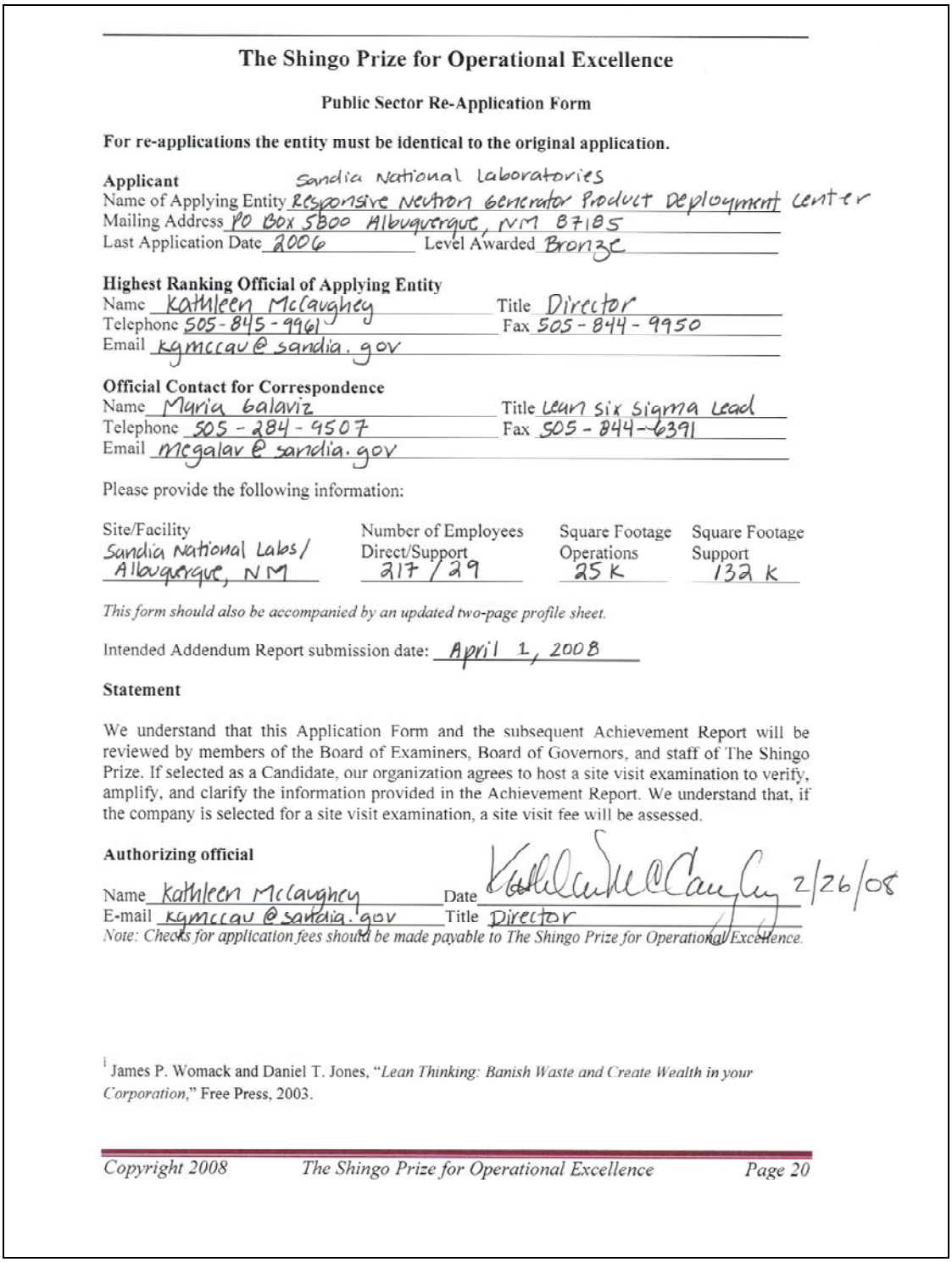
Approved Application Form

The Public Sector Re-Application Form shown below in Figure 1 for Sandia National Laboratories Responsive Neutron Generator Product Deployment Center was approved by the Shingo Prize office on March 5, 2008.



The Shingo Prize for Operational Excellence

Public Sector Re-Application Form

For re-applications the entity must be identical to the original application.

Applicant Sandia National Laboratories
Name of Applying Entity Responsive Neutron Generator Product Deployment Center
Mailing Address PO Box 5800 Albuquerque, NM 87185
Last Application Date 2006 Level Awarded Bronze

Highest Ranking Official of Applying Entity
Name Kathleen McCaughey Title Director
Telephone 505-845-9961 Fax 505-844-9950
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Name Maria Galaviz Title Lean Six Sigma Lead
Telephone 505-284-9507 Fax 505-844-6391
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Please provide the following information:

Site/Facility	Number of Employees Direct/Support	Square Footage Operations	Square Footage Support
Sandia National Labs/ Albuquerque, NM	217 / 29	25 K	132 K

This form should also be accompanied by an updated two-page profile sheet.

Intended Addendum Report submission date: April 1, 2008

Statement

We understand that this Application Form and the subsequent Achievement Report will be reviewed by members of the Board of Examiners, Board of Governors, and staff of The Shingo Prize. If selected as a Candidate, our organization agrees to host a site visit examination to verify, amplify, and clarify the information provided in the Achievement Report. We understand that, if the company is selected for a site visit examination, a site visit fee will be assessed.

Authorizing official

Name Kathleen McCaughey Date 2/26/08
E-mail kgmccau@sandia.gov Title Director
Note: Checks for application fees should be made payable to The Shingo Prize for Operational Excellence.

[i] James P. Womack and Daniel T. Jones, "*Lean Thinking: Banish Waste and Create Wealth in your Corporation*," Free Press, 2003.

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Figure 1. Approved Shingo Application Form

Profile Sheet

Sandia National Laboratories
A Department of Energy National Laboratory

Responsive Neutron Generator Product Deployment Center

COMPANY PROFILE

The Responsive Neutron Generator (NG) Product Deployment Center at Sandia is responsible for the lifecycle value stream of Neutron Generators, which includes: science and technology maturation, design, product development, full-scale production, product surveillance in the field, retirement, and dismantlement, for our Nation's nuclear weapons stockpile. Neutron Generators are delivered to the customer as needed to replace existing limited life components. The Center also maintains the capability to design and develop NGs in the future, and manages the performance information of the NGs for long periods of time to enable data-driven decisions during production, and answer questions as needed from field surveillance to ensure component reliability.

We have a staff of 217 regular employees and an annual operating budget of approximately $80M.

Mission: Responsive to deterrence needs, through science-enabled product realization and stewardship of non nuclear products, today and tomorrow.

Vision: Be the Nuclear Weapons Complex Model.

ACHIEVEMENTS

- Integrated entire Neutron Generator lifecycle value stream (from concept to retirement) in one organization.
- Implemented Portfolio Management System.
  - Increased focus in Center from 184 projects in FY06, to 92 in FY07, to 74 in FY08.
  - Reduced people fractionation from an average of ~4 projects per person in FY06, to 2.3 in FY07, to 1.9 in FY08.
- Implemented Hoshin-Kanri methodology for strategy deployment.
- Achieved goal of 5.3% enterprise cost reduction in FY07.
- Awarded nine new missions to the Center in 4 years without increasing number of employees.
- Established production takt time for all operations.
- Successfully implemented work cells for: Engineering Change Orders, Incoming Receiving of Material, and New Product Development.
- Achieved 100% Neutron Generator on time delivery since 2002.
- Reduced Neutron Generator Subassemblies Span Time:
  - Neutron Generator Subassembly (NGSA) from 379 days in FY05 to 84 days in FY07.
  - Neutron Tube (NT) Subassembly from 61 days in FY05 to 43 days in FY07.
- Reduced incoming part inspection cost by 65% from 2002 to 2007.
- Reduced WIP by 61% in the entire Neutron Generator product line from FY05 to FY08.
- Eliminated over 66 wasteful assurance activities using Product Assurance Model.
- Defined and implemented a process to do Lean within Science and Technology Maturation.
- Achieved 18 month goal for new tester development cycle.
- Achieved Days Away Case Rate (DACR) of zero in 2005, 2006, and 2007.
- Achieved a 90% reduction of Total Recordable Case Rate (TRCR) from 2004 to 2007.
- Achieved a 72% reduction of non recordable safety incidents from 2004 to 2007.
- Reduced kilograms of Hazardous Waste Generated by 36% from 2004 to 2007.
- Implemented Behavior Based Safety (BBS) in 2006 and achieved 43% reduction in injuries on average for the first year of BBS.
- Achieved ISO Registration in November 2006.

AWARDS

- 2006 Shingo Public Sector Bronze Recipient.
- 2006 Quality New Mexico Roadrunner Recognition.
- 2006 President's Quality Award for the "Purchased Materials Team."
- 2006 Environmental Awards:
  - DOE/NNSA Best in Class "Metal Recycling."
  - DOE/NNSA Environmental Stewardship for "ESSP" and "Packaging Reduction."
- Sandia Environmental Awards/Nominations:
  - Tyvek Recycling (2006 Winner).
  - Waste Management (2006 Winner).
  - Energy Bug (2007).
- Employee Recognition Awards
  - NGSA and Quality Acceptance (2006).
  - Neutron Tube Target Loading (2006).
  - Arc Modeling & Simulation Team (2007).
  - Automated Quasi-Metallize Spray (2007).

PEOPLE

A highly qualified, well trained, and engaged workforce is critical to the success of the Center. As a learning organization, it is one of the Center Strategic Objectives to "Grow Our People," with the goal of minimizing under skilled competency gaps and increasing employee satisfaction. To achieve this, leadership has deployed the "Employee Development Program (EDP)." The outcome:

- All staff members have a career development plan.
- Center has defined the required competencies to achieve Strategic Objectives.

The employee satisfaction survey has been improved to provide quarterly real-time data enabling quicker action to address employee needs.

All employees are expected to participate in Lean Six Sigma (LSS) events. The goal is to have every employee Lean Six Sigma Green Belt trained. Throughout the years, the Center has been successful in maintaining a greater than 80% trained workforce. 8% of the Center's population is Black Belt trained and 5% is Black Belt certified.

Systems are in place to involve employees at all levels of the organization, both at the individual and team level, in achieving mission and operational excellence, and also to recognize and reward their contributions.

PROCESS

In the Center, the standard and expected way to perform work is to integrate mission assignments and operational excellence in Environment, Safety, Security & Health (ESS&H) and LSS. The Center assimilated Lockheed Martin's LM21 program into our continuous improvement journey; we have been using Lean Six Sigma principles for over 7 years now. In October 2006, leadership sponsored the second Center-wide value stream analysis after we had integrated the entire NG lifecycle value stream under the same organization. The outcome was a 4 month activity (tracked via vertical value stream map) that transformed the way we do business. It resulted in a set of standard work for the Center that is more focused on customer needs, aligns work to Strategic Objectives via a Portfolio Management System, and drives the use of Lean tools in a more systemic and principle based way to eliminate waste and achieve product, service, and information flow.

The Center has a LSS Office with four full time Black Belts. There are also 17 part time Black Belts who use and apply LSS principles as part of their regular work. We have been able to maintain a rhythm of 26 LSS events per year, using different tools depending on the business needs. As those needs change, new tools are introduced, piloted, validated, and then applied systematically to other areas of the Center.

PRODUCTS

We produce Neutron Generators, miniature particle accelerators that are part of every nuclear weapon in the U.S. stockpile. We are the only source of Neutron Generators for weapons in the United States. Because Neutron Generators must be replaced periodically, our product is essential to the U.S. national security. We produce Neutron Generators for the Department of Energy/National Nuclear Security Agency, with the ultimate customer being the Department of Defense/US Air Force and Navy, on regular schedules.

PLANT

The Neutron Generator Product Realization facility is a complex of six buildings housing two production floors, a product and process development floor, science and technology laboratories, a warehouse, high tech teaming and conference rooms, and staff offices. The complex is over 132K square feet, with 25K square feet of production space. The facility houses special processes such as thin film deposition, metalizing and plating, encapsulation, coating, and testing, as well as specialized facilities to handle tritium.

PARTNERING IN COMMUNITY

Every year, the Center participates in two major community involvement activities:

- Habitat for Humanity, with an average participation of 18 person days per year, and the
- Employee Contribution Program (United Way), with an average participation of 65%, donating more than $63K in 2007.

Other activities include Make a Difference Day, Road Runner Food Bank, and Gifts for Kids-Salvation Army, to whom the Center donated more than 65 gifts for needy children this past December.

CORPORATION

The Responsive Neutron Generator Product Deployment Center is part of Sandia National Laboratories, a government owned, contractor operated (GOCO) facility managed by Sandia Corporation, a subsidiary of the Lockheed Martin Corporation, and one of the U.S. Department of Energy's Defense Programs laboratories.

Sandia is responsible for maintaining the U.S. nuclear weapons stockpile and other national security missions. Sandia's operating budget is more than $2 billion, employing 8,000 staff and 4,000 subcontractors. Sandia's vision and core purpose are to help the Nation secure a peaceful and free world through technology.

For more information contact:
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Responsive NG Product Deployment Center
Sandia National Laboratories
Phone: 505.284.9507, e-mail: megalav@sandia.gov

Summary of Accomplishments

Process:

- Integrated entire lifecycle of Neutron Generator value stream under one Center.
- Implemented Value Creation Process for performing work at the Center level.
- Implemented Hoshin-Kanri Policy Deployment.
- Implemented a Portfolio Management System.
- Implemented Lean in a science and technology (S&T) environment.

People Development:

- Implemented Employee Development Program. Identified intellectual recapitalization gaps in Center and created plans to eliminate gaps.
- Achieved 36% reduction in hazardous waste generated from 2004 to 2007.
- Achieved Days Away Case Rate (DACR) of zero from 2004 to 2007.
- Achieved a 72% reduction of non recordable safety incidents from 2004 to 2007.
- Achieved 100% Green Belt certification of leadership team.
- Achieved 84% Green Belt training of employees, 57% Green Belt certified.
- Implemented Behavior Based Safety.

Quality:

- Maintained yields greater than 90% at the NGSA level with continued 100% yields at the NG level.
- Historical field return rate of 219 ppm.

Delivery:

- 100% on time delivery to customer negotiated schedules.
- Reduced span time by 77% from 2005 to 2008.
- Demonstrated feasibility of 18 month product realization goal.

Cost:

- Reduced inventory levels by 61% from 2005 to 2008.
- Increased direct labor productivity by 40% from 2003 to 2007.

Financial Impact:

- Reduction of enterprise cost by 16.5% from 2006 to 2008.
- Reduction of product cost by 12.4% from 2006 to 2008.

Competitive Impact:

- Added nine new missions to the Center in 4 years without increasing number of employees: Target Loading, NG Packaging, NG Demil, Switch Tubes, NG Design, NG Monitors, NG Supply Chain, Qualification Drivers, Manganin® Foil Gauges.
- Customer Engagement System has shown increase in customer satisfaction.
- Achieved 2006 ISO Registration.
- Received 2006 Shingo Bronze Medallion.
- Received 2006 Quality New Mexico Baldrige Road Runner Recognition.

Required Measures Form

Table 1 below shows the Required Measures Form. These measures are performance metrics used by the Responsive Neutron Generator product Deployment Center (2700) for the past 5 years. The link to Strategic Objectives and the way these metrics are used to drive actions in the Center are described in Section 4 of the report.

Table 1. Shingo Report Required Measures

Fiscal Year	Quality & Quality Improvement		Cost & Productivity Improvement						Customer Sat & Profitability	
	Finished Product 1st pass yield (QAIP Acceptances)	Customer Rejects (Percent Return from Field)	Work in Process by Pieces	Product Cost (Restated to FY08 dollars, in $K)	Mfg Span Time (days) ***	Productivity (Number of new NGs built per operator)	% Product Ship-on-time (original schedule) **	% Product Ship-on-time (re-negotiated schedule)	Performance to Budget	2700 Enterprise Cost (in $M)
2008 YTD (April 2008)	100%	0	200	$71.9	108	10.9	100%	100%	48% at 54% of FY. Expect to be on target by EFY.	$79.9
2007	100%	0.20%	249	$80.3	205	8.14	85.40%	100%	93.90%	$89.9
2006	100%	0	346	$81.9	265	4.40	96%	100%	97.70%	$94.9
2005	92%	0	524	$83.2	472	4.18	100%	100%	99.30%	$93.9
2004	100%	0	889	$75.5 *	361	5.80	100%	100%	100.20%	$94.0
2003	100%	0	1130	N/A	222	5.82	100%	100%	95.70%	$91.7

* FY04 costs were restated to include all corporate burdens similar to subsequent years.
** Delays in shipping product were re-negotiated with the customer.
*** The numbers for Manufacturing Span Time shown in this table are based on the "Historical Span Time" chart shown in Section 4.3 of the report.

Introduction

The Customer and the Changing Environment

The Responsive Neutron Generator (NG) Product Deployment Center (Center 2700) is part of Sandia National Laboratories (Sandia), which is one of the U.S. Department of Energy's (DOE) National Security R&D laboratories. DOE's National Nuclear Security Agency (NNSA) is Center 2700's main customer. Since the reconfiguration of the Nuclear Weapons Complex (NWC) in 1993 (see Figure 2), Sandia was given the mission assignment for production of various nuclear weapon components, including Neutron Generators, Center 2700's main mission assignment. Neutron Generator manufacturing was moved to Sandia to reduce risk. At the time, NGs were difficult to manufacture and had sustained low yields. Performance problems existed due to a lack of fundamental knowledge regarding the technically complex design. NG manufacturing transitioned to Sandia from the Pinellas Plant in the mid 1990's. We successfully delivered, on time, our first product in October 1999.

NG Manufacturing Transfers to Sandia:
Nonnuclear Reconfiguration

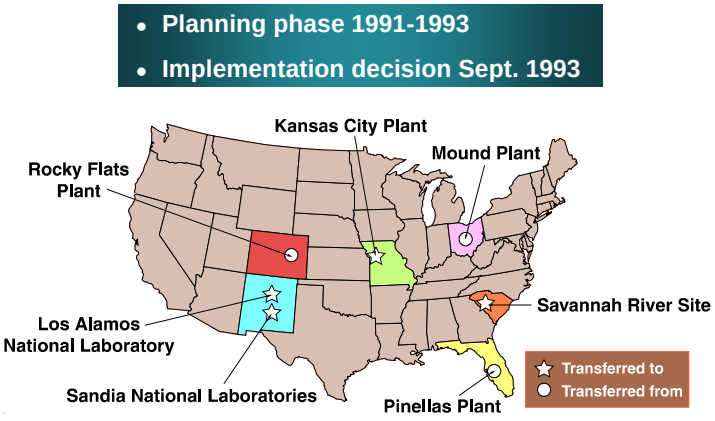
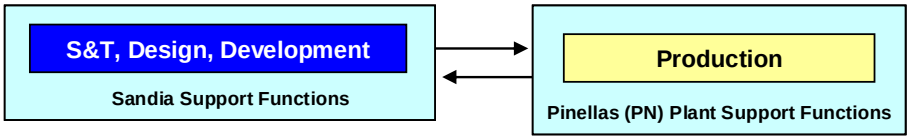


Figure 2. Non Nuclear Reconfiguration

Today, NNSA is finding it can no longer afford even its eight current sites. Congress, and the Department of Defense (DoD) is expecting NNSA to provide value at a substantially lower cost, and to develop much greater responsiveness, i.e. the ability to field requested new product in dramatically compressed timescales. Specifically, DoD is asking for new weapon systems to be developed in 36 months, translating to 18 month product realization cycles for components like NGs. NNSA released a plan to transform the NWC in December 2007. The plan transforms the current outdated, Cold War Complex into one that is smaller, safer, more secure, and less costly. The eight current sites still remain. The new NWC will leverage the scientific and technical capabilities of our workforce and meet evolving national security requirements. The proposed plan announced is described in a draft Supplemental Programmatic Environmental Impact Statement (SPEIS) that NNSA issued in January 2008.

NG Integration Transformation

1955 - 1993



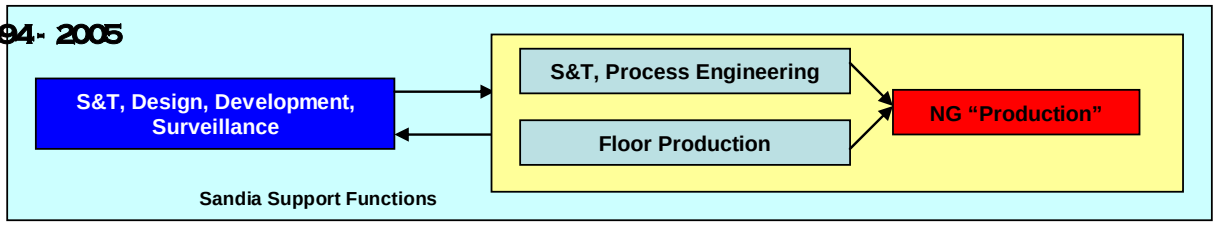
Model Characteristics:

- Product issues passed to Design Agency (DA) to solve
- Emphasis on schedule, cost secondary
- Integrated Contract Order with Pinellas had 8% load

Results:

- 15 Major Components produced over 40 years
- High yields for NT achieved after 15-20 years building at rates of 5-8000 NG's/year; high voltage breakdown scrap rate 3.6%

1994 - 2005



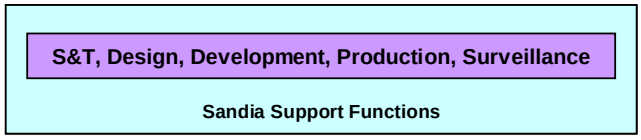
Model Characteristics:

- Collocation of DA and Production Agency (PA) to improve manufacturability of products and reduction of risk; initial focus on improved teaming
- Maximum use of existing capabilities within Lab through Memorandum Of Understanding's
- New focused ion beam Neutron Tube (NT) design decreases single biggest historical reliability issue
- New small NT design has 44% less parts, 46% less process steps, 53% common processes
- Emphasis on meeting cost and schedule
- Major effort on implementing Lean/Six Sigma Continuous Improvement
- Movement of development work off production floor
- Application of Science & Technology to more quickly address production issues

Results:

- Administrative savings of ~$43M/year with closure of Pinellas & Target transfer; $137M transfer costs from Pinellas (PN) to Sandia
- Comparable (to PN) high NT yields achieved within 5 years building at rates of 200 NG's/year; High Voltage Breakdown scrap rate 0%
- Reduced Product Cost by 25% from FY01 through FY05
- Unreliability for new NG's lower than previous designs (0.004 vs. 0.007, 1st assessment)
- Increased floor capacity by 33% in three years while reducing staff
- Chronic ion source issues resulting in 20% waste was resolved by integrated DA/PA team in 1.5 years that included redesign and increased yields (avg 58% to 84%) and shot life (avg 44 to 69)

2005 – PRESENT & *FUTURE*



Model Characteristics:

- Integrated Design & Production within Sandia
- Integrated NG Value Stream
- Prioritized Portfolio aligned with Strategic Objectives
- Focus on Responsiveness
- Separation of Capability Maturation & Product Realization
- *Science-enabled product realization*
- *New Product Assurance Model just implemented; managing risk with reduced inspection*
- *Focused Quantification of Margins & Uncertainty activities to increase NG knowledge*

Results:

- Awarded Shingo Prize for Manufacturing Excellence & ISO Registered, both in 2006
- Took on new mission assignments of target loading (Loader equipment move to delivered tube with SNL target in 5 months; reduced span time by 67 days), packaging and demil with no additional dollars
- Enterprise Cost had been constant over last 5 years, yet absorbed inflation and took on new work. With recent Center VS work, achieved reduction of 5.3% in FY07 and 11.2% in FY08.
- W76-1 environments issue resolved in 2 months

Sandia National Laboratories

For more info: kgmccau@sandia.gov

Figure 3. Center Transformation and Integration History

Responding to a Changing Environment

A summary of the transformation that has occurred within Center 2700 over the last 15 years is shown in Figure 3 along with accomplishments. For almost 40 years, designs were created by Sandia with rigid specifications and "thrown over the wall" to the Pinellas Plant. Pinellas, in turn, built product to those specifications, with high scrap rates and excessive inspection and testing. After being transferred to Sandia in 1993, NG production started as a separate entity contained within Sandia. The initial focus was to create a basic production system to deliver quality product. As we began our Lean journey, waste and inefficiencies resulting from the handoffs between organizations of the total NG enterprise became more apparent. Design concurrency was lacking and the separate organizations had widely different goals and approaches to work. In 2006, we reorganized to bring all of Science & Technology, Design & Development, Production, and Surveillance together. In addition, we focused on being more responsive and cost effective in delivering to the customer.

Scope of Application

Figure 3 shows the scope of Center 2700's Shingo application in 2006 in the red box, *NG Production, 1994 – 2005.* The scope of the Shingo application today is shown in the purple box, *S&T, Design, Development, Production, and Surveillance.* We have transformed Center 2700 into a seamless, integrated lifecycle product model that delivers NGs to the customer. This application highlights the changes made to achieve this transformation.

Our Product

Center 2700 designs and manufactures Neutron Generators; miniature particle accelerators that are part of every nuclear weapon. We develop the fundamental science and technology, and design and manufacture Neutron Generators. We steward the product in the field and dispose of NGs when they reach their end of life. We also design and produce the monitors to test and support this mission assignment.

Neutron Generators fuse deuterium and tritium, which produces neutrons used to initiate the fission reaction in nuclear weapons. They must meet the highest levels of reliability and survive severe environments. Requiring periodic replacement, Neutron Generators are technically sophisticated devices composed of 75 parts manufactured through over 100 processes, including cleaning, thin-film deposition, plating, brazing, welding, encapsulation, coating, and testing. Piece parts enter the factory and are built into two major subassemblies, the Neutron Tube (NT) and the Power Supply (PS) (see Figure 4). These subassemblies are then assembled and encapsulated into a Neutron Generator subassembly, or NGSA. The NGSA is combined with a timer and detonator (both procured from outside the Center) to become the shipped product, the Neutron Generator (NG).

The NNSA sets the schedule and level of production based on the needs of the nuclear weapons stockpile and sends ship schedules to Center 2700. Major schedules are published annually and cover at least 15 years. The product is delivered directly to the custody of NNSA at Sandia. The result is a production environment that is stable, with low volume, low mix, and high reliability requirements for a unique, specialized product. Originally highly classified, Neutron Generators continue to contain classified parts, and some manufacturing processes are also classified. Because of this, some details of our operations cannot be published in this report.

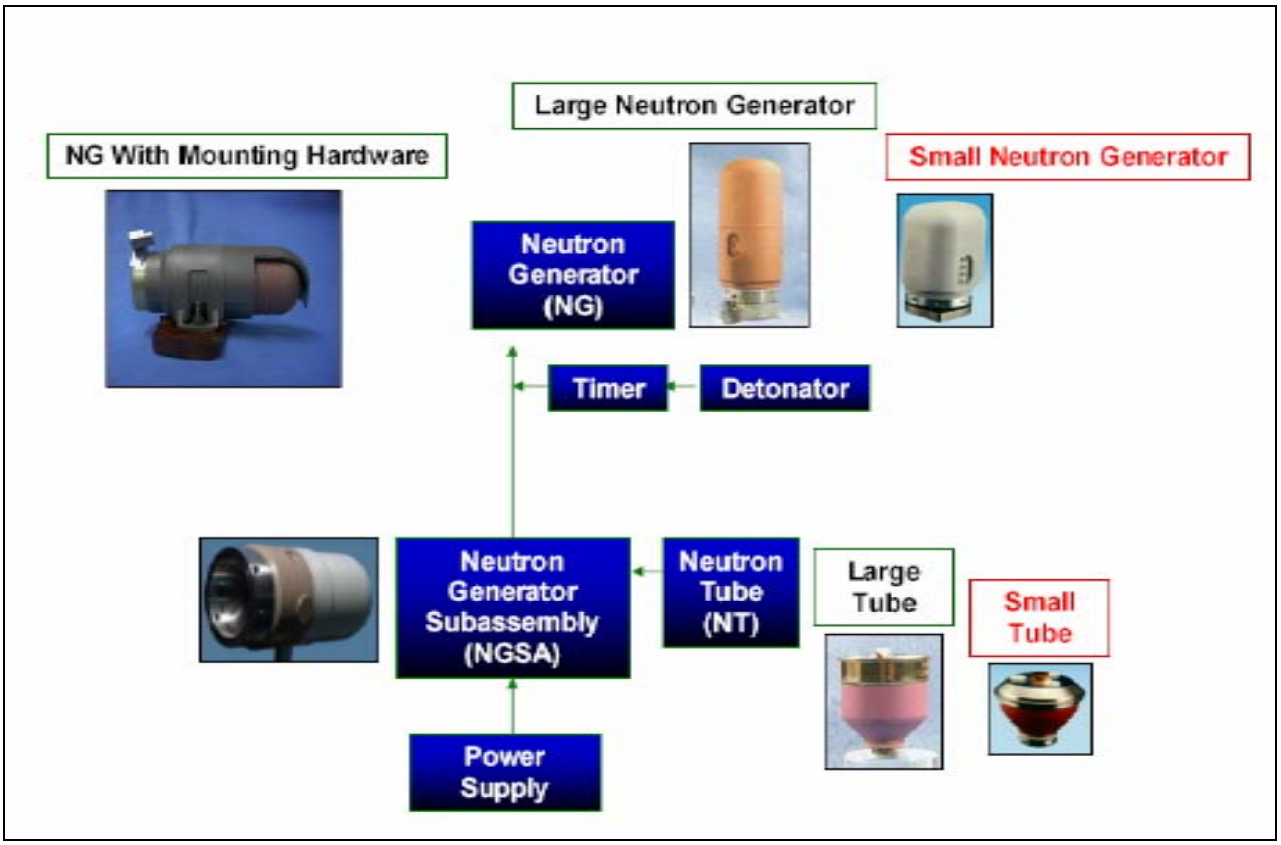
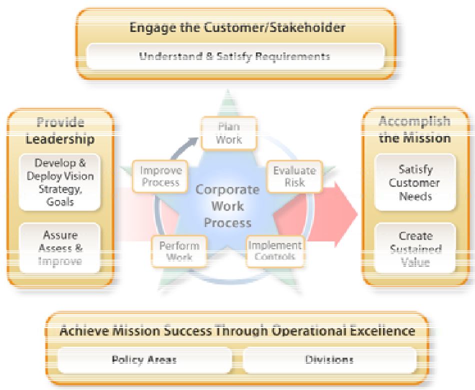


Figure 4. Neutron Generator Supply Chain

Connection with Corporate

Sandia plays a unique and essential role in maintaining the U.S. nuclear weapons stockpile through the Nuclear Weapons Strategic Management Unit (NWSMU). Sandia's vision and core purpose is to help the Nation secure a peaceful and free world through technology. Center 2700 is one of 63 Centers within Sandia. We cascade the Sandia and NWSMU vision, mission, values, strategic objectives, and goals into Center 2700 for alignment of our Strategic Objectives. This is depicted in Figure 5.

Sandia and Center 2700 operate in a highly regulated environment. We must respond to and comply with local, state and federal environmental and other regulations. The use of tritium, a radioactive material in our product, creates potentially significant liabilities and requires carefully engineered controls, training, procedures, monitoring, and oversight.

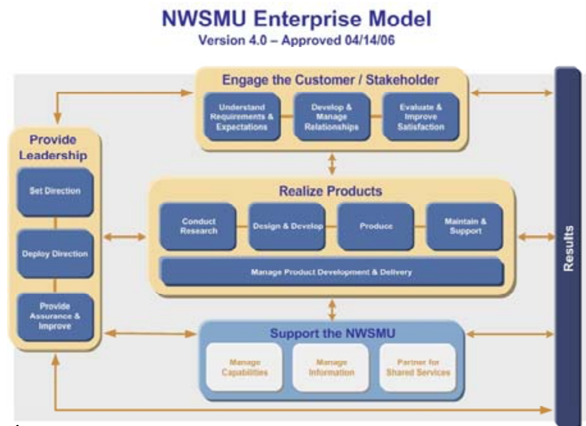


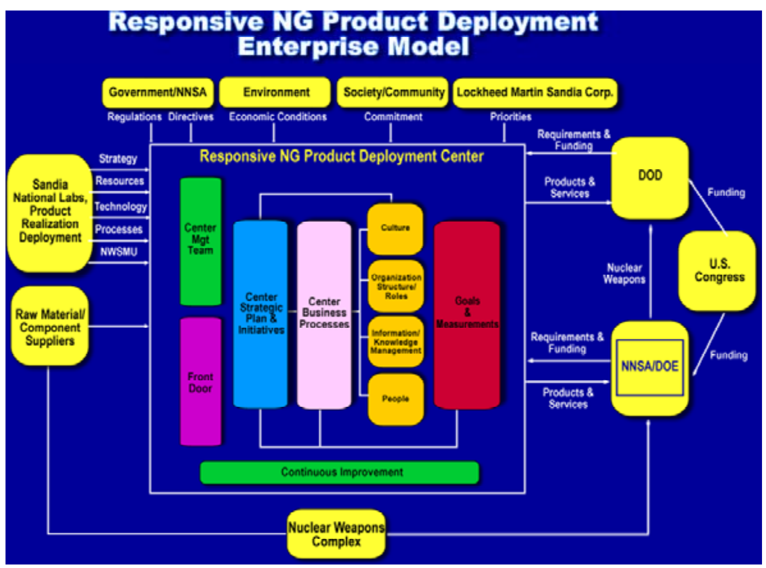
Core Purpose
Exceptional Service in the National Interest

Vision
Sandia National Laboratories is the provider of innovative, science-based, systems-engineering solutions to our Nation's most challenging nationals security problems.

Highest Goal
Sandia's highest goal is to become the laboratory that the U.S. turns to first for innovative, science-based, systems-engineering solutions to the most challenging problems that threaten peace and freedom for our nation and the globe.

Mission
Committed to "science with the mission in mind," Sandia creates innovative, science-based, systems-engineering solutions that
• sustain, modernize, and protect our nuclear arsenal,
• prevent the spread of weapons of mass destruction,
• provide new capabilities for national defense,
• defend against terrorism,
• protect our national infrastructures, and
• ensure stable sources of energy and other critical resources.





Nuclear Weapons SMG and SMU

Support, through our leadership, the transformation of the nuclear weapons stockpile and complex into a modern, agile enterprise which maintains strategic deterrence far into the 21st century.

Strategy Statement and Strategic Objectives

Design, develop, qualify, manufacture and manage the life-cycle of the nuclear weapons stockpile throughout its life-cycle, all through the use of science-based engineering. In doing so, this will contribute to the transformation of the nuclear weapons stockpile and complex.

NW 1.0 *Stockpile*. Ensure a credible nuclear weapon stockpile for the nation. We must increase our technical knowledge base for the existing stockpile through innovative evaluation techniques and implement a Common Adaptable System Architecture (CASA), enabled by microsystems and other advanced technologies, for the transformed stockpile.

NW 2.0 *Complex/Enterprise Transformation.* Achieve a transformed nuclear weapon enterprise, with capabilities responsive to changing environments and threats by leading all non-nuclear product realization and by providing the technical support to systems integration for the Complex through demonstrated performance at lower cost.

NW 3.0 *Integrated Surety*. Assure predictably safe weapon response in all environments at all times without exceptions and assure absolute control and security of nuclear assets at all times, independent of the threat, without compromising reliability.

NW 4.0 *SBET for Transformation.* Accelerate engineering and innovation through the integrated application of simulation, scientific understanding, experiment, and test. (Joint with STE SMU)

NW 5.0 *Reducing the Nuclear Danger.* Advance and apply our Laboratories' capabilities at the frontiers of science and engineering to avoid technological surprise and reduce the nuclear danger. (Joint with ITS SMG)

Figure 5. Cascade of Sandia and NWSMU Vision, Strategic Objectives, and Enterprise Model

SHINGO ACHIEVEMENT REPORT 2008
Sandia National Laboratories
Responsive Neutron Generator Product Deployment Center (2700)

1. Cultural Enablers

1.1. Leadership and Ethics

Our leadership team's commitment is critical to our ongoing transformation. Our journey started as a result of an inability to create a production system that delivered continuously, and that lacked the required capacity. The Center has transformed by creating and implementing principle based systems, building a model for Sandia and the NWC. Further, we provide the leadership for Sandia in Lean Six Sigma (LSS), assist other organizations in defining and starting their journey, and mentor them along the way. Sandia has been called upon to provide leadership across the NWC resulting in targeted improvements for other NWC sites.

Center 2700 leadership has been practicing a set of principles for over 7 years in our Lean journey, starting with the removal of waste on the production floor, and continuing with holistic reorganizations that redefine how we do work. Leadership must provide an inspiring vision and a plan on how to reach that vision; challenging work that excites the *best and brightest* employees, empowered by clearly defined Business Objectives, enabled by efficient systems, and unencumbered by waste; and relentless support of continuous improvement (Plan-Do-Check-Act) acting not only on data generated as part of work activities, but also data regarding changes to the global environment.

Inspiring Vision – *Be the NWC Model*

The Center 2700 leadership team set out 2 years ago to define a mission and vision that better aligned with the new NNSA vision for the NWC: to be more responsive and cost effective. We had already realized some cost savings while increasing mission space, and had already started down the path of an integrated total Neutron Generator (NG) lifecycle that included science and technology, design and development, production, and surveillance. We needed to define what responsiveness meant to us and put a plan in place to achieve results. We therefore redefined our Center mission to be: *responsive to deterrence needs, through science-enabled product realization and stewardship of non nuclear products, today and tomorrow*, where "responsiveness" in our words meant:

- Full, seamless integration of the entire NG lifecycle to further decrease costs,
- Science-enabled product realization to further increase our product understanding and product yields, and to reduce issue resolution time for production floor stoppages,
- Separation of capability maturation and product realization, so that the required level of technological maturity is ready to achieve the required 18 month product realization cycles, and
- Continuous improvement of our Quality Management System (QMS), including the deployment of a formal Product Assurance Model (PAM), to drive down costs.

The Center 2700 leadership team believes that the consistent, sustained application of our Lean principles will enable us to continue our journey. We also believe that the NWC must successfully adopt Lean for it to achieve its transformational objectives. As a result of the advantage of our Lean "head start," our Center has been able to *model the way* for the NWC, by espousing the advantages of an integrated non nuclear design and production site with demonstrated results. The transformation of our Center is delivering Neutron Generators with greater responsiveness, for less cost.

Figure 6 summarizes our Hoshin-Kanri, which is based upon the four key concepts of our responsiveness definition. Each of our Strategic Objectives (Realize NG, NG Monitors, and Switch Tubes Better; Grow Our People; Understand Our Product; Manage Our Risks Cost Effectively; and Create and Deploy Responsive Production System for Sandia) fundamentally support responsiveness and cost effectiveness. Our leadership team created a simple one-page deployment that is less complex and easier to understand than previous policy deployments. Key one-word reminders help employees remember the Strategic Objectives. The true north metrics and values are also included. To deploy key messages throughout the organization, our leadership team creates and deploys formalized communication messages. Our Hoshin-Kanri was one of those messages. Quarterly employee satisfaction surveys measure the effectiveness of our deployment. Section 3 discusses our management reviews and the cascading of our Hoshin-Kanri into A3's.

Our fifth Strategic Objective (discussed here because it pertains to our leadership within Sandia), Create and Deploy Responsive Production System (RPS) for the Lab, has applicability across all production Centers within Sandia. We have actively led the RPS to promote common systems, tools, and procedures across these Centers for over 8 years. The core RPS leadership team performed an analysis last year defining the current state based on an IDEF (Integrated DEFinition) manufacturing model, and identified top priority projects. One of these projects was to expand the scope of Center 2700's Supply Chain Management system across all production Centers. The Center 2700 Materials Value Stream (VS) now does all procurements for on-site production and government furnished material for all external suppliers.

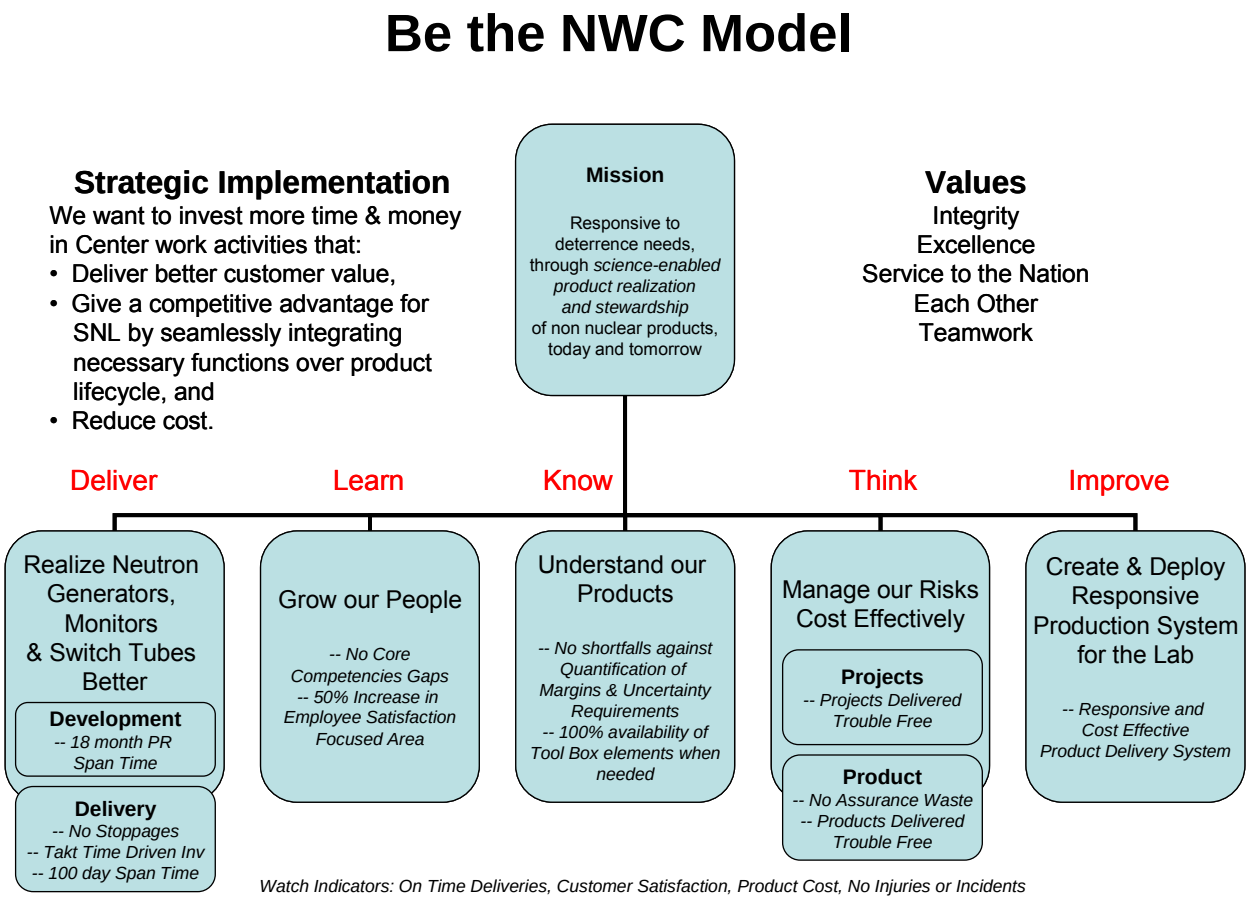


Figure 6. Center 2700 Hoshin-Kanri

Challenging Work

In our employee satisfaction surveys, "challenging work" is consistently the first or second highest ranked characteristic – "what I like best working in Center 2700." We believe this is because our system of prioritizing work guarantees that the work each staff member is asked to do is clearly tied to Center objectives. Center employees are empowered by knowing how their work fits into the larger picture, and by the assurance that their work is critical to Center success.

Communicating Center Business Objectives to our employees provides them with the ownership of ideas for continuous improvement and new work. Our Portfolio Management System is initiated with a call to solicit ideas in the form of proposed projects. There is a formalized process by which proposals are evaluated using a set of criteria derived from the Business Objectives, then priority ranked and selected. This process actively engages our internal weapons system design customer. Any employee can develop a proposal. As a result, this is our most active method of idea generation and information sharing. Other idea and recognition systems are discussed in the People Development section.

Efficient Systems

The Hoshin-Kanri is one piece of a larger principle based system the leadership team has created to define and communicate how we do work within the Center. The Value Creation Process (see Figure 7) defines how strategic direction is set through Hoshin-Kanri and Center Value Stream, how work is aligned through Business Objectives that flow down and drive Center work through lower level value streams and projects, and how work is managed through management reviews. The three principles of this system are value from the customer perspective, seek perfection, and enterprise thinking (holistic, dynamic, and closed-loop). The Value Creation Process uses the voice of the customer as an input to strategic planning and also engages the customer throughout the process. It applies Plan-Do-Check-Act cycle to seek perfection, and enables enterprise thinking as described in Section 3.1.

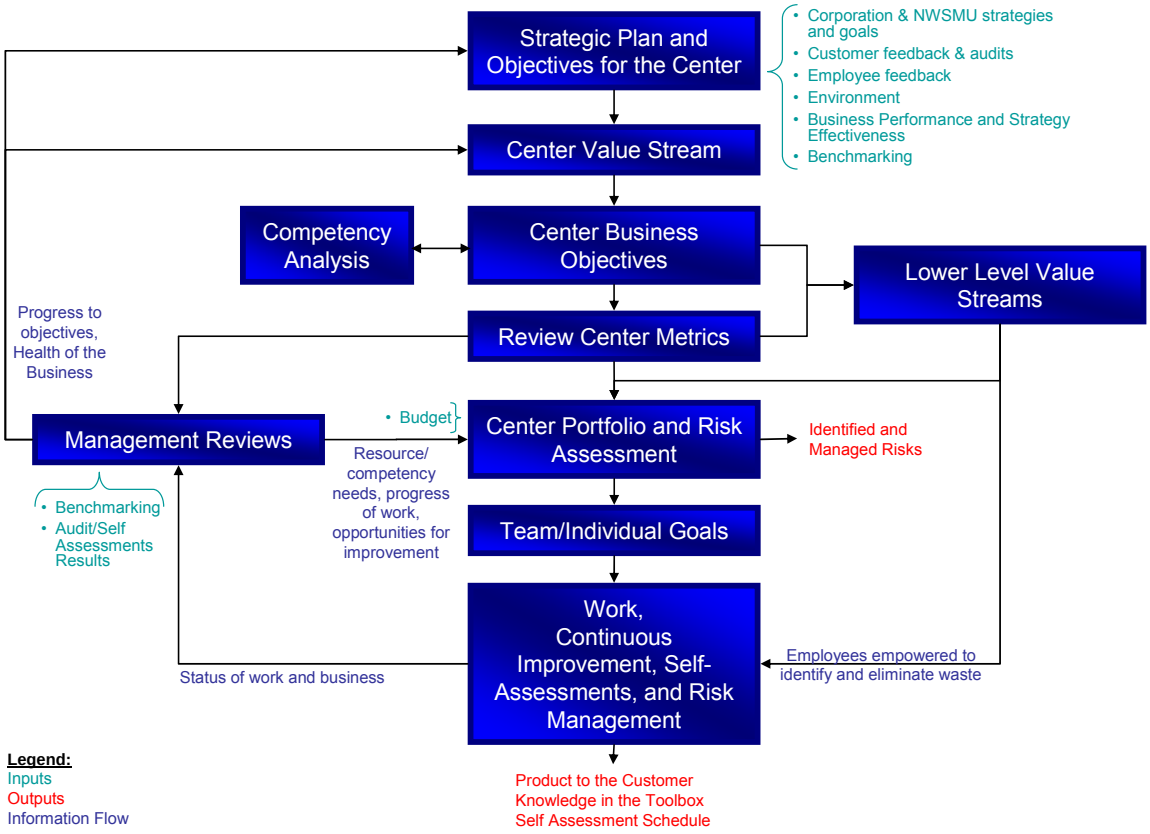


Figure 7. Center 2700 Value Creation Process

Quality Management System (QMS)

Our leadership team identified ISO 9001 as a principle based system to provide the foundation for consistently meeting customer expectations. Our Quality Management System is governed by the eight principles: customer focus, leadership, involvement of employees, process approach, management system approach, continual improvement, fact based decision making, and mutually beneficial supplier relationships. ISO is the mechanism the Center uses to identify critical actions and ensure that processes are well documented, understood, and implemented. This system enables us to *provide outstanding mission performance and customer satisfaction through continuous improvement* – our defined Quality Policy.

In 2006, the NWSMU decided to pursue ISO registration to demonstrate to the customer, NNSA, that a QMS had been put into place. In order to do so, one (or more) Centers that realize product also needed to be registered at the same time, because the NWSMU is only a management unit. Center 2700 was one of very few Sandia Centers that had a mature QMS in place that could support the NWSMU plan. Center 2700 was awarded the ISO Registration as a Center, and supported the NWSMU ISO registration in November 2006. Re-assessments are performed every six months. Figure 8 shows the trends of the Center's ISO findings.

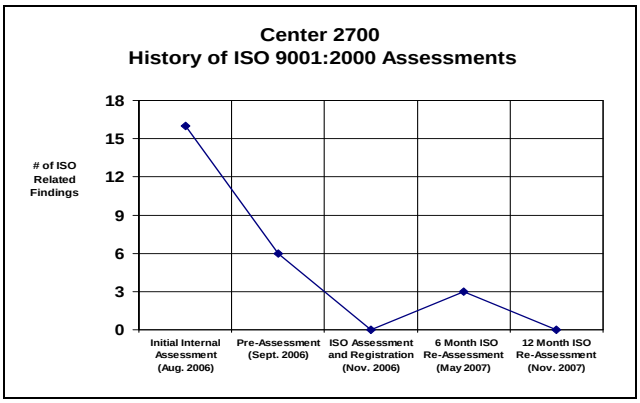


Figure 8. Center 2700 ISO 9001:2000 Assessment History

We created a QMS Council to ensure that our Center's QMS is maintained up-to-date. Figure 9 shows our document hierarchy that includes Center processes and guidelines. Key to our success has been the continual assessment and improvement of all our procedures and guidelines. As a result of this effort, 35% of Center 2700 procedures were deemed to be wasteful and were eliminated.

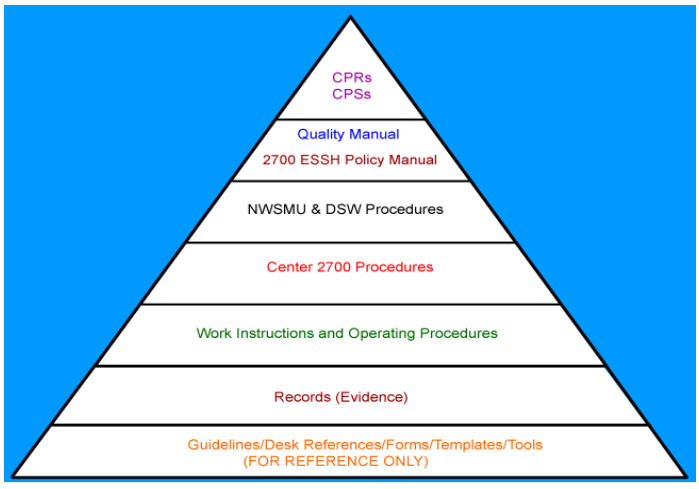


Figure 9. Center 2700 Hierarchy of Documents

Our Center Enterprise Model (see Figure 10) is cascaded down from the Corporate models (see Figure 5) and is used extensively as the knowledge management tool for our Center. It forms the basis of our management reviews, and is organized by Plan-Do-Check-Act. It provides a repository for Center knowledge regarding strategic execution and measurement, the "what" and "how" for all work. The Enterprise Model is available to all employees from the Center 2700 home page and links to the hierarchy of documents.

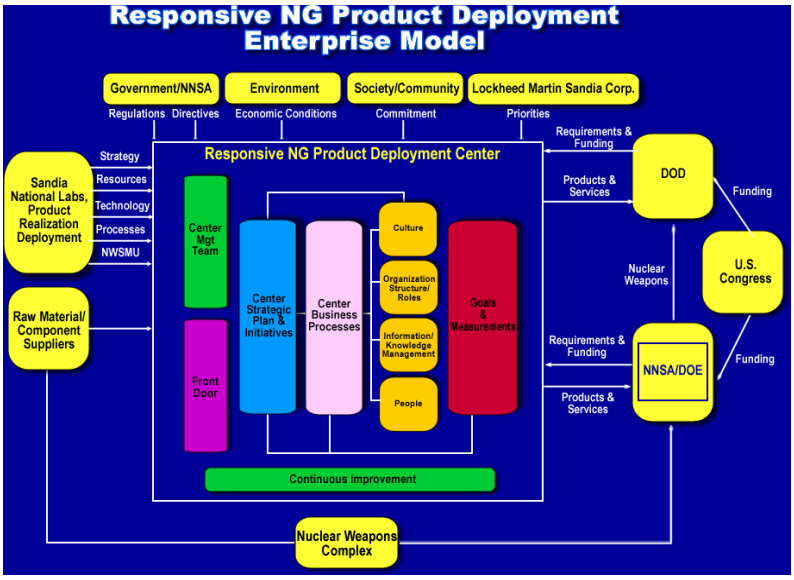


Figure 10. Center 2700 Enterprise Model

The Center processes and guidelines coupled with the Corporate and NWSMU policies and procedures in totality define how work is done, including management expectations for employee behaviors. Sandia Corporate policies exist to document and communicate the philosophies and fundamental values of Sandia and to establish the boundaries within which our employees conduct business and for which all employees are held accountable. As a Center, we have expounded on the Corporate values of integrity, excellence, service to the Nation, each other, and teamwork to further define Center expectations. Our values are the foundation upon which we have built our superb reputation for fulfilling the Sandia mission *providing exceptional service in the national interest.* We provide a model for all of Sandia in never accepting the status quo, instead delivering value to the customer, and striving for perfection.

Continuous Improvement and Lean Leadership

Leadership's involvement in LSS activities is critical in sustaining the culture of continuous improvement within the Center. The leadership team is 100% Green Belt (GB) certified. Green Belt certification ensures that the leadership team understands the opportunities and tools that LSS provides, and are able to identify waste and allocate LSS trained resources to eliminate that waste. We expect leadership participation in at least two events per year as full time participants. In addition, the Center has invested in developing LSS trained resources. Our LSS office has been in place since the deployment of Lean 7 years ago. Currently, four full-time Black Belts (BB) work closely with the leadership team to prioritize and work on Center level continuous improvement activities. In addition, 17 part-time Black Belts perform continuous improvement activities at the department level. Furthermore, each manager expects all of their employees to be Green Belt trained and involved in Lean activities to eliminate waste and improve flow of product, services, and information at all levels of the organization. A task of the core competency Center Fundamentals is to "become LSS competent and

continuously improve all work activities." From the deployment of our Center value stream and cascading those into lower level value streams; to the management of complex, high visibility Center projects planned through vertical value streams (VVS); to Green Belt projects aligned with Center Business Objectives; to 6S events, our Center uses LSS tools and systems to continuously improve the environment, the work, and the Center's outcomes. Managers are the champions for all Lean activities in the Center. They are involved from the beginning with the creation of the event's charter to ensure alignment to Strategic and Business Objectives and to challenge teams to define stretch goals. They attend event kickoffs/closeouts to communicate expectations and recognize results, remove barriers, support the team in the implementation of the action items, and apply lessons learned across the Center. Lean activities are tracked to completion at the Tactical Management Reviews.

The leadership team understands that Lean is a journey and that we continue to learn as we make progress in the Center. To stay up-to-date and engage in continuous learning; the leadership team attends Lean conferences periodically; brings in Lean leadership workshops; uses Lean consultants when external help, expertise, or mentoring is needed; and performs benchmarking activities.

Benchmarking

Center 2700 uses benchmarking to identify and incorporate world class practices in alignment with the Center goals and objectives. Through this activity, the Center also obtains external validation for our practices that contribute to realistic and appropriate goal setting.

Benchmarking areas are identified during strategic planning and the yearly Center value stream analysis. The goal is to have the leadership team participate in one to two benchmarking activities every year. We have a benchmarking procedure in our Center 2700 Guidelines. After a site visit, the evaluation team fills out a standard benchmarking report and identifies best practices that could be implemented in the Center. The team then presents a summary of the site visit at the quarterly Strategic Management Review, where the leadership team votes whether or not to implement recommended suggestions.

An example of a best practice learned through benchmarking is the adoption of the Lean tool, 3P. Last fall, the Center identified the need to invest in a recapitalization project and wanted to do it in a Lean way. One of our consultants suggested the use of 3P (a tool we hadn't used in the Center before), and arranged a benchmarking site visit to HNI Corporation in Muscatine, Iowa. Significant 3P knowledge was acquired during the site visit and a plan was put together to bring the tool to the Center. Currently, 50 people in the Center (managers, technical staff, lab staff, technologists, and operators) have been trained on the tool, and one successful event was conducted with cost avoidances of $90K. We plan to continue use of this tool as a part of our recapitalization project and to develop the 3P expertise in house.

Using experts is another way to assimilate knowledge from others. We are currently working with Art Smalley (Art of Lean®) to help us improve our problem solving skills. We are using the Goldense Group Inc. to evaluate our "research and development metrics," provide a benchmark on how we compare against the rest of the industry, and make recommendations on how we can improve them. We have had an ongoing relationship with Simpler®, most recently to independently assess where we are on our Lean journey. They also helped us conduct a Lean Leadership training class in April 2008. Alan Brache (Kepner-Tregoe®) helped us through our revamped strategy implementation, and most recently applying Kepner-Tregoe methodology to a Nuclear Weapons Complex-wide effort to create a consolidated sourcing strategy that we led.

Another way of engaging in benchmarking activities is by being a Shingo examiner. There are five Shingo examiners in the Center who participate in both the business and public sector examinations each year. These visits provide us with an opportunity to see how other applicants are applying Lean principles and how they're using the tools to achieve the desired results.

1.2. People Development

1.2.1. Education, Training and Coaching

One critical Corporate principle is that our people are the key to successful achievement of our mission and are our most important resource. Two years ago we identified a Strategic Objective specifically focused on people (see Hoshin-Kanri, Figure 6). Grow Our People is focused on creating a learning organization, defined by creating, acquiring, and transferring knowledge within the Center. The Center Portfolio, toolbox, and knowledge management sites are the centralized repository for knowledge within the Center. We identified a leadership gap in commitment to the intellectual recapitalization within the Center. We created a total human resource system tied to the Value Creation Process (see Figure 11) to focus activities and measurement on the four components of intellectual recapitalization (acquiring, developing, managing, and rewarding). The leadership team is now spending more time on each of these components.

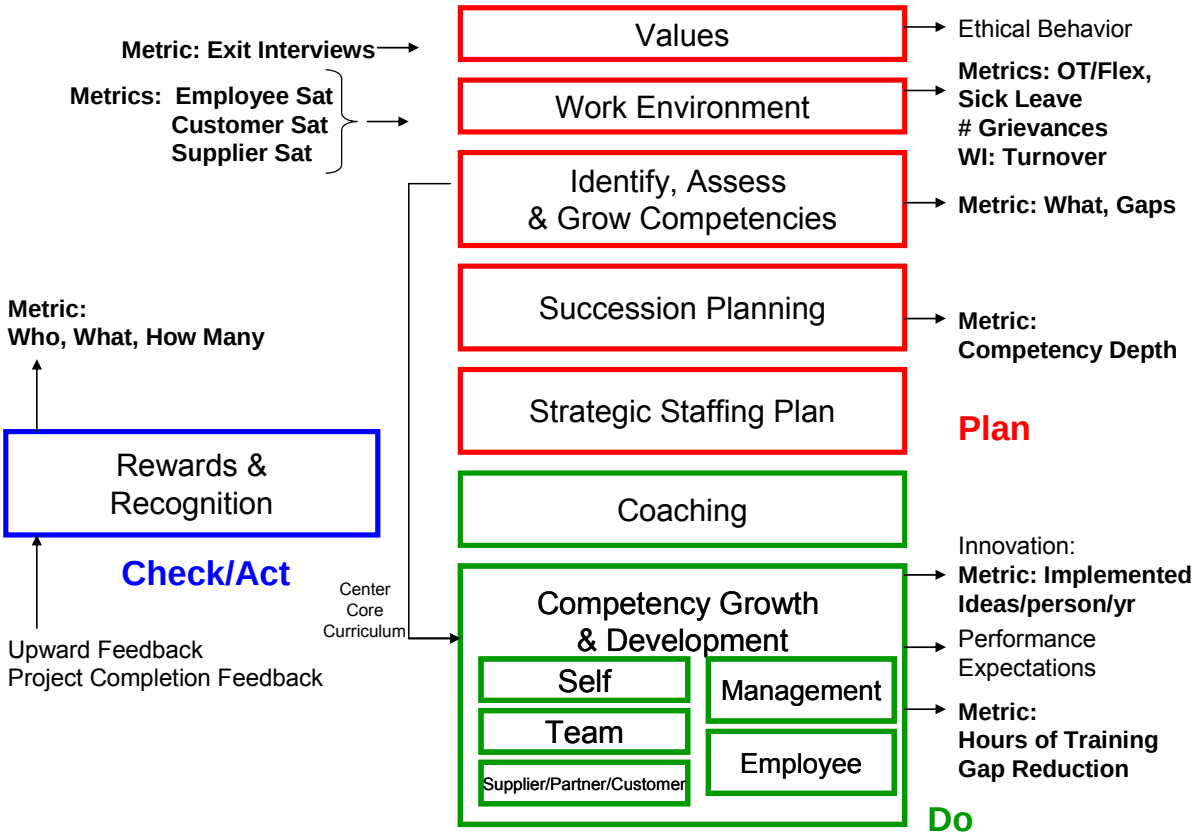


Figure 11. Center 2700 Value Creation Process Human Resource System

Over the last 18 months we placed a critical focus on creating systematic employee and leadership competency programs to continually improve competencies that contribute to Center success. This section discusses both of these development programs. Using the output of the Employee Development Program (EDP) helped us create our strategic acquisition plan. Better management of the people around work activities is discussed in Section 3.2. Rewarding and recognizing employees is discussed in Section 1.2.2. We put a leadership sub team in place to manage the ongoing improvement of our HR system.

Acquiring Staff

A Center level baseline competency analysis, accomplished through the Employee Development Program, allowed us to identify areas of need that are being filled either through employee development or strategic hiring. This analysis was used to make decisions in our annual strategic staffing plan. The Center follows Sandia's Corporate standards for hiring employees.

Developing Staff

We instituted our Employee Development Program prior to start of the FY08 performance period to grow our employees to their fullest potential in the areas that our Center will need most to succeed in the future, and to give them the skills needed to fill our competency gaps. Through focus groups, we defined critical competency domains along with stages of development and Center roles. Figure 12 shows the identified Center roles and the Center core competencies, both unique and cross cutting. Managers and employees met individually to determine the stage of development for each competency and identify areas of growth. Agreed upon growth areas were included as a part of the annual performance management process. One method to expand individuals' competencies is by moving employees around the Center. The Center better meets its Business Objectives while allowing employees to broaden their current skills, leverage experiences, and cross-training in new work.

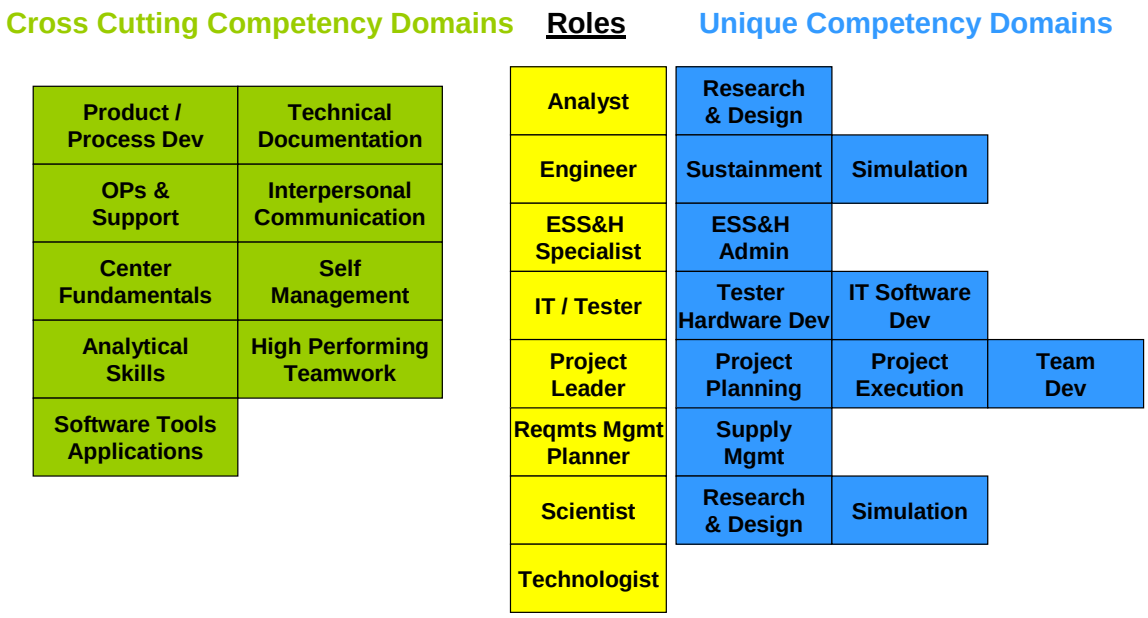


Figure 12. Center Roles and Competency Domains

Each manager is an owner of a competency domain and it is his/her responsibility to define developmental opportunities to support employee development plans, called Training-to-Task matrices. An excerpt from this matrix is shown in Table 2 for the core competency Center Fundamentals.

Table 2. Training to Task Matrix for Center Fundamentals

Task	*Development Opportunities*		
	Non-Training	*Training*	
CENTER FUNDAMENTALS	*Suggested examples Other opportunities may be available*	**Internal Courses**	**External Courses**
Understand and contribute to Center Value Stream process, roles and responsibilities, Value Creation process, Center enterprise model, Center QMS	Stage 1: ▪ Become familiar with organization structure, roles & responsibilities, QMS including cent er procedures and guidelines, enterprise model ▪ Understand how your PMF goals align with Center strategic objectives and business goals Stage 2: ▪ Participate on a center project ▪ Participate in job rotations Stage 3: ▪ Lead a center project ▪ Participate in job rotations Stage 4: ▪ Participate in strategic planning	▪ Center "New Employee" Training	See ISO training under Center QMS

The Center invests an average of 11,000 hours of internal training (compliance and non compliance) in its employees each year. In addition to this we invested in 4,720 hours of external training in FY07. We also participate in Sandia's University Programs that provide employee development. Sandia provides education assistance benefits to eligible employees for approved courses and degree programs. Center participation in these programs such as Doctoral Studies, Special Masters, and One-Year-On-Campus has varied over the years from one to three people. In addition to attending Lean conferences, our employees attend work-related conferences to advance their skills and competencies. In the past two years, 23 employees have attended or presented at such conferences.

Developing Union Employees

We created our Employee Development Program for our non union employees to formalize training and non training opportunities for career development. For our union employees, we have two formalized programs: the Production Trades Training Program (PTTP) and the Pre-PTTP. We have two classes of represented employees in the NG Production Value Stream, Grade 8s and Tradesmen (a higher skilled classification). The PTTP is the mechanism for employees to acquire the specialized skills needed to become a NG Production Tradesman. Over the almost 12 years of its existence, the PTTP has built a strategic partnership among the union represented workforce, production management, labor relations, and community schools, ensuring NG Production has the workforce skills needed to succeed in producing Neutron Generators. The program has clearly defined pre-requisites for candidates to become PTTP trainees, and a well designed curriculum of both academic courses and on-the-job (OJT) learning experiences. Trainees are in the program typically three years before becoming fully qualified NG tradesmen.

The Pre-PTTP Program allows our Grade 8s and other entry level employees (such as janitors and clerks) to become candidates for the PTTP. The Pre-PTTP is a program of college level courses required of candidates for the PTTP, and has been successful in providing an internal path of upward mobility for our highly motivated entry level employees. Participation levels in the PTTP program are shown in Figure 13. The recent trend in increased participation is accounted for by the need to replace union employees that have left. The Center also has a formalized OJT system that all union employees participate in to ensure standard work is used to build Neutron Generators.

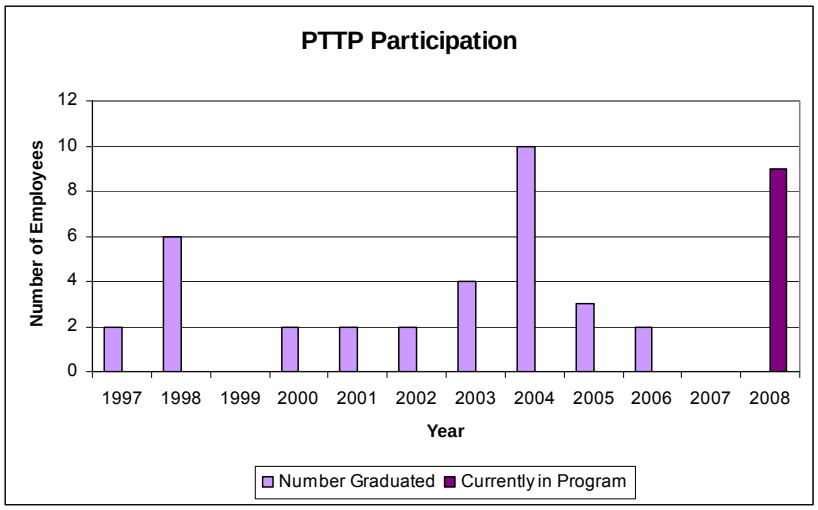


Figure 13. PTTP Participation

Developing the Leadership Team

The leadership team's tool to identify and increase leadership competencies is based on Lominger Leadership Architect Competencies and contains three phases: Leadership Team, Individual Leadership, and Organizational (see Figure 14).

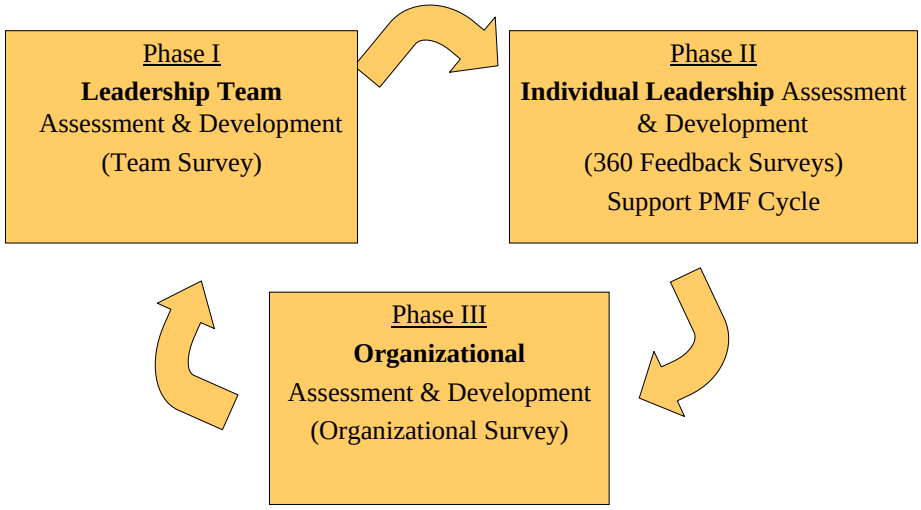


Figure 14. Lominger Phases for Leadership Team Competencies Development

The leadership team has worked with the Lominger competencies since 2003 to become a more cohesive, high performing team. In 2007, we instituted the three phased plan. Desired outcomes include creating a more effective leadership team, identifying competencies, developing ourselves as a "learning organization," and filling the gaps of our *Competency Culture*[1]. In the first phase, we created a team success profile and identified priority areas (thrust, trust, and talent) where we could improve as a team. One of these priority areas resulted in the Grow Our People Strategic Objective to focus more on talent acquisition and enhancement. In Phase II, individual feedback on leadership competencies were identified through a 360 feedback tool. Managers were also able to connect their own individual

[1] The Reengineering Alternative: A Plan for Making Your Current Culture Work, by William E. Schneider

competencies action plan to previously identified competencies that would contribute in turn to team success. The last phase connected all the pieces together into a Center action plan identifying current state strengths and weaknesses, and again, focusing on priority areas to achieve future state success as a Center. All of this links to the Employee Development Program through the project leader role, where we are incorporating the Lominger leadership competencies for identified high potential staff.

1.2.2. Empowerment and Involvement

The Center's empowered culture enables employees to continuously improve and transform our enterprise through team driven activities bounded by our Business Objectives. Working on challenging work, with people they respect, and influencing the outcomes of the Center, creates an empowered workforce. This empowered workforce is a key piece of what sustains our Lean journey. We accomplish work through teams made up of customers, partners from other Centers, unions, and suppliers. Our employees are involved in the generation of ideas, either through the solicitation of work proposals or continuous improvement activities. The Center rewards and recognizes individuals and teams through Corporate based performance and compensation systems, and Center based recognition systems. Idea systems and employee surveys give immediate feedback for improvement.

Recognition Programs

We had a kaizen event to create a standardized Center rewards and recognition approach for the Center to enhance a culture and environment that promotes employee recognition at all organization levels. Each element of the resulting Employee Recognition Program is focused on identifying employee behaviors that advance Center goals and values, and recognizes these behaviors. We believe this program will change our culture to one where everyone is responsible for showing appreciation. We want all employees to feel appreciated and have an understanding that what they do makes a difference. The program consists of three tiers: Tier 1 is person-to-person or person-to-team recognition; in Tier 2, we select recipients based on predefined criteria for recognition at our quarterly celebrations; and in Tier 3, management selects recipients that move forward to outside-the-Center sponsored recognitions. Volunteers from the kaizen event self organized into an Employee Recognition Council to oversee the communication of the program, train employees, and select Tier 2 recipients.

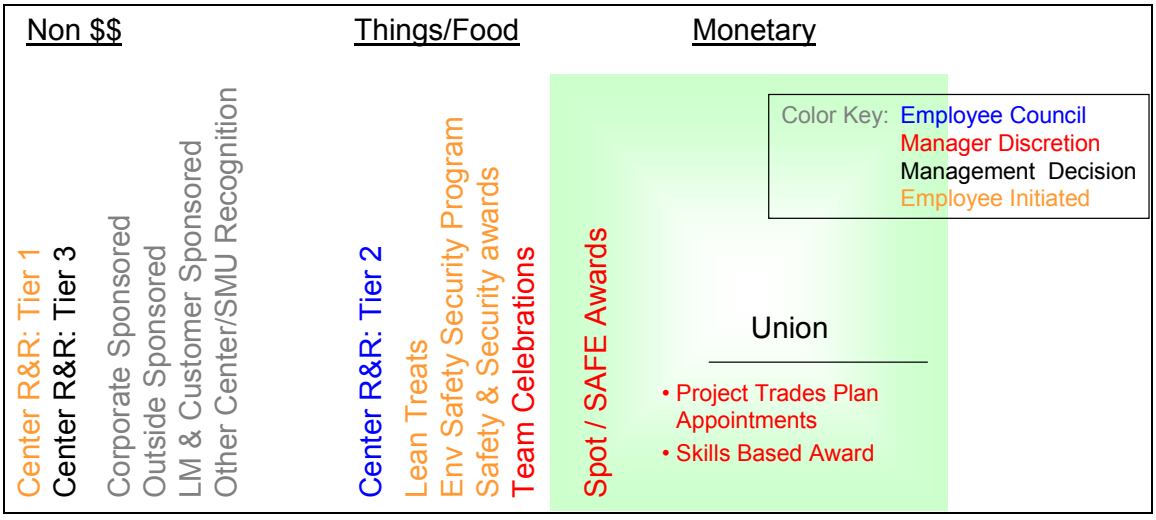


Figure 15. Center 2700 Variety of Rewards and Recognition Methods

We use a variety of rewards and recognition methods to highlight excellence and acknowledge contributions from all of our employees (see Figure 15). Our Production Specialist Skills Based Award Program for union employees is an example. This award process has been formally written into the union contract and is now on its fifth cycle. Developed as a method to encourage Lean skills in the represented workforce, it provides monetary awards to union employees for attaining new skills and demonstrating their performance on the job. Eligibility for the award requires three or more years experience; at least two years of sustained, excellent performance documented in our represented employee performance evaluation process; and successful completion of Green Belt training and certification. Individuals are awarded for skill certifications from two ($1500) to five ($3000) skills. Awards are issued upon completion of eligibility and then yearly to individuals who maintain qualifications and skill certifications. Since 2003, we have awarded over $383,000 in cash incentives. Thirty-four improvement projects have been implemented for Green Belt certification. In addition, we estimate that the cross-training has eliminated the need for adding over 17 operators to achieve and maintain our current production capacity. Many operators have implemented additional Lean improvements and a few have become zealous, Lean practitioners.

Idea Systems

We also have two formal idea systems that have been successful within the Center. One is a part of our Employee Safety & Security Program (ESSP). Employees are able to make suggestions and recommendations for environmental, safety, or security improvements. Submitters get safety bucks for purchase of gift items. One of our production floor supervisors had also implemented a suggestion system that we recently expanded to all manufacturing areas. This idea system focuses on realizing products better through elimination of waste in the immediate work area and the reduction of production risk. The goal is to approve ideas in 2 weeks, implement the ideas in another 2 weeks, and recognize individuals and teams who engage in this form of voluntary participation.

Employee Satisfaction System

The system is based on Plan-Do-Check-Act. Our system surveys 25% of our population quarterly and all Center employees annually. The results of each survey are analyzed to measure the effectiveness of the actions we are taking to improve our Center's overall effectiveness. From each survey, we identify areas of improvement. Results and trends, along with ongoing actions, are posted on our HR wall and shared with the whole Center through email. Whereas we use to get this data biannually, the quarterly data is giving us real-time data on the impact of our ongoing activities. Our employee satisfaction system is a key method of listening to our employees and acting on suggestions and trends. In addition, this is a method by which employees are able to suggest improvements to the work environment. For example, actions in the areas of career development, rewards & recognition, and manager 360 feedback, came from employee satisfaction survey results.

Benchmarked data indicates a direct correlation of employee satisfaction to the number of Lean events employees participate in. We also found this to be true in our Center (see Figure 16). As a result, we are keeping better data on employee involvement. Managers are also working to better distribute their employees among events rather than using the same subject matter experts (SMEs).

Each of these empowerment systems and processes require involvement of all employees to create the desired change and a positive work environment.

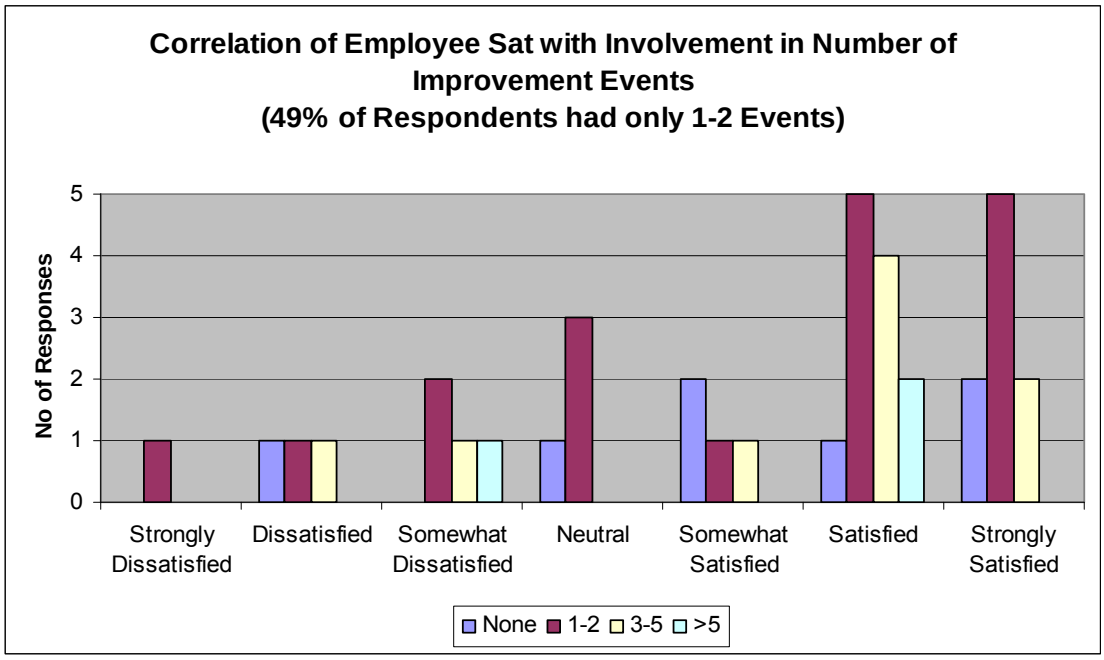


Figure 16. Correlation of Employee Satisfaction with Employee Involvement in Events

Community Involvement

We encourage our employees to participate in the Center 2700 community involvement projects. Every year, the Center participates in two main programs: United Way and Habitat for Humanity. In the past two years, Center employees have donated more than $136,000 to the United Way agency, and participated in the Habitat for Humanity at a higher rate than the Corporate average. In addition, Center 2700 employees participate in other activities such as Road Runner Food Bank, Shoes for Kids, Gifts for Kids, and the Giving Tree. This past holiday season, the Center donated more than 65 gifts to children of need.

The Center has a Community Involvement Committee that is in charge of planning the activities for the Center annually. This year we engaged employees with the "Community Involvement Café." The Café was an open house format to share ideas, learn about Corporate volunteering opportunities, and help develop our Center community involvement activities for the future years. The Café provided a fun environment with coffee, donuts, and a newsletter showcasing employee participation.

1.2.3. Environmental and Safety Systems

Respect for the individual is one of our Center (and Corporate) values. Nothing shows more respect than sending our employees home at the end of the day injury free. Successfully integrating mission and operational excellence in environment, safety, security, and health (ESS&H), is fundamental to Center 2700. ESS&H is more than an enabler; it is integrated into all that we do. The goals of the leadership team are that:

- Every person goes home every day injury free (zero job related injuries/illnesses),
- Operations have minimum impact on the environment (zero environmental incidents), and
- Operations fully comply with environmental and securities laws, regulations, and requirements (zero fines, violations, compromises, or penalties).

Holistic ESS&H

ESS&H is integrated in all work that is done in the Center and is demonstrated by the following practices.

- An ESS&H Management Steering Committee makes decisions on the roadmap to attain ESS&H Best-in-Class status and cultural change topics.
- An ESS&H manager is part of the leadership team that is knowledgeable and leads a technical team of experts able to address systemic problems with adequate resources and authority.
- Monthly metrics are presented at Management Reviews. See results Section 4.1.
- ESS&H experts are collocated within the facility allowing daily interaction that helps the line ensure compliance with laws and regulations, provide ESS&H expertise, perform self-assessments, assist in accident reduction activities and root-cause analysis events, generate and communicate lessons learned, and other activities that are related to the environment, safety, security, and health of the Center.
- ESS&H is covered at every management meeting. Topics are chosen based on current events or data trends and prepared by the ESS&H Manager or the Employee Safety and Security Program Team.

The Center participates in numerous ESS&H audits every year. Many are internal self-assessments we have performed monthly for 8 years. The Center emphasizes closing corrective actions as soon as possible, the day of the assessment if possible, otherwise within 60 days. Our robust self-assessment program allows us to perform well on customer audits. A 2003 Lockheed Martin audit of Environmental, Health, and Safety Compliance identified no findings within the Center. The 2003 and 2008 audits by the Department of Energy Office of Independent Oversight and Performance Assurance identified no findings within the Center. Annual audits performed since 2003 by the New Mexico Environment Department (NMED) resulted in no violations within the Center. Local customer audits have also identified no significant problems.

Integration of ESS&H with Center Work

Integrated Safety Management System (ISMS) is the Corporate system used to integrate ESS&H into our daily work and Value Creation Process. ISMS divides all work into five categories: *Plan Work, Analyze Hazards, Control Hazards, Perform Work, and Feedback & Improve*. How our work fits into each category of the ISMS system is described below.

Plan Work

The Center has incorporated ESS&H into its work planning systems. All proposals submitted to the Portfolio Management System must have the potential ESS&H risks and mitigations documented in the project proposal. The proposal acceptance scoring criteria includes a category for ESS&H impact. This system ensures ESS&H input into the work planning stage so risks can be identified and mitigated early when they are the most cost effective and have the most impact. Once a proposal is approved, Lean tools are used to plan the work. The tritium capture system upgrade and the development loader move, both high risk projects, used a vertical value stream map.

Analyze Hazards

Hazards are analyzed using the expertise of our engineers, line personnel and ESS&H SMEs. Before any work can begin at Sandia, a Primary Hazard Screen must be completed. This electronic tool identifies hazards and required training. The tool helps the work owner, who teams with applicable ESS&H experts, through a series of questions about different types of hazards. Training and other requirements are documented based on the answers to these questions. If the answers indicate that potential hazards exceed thresholds, a hazard analysis must be completed. A hazard analysis tool documents the controls in place that will mitigate the hazard. These documents are reviewed annually using a multi-disciplinary team to ensure all hazards have been identified and controlled.

Technical Work Documents that document the standard work for the floor employees are written in a way that best communicates the information needed. We held a kaizen event to improve the way our documents communicated the work and hazard information. The result was a template that used many annotated pictures and text fields that could be expanded or contracted to four different levels based on the expertise of the user.

Control Hazards

We use a multi-disciplinary team approach to control hazards. The SMEs work with the engineers and line workers to develop controls that manage the hazard while allowing work to be performed. We first try to engineer the hazard away; we then consider administrative controls; and last, we use personal protective equipment. The team has bi-weekly meetings to share ideas and concerns to better resolve any issues.

Perform Work

After controls are in place and training has been completed, the work begins. Routine self-assessments of the work being performed are conducted to ensure that the planning adequately controlled the hazards.

Feedback and Improve

Center 2700 has a robust self-assessment program. Standard work was developed for the self-assessment process to ensure that proper assessments were planned and performed correctly, results were documented consistently, and the improvement actions were closed out on time. All improvements actions identified from self-assessments have been completed on time for the last eight months. When we find problems we address them with root cause analysis, kaizen events, and awareness campaigns through the ESSP.

ESS&H Education and Awareness

Behavior Based Safety (BBS)

In 2006, the Center implemented Behavior Based Safety with the goal of reducing injuries and near-misses by addressing behaviors that may contribute to accidents and other forms of waste. This program is based on examining past accident data to identify behaviors that could lead to increased accidents or waste. Employees observe others performing work, focusing on targeted behaviors, and provide immediate feedback for improvement if needed. Data from observations are aggregated to track changes in behavior and guide further improvements. Figure 17 shows the BBS number of observations since the program was deployed, and the transition from the production floor to the Center. Once we met observation goals for represented employees, we expanded the program to the rest of the Center. We are still working on increasing the number of trained observers to meet our new goal. (April observations are partial data.)

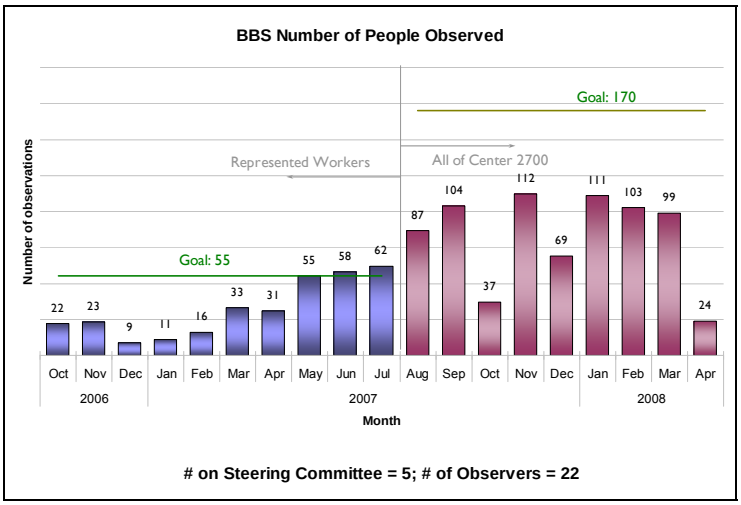


Figure 17. BBS Number of People Observed

Employee Safety and Security Program (ESSP)

The Employee Safety and Security Program is a grass-roots level program to educate and increase awareness of ESS&H. The program contains a formal idea system that allows anyone to submit a concern or suggest an improvement. The ESSP team reviews and can implement the suggestion with the help of the Enabling Services Department. Other ESSP activities include: picture of the month and quiz; a monthly presentation for managers to present to their staff on a safety or security topic; and contests that increase awareness. All participation is awarded with Safety Bucks redeemable at our safety store. More than 60% of the Center workforce participates in this program. The ESSP idea program has enabled the removal of hazards from the Center as shown in Figure 18.

Originally, the program was established to foster safety awareness and was centered on ES&H education. The program's educational format and successful distribution to the general workforce has provided opportunities through the years to integrate with other programs: Security and the Environmental Management System implemented in 2005, and Behavior Based Safety implemented in 2006.

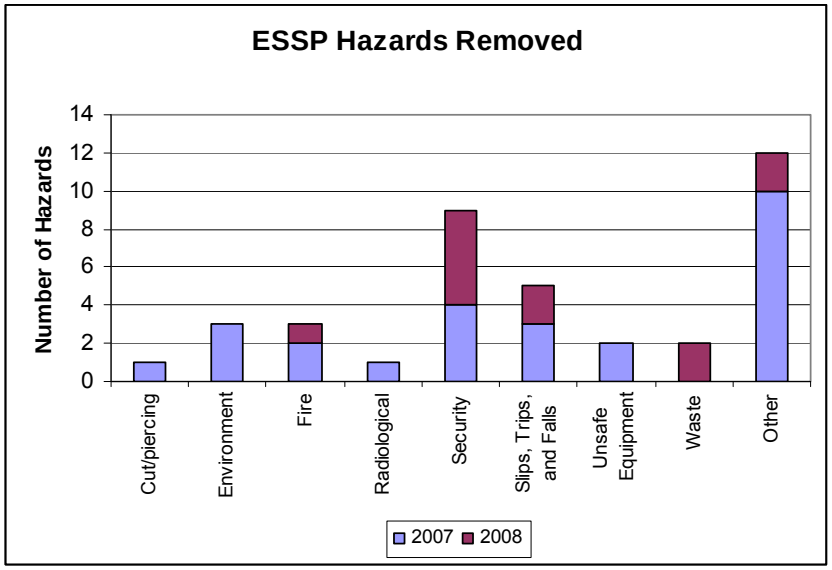


Figure 18. Hazards Removed in the Center Using ESSP System

Energy Bug

The Center has an initiative called the Energy Bug to remind people to be conscious about energy use to protect the environment and reduce unnecessary costs to the corporation. The Center accomplished an overall 2% reduction in kWh use in our buildings from FY06 to FY07. All of the buildings achieved an energy use reduction last year. Additionally, the Center participates in Sandia's Lights Out! campaign to demonstrate savings from turning off all unneeded energy sources in the evening.

Examples of ESS&H Continuous Improvement Activities

The Center has been consistently applying the Lean principle of seeking perfection to ESS&H areas. Mistake proofing, 6S, standard work, and root cause analysis are commonly used tools. For example, a kaizen event was held to address why there were an excessive amount of security incidents in our secure production areas. As a result, there have been no incidents over the last year. Another example is a kaizen event that focused on preventing slips, trips, and falls – our most frequent safety issue. Since implementation, we have seen a downward trend in the number of occurrences (see Figure 19).

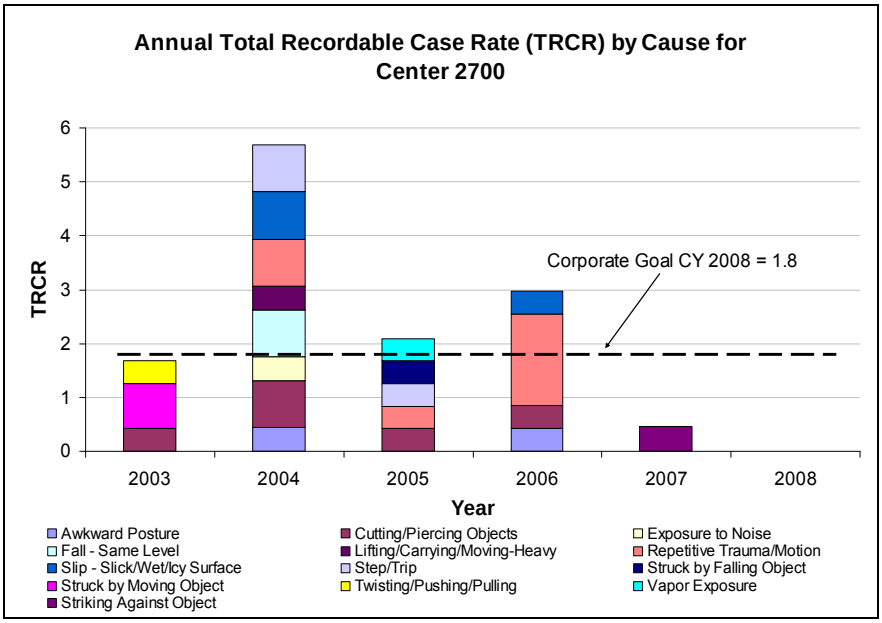


Figure 19. Annual TRCR by Cause for Center 2700

Ergonomics

The Center uses the Corporate Ergonomics Program to help achieve zero ergonomic related injuries. Through this program, every employee gets the opportunity to have their workstations evaluated. When the program started in 2006, the number of injuries in the Center increased due to the awareness of ergonomic issues. With recent improvements, injuries and future risk has decreased (see Figure 19).

Center 2700 Packaging (Winner DOE honorable mention Pollution Prevention award)

A team of employees developed a simple system to improve the efficiency in what had been a complicated cleaning process. The main goal of this quality improvement event was to streamline the cleaning of Styrofoam packages used to transport explosive material. The team developed a simple, nearly waste-free nitrogen blow-off process that replaced a time-consuming, hand washing system.

Table 3. Center 2700 Packaging Cleaning Improvement Event Results

Category	Before	After	Improvement
Process Waste	150 gallons of cleaning material per year	0 waste	Use Nitrogen blow-off
Product Waste	40 cubic feet of polystyrene lost or not recycled	4 cubic feet of polystyrene rejected by recycle process	Standardized process
Lead Time	120 days	5 days	Improved efficiency
Cost Reduction	$25,848 per kit	$395 per kit	Reduced use of chemical inputs

Encapsulation Process Improvement

A root cause analysis event was held after an employee received an exposure to a hazardous chemical while transporting contaminated parts in a basket to the cleaning operation. A fishbone problem analysis resulted in a redesign of the basket. The new basket has no sharp edges and better handles. Before and after pictures are shown in Figure 20.

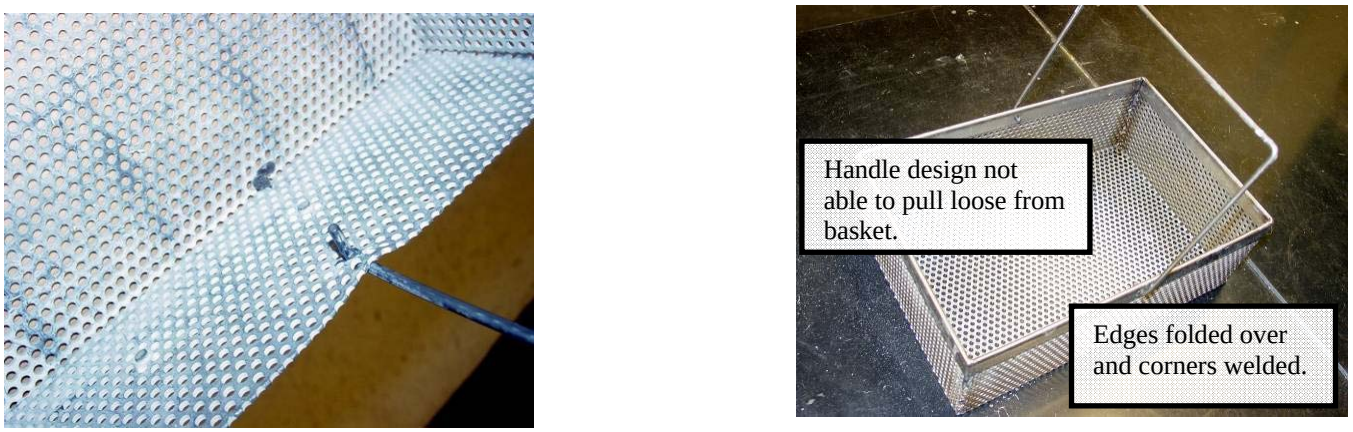


Figure 20. Basket for Holding Encapsulation Parts to be Cleaned Before (left) and After (right) Mistake Proofing

There are many more ongoing efforts that use Lean tools focusing on safety, waste minimization, security, and environmental stewardship. Most importantly, our injury records show notable improvement in achieving “every person goes home injury free.”

2. Continuous Process Improvement

2.1. Lean Principles

Center 2700 adopted Lockheed Martin's LM21 continuous improvement core principles and assimilated them into our culture. These core principles, which we have incorporated into all work, are listed below and depicted in Figure 21.

- Value from the customer's perspective: Listen to the voice of the customer, identify their needs, engage and communicate continuously.
- Value Stream: Define the set of value added steps that will achieve the desired deliverables.
- Flow: Effectively and efficiently perform quality value added work at all times.
- Pull: Be responsive, deliver (product or knowledge) when needed.
- Perfection: It's a journey, attain stretch goals for the Center using the scientific method and Plan-Do-Check-Act cycle.

The Center's vision and mission demonstrate our eagerness to seek perfection. We want to be the model for the NWC and we want to provide maximum responsiveness to our customer. We are seeking perfection by performing continuous improvement in all the work activities of the Center by respecting our people through empowerment to improve their own work, and through providing a safe and secure work environment by integrating ESS&H into work activities.

Work in the Center takes the form of either project work (delivers product knowledge) or value stream work (delivers hardware and its associated quality evidence), but both forms incorporate the Center's continuous improvement principles. Figure 50 in Section 3 of this report shows the type of work that each department in the Center performs. Departments in green perform or integrate their work with the value streams. Departments in purple perform work in the form of projects, and departments with both colors perform both value stream and project work.

Any type of work in the Center starts with an identified customer (internal or external) or business need tied to Strategic Objectives. For **project work**, the customer communicates a need for product knowledge or intellectual capital for future nuclear national security (value from customer's perspective). Once the work is prioritized and authorized by the Portfolio Management Board (PMB), teams create a vertical value stream map where the deliverables are clearly identified and the sequence of value added activities (value stream) are defined. Projects are executed using collaborative work environments, where dedicated resources focus on completing tasks efficiently through the use of the scientific method, LSS tools (kaizen, 3P, 6S, design of experiments, etc.), and Plan-Do-Check-Act. Tasks are completed to a takt time determined by customer needs (pull) in order to deliver the agreed upon product (knowledge) on time and on budget (seek perfection). For **value stream work**, the customer communicates a need for a certain quantity and type of Neutron Generators (value from customer's perspective). The Center continuously evaluates the value stream production line to maximize the amount of value added activities and minimize waste from processes (value stream). Value stream work in the Center includes seeking uninterrupted flow of products, i.e. no stoppages (flow). Product flows through the line at an established takt time (pull) based on the customer's need and with supporting takt time driven inventory levels. The NG Production Value Stream goal is to maximize responsiveness to customers by eliminating any production stoppages, and delivering quality NGs when needed at the lowest cost (seek perfection). See Figure 21 for a representation of the Center's continuous improvement philosophy applied to both project and value stream work.

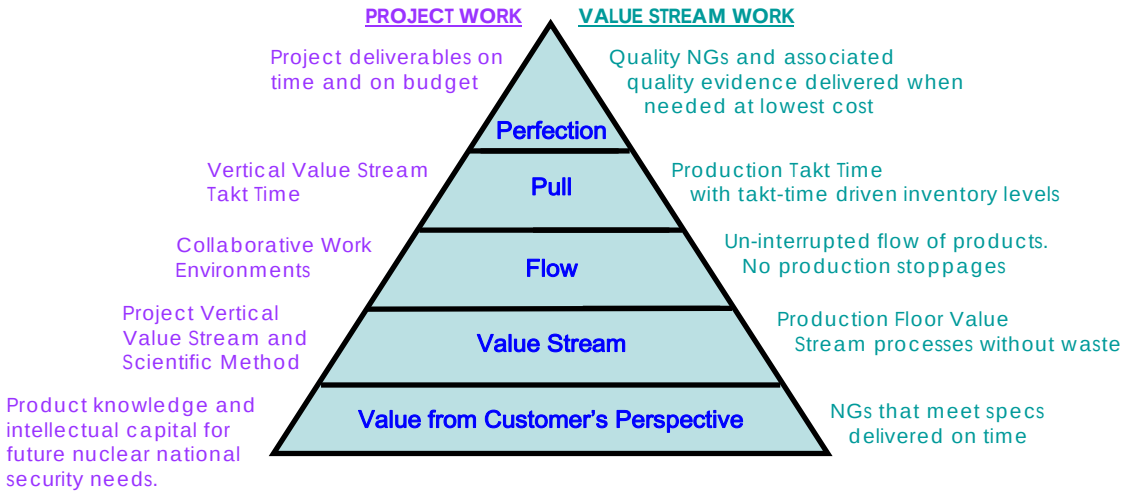


Figure 21. Application of Center 2700 Continuous Improvement Principles Defined for Project and Value Stream Work

Throughout the 7 years of our Lean journey, we have applied these principles in different areas of the business. The principles, systems, tools, and impact at a high, Center level, are presented in the Lean Timeline in Table 4. Details on specific examples of the use of our continuous improvement principles are described in Section 2.2. The NG Shingo Lingo in Appendix A can be used as a reference to understand the structure of activities that support our continuous improvement journey.

Table 4. Center 2700 Lean Timeline

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Principle	LM21 Pyramid of Operating Excellence: Value from Customer Perspective, Value Stream, Flow, Pull, Perfection								
	As we progress in our lean journey, our continuous improvement philosophy/principles become more ingrained in our culture and drive and align more work in the Center.								
Need / Creation of Readiness for Change	Burning Platform Read "Lean Thinking"	Trained 3 BBs Started training GBs Lean Leadership Training Implemented LSS Office		Mistake Proofing Training Kepner Tregoe Training	Vertical Value Stream Training	Increase Responsi-veness Reduce Cost		Basic Stability Training A3 Problem Solving Training Pull Training	3P Training
	Creating readiness by understanding the needs of the business and providing training to create change is critical for the Center's success.								
Scientific Thinking/ Use of Tools		6S Kaizen	Value Stream Analysis	First Center-wide VSA.	Mistake Proofing Kepner Tregoe Root Cause Analysis	Vertical Value Stream	Second Center-wide Value Stream Analysis	Strategy Deployment A3s. Review of Center – wide VSA.	3P
		We continue to learn new LSS tools as our business and understanding of Lean evolve.							
Systematic use of Tools						Mis Vis Kaizens, including: 6S, Mistake Proofing, and Visual Work Instructions	Transformation Lean S&T: VVS, Design of Experiments, Scientific Method.	Product Assurance Model, including: QFD, FMEA, Mistake Proofing, QMU (6 sigma)	Production Stability, including: Flow, Problem Solving A3s. Strategic re-capitalization project utilizing FMEA, 3P, and KT decision analysis.
	We are moving towards a more systematic use of tools to better accomplish our vision, mission, and strategic objectives.								
Accomplishments				Production Workcells Re-org into Value Streams		Transactional Workcells	Integrated entire NG live-cycle value stream (science, design, production, surveillance)	Hoshin-Kanri Portfolio Management	
New Missions without extra resources						Target Loading NG Packaging NG Demil	Switch Tubes	NG Supply Chain	Qual drivers MFG
Recognition				LM Straight to the Top Award			Shingo Bronze ISO Registration Quality New Mexico Baldrige Recognition		

Degree of Maturity:
White: Minimal Evidence or Use
Light Green: Some Evidence or Use
Green: Good Understanding and Utilization
Dark Green: Excellent Understanding and Utilization

When exercising the Center continuous improvement principles to achieve Strategic Objectives, the Center engages in a set of Lean activities. Depending on the business needs and the particular details of the continuous improvement activity charter, we use different Lean tools to achieve the goals and make the best use of resources. As we progress along our Lean journey and aspire to the principle level, we continue to add Lean tools to our toolbox and develop the appropriate expertise to apply them. Figure 22 shows the increase in tool diversity throughout 14 years. (2008 is partial data.)

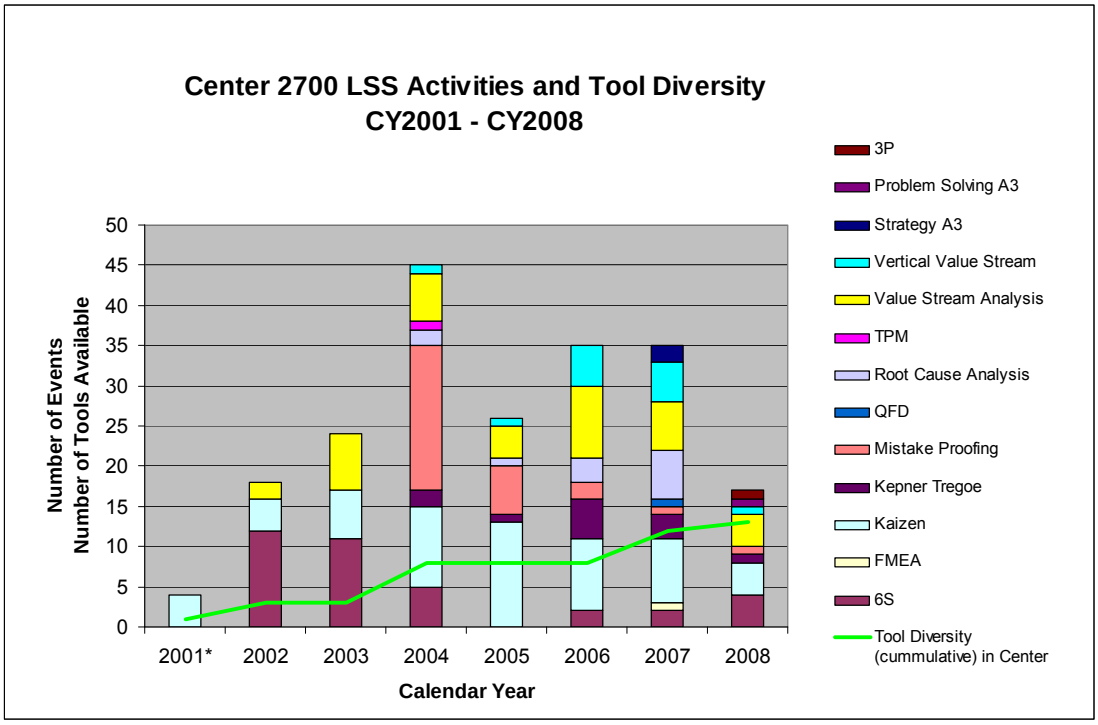


Figure 22. LSS Activities Through the Years

It is important to note that our LSS activities are performed in all areas of the Center: Capability Maturation, Product Realization, Continuous Production, Component Surveillance, and Shared Services. Figure 23 shows how the Center has expanded the application of Lean from production areas to all areas of the Center. Currently, 38% of our Lean events are in functions other than the NG Production and Materials Value Streams (non-operations).

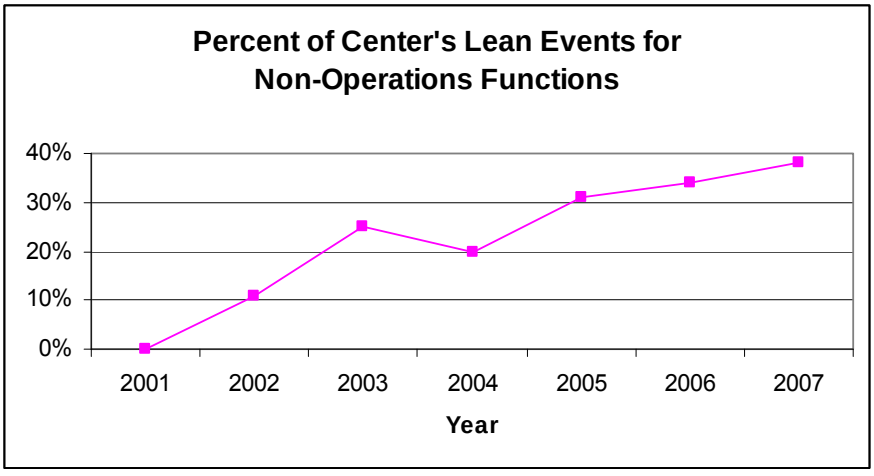


Figure 23. LSS Activities in Non-Operations Functions

As our understanding of Lean principles matures, we continue to develop principle based systems that use appropriate LSS tools to do work efficiently. Figure 24 shows examples of systems that have been implemented.

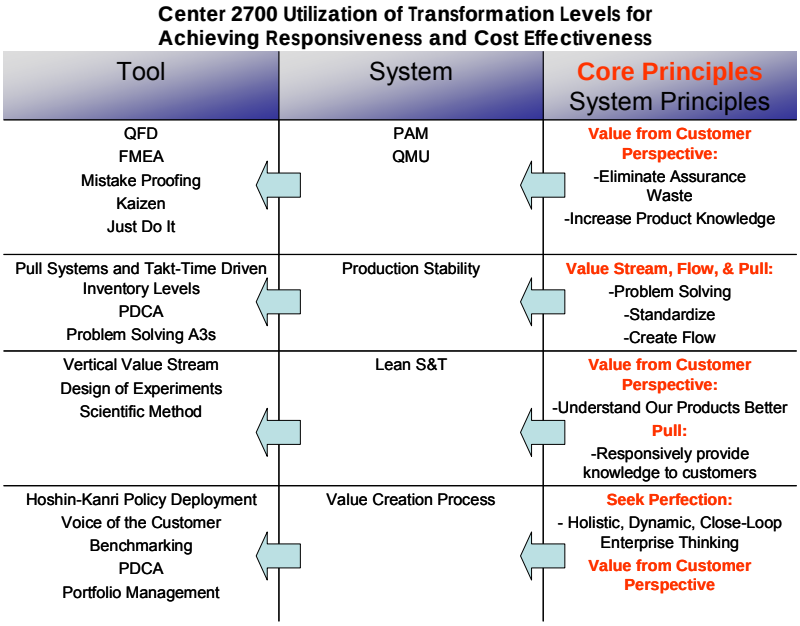


Figure 24. Center 2700 Utilization of Transformation Levels

To sustain the Center's Lean deployment, the leadership team continues to invest in Lean resources (Black Belt training, Green Belt training, consulting experts). Currently, there are four full time Black Belts who work closely with senior management on continuous improvement activities at the Center level. There are also eight certified and nine trained part time Black Belts who apply Lean principles and lead continuous improvement activities in their departments. Figure 25 shows the Black Belt structure. The Black Belt support structure and our leadership team's commitment to Lean, guarantees that Lean Six Sigma remains embedded in our culture, independent of turnover in the Center.

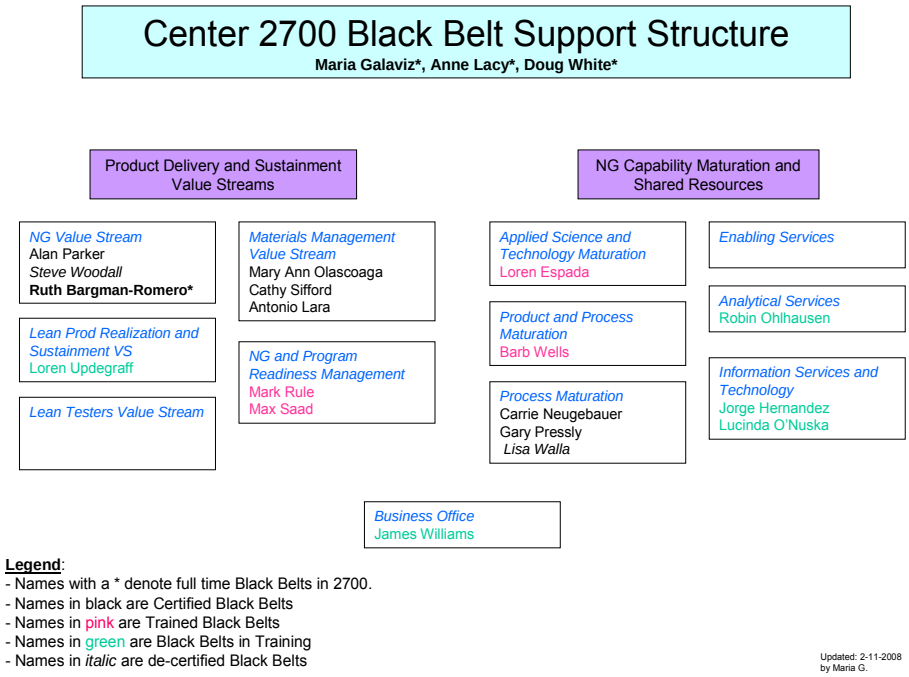


Figure 25. Center 2700 Black Belt Support Structure

All continuous improvement activities in the Center align with the Strategic Objectives and the Center Value Stream Map (see Figure 49). The champion manager and the Black Belt ensure that the Lean activity aligns with the Center priorities when reviewing the charter during the scoping phase.

LSS events are tracked in the LSS database and progress to completion is reported at the Tactical Management Reviews. All LSS standard work resides in the LSS webpage to which all of Sandia has access. The leadership team and the Black Belts attend Green Belt project presentations and event closeout presentations; however, these can also be accessed by the entire organization through the LSS webpage. Teams present lessons learned from the event. In addition, Black Belts share continuous improvement activity lessons learned at quarterly Black Belt meetings.

Lean Six Sigma Involvement

In the Center, all participation in Lean activities is voluntary. Since we started doing Lean, the Center has been averaging about 26 LSS events per year. These activities have provided an opportunity to engage over 88% of our employees in at least one LSS event. Our employee's involvement in continuous improvement activities is important to the Center. We want to ensure that everyone is given the opportunity to make and be part of change, to make improvements to their work, and to feel more satisfied with their work. Our employee satisfaction survey consistently shows that the more people get involved in continuous improvement activities, the more satisfied they are at work (see Figure 16).

The Center encourages people from all levels in the organization to attend Green Belt training and obtain their certification by working on a continuous improvement activity in their areas. The goal is to have 100% of the Center Green Belt trained. Currently, 84% of the Center is trained; this is a 4% increase in 2 years where more than 22 employees (non GB trained) joined the Center due to reorganizations and new mission assignments (see Figure 78). Figure 26 shows the percent of trained and certified Green Belts in the Center.

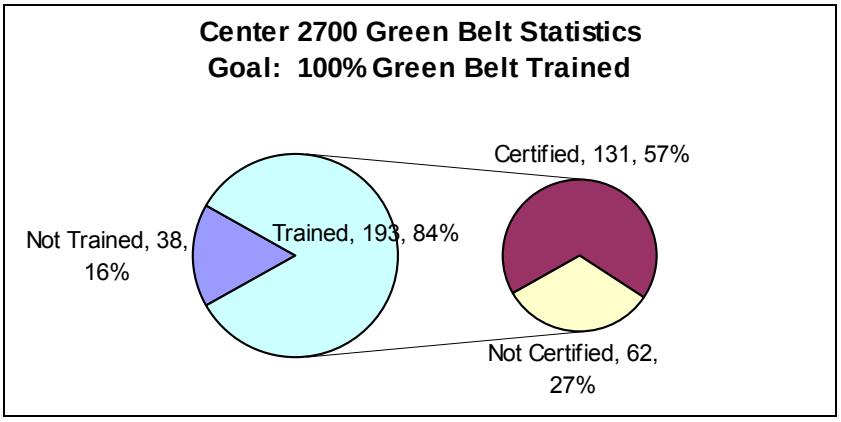


Figure 26. Green Belt Statistics

The Lean office sponsors a monthly contest called "Lean Treats." The contest consists of three questions related to Lean. People who participate obtain a "Lean Treats Coupon" that can be exchanged for candy bars, sodas, or ice cream. The Lean Treats program has been very successful in the Center. Participation averages 130 employees per month (~50% of the Center's population).

It is part of our continuous improvement culture (and expected of our Black Belts) to attend Lean conferences so that employees can increase their knowledge in Lean principles and methodology, learn new tools, and see how others are applying them in order to continue to make progress in our journey. Figure 27 shows the attendance (A) and participation as presenters (P) of the Center employees in

different Lean conferences. The high attendance to the Shingo Public Sector conference in 2006 was the year the Center was awarded the Bronze Shingo Award.

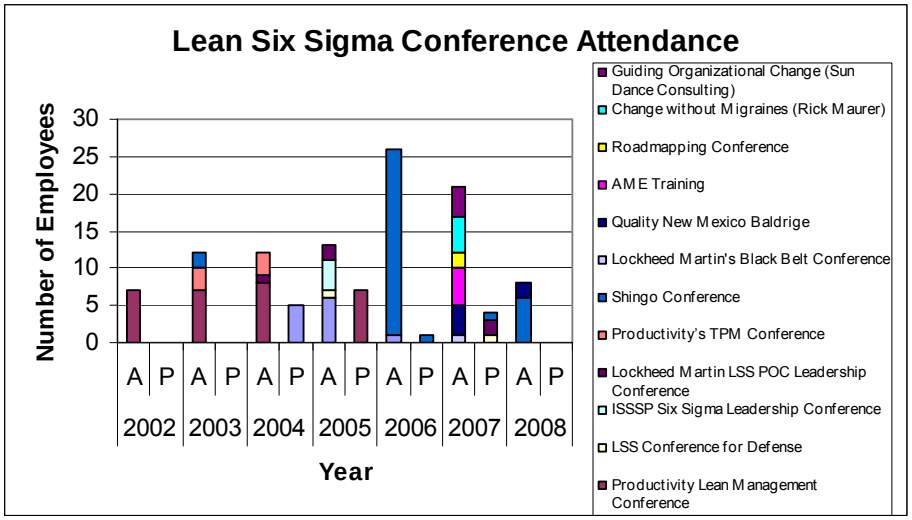


Figure 27. Lean Six Sigma Conference Attendance

In addition to encouraging people to attend conferences and workshops, the Center brings on-site training as needed, to train a significant number of people or when there is a need to create readiness for change (i.e. introduction of new tools). A few recent examples include:

- "Basic Production Stability" training by Art Smalley in the fall of 2006.
  More than 20 people trained.
- "Problem Solving A3s" and "Pull and Flow" training by Art Smalley in the fall of 2007.
  More than 15 people trained.
- "3P" training by Simpler® in the winter of 2008.
  More than 50 employees from across the Center trained (S&T, design, manufacturing, IT, enabling services, analytical technologies, program management).

The following sections in this report describe how the Center has used our Lean principles to achieve Operating Excellence through the application, integration, and alignment of principle based systems and tools to eliminate waste and provide better value to our customers by being more responsive and cost effective.

2.2. Value Stream and Support Processes

2.2.1. Customer Relations

In order to achieve the Center's vision, mission, and operational excellence, it is critical that we engage our customers in our work. The Center Value Stream Map, shown in Figure 49, depicts the customer at the center of all of our activities. Understanding value from the eyes of the customer is a principle to becoming more responsive and cost effective. By engaging the customer, expectations are clearer, our work is more focused, and it is easier to plan for the future.

Center 2700 has multiple customers. Customers outside Sandia are: the Nation, the President, DoD (StratCom and Warfighters), and NNSA (local and headquarters). Inside Sandia, our customers are Sandia's Weapon Systems. Within the Center, individual departments and value streams are internal customers to other departments.

Described below are several systems to engage the customer in the Center: the Customer Satisfaction Survey, Quality Assurance Surveys, NG Systems Reviews, Stockpile Review Conference, Product Order Taking and Delivery Scheduling, and Projects.

Customer Satisfaction

Every year, Sandia is evaluated by the NNSA through the Performance Evaluation Report (PER). The PER presents the U.S. Department of Energy/National Nuclear Security Administration's (DOE/NNSA) evaluation of Lockheed Martin's performance in managing and operating Sandia each fiscal year. The PER evaluates three performance groups: Performance Objectives, Performance Incentives, and Award Term Incentives. Most of the work in Center 2700 is under Performance Objective 1 titled "Stockpile & Conduct Surveillance." Figure 28 shows the numerical and objective rating. Table 5 provides the definitions for the ratings.

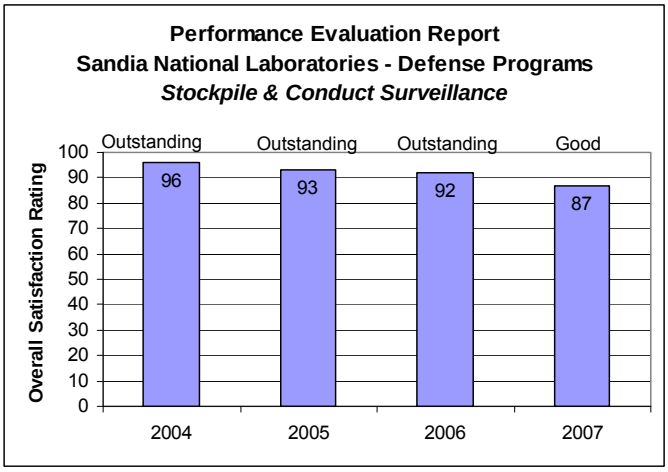


Figure 28. NNSA Customer Satisfaction Results

Table 5. PER Rating Scale Definitions

Adjectival Rating	Numerical Rating	Definition
Outstanding	90-100	Significantly exceeds the standard of performance in all areas: Achieves noteworthy results. For projectized work, significantly exceeds either or both of the budget and schedule expectations.
Good	80-89	Exceeds the standard of performance; although there may be room for improvement in some elements, performance in critical and mission area remained at a high level. For projectized work, exceeds either or both of the budget and schedule expectations.

The 2007 rating of "Good" was because of weapon systems quality issues at Sandia. Center 2700 impacted this rating by having one NG returned from the field (the first time in the history of NG production, we are now at a 219 ppm customer return rate). The Center took this problem very seriously. A mistake proofing event occurred immediately after the finding to prevent this from happening again.

The information from the PER provides good feedback at the Sandia level, but it does not provide enough detail for the Center to focus improvements. It only provides the point of view of one customer. For this reason, the Center created a new approach that would allow us to reach to all of our customers and respond in a timelier manner. This new process is described in the following section.

Customer Engagement System

Last year, we deployed a new Customer Engagement System including a customer satisfaction survey. It consists of surveying all of our customers, Sandia Weapon Systems and NNSA, and partners at least once a year (more than 70 total). Every quarter, a subset of all customers and partners is surveyed. The resulting information is analyzed and presented at the Strategic Management Reviews, and action items are identified if there is an area where we need to improve, or if we need to leverage a best practice to other areas. Customer satisfaction is a key watch indicator in our Hoshin-Kanri (see Figure 6). In addition, there are Center 2700 Manager points of contact for each of our customers. These points of contact ensure that any issues are resolved in a timely manner, they engage in continuous dialogue with the customer throughout the year, and they make sure they communicate any concerns to the rest of the leadership team. The information obtained from our customer surveys becomes an input for the Center's strategic planning (see Figure 7, Value Creation Process). Figure 75, Figure 76, and Figure 77 in Section 4 show the satisfaction results of this new system to engage the customer. On average, overall customer satisfaction improved from 5.9 to 8.24 (on a scale 1 to 10) since starting the surveys.

Quality Assurance Survey, QAS

The National Nuclear Security Administration (NNSA) executes periodic Quality Assurance Surveys (QAS) in our Center and other Centers in Sandia. The purpose of these surveys is to verify that all weapon work is in compliance with the NWC Product Realization Process Weapons Quality Policy (QC-1).

Throughout the years, Center 2700 has continuously demonstrated high performance in the QASs. The relationship with this customer has strengthened to one of higher trust and confidence due to open and honest interaction and respect. As a result of successful QASs, NNSA has reduced oversight of the Center's work. A few examples follow.

Decreased Number of Product Acceptances

In the past, at every major subassembly of our product, NNSA would perform product acceptance activities. By engaging NNSA in our continuous improvement activities and by providing historic evidence of no findings of certain subassemblies, the Center has been successful in reducing the number of product acceptances (see Figure 29). The NNSA has selectively delegated their product acceptance authority to Sandia, based on achieved high confidence levels demonstrated by excellent historical performance. For example, the product acceptance at the NGSA level was eliminated, leaving us with one NNSA acceptance process at the final Neutron Generator level (green font on Figure 29). All other acceptance processes are done by Sandia's internal Quality Department.

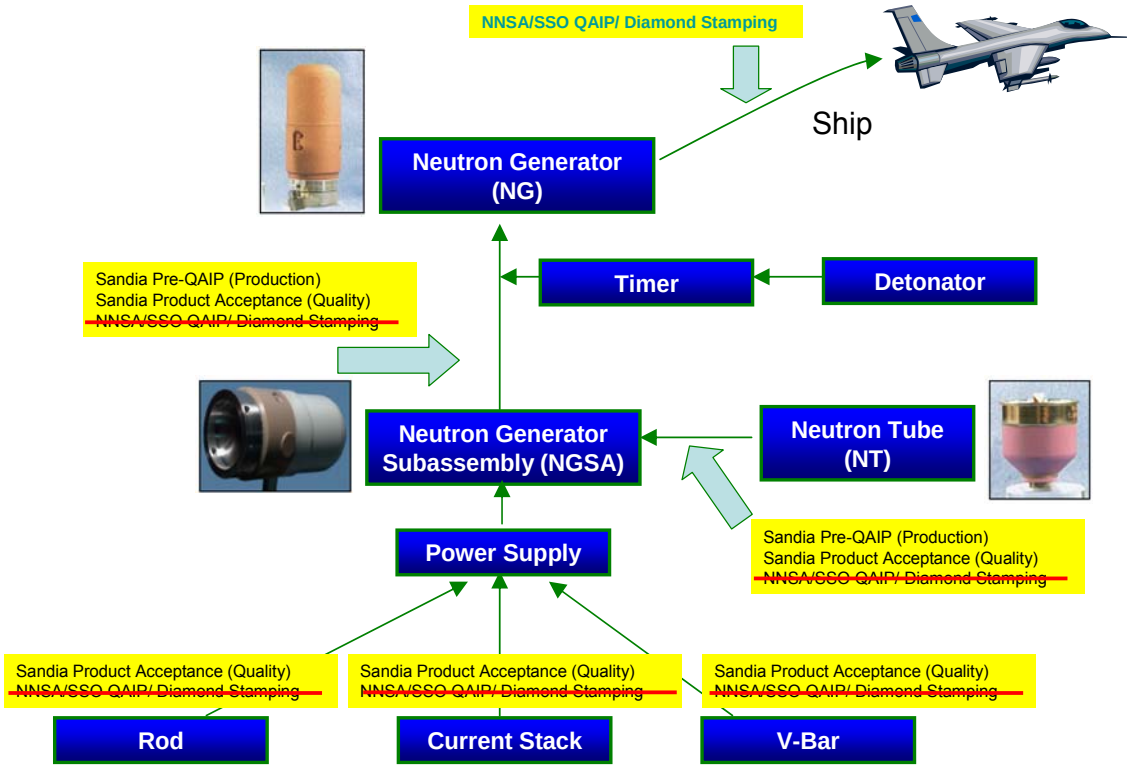


Figure 29. Neutron Generator Product Acceptance Model

Leveraging Center 2700 Self-Assessment

As mentioned previously, NNSA performs periodic QASs on the Center. After learning that the Center performs bi-weekly self-assessments, the NNSA now jointly participates in our self-assessments and has leveraged these to reduce their QAS activities. This activity has just begun, but the Center hopes to achieve greater efficiencies for ourselves and NNSA similar to the product acceptance process.

Neutron Generator Systems Reviews

Neutron Generators are components that go into different weapon systems, therefore, weapon systems organizations are customers of the Center's work. The results of our customer satisfaction surveys from our weapon systems customers indicated that communication between us was ineffective. We took action to improve this relationship and implemented a "Neutron Generator Systems Review" every quarter. At this review, metrics and status of the Center's work (production, development, and surveillance) are presented, updates are provided, issues are addressed, and future plans are discussed. The weapon systems community has responded well to this new formal engagement.

Stockpile Review Conference

The Stockpile Review Conference (SRC) is a key interaction between the Center and Sandia's weapon systems customers. It takes place every year to evaluate the status of the products in the field. The S&T Department and the Product Realization and Sustainment Value Stream evaluate the lifetime estimates for all fielded Neutron Generators using the Quantification of Margins and Uncertainties (QMU) methodology and present this information to the weapon systems organizations for decision making. The outcome of this conference provides the basis for the annual certification review of the nuclear weapons stockpile to the President of the United States.

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Product Order Taking and Delivery Scheduling

The Center obtains shipping requirements via the "Directive Schedule" provided by NNSA. This document authorizes us to build and ship Neutron Generators. The Directive Schedule spans over 15 years. NNSA updates it at least once a year based on long term stockpile needs, and provides details on quantities needed to be shipped every month. The NNSA uses total Neutron Generator production capacity as an input when creating the Directive Schedule. The Center master scheduler uses the Directive Schedule to create a Master Production Schedule (MPS).

The job of the master scheduler is to analyze the Directive Schedule, engage the customer to understand the schedule needs, and gather assumptions based on environmental scans, in order to create a Master Production Schedule that:

- Level loads the work on our production floors,
- Manages our finished goods inventory to an acceptable level of risk based on our product span times and production floor stoppages, and
- Highlights 1-3 year capacity constraints.

Over the years, we have been successful in reducing our finished goods inventory. In the past, we carried more than 1 year of inventory. Currently, we carry 6 months. The objective is to manage our risks with reasonable levels of inventory.

Customer communication is accomplished both through formal, complex wide provisioning meetings and via e-mail, phone, or face to face. Provisioning meetings occur 4-6 times a year and other communication occurs as needed.

The Center's performance in meeting the Directive Schedule is presented in Figure 66 in Section 4. In addition, our NNSA customer provided positive feedback on last year's customer satisfaction survey: [Center 2700 is] *"Responding well to last-minute change requests to Directive Schedules. Also good communication from the Production Side on the W76-0/-1 shipment holds. 'Can do' attitude is perceived. All these are considered important attributes."*

Projects

Each project in the Center Portfolio has a project lead assigned to it, and it is this individual's responsibility to work closely with the customer to ensure success of the project on all three dimensions critical to the Center: cost, schedule, and performance. As described in Section 1, project statuses are presented at the Tactical Management Reviews where actions are identified to address any issues with the projects.

2.2.2. Product/Service Development

New Product Development

Becoming the NWC model implies that we do our mission very well. As mentioned in Section 1.1, a key concept to achieve responsiveness is to realize products in 18 months. This presents a new challenge to the Center. We have started to transform by clearly defining how we do work in our Center Value Stream Map (see Figure 49). Some of the concepts to contribute to a more efficient process for new product development are:

- Engaging the customer early on to identify needs and mature technologies,
- Engaging the customer throughout the development phase,
- Separating capability maturation from product realization to provide better value to the customer by exploring different options (set based design), and

- Creating a toolbox that documents our capabilities and their associated readiness level to enable effective decision making and to ensure knowledge preservation in the Center.

We are also leveraging the scope of the Center (entire Neutron Generator lifecycle) to perform concurrent engineering. The Center is not frequently presented with the opportunity to design and develop new products, however, we currently have two new products in capability maturation. The Small Ferroelectric Neutron Generator (Small FENG) and the Electronic Neutron Generator (ELNG) present the perfect opportunities to apply our Center Lean principles.

The design portion of the two teams (Small FENG and ELNG) was originally housed in separate buildings, apart from product realization. First, we collocated these teams in two buildings (side by side) to improve communication and concurrency. Both the Small FENG and ELNG share product development floor space in Building 700. This building was designed to be flexible and agile for product development activities, and was originally laid out to support the ferroelectric-type NGs. With the ramping up of ELNG activities, the first Lean activity for these two teams was to redesign the floor space into a work cell to improve flow for both products. Before and after spaghetti charts were created to analyze the work cells. The results of the value stream analysis are shown in Table 6.

Table 6. ELNG and Small FENG Work Cell Accomplishments

Measurement	Current State	Future State
Distance of product flow	FENG = 5685 feet ELNG = 9815 feet	FENG = 3027 feet ELNG = 5008 feet
No. of Handoffs	FENG = 11 ELNG = 2	FENG = 9* ELNG = 1*
Process steps	FENG = 114 ELNG = 185	FENG = 108 ELNG = 120
Equipment Count	FENG = 31 ELNG = 65	FENG = 26 ELNG = 64

* One outcome from this event is the freeing up of floor space in the hi-bay area. This space could be used for the dynamic hipot tester and a flame spray which would reduce FENG handoffs to 2 and ELNG handoffs to 0

The ELNG team recently put together a vertical value stream map to plan the work of successful capability maturation and product realization. The team had representatives from: Testers VS, Manufacturing VS, Materials VS, Product Realization VS, Product and Process Capability Maturation Department, Weapon Systems Customers, and Quality Department. Some of the "new ideas" incorporated into this plan include:

- set based design approach to explore different options and advanced concepts for specific customers,
- emphasis on modeling and simulation including early reliance on modeling to alleviate testing and excess physical builds,
- measuring capability maturation using Sandia's Technology Readiness Levels (TRLs),
- documentation of capabilities using the toolbox methodology,
- incorporation of the Materials VS early on to evaluate and mature supplier capabilities,
- involvement of the Tester VS to provide requirements when needed,
- involvement of the tooling team early on to plan for tools and gauges that will be needed,
- scheduling of early flight tests to optimize use of results,
- use of Design of Experiments throughout the project,
- detailed Failure Modes and Effects Analysis (FMEA) at conceptual design,
- Design for Manufacturability and Assembly (DFMA) throughout the phases,

- Quantification of Margins and Uncertainties analysis for Critical Performance Parameters,
- incorporation of mistake proofing in product and process designs,
- proactive use of process modeling (i.e. solder, welding, environmental test, encapsulation, etc.) to reduce cost,
- proactive "green" design to reduce hazardous waste generation and improve worker safety,
- incorporation of product development kaizens and 3P events with the NG Production VS to transition from development to production, and
- minimizing complexity of materials and parts by identifying and using COTS.

To accomplish the tasks in the VVS on time, our team is working in a collaborative environment. A collaboration room is equipped to meet the team's needs of hosting update meetings, facilitating visual project management, and holding working sessions to complete the tasks. All the team members are dedicated resources to the project. Most members are Green Belt trained, and the team lead is Black Belt trained.

The ELNG team has been successful in implementing the new set based design approach. In the past, the way to do business was mostly through point based solutions. Figure 30 shows how the set based approach is helping the team to advance the design of the ELNG subcomponents: timing inductors, capacitors, timers, and transformers. Before options are dropped, they are documented and captured in the toolbox for possible future use. This new approach will enable the team to explore as many options as possible during the capability maturation phase in order to provide the best value to the customer, achieve the product realization span time of 18 months, and meet the budget goal for the project.

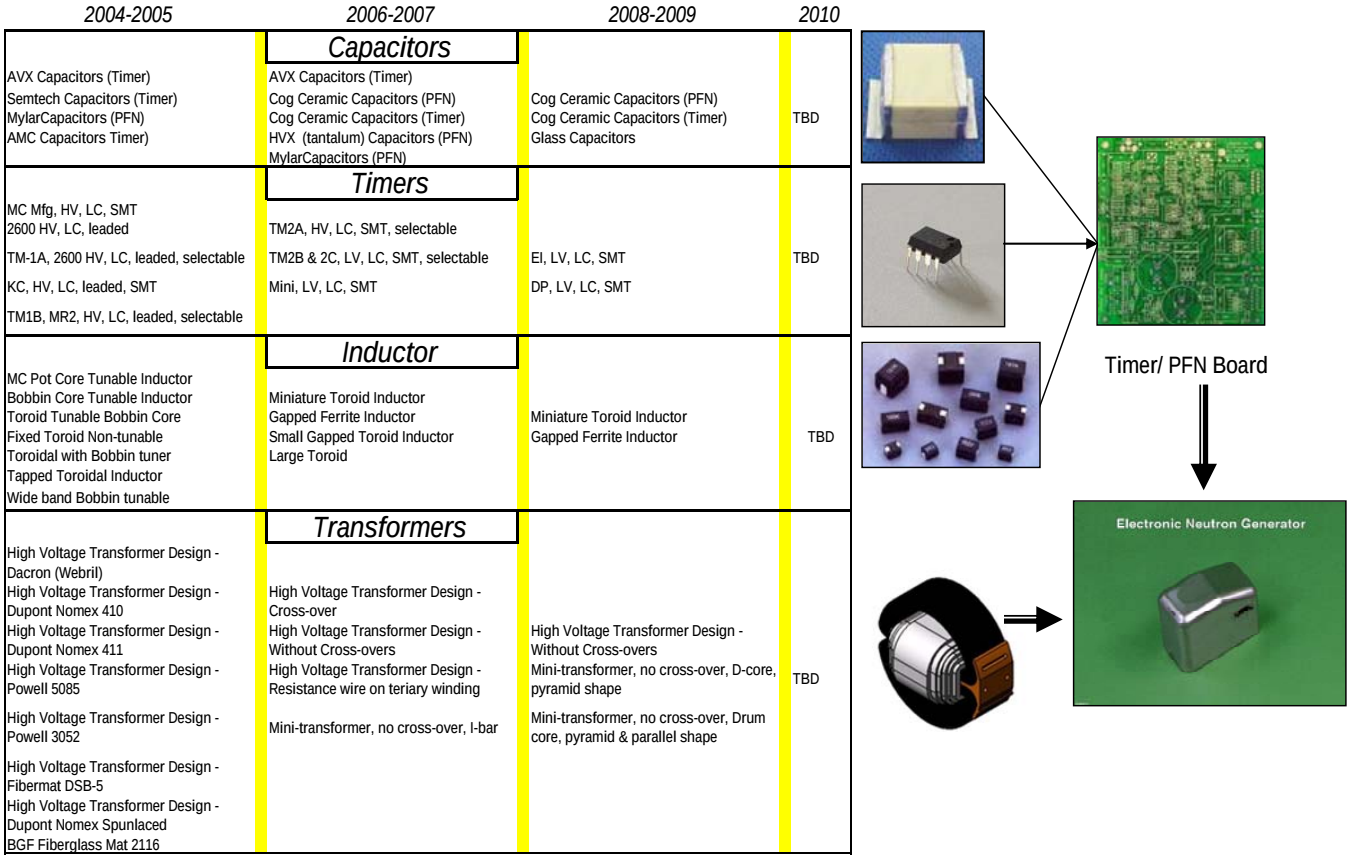


Figure 30. ELNG Set Based Design Approach

MC4368C Development

The MC4368C is the first product development project to exercise all of the elements of the Product Realization Value Stream Map developed in 2006. This product is on schedule to be completed by December 2008, one month under the 18 month goal. The MC4368C is slated to replace the current designs in production (MC4368A and MC4368B) primarily because of obsolescence concerns for an important subassembly. This replacement improves flow and prevents mistakes on the floor. By combining efficiency and standardization elements into the planning, we were able to leverage the significant qualification cost savings associated with developing a new product. Lessons learned from this project are helping us pave the way for future component development projects that will allow us to achieve the 18 month production realization goal. In addition, the standardization and efficiency benefits will improve flow and reduce span time for the subassembly by 5-10%.

Modular Design and Standardization in Tester Design and Development

The Tester Value Stream has been leading the way in using standardization for continuous improvement and increased production stability. Historically, each new tester and subsequently its modernization or obsolescent replacement was a unique integration of custom and commercial hardware and software. This led to an array of inflexible testers with aging technologies that were difficult and expensive to maintain and replace. Design, development, and qualification cycle times were typically 3 to 5 years with testers being released with obsolete hardware and software, or abandoned altogether because of changing priorities. Because testers are an integral part of the production process, they have a huge impact on responsiveness and operating cost. Testers are a significant contributor to production stoppages. In 2004, the tester organization launched an initiative to examine a new tester lifecycle management strategy that was aimed at enabling the attainment of production operation's goals.

Using benchmarking and analysis of industry best practices, the tester team adopted a standard hardware platform and in 2005, standard software. The focus was on right-sized equipment, taking advantage of commercial hardware and software that is specifically designed for automated test and measurement systems, and exploiting modularity and re-usability wherever possible. Because testers must be active for the full lifecycle of our products, we chose the hardware and software suppliers for their record and commitment to long term maintenance of their products. Right-sizing frees up production and development floor space. Modularity and re-usability ensures faster deployment, modification, modernization times, and maintenance costs. The Tester Value Stream Department developed a modernization strategy using down-time history to develop priorities for tester replacement within 18 month product realization cycles.

Although the initial learning curve was steep, the tester group has deployed five new testers, a portable calibration station, and a tester simulator with the new standards. Two more tester replacement projects will be launched this year. Two of the more complex testers recently deployed were completed in less than 18 months and all of them take up a fraction of the space their ancestors required.

Photograph of a tester designed using modularity (PT3700) is compared to its predecessor (PT3697) in Figure 31.

Figure 31. Comparison of PT3697 FE NG Acceptance Tester (old) on left vs. PT3700 FE NG Acceptance Tester (new) on right.

Engineering Authorization Cell

The products produced by Center 2700 are made up of hardware and quality documentation. Accurate, quality documentation is vital to the product acceptance process. The Engineering Authorization (EA) process uses engineering change orders (ECOs) to make official changes to product documentation supporting ongoing production and new product development. The change configuration management team updates the enterprise resource management system as well as the design definition documents. Table 7 describes the evolution of the Engineering Authorization process including the performance results that have been realized.

Table 7. Evolution of Engineering Authorization Process

Time	Improvement Activity	Changes	Results
Before 2004			- 30+ day span time - 17.5% rework - 11 hand offs
November 2004	Value stream mapping and kaizen event	-Implement single-piece-flow transactional work cell: "EA Cell"	- 13 day span time - 2 hand offs - 0% rework
January 2007	Customer Survey		Customers want: - Faster processing - Simpler customer interface - More services
May 2007	Value stream mapping and kaizen event	-Implement new web based EA traveler system for requests and EA tracking. -Increase variety of ECOs processed in EA cell	- 8 day span time - 2 hand offs - 0% rework

New Service Development

Component Surveillance

Component surveillance is the Center's warranty responsibility to ensure the acceptable performance of our product in the field over its life. We provide assurance to our military customer that our product will perform as required, with the specified level of reliability, until retirement. To meet this commitment, we perform an extensive program of ongoing testing of retained and fielded product in what is known as the Shelf Life Program. Functional testing, both destructive and non destructive, of these assets allows us to check for any unexpected performance degradation or unanticipated aging issues. In addition, assets are regularly returned from the stockpile for testing. Data from these two testing programs are used to refine our Life Estimation Model, and to recertify stockpile reliability.

When a potential problem is discovered we initiate a process known as a Significant Finding Investigation (SFI). The SFI process is an NWC process used to respond to anomalies in the stockpile using cross-functional teams. In 2005, a Center 2700 Black Belt led a Sandia-wide value stream analysis event to define a more effective process and reduce the SFI to closure span time from 39 months to a 12 month goal.

The SFI span time represents our warranty response time and is another way of demonstrating responsiveness to our customer. Our Center goal is to close all SFIs in less than 12 months. This is a challenge because the complexity of the SFIs varies significantly from one case to another. Figure 32 shows both closed (blue) and open (purple) SFIs the Center has had since 2004. The increasing number of SFIs is a reflection of older NGs in the stockpile.

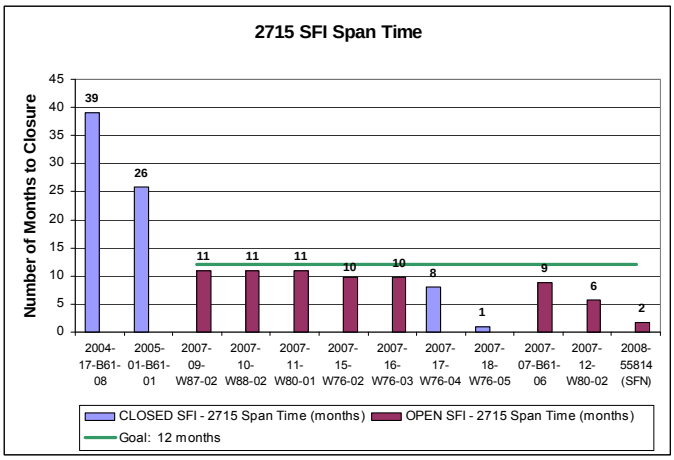


Figure 32. SFI Closure Span Time for Neutron Generator Responsibility

Because the customer satisfaction interviews showed that our weapon systems customers wanted more communication around NG surveillance topics, we created a Sustainment Steering Committee (SSC). The purpose of this committee is to:

- Establish standard processes to collect and analyze NG/NT data (e.g. production test, stockpile and Shelf Life test, post-mortem), ensure validity, and produce estimates (including confidence, margins, reliability) for end of life,
- Vet new challenges that cross-cut weapon systems and recommend a path forward, and
- Enable our systems partners to make informed stockpile sustainment decisions with our NNSA customer.

The SSC has specific goals that align directly to two of the Center's Strategic Objectives ("Think: Manage Our Risks Cost Effectively" and "Know: Understand Our Products") and with the Customer Engagement System.

2.2.3. Operations

The NG Production Value Stream is made up of four production shops: Neutron Generator (NG), Neutron Generator Subassembly (NGSA), Neutron Tube (NT), Piece Parts and Subassemblies.

The Strategic Objectives Think and Deliver drive the goals established for production operations. These goals are: 100 day span time (135 days for FY08, 100 days for FY09), takt time driven inventory levels and no product assurance waste. Achieving these goals requires focusing on value, creating production flow, and eliminating wasteful activities in a structured way using data to make decisions.

Given the goals, the Center value stream analysis (VSA), and the more holistic view of the Production Value Stream, two principle based systems were established: eliminate assurance waste and establish production stability. The Center VSA revealed that the majority of enterprise cost was driven by product assurance, much of which we believed to be non value added. Center 2700 needed a way to determine the value of assurance activities and eliminate assurance waste without sacrificing quality performance. The Product Assurance Model (PAM) is our principle based approach to driving down assurance waste.

Again, the Center VSA led to a holistic view of production operations and to the understanding that production goals and continuous improvement activities had to encompass all four production shops that make up the Production Value Stream. In analyzing production problems across the shops, it became apparent that production interruptions undercut our performance. This unstable production situation was a barrier to meeting the NG Production Value Stream's goals and pursuing perfection. Stable production is necessary to meet the current span time goals and is also the foundation to achieve a higher level of performance. This led to the creation of the Production Stability system.

These two principle based systems (Product Assurance Model and Production Stability) are the primary basis for continuous process improvement within production operations. Center 2700 leadership consciously decided to have fewer, but more focused continuous improvement efforts. These more focused principle based systems are yielding greater impact than the previous discrete application of tools. The production floor still maintains the 6S workspaces and work cells that were established previously.

Product Assurance Model

The Product Assurance Model (PAM) has enabled Center 2700 to make risk based decisions on waste elimination with respect to the extent of controls and resources needed to ensure our product performance requirements. We have completed the PAM pilot phase and are now into the implementation phase.

Through the design and qualification process, many production processes had checks and data entry associated with them. There was not a tool or method for determining when these could be eliminated. The PAM uses risk analysis tools to quantify the effect of removing assurance activities.

The challenge for the PAM program is to maintain quality while employing a risk based approach to assurance waste elimination. Although the PAM is rooted in Center 2700's continuous improvement principles, the PAM has defined a set of principles for assurance waste elimination. The PAM principles are: know how customer's needs and wants relate to product and process; evaluate risks to product performance; mitigate unacceptable risks but avoid assurance waste; apply traceability wisely; and clearly distinguish between elective and compulsory activities.

The PAM System

The PAM is executed by completing a risk analysis, identifying the assurance waste, mitigating risks associated with eliminating the assurance activity, and implementing the changes.

The primary tool of the PAM is the Failure Modes and Effects Analysis (FMEA). Using FMEA, each production process is evaluated and the risk priority number (RPN) is calculated. Processes with an RPN below 25 were targeted for change or elimination; those with very high RPNs are opportunities for risk mitigation through design changes, mistake proofing or additional assurance. The goal is better assurance with less waste.

Figure 33 depicts the use of FMEA in the PAM. It shows the three factors used to compute the RPN and the source data and tools for each.

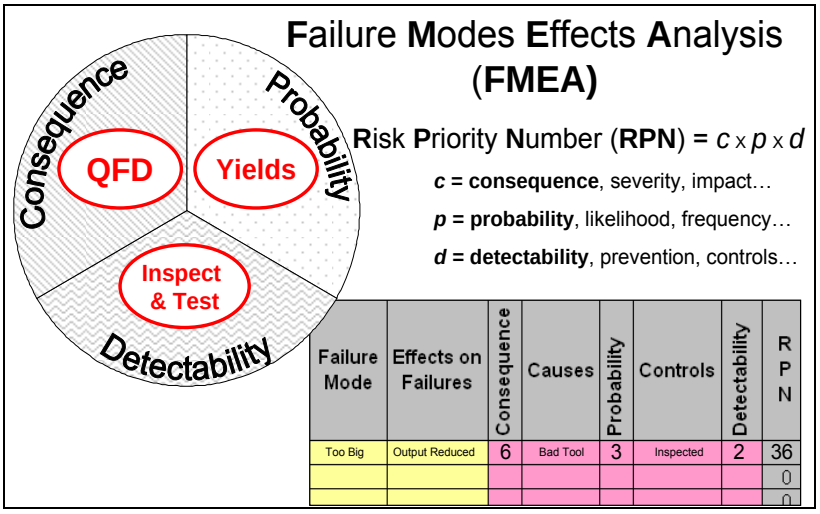
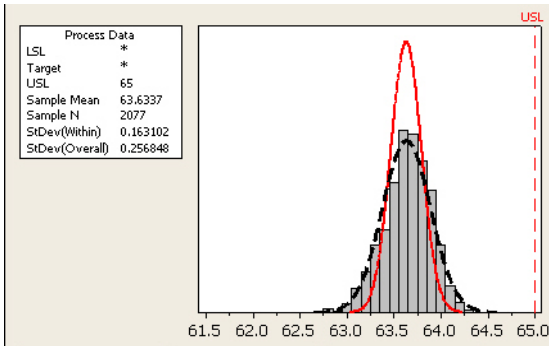


Figure 33. Product Assurance Model

Kaizen events are used to make changes, eliminate waste, and mitigate risk. Processes with a RPN below 25 are considered "just-do-its;" these were the first to be tackled. Five kaizen events have been held on production processes. The kaizen events include an in-depth study of the risk in the process, mistake proofing using the Center 2700 standard tool to mitigate risks, and the elimination of wasteful assurance activities based on data. Through the kaizen events, 66 wasteful assurance activities have been eliminated resulting in over $75K in annual savings. This will free up resources, increase capacity and facilitate greater cross-training of operations employees. In order to grow the success of PAM kaizen events, we have established standard work and checklists.

For example, a kaizen event was held on the Gage, Weigh and Measure process for the Neutron Tube. For each failure mode, the team evaluated options for reducing waste and the corresponding impact to risk. The 100% weighing of the Neutron Tube historically had 100% compliance. Using the PAM methodology, the assurance step was eliminated. The RPN increased from 7 to only 21 because the weight of the product was mistake proofed by the design, assembly fixtures, and previous incoming inspection processes. The data for this analysis is shown in Figure 34. During the kaizen event, the necessary changes were made and the step was fully eliminated. This saved 63 hours of operator time that could be redeployed to other areas through cross-training and was estimated to have avoided 38 hours of time spent in monitoring and correcting unnecessary data. This resulted in $10,000 per year in savings.



Failure Mode	Consequence	Causes	Probability	Controls	Detectability	RPN	Comments/Suggestion	Consequence	Probability	Detectability	PRPN
not the correct weight - too heavy	7	previous process error - **wrong size or density of parts** (e.g. vendor out of spec or at MMC)	1	Prior Process: Designed to be under weight; Design is mistake proofed (no single error causes failure); Sample based incoming inspection; some MMC features are checked by tooling/equipment Process Controls: 100% weigh using calibrated scale; Weight recorded in Oracle Post Process: Gross errors detected at NG weighing & center of gravity measurements	1	7	Suggestion - Stop measuring & collecting the weight of the tube. Justification - prior & post process controls should be adequate; incoming inspection would catch out of spec; no single MMC condition would cause failure (e.g. MMC frame (largest part & tolerances) would not fail the .7g margin)	7	1	3	21
not the correct weight - too heavy	7	previous process error - **too many parts** (e.g. braze washers)	1	Prior Process: Designed to be under weight; Design is mistake proofed (no single extra part would cause failure); other process inspection would detect extra parts; tube test would detect extra parts Process Controls: 100% weigh using calibrated scale; Weight recorded in Oracle Post Process: Gross errors detected at NG weighing & center of gravity measurements	1	7	Suggestion - Stop measuring & collecting the weight of the tube. Justification - prior & post process controls should be adequate; tube would not operate if additional large part, no single additional small part would cause failure (e.g. it would take X frame braze washers to fail the .7g margin)	7	1	3	21
not the correct weight - too heavy	7	previous process error - **too much added** (e.g. mounting cup or tubulation cap encapsulant)	1	Prior Process: Designed to be under weight; Design is mistake proofed (too much material would be obvious) Process Controls: 100% weigh using calibrated scale; Weight recorded in Oracle Post Process: Gross errors detected at NG weighing & center of gravity measurements	1	7	Suggestion - Stop measuring & collecting the weight of the tube. Justification - prior & post process controls should be adequate; failures would be obvious (e.g. it would take huge mound of encapsulant/epoxy to fail the .7g margin)	7	1	3	21

Figure 34. NT Weight Kaizen

Measurement Assurance Plan

The Measurement Assurance Plan (MAP) is an integral part of our Product Assurance Model. The tool, although developed outside Center 2700, embodies the principles of continuous improvement in Center 2700. Maintaining calibration and certification for measurement and test equipment creates necessary waste and can be costly. The MAP was developed by Sandia's Primary Standards Lab as a simple tool that allows users to identify important measurements, evaluate the equipment supporting those measurements, and make cost effective decisions on the extent of calibration for the equipment. The technique is introduced through a one-day course entitled "Good Measurement Practices for Staff." Forty-six Center 2700 employees have completed the course.

One of several examples of the use of MAP is the application in the Active Ceramics area, a subassembly of the Neutron Generator. The application resulted in the reduction of annual calibration costs by $55K, a 40% reduction. By looking at calibrations and measurements more scientifically, we have increased confidence in the quality of measurement results.

Data Based Decisions

Interdependent assurance means that removing an assurance process could increase risk in another area. Because of this, it is difficult to make the decision to remove wasteful processes when the ramifications are not fully understood. The PAM allows us to study the impact of these complex decisions on risk in other aspects of product performance using the FMEA. The PAM links to other Center 2700 systems such as Production Stability. For example, The FMEA is being used to analyze the proposal of removing the Vacuum Fire process for subassemblies. This could result in savings of $300K/year and reduce production stoppages. It would not be possible without the understanding provided by using the PAM.

Another example is the removal of the Dynamic Hi-pot Tester from NGSA production. This project is also an A3 problem in the Production Stability system because the tester added significant processing time to the NGSA and a major cause of stoppages. The tester was unreliable and was known to give false failures leading to unnecessary scrap. The FMEA in Figure 35 shows the risks associated with the removal of the tester before and after risk mitigation using earlier detection and mistake proofing. With the risks mitigated, the Dynamic Hi-Pot Tester was removed from production. This eliminated about 14 days per job from production span time and almost $600K/year of unnecessary scrap. In addition, the tester was scheduled to be replaced with an estimated cost of over $1M. Additional savings come from calibration and maintenance time, engineering support time, and stoppage recovery support.

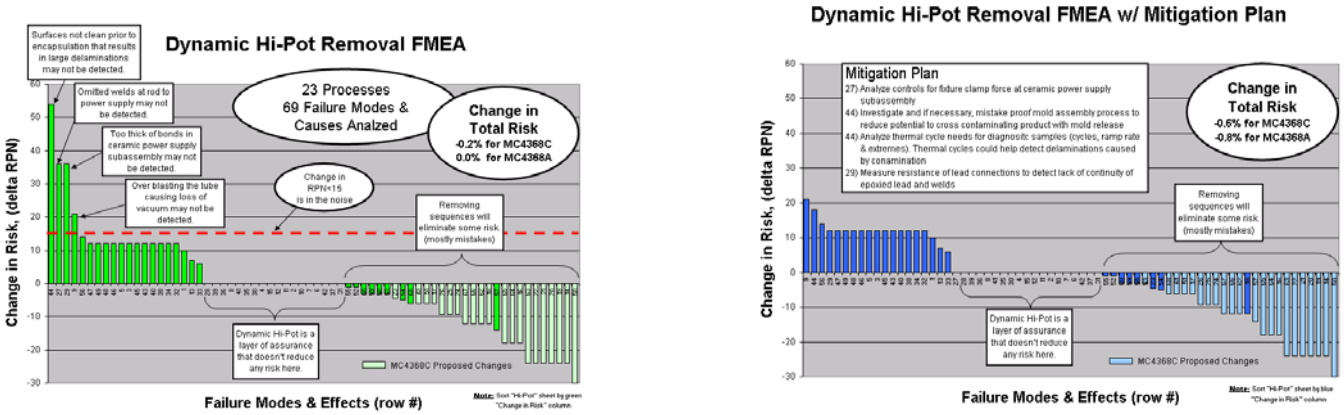


Figure 35. Dynamic Hi-Pot Removal FMEA

Production Stability

Production instability hinders process flow and makes responsive production impossible. The Production Stability system is based on the principles: create flow, problem solving, and standardize. Figure 36 shows the Production Stability system and principles and how these relate to approaches, projects and tools.

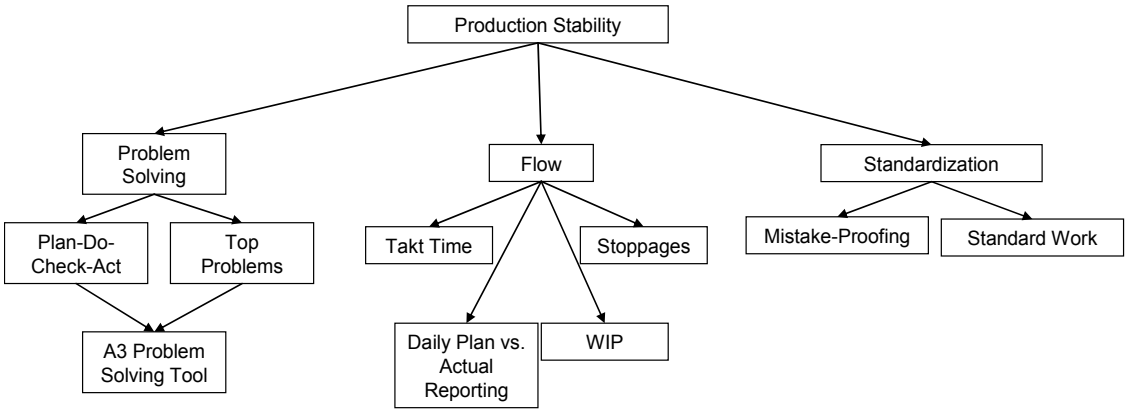


Figure 36. Production Stability Principle Based System

The approach to creating production stability is modeled after the Toyota system for problem solving that has been used for decades and is now ingrained in their culture. This approach is based on the fundamentals of Plan-Do-Check-Act and its use in a continuous cycle. The Production Stability system goal is 135 day span time for a completed job of Neutron Generator assemblies.

Our Production Stability system was initiated in May 2007 with a diagnostic phase aimed at understanding the current state and training production employees. This included observing issues on the production floor and analyzing data on yield, stoppages, and span-time. In addition, we provided on-site training on the concepts of Basic Stability. The diagnostic phase was completed in August 2007. This phase led to a better understanding of our operations, recognition of the need to improve visibility of flow, and identification of the top three problems in each of the four production shops.

The Production Stability System

The system for achieving Production Stability is depicted in Figure 37. Stoppage monitoring and tracking of daily production plan vs. actual output make flow barriers visible and provide data to the problem solving process. The ongoing Production Stability process is a repeated cycle of Plan-Do-Check-Act using A3 problem solving in pursuit of production goals.

The problem solving process uses a fishbone diagram to identify, using data and risk analysis, the production instability contributors. These issues are prioritized and turned into problem solving A3s as a way to execute Plan-Do-Check-Act for each problem. Performance is measured, the process is validated and adjusted, and the cycle is repeated continuously in pursuit of production performance goals.

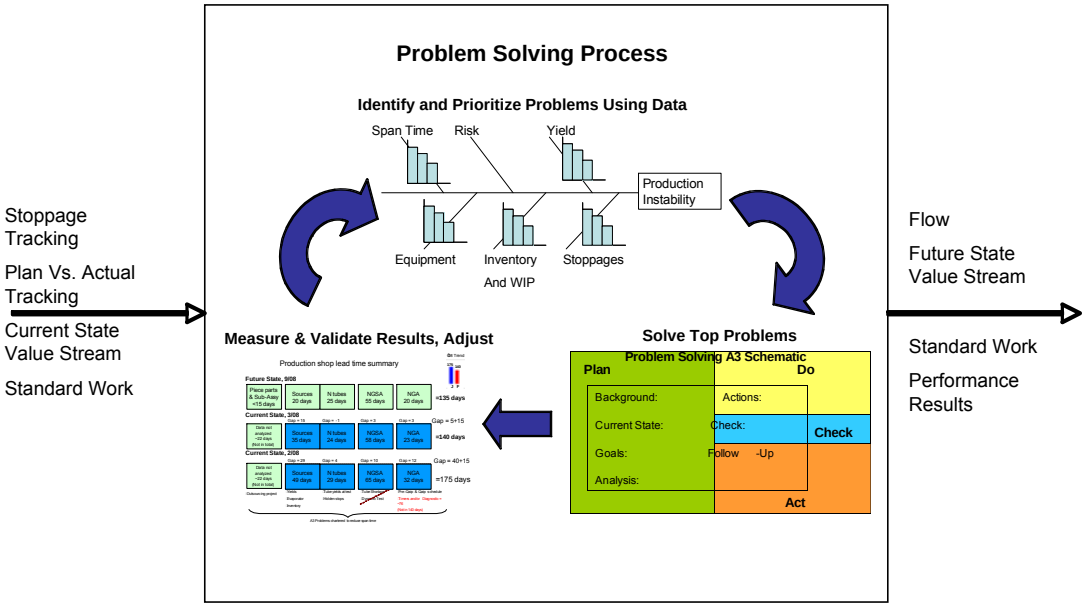


Figure 37. Production Stability Input-Process-Output Diagram

The A3s include a hierarchy to provide context for each problem being worked. The value stream level A3 shows the production goals and the top problems that need to be solved to meet the goals. This flows down into four shop level A3s that focus on the problem in a particular area. Under each of these are the specific problems currently in work. The A3 hierarchy with current copies of all of the A3s is posted on the wall for all to review and understand the current set of top problems.

The A3 problem solving format works well for focusing efforts on understanding a problem and completing accurate analysis before pursuing a solution. By describing the current state of a problem it is clear that the problem solver understands the problem and thus, can pursue root causes and eliminate them rather than temporarily reduce their impact. Mentors work with each A3 owner to help them learn problem solving skills and ensure that we do not jump to solutions without understanding root cause(s).

Production Stability Principle: Create Flow

Although each production shop had conducted value stream analyses in the past, the entire NG Production Value Stream completed a value stream analysis in September 2007. The event focused on achieving flow and pull across the four production shops using daily takt times and planned vs. actual reporting. The event also addressed inventory levels, buffers, triggers, and metrics. Figure 38 illustrates the NG Production Value Stream showing the current state in September 2007.

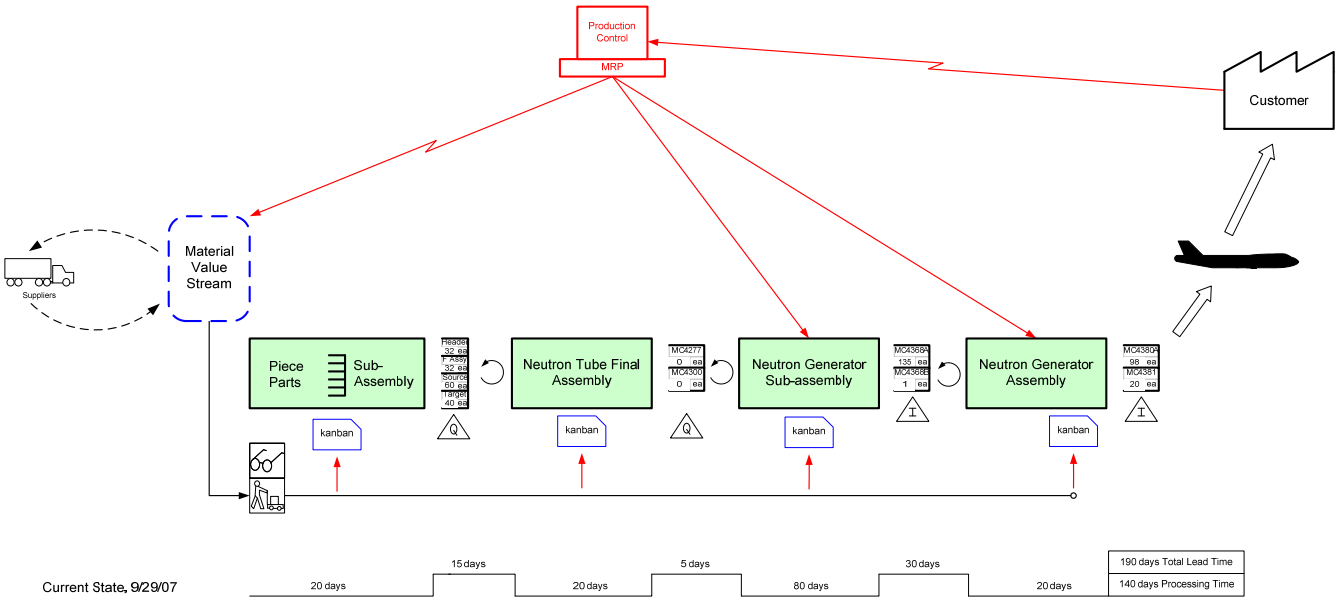


Figure 38. NG Production Value Stream Map

Seeing flow in a lab based and secure production setting is difficult because of compartmentalized vault rooms, equipment size and infrastructure, and safety requirements. We created daily boards to show the flow of product and allow staff to see where flow is impeded (see Figure 39). The boards show the daily takt time rate along with the actual completions for each operation. Pull systems have been implemented between production shops with small buffers. The quantity of Work in Progress (WIP) and buffer stock is also monitored weekly to ensure that pull is working. These numbers are summarized weekly for production management.

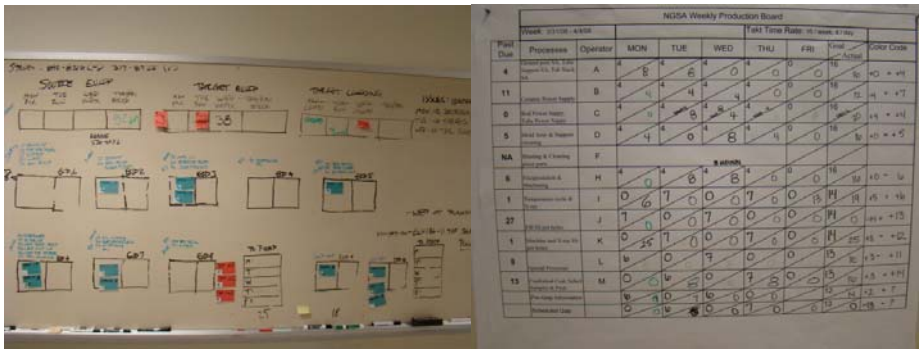


Figure 39. Production Daily Takt Time Boards

In addition, stoppages (issues that keep production goals from being met for a day) are discussed daily and recorded in a database. We developed a process to reduce the impact of stoppages. This system is designed to quickly work to resolve the stoppage and provide data to identify and prioritize top problems. We hold a daily morning meeting to discuss current stoppages and recovery plans and to focus resources for the day.

The daily boards and stoppage tracking reveal production flow problems so operators, team supervisors, and engineers are able to prioritize their work and eliminate minor problems more quickly. The emphasis has led to improvements in production span time just by helping reduce the impact of stoppages (see Figure 40).

Production Stability Principle: Using Data to Solve Problems

In the initial phase, the top three stoppages were identified for each shop. From these, the first set of 12 problems was chartered. An A3 was assigned to each manufacturing operations engineer, product engineer and team supervisor. The A3s in progress cover risk in the area of cross-training, low and variable yields, equipment downtime, process bottlenecks, and long lead time processes.

For example, an A3 problem on the downtime of the exhaust system was recently completed. By analyzing the downtime data, it became clear that 50% of the downtime was due to stock outs of a $500 replacement part called an ion gauge. The engineers established new on-hand and reorder points so that stock outs will not occur in the future and established processes with the maintenance group to replace ion gauges rather than try to fix them. The downtime in the exhaust area will be monitored for the follow up to verify that the problem has been eliminated. By using analysis, rather than jumping to solutions, the problem was resolved with a very simple fix.

Other A3s are more complicated and require experiments and data collection to understand the problem and root cause. For example, in an A3 studying low yield at subassembly brazing, the use of the five whys lead to a hypothesis that changes in fixture dimensions were causing dimensional defects in the parts. The team is now working on correlation studies to prove the cause and effect relationship and will implement mitigation strategies. Once the problem is well understood, new fixtures may be designed to fix the problem permanently.

As several A3s have been completed and others are in progress, the increased focus on problem solving and visibility of flow is already yielding results. Figure 40 shows positive results to the span time goal through the use of data analysis, problem solving tools, and the application of flow. The chart is used to show progress as well as focus attention on the critical path (displayed in the boxes), the largest gap areas, and the span time drivers in each area.

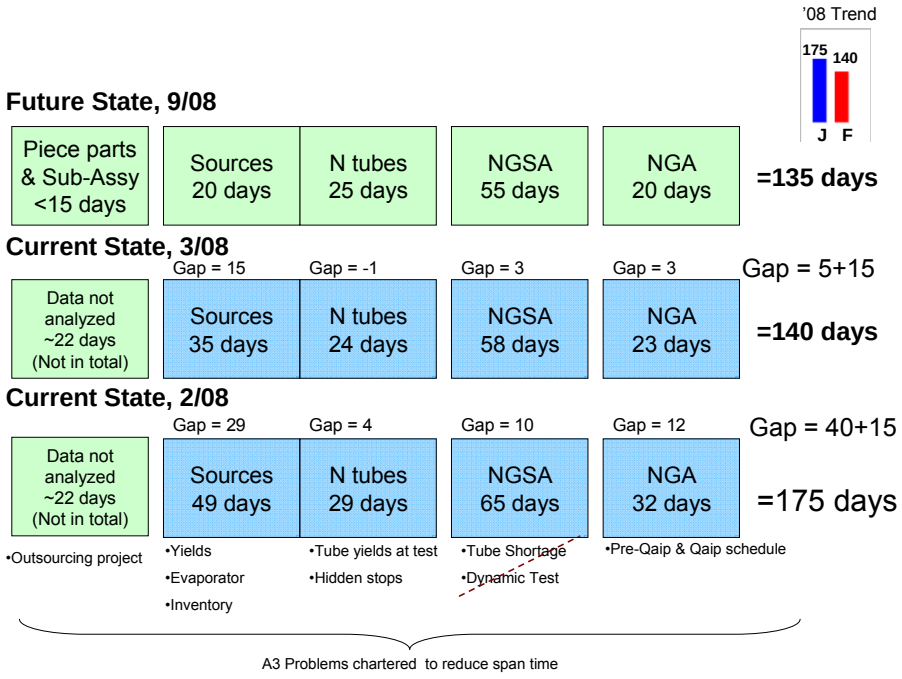


Figure 40. NG Value Stream Span Time (Current and Future)

The sustained use of the problem solving cycle will continue to improve our operations, uncover more opportunities for improvement and sustain flow and pull.

Production Stability Principle: Standardize

Controlled production processes are a foundation for production stability. Production operations are rigorously documented and controlled because of the nature of our product and the need for long term product surveillance. These controlled processes give us a base to confidently introduce process and product improvements in a controlled manner.

The second element of standardization is mistake proofing. We have developed a methodology to, as far as is practical, eliminate the causes of errors in production processes. This methodology involves operators and engineers going through a prescribed process to identify and rank error possibilities. Then a set of techniques is used to systematically eliminate, or greatly reduce, the chance of these errors occurring. The results are then documented in the controlled production procedures described above.

We use mistake proofing proactively when new products are introduced to maximize its impact. It is also used to provide sound preventive measures for high impact issues identified in the value streams. For example, in FY07, our mistake proofing methodology was used to address two significant problems. The first example is a product returned from the customer with a missing screw. Although this was a singular and rare event, it represented a serious quality concern and demanded prompt, effective action. Based on the root cause analysis, a fairly simple change to the assembly process was able to virtually eliminate the chance of recurrence.

The second example involves the elimination of the Dynamic Hi-pot tester (described in PAM). Part of the risk mitigation for the tester removal was to mistake proof an upstream process to eliminate a defect that was screened by the tester. In this case, a simple product design feature in the Neutron Tube was introduced to eliminate the possibility of that defect. Removal of the tester would not have been possible without mistake proofing.

2.2.4. Supply

The Materials Value Stream (MVS) is responsible for interactions with our commercial supply base as well as the inventory management and logistics operations in support of the production operations. The MVS is divided into two teams: Purchased Product Team (PPT) and Inventory Management and Logistics Team (IML). The PPT is a cross-functional team responsible for the management of the materials supply chain, serving as the liaison between our outside suppliers and our internal design engineers, production engineers and operations. The IML team is responsible for management of material in production stores, material movement and shop supplies management. The primary goal of the MVS is to have production material and production tooling available when it is needed by the production operation. The MVS mantra “Quality Parts, Delivered On Time, for the Lowest Cost, with Maximum Agility” exemplifies the principles by which the MVS works.

The set of tools, processes and systems used by the MVS for continuous improvement is best described in relation to the Center continuous improvement principles (see Figure 21). Table 8 shows the tools and systems for each principle.

Table 8. Continuous Improvement Principles in the Materials Value Stream

Continuous Improvement Principle	MVS System, Process, Tool
Value from the Customer Perspective	Item Definition and Order Readiness Process
Value Stream	Materials Value Stream and Supplier Quality Management System
Flow	Item Definition and Order Readiness, Receiving Work Cell
Pull	Visual Inventory Management and kanban Delivery Systems
Seek Perfection	Purchased Material Acceptance Application, Procurement Methods, Supplier Satisfaction Survey

Value from the Customer Perspective: Item Definition and Order Readiness (IDOR)

The primary focus of the item definition and order readiness process and tool is to ensure the materials procured will meet customer requirements the first time and to ensure flow of the procurement process. The item definition portion of the process is aimed at carefully defining customer requirements in released drawing definition that is manufacturable and measurable. The order readiness portion of the process ensures all elements are in place for the procurement and subsequent receipt, acceptance, and stocking. The IDOR tools contain standard work, tools, and templates on how to gather requirements from the customer and help the customer to define their needs. By helping the customer think about things that they may have otherwise overlooked, the MVS is able to provide their customers with the right product the first time.

The Materials Value Stream

Using several value stream analysis events, Green Belt projects and other Lean tools over the years, the PPT defined the supply chain management system and changed the way that Center 2700 and Sandia think about supply chain management. The MVS value stream map is shown in Figure 41 indicating the five different types of requests (yellow boxes) and the graded approach taken to supply chain management.

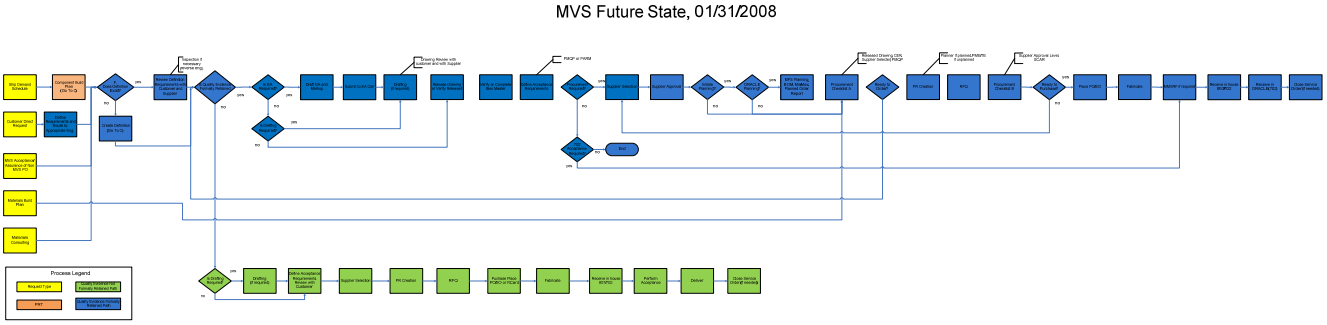


Figure 41. Material Value Stream Map from January 31, 2008

The details of the steps are documented in procedures at the NWSMU and Center level. In 2007, all product realization Centers adopted the Center 2700 procedures and modified them to become the NW Supplier Quality Management System. This system of procedures coupled with some Center level procedures defines in detail the steps of the MVS. The supplier quality management procedures are designed for mutual success of Center 2700 and its suppliers.

Figure 42 shows the high level overview of the steps included in the Supplier Quality Management System. The procedures outline requirements and best practices used for supplier quality management and include a set of tools used to consistently execute supplier management work. The procedures include standard methods such a non conformance resolution and corrective actions as well as proactive steps such as supplier selection, product and order readiness, and supplier performance monitoring.

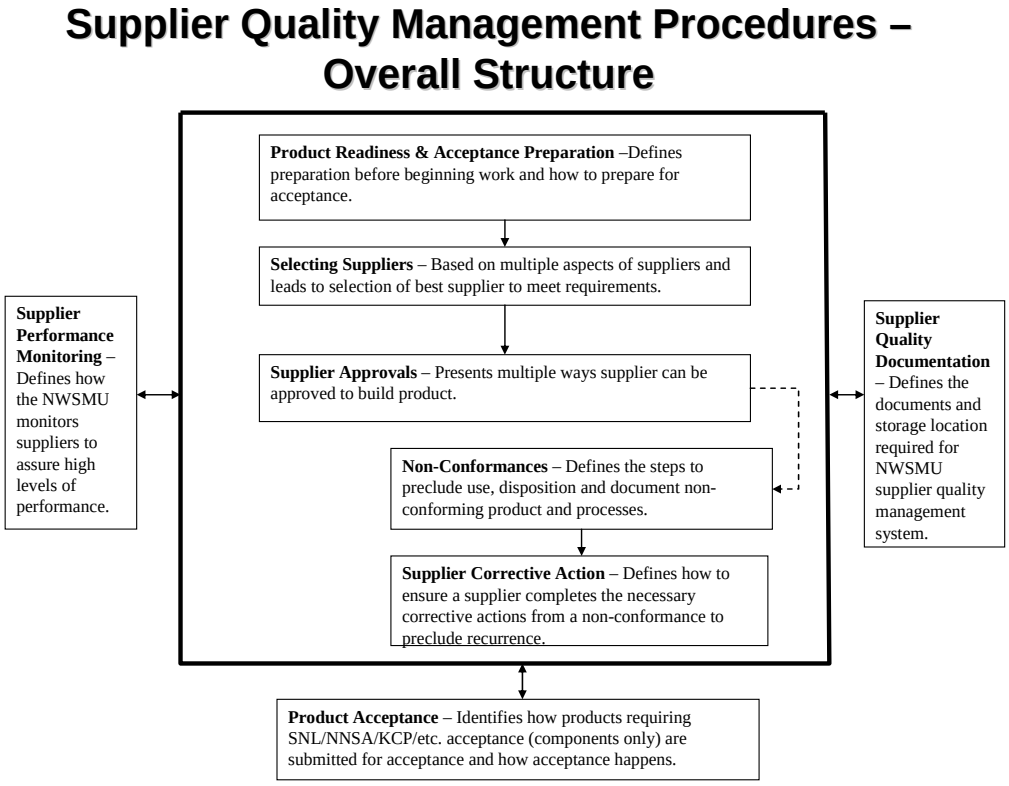


Figure 42. Supplier Quality Management Procedures Structure

Selecting Suppliers

To successfully deliver quality parts, the MVS recognizes that selecting the right suppliers and establishing and maintaining partnerships with those suppliers is a must. Suppliers are selected based on evaluation in four areas: Technical Capability, Business Management System, Quality Management System, and Resource Planning.

The greatest likelihood of a successful partnership comes from suppliers who are a good fit in all areas. Supplier selection is completed as early as possible in the design process. Whenever possible, the existing supply base is considered first for new work to enhance supplier partnerships and leverage existing relationships. The supplier infrastructure review checklist is a tool used to evaluate suppliers from multiple perspectives.

Supplier Performance Monitoring

Supplier performance monitoring includes setting clear performance expectations for suppliers, providing timely feedback with regard to quality and other performance measures, and recognizing suppliers for exceptional performance.

Supplier Performance Feedback

Suppliers are sent quarterly performance feedback on both quality and delivery performance. Through these metrics, suppliers are able to clearly understand the goals and expectations of the MVS and thus strive to achieve these goals.

These metrics are leading indicators of the performance of the MVS with respect to the production customer. To the extent that the MVS can assure quality parts on time, the amount of inventory on hand can be reduced and the risk of a stock-out is reduced. The MVS uses proactive monitoring to safeguard supplier performance issues from the production floor through the Materials Issues process. The effective execution of the materials issue process and the entire supply chain management system has resulted in only two days of stock-out for a single part in the last 18 months.

In addition to reporting data to suppliers, engineers visit supplier sites for face-to-face meetings and to help solve problems.

Supplier Conference

The annual Production Supplier Conference is one of the most important activities for renewing partnerships and communication each year. The central theme of the Production Supplier Conference is to acknowledge the efforts of our suppliers in providing exceptional quality and delivery performance for the year. At the conference, suppliers are given a greater understanding of the challenges associated to the production of weapons components. The conferences have also served to share our Lean journey and to educate our supply base in Lean. The 2007 conference, themed "Exceptional Service in the National Interest," featured presentations on responsiveness within Center 2700 and a Sandia Expo that allowed suppliers to talk one-on-one with the various production groups, to help suppliers learn about the larger Sandia community, and to grow their business.

Flow: Purchased Product

The flow of product orders is primarily managed by the IDOR process and tool discussed earlier. This includes defining acceptance requirements so that they can be communicated to the supplier, ensuring documentation is released, and ensuring the inventory system is ready to accept the product. The process is executed by using the IDOR tool that tracks items through the process thus ensuring that no items are missed.

Once material arrives at Sandia, the incoming receiving and acceptance process is handled by a single piece flow transactional work cell. This work cell was designed during a kaizen event in August 2006. The area has two identical stations that can process material lots to stock without handoffs. Through the use of this work cell, capacity increased to allow the cell to process 25% more lots per week. The work cell eliminated 17 hand offs and reduced processing time from 5.3 to 3.5 days.

Pull: Visual Inventory Management and Kanban Delivery System

The IML team uses visual inventory management for shop supply items (i.e. gloves, goggles) that don't require detailed inventory tracking. The material handlers and administrative personnel developed the process themselves through Green Belt projects. These employees took ownership of the problems to make sure the production customer received the needed materials just-in-time. Minimum and maximum quantities were determined based on use and supplier lead-time. The storage area was arranged accordingly so that the purchaser could easily walk through and see what needed to be ordered. For each area using shop supplies, employees created a list of the supplies and the necessary quantity to be on hand. On a set schedule, a material handler uses the check sheet to note what needs to be stocked.

For other items that need closer tracking such as chemicals, a card system is used to manage material delivery. The result of this work has required less on-hand inventory and better customer service to the production customer.

The IML uses the Oracle system to manage the rest of material deliveries. Requests come through automated notifications to material handlers. The IML has leveraged the use of their standard system to improve service to production customers. The surveillance program called Shelf Life maintains a separate inventory. The previous process was highly people dependent and took a week to get product delivered to the floor often holding up the testing and other work being processed through the test area. When the IML team took over the management of the shelf life material and integrated it into the standard material handling process, deliveries now occur within the day requested, virtually eliminating material stock outs.

Waste Elimination and Seeking Perfection

Inspection Waste Reduction

The MVS is relentless in the elimination of inspection waste. From 2002 to 2007, through various efforts, the MVS has reduced inspection costs from approximately $1.6M/year to $500K/year. One of the primary tools for achieving a reduction in incoming inspection cost is the Purchased Material Acceptance Application (PMAA). PMAA is a custom web based application that applies data driven decision making to product acceptance. Using historical quality data, PMAA uses a computer algorithm to determine when inspections are necessary. Inspection reduction is done based on several parameters set by the purchased product engineers so that there is no reduction in material quality. An integrated computer system allows the concepts to be implemented efficiently and consistently across all incoming material lots. PMAA has been implemented in phases with increasing savings with each phase. The most recent phase incorporated outside inspection suppliers into the MVS process. We have formed partnerships with mechanical and chemical inspection houses allowing for the out-sourcing of many types of inspection. These accredited laboratories provide rapid turn-around, quality results, and significant cost savings. The implementation of outside chemical inspection laboratories was done through a Green Belt project. The results project 90% cost savings and 50% cycle time improvement. Figure 43 shows the overall cost reductions in all inspection costs by year.

Modifications made to PMAA allow the suppliers to log into the PMAA system and enter data directly into the acceptance system. The implementation of PMAA and inspection outsourcing has to lead to cost savings as well as cycle time savings. Lots are completed, on average, in less than 10 days compared with previous cycle times of over 8 weeks. The ability to quickly evaluate incoming material leads to the benefits of timely supplier feedback and resolution of problems without additional WIP at the supplier.

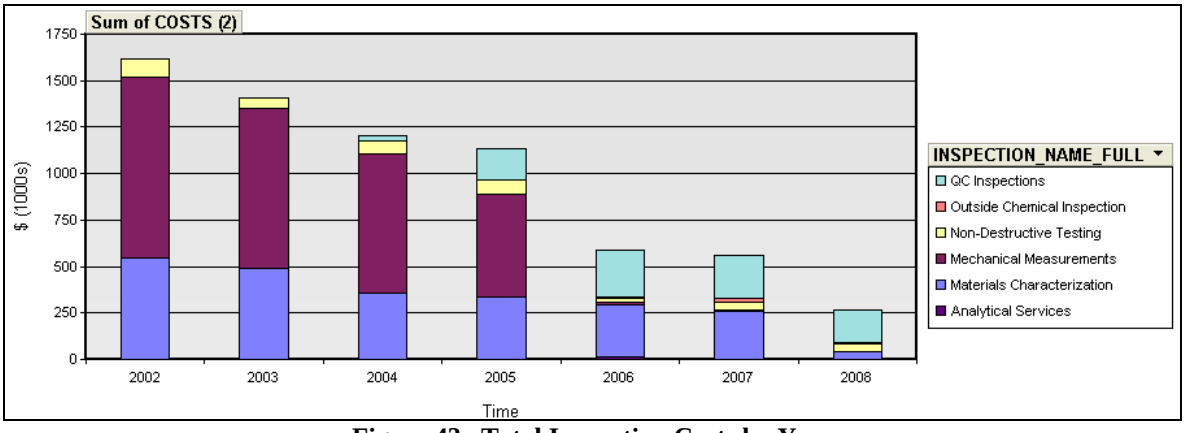


Figure 43. Total Inspection Costs by Year

Procurement

Historically, the procurement process has been to request quotes, evaluate the bidders and place contracts for each item separately. This process did not support the MVS supply chain management system, thus the MVS has partnered with Sandia Corporate procurement to explore other methods of procurement. The changes to procurement include dedicated and collocated procurement personnel, and procurement personnel taking ownership for supplier metrics. In addition, the contract purchase agreement (CPA) contracting practice has proven to be very successful for the MVS. A CPA uses a long term forecast to gather fixed price and lead time quotes for a set of products over a period of time. Because of the CPA, the request for quote process is eliminated and suppliers produce the same products repeatedly which leverages their expertise.

Since 2002, the MVS has established four contract purchase agreements with sustained results. The first two that were issued in 2002 covering over 75 parts are still in place today. The suppliers for these parts have improved their quality and delivery performance because of product knowledge and partnership with Center 2700. In addition, procurement span time reduced from over 25 days to 2 days and has been sustained at this level. The CPA makes the outsourcing of inspection feasible because of quicker contract placement and pre-negotiated lead times for each inspection type.

Supplier Satisfaction Survey

In 2006, supplier feedback was instituted to help identify continuous improvement and supplier partnering opportunities. The supplier conference is the natural venue for administering this survey. The survey asks for feedback on Sandia performance and improvement opportunities. Table 9 shows the results of the survey in 2006 and 2007 where respondents ranked statements from 1 to 5, with 5 being the best. The trends from 2006 to 2007 showed increases in supplier satisfaction from 4.17 to 4.31. The results showed that 100% of respondents were interested in building a long term partnership with Sandia and that suppliers believe that the match between supplier's capabilities and Sandia requirements has improved since 2006. Based on the data, the MVS has activities underway in the following areas: improve the readability of Quarterly Reports; increase the frequency and effectiveness of Sandia staff visits; change from requiring on-site audits to allowing ISO; ensure upfront engagement on new designs by requiring Purchased Product Engineering approval on change orders, and document process to ensure seamless changes of Sandia personnel with respect to the supplier.

Table 9. Supplier Satisfaction Survey Questions and Data

	Question	2006	2007
1	Requests for quote	4.23	4.40
2	Purchase Order (including attachments)	4.38	4.19
3	Purchased Material Quality Plan (PMQP) (e.g. certification requirements, special instructions etc.)	4.36	4.21
4	Drawings/Specifications (as a communication tool – not manufacturability of parts)	4.42	4.14
5	Supplier Corrective Action Reports	4.43	4.42
6	Quarterly Feedback reports (quality and delivery performance results)	3.75	4.41
7	Visits from SNL staff	3.55	3.93
8	Teleconferences	4.00	4.13
9	Annual Supplier Conference	4.64	4.57
10	On-site audits of quality management system	3.71	4.00
11	The partnership/relationship between SNL and your company	4.36	4.43
12	Upfront engagement on new designs and drawing changes	3.73	3.90
13	Timeliness of SNL response to your concerns (Technical, and Procurement. If scored 3 or less please explain which area)	3.92	4.20
14	Effectiveness of SNL response to your concerns	4.00	4.09
15	The value of winning an SNL supplier recognition award	4.33	4.83
16	The profitability of doing business with SNL	4.08	3.95
17	Your interest in building a long-term relationship with SNL	4.92	5.00
18	The match between SNL requirements and your capabilities	4.23	4.71
	Overall	**4.17**	**4.31**

2.2.5. Administration (Capability Maturation and Shared Services)

Transformation in the Center, to increase responsiveness and reduce cost, can only occur with the seamless integration of all functions and the application of continuous improvement principles in all activities within and between departments. The functions of the departments described in this section have not been covered in other sections of this report. Their work is vital to achieving the Center's mission of being *responsive to deterrence needs, through science-enabled product realization and stewardship of non nuclear products, today and tomorrow*. These departments are organized in two functional areas: capability maturation and shared services.

Departments in Capability Maturation:

- Applied Science and Technology Department
- Process Capability Maturation Department

Departments in Shared Services:

- Information Services and Technology Department
- Analytical Technologies Department

The Capability Maturation departments engage the customer to develop future technologies in order to be responsive. They also work on projects that increase our product understanding to minimize and/or prevent stoppages on the production floor or to answer questions about our fielded product. The Shared Services departments integrate with the product realization value streams and Capability Maturation departments to provide timely and accurate information and services to enable efficient flow in all work done in the Center.

Capability Maturation: Applied Science and Technology Department

Alignment and Integration

The Applied Science and Technology (S&T) Department conducts focused research toward discovery, integration, and preservation of the scientific knowledge supporting the design, production, and surveillance of Neutron Generators. Section 1.1 lists four "key concepts" supporting the Center's business drivers of increased responsiveness and lower costs. This department's work particularly supports the second key concept of "science-enabled product realization to further increase our product understanding, product yields, and reduce issue resolution time for production floor stoppages." The department directly supports two main customers:

- NG Production Value Stream, by identifying root causes of manufacturing and design issues and providing timely solutions, and
- Product Realization Value Stream, by engaging early with the customer to identify and mature technologies that will be required in the future.

Continuous Improvement Activities

While it is true that Lean can be thought of as the application of scientific thinking to product development and manufacturing work, we sought out methods where Lean principles could be applied to science and technology (S&T) activities. Our basic knowledge work is planned intelligently (based on alignment with the larger organization's strategic goals), resourced using data-driven processes to maximize added value, fully integrated into the larger organization, and evaluated against effective metrics.

When the Design S&T Department joined the Center in 2006 (merged with Production S&T to form new Applied S&T Department, see Figure 3), no Lean principles had been applied to their work. Since then, the department has sponsored a value stream analysis and several kaizen events to create a Lean S&T principle based system that uses the scientific method, vertical value streams for project management, and Design of Experiments to demonstrate the application of Lean in a research environment.

Figure 44 shows the S&T Value Stream Map, which directly cascades from the Center's Value Stream Map. The VSA event captured in detail the current state of the S&T Department. By interviewing staff from the department, the team gathered information on the department's current state metrics, such as resource allocation, amount of time projects remain open, and documentation. Statistics showed that on the average, people worked on 6 projects at a time, projects remained open for more than 18 months, only 63% of the projects were documented, and there existed 8 different systems where project information was stored. The underlying principle of the future state value stream map is the "scientific method" (boxes in green). Also, in this Lean S&T process, the "Knowledge Work" concepts by George Falldine (boxes in pink) presented at the Shingo Business Conference in 2006 were incorporated (this is another example where benchmarking learning has been applied to our work). During this event, standard work was also created to support the Lean S&T process. Specifically, standard work for project planning (vertical value stream) and communication (both communication within the department and with the rest of the Center) was developed to perform work in a more effective manner. The metrics that define success for the Lean S&T system include having project plans with specific deliverables and due dates along with resource allocation for all activities in the department, 100% documentation of projects in a single repository and people working on less than 3 projects at a time.

The staff supporting the S&T work is fully aware of our Strategic and Business Objectives, and knows how their work fits into the overall plan. As a result, their work consists of a balanced Portfolio of activities supporting the Center's Strategic Objectives with short, medium, and long term deliverables.

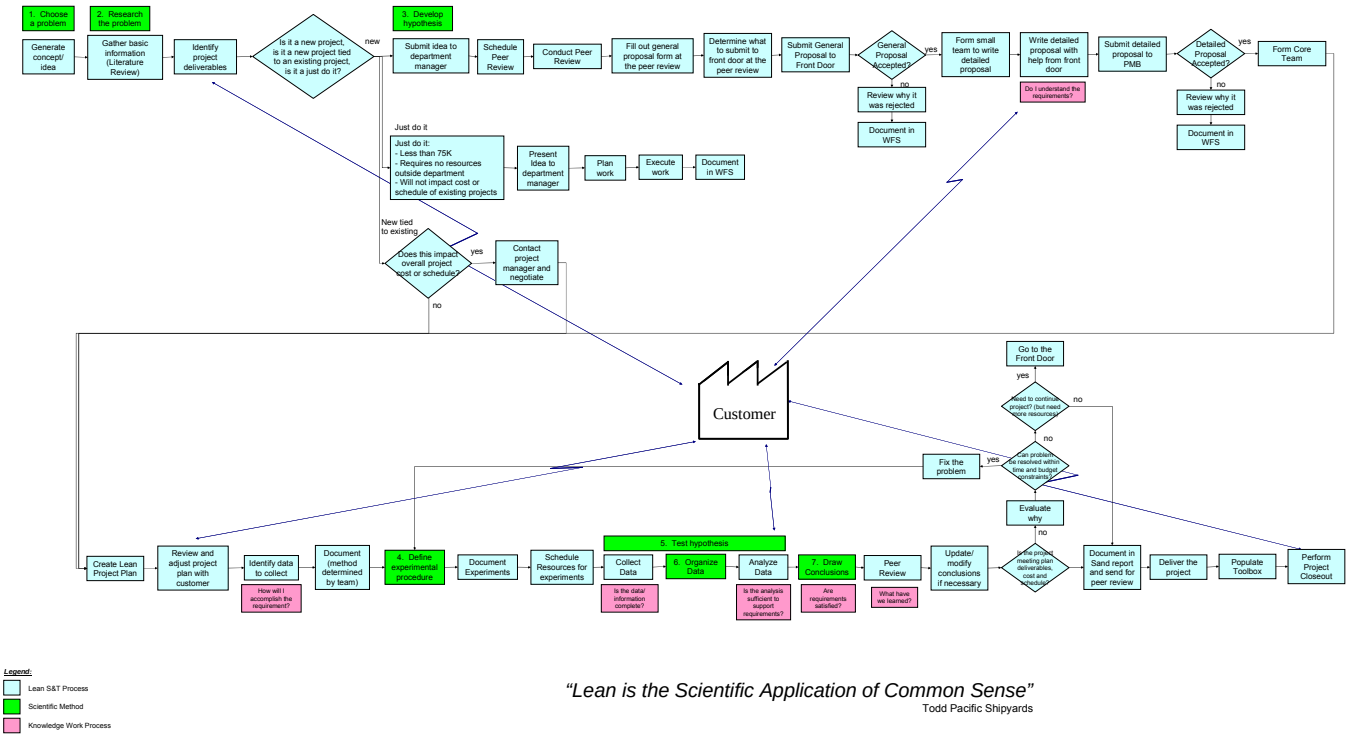


Figure 44. Applied S&T Department Value Stream Map

With the implementation of the Lean S&T process, the department has increased the focus of its work (currently working on 9 projects vs. 55 in 2006) and is using vertical value stream maps to manage projects. These plans eliminate waste that typically exists in an S&T research project such as creating too many samples and reworking samples. Today, the department uses Design of Experiments, modeling, and simulation techniques to run experiments more effectively. The VVS also incorporates

structure for project management: peer reviews are scheduled throughout the project, phase reviews are scheduled after the completion of each major phase, and people are working together toward a common goal in a collaborative type environment. The use of VVSs not only helps in planning the projects, but enables the team to identify knowledge gaps and to agree on what is important to pursue at this time and determine when good is "good enough." It has been part of the culture to never stop working on projects; however, with the use of VVSs, the team comes to an agreement on when to stop based on value to the customer and cost-benefit analyses.

The department has conducted several kaizen events that have increased productivity for the scientists and technologists in the department.

Pressure Composition Temperature (PCT) Lab Kaizen

The team conducted a 6S on the lab, arranged the equipment and storage areas for sample flow, implemented visual management for incoming and outgoing sample locations, implemented preventive maintenance schedules, improved the Primary Hazard Screening procedure, and arranged a kanban system so that the Materials Value Stream could supply the consumables for the lab. These actions resulted in improvements shown in Table 10 below.

Table 10. PCT Lab Kaizen Event Results

Metric	Before	After	Improvement
Span Time	6.7-28.3 days	5.9-14.4 days	12%-49%
6S Score	49.3%	98.7% Gold	Achieved gold status
Capacity	66 lost days per yr	0 lost days per yr	Increase of 26.4% per yr

Process Modeling Kaizen

During this event the S&T Department engaged the customers to identify and prioritize process modeling and simulation needs by the production floor, product realization, and product and process design. The prioritized list (see Table 11) is now being used by the department to assign work and to proactively deliver the 14 models identified as critical for the Center's work.

Table 11. Process Modeling and Simulation Prioritized List (section)

Rank	Title	Business Case	Persons Interested
1	Mechanical Alignment and tolerance model for whole NG and components such as the tube; Product AND Tooling; DFSS	Simplify Tooling. Reduced Operator Time. Increased reliability. Reduced scrap and rework. Increased output. Identify critical tolerances. Generator (?) real or critical requirements	Todd Haverlock, Barb Wells, Gary Pressly, Keith Vollmer, Tim Scofield, Anne Benz, Juan Elizondo, Errold Duroseau, Dan Garcia, Dan Appel,
2	Circuit Modeling for the ELNG and FENG	Reduce number of ELNG/PFN prototypes that are built. Identify component failures without changing out components. ID production failures more easily. ID source of failure on NG. Speed up failure analysis on field returns. Give design parameters for tube and NG. Help ID functional requirements. Assist with 18 month product realization cycle – supports rapid development. Characterize and select each subcomponent. Provide correct tolerancing for purchased components (buy what we need).	Barb Wells, Juan Elizondo, Errold Duroseau, Todd Haverlock, Keith Meredith, William Curtis

The department has also incorporated quarterly poster sessions for the Center. The purpose of these half day open house activities is to increase communication with the rest of the Center and share updates on the S&T projects under way and the impact that they will have in our products and processes.

Given the importance of the Center's Strategic Objective to Understand Our Products, the S&T Department formalized, in the form of a Center 2700 Guideline, the Quantitative Margins and Uncertainties (QMU) approach to research projects. QMU is a collective set of tools and methodologies to account, monitor, and analyze margins and uncertainties in the Nuclear Weapons Complex. Performance thresholds and requirements should be kept simple enough to analyze while separately accounting for the uncertainty in the actual requirement. A Confidence Ratio documents and expresses the quality of the measured data against performance thresholds, and to a large extent is formulated by the trust that those values were collected in accordance with standard QMU principles. Applying QMU principles enables accurate assessment of reliability over time, and data-driven decisions on resource allocation to potentially decrease product assurance cost and improve knowledge without sacrificing product quality. Center QMU processes are consistent with Corporate initiatives. In fact, the Center's input on QMU methodology is playing a very important role on a new set of procedures for the Nuclear Weapons Strategic Management Unit.

One of the S&T projects that used the QMU methodology saved the Center $130K/year through reduced cost of a piece part by better understanding product specifications. A change in tolerance allowed the material to get to the production floor on time and prevented a stoppage.

Capability Maturation: Process Capability Maturation Department

Alignment and Integration

The Process Capability Maturation (PCM) Department's objective is to provide support to the production floor in two ways: support stoppages when they occur, and prepare for future production needs with Lean processes and equipment. In addition, the PCM Department leads the PAM initiative described in Section 2.2.3 to reduce assurance waste and therefore Center cost.

Based on business needs (equipment obsolescence and limited recapitalization funds over the past 5 years), the PCM Department has the responsibility of developing a strategy and methodology to perform recapitalization in the Center. In the past, the approach to recapitalization typically involved purchasing equipment with the most capability. Since the beginning of our Lean journey, the Center has been deploying "right-sized" equipment that better fits our product, process, and business needs. Single purpose, right-sized equipment has resulted in elimination or reduction in setup times, freed up production floor space and reduced maintenance costs. Recent examples include small curing ovens in the NT work cell, single purpose laser welders in the NT Piece Part and Final Assembly areas, and new testers in FENG and ELNG production. These deployments were leveraged by a combination of needs that include the moves toward smaller lot sizes, cellular flow arrangements, new product introductions and replacement of obsolete equipment.

Continuous Improvement Activities

The priorities for equipment replacements are established by Value Stream Analyses and other waste elimination processes aimed at identifying opportunities to improve flow and reduce span times. The department's focus is on improving the recapitalization process. The recapitalization project team is using a new structured approach to evaluate and prioritize equipment needs on the production floor that consists of using FMEA for risk analysis and prioritization, 3P for consideration of alternatives, and Kepner-Tregoe techniques for decision analysis.

An example of the successful use of the 3P methodology was the analysis of the "Laser Serial Marker" in the NGSA production floor. This piece of equipment ranked high on the FMEA analysis. A 3P event was conducted to explore our options. Kepner-Tregoe and return on investment analyses (see Figure 45) showed that the best option for the Center was to mistake proof the current piece of equipment rather than buying a new piece of equipment. This event resulted in at least a one time savings of approximately $90K to the Center. The recapitalization approach is now being exported to other departments of the Center.

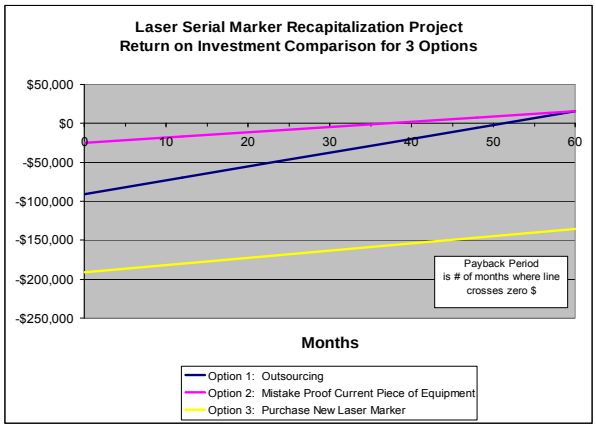


Figure 45. Laser Serial Marker Recapitalization Project ROI Results for Top 3 Options

In addition to equipment, the PCM Department is also responsible for improving the use of product and process engineering facility assets used by the Center. They ensure that the "Product and Process Development" building maintains its flexible and agile design for the Center.

The PCM Department is striving to be the model for using standard work in the Center. All of the current 13 projects in the department are managed through a VVS Map. A generic VVS format has been created that can be applied to most of the projects worked in the department. In addition, project closeout standard work is always followed to ensure proper documentation, storage of knowledge, and easy retrieval.

Shared Services: Information Services and Technology Department

Alignment and Integration

The Information Services and Technology (IS&T) Department is responsible for providing the Information Technology (IT) solutions that the Center needs to perform work efficiently and ensure proper storage, management, and retrieval of data. The department's main value is to provide lean IT services with applications that meet customer requirements. The IT&S Department uses a systems approach to integrate business needs, processes, people, and tools, to provide an effective, efficient, and superior IT experience when performing work activities.

The FY08 IS&T Department goals support the Center Strategic Objectives.

- Build a partnership with internal Sandia customers to understand their business processes. This will be achieved by proactively building relationships through techniques like face-to-face dialogue, observation, and job shadowing.
- Prioritize work to support the goal of ensuring that our customers have the right environment to do their job by implementing effective and easy-to-use processes for organizing our work.
- Expand knowledge and IT skills through training and communication.

To achieve these goals, the department was organized into smaller sub-teams that provide the following services: Small Apps, Oracle, Web, Hardware, NG Data Acquisition System, Business Objects, and Maximo, along with providing many unique applications.

Continuous Improvement Activities

The IS&T Department's approach to doing work is by applying our Lean principles to IT activities. The department has two trained Black Belts working toward certification. Some of the continuous improvement activities in the department are described below.

- Standard processes throughout the department:
  - Quality Function Deployment to gather requirements,
  - State-of-the-art software development process Rational Unified Process or RUP, and
  - Customer satisfaction surveys to continuously assess and improve performance (FY08 objectives reflect areas of improvement identified on last year's survey results).
- Department Quarterly Reviews to present highlights of work to all sub-teams, share ideas and new capabilities, apply quality standards to all areas, and communicate upcoming work.
- State-of-the-art technology to prevent obsolescence of tools and provide best experience to the users.
- Collaboration software such as e-room and SharePoint to enable communication, team work, and collaborative work environments.
- Center computing assets management (servers, desktops, laptops, thin clients, etc.) to prevent excess accumulation that increases Center cost.

An example of how the IT Department has improved productivity and quality of work in the Center (and Sandia) is the development and implementation of the Maximo IT tool for Calibration and Maintenance. A few years ago, an opportunity was identified to streamline the calibration and maintenance process in the Center since there were two systems being used, one for calibration (Bench Top) and the other for maintenance. When surveying other production areas at Sandia, it was found that each of the six groups that perform calibration and maintenance activities were using 20 different processes. Center 2700 led the effort to value stream the calibration and maintenance process across Sandia. The team created one future state map to implement. The IT Department was involved since the beginning of the project because they were going to play a big role in achieving the future state. In Center 2700 alone, there are more then 4000 pieces of equipment, justifying the need for a repeatable and reliable process. The new tool has been created and is being implemented across Sandia. Significant improvements include:

- Consistent and accurate data logging process,
- Work orders controlled by workflow,
- Easier, more accurate, and common reporting system,
- Maintenance of only one IT tool versus two,
- Elimination of discrepancy between calibration sticker information on equipment and information entered in tool,
- 25% improvement productivity for the calibration laboratories,
- Easier implementation of preventive maintenance and level loading, and
- Electronic recall system and calibration certificates.

Three other applications that were developed this year using the systems approach to software development (business needs, process, people, and IT tool) are described below.

- EDP: As described in Section 1, one of our Center Strategic Objectives is to Grow Our People. The leadership team identified a need for an Employee Development Program that identifies gaps and opportunities for career development, hiring, and succession planning. Along with a team of experts,

they developed a process to meet the objectives and the IT team was involved up front to understand the process and develop a tool that meets the process needs and that provides a user-friendly interface for both the managers and staff. The tool was delivered on time and is now in use by all staff members within Center 2700 to develop their career plans.

- Employee Recognition: This tool supports the process that the Recognition kaizen team developed for the Center by enabling real time recognition in all levels of the organization. It provides an easy-to-use interface that allows people to recognize their peers and teams, and notify them when they're recognized. In addition, it provides reporting capabilities to support the process needs of elevating recognitions to Tiers 2 and 3 as described in Section 1.

- NG Work Management System (WMS): This tool supports the new way of doing business in the Center. It provides a means for the Center to submit proposals to the Portfolio Management System when the call is made. It links each proposal to the Center Strategic Objectives and facilitates the scoring of the projects. This tool was used to create the FY07 Center 2700 Portfolio and it is currently undergoing an upgrade to support other areas of the Portfolio process. The next step is to link WMS to EDP in order to integrate resource allocation. It will also be linked to another tool called Work Activity Authorization System (WAAS) to ensure each project complies with all ESS&H requirements. In addition, it will also provide project status updates that will be used for reporting at the Tactical Management Reviews.

Shared Services: Analytical Technologies Department

Integration and Alignment

The Analytical Technologies Department (ATD) provides unique analytical laboratory capabilities and technical expertise that are required to support the Neutron Generator development and production programs and tritium materials research studies. The ATD consists of eight laboratories: Chemistry, Gas Analysis, Defect Analysis, Metallurgy and Ceramics, Particulate Contamination Control, Radiochemistry and Surface Analysis.

The work of the ATD is integrated into the deliverables of the Center to increase responsiveness to customers and achieve the Center's cost reduction efforts. The responsiveness of the ATD is critical to minimize and/or prevent stoppages on the production floor and in new product development projects. This is accomplished by engaging the analysts in problem solving activities with cross-functional teams and devising solutions to prevent them from happening again. ATD's role is to integrate with the other Value Streams to ensure uninterrupted flow of products and services.

The Analytical Technologies Department provides a full spectrum of capabilities for production, research, and development associated with tritiated materials. Routine analysis includes:

- Quantitative and qualitative metal analysis ranging from ultra trace levels to major constituents,
- Testing for gases in tubes and parts taken from production floor and facilities monitoring samples,
- Post-mortem analysis on all types of electronic Neutron Generators, explosively-tested Neutron Generators, and Neutron Tubes,
- Optical and metallographic analysis of Neutron Generators, Neutron Tubes, and production raw materials,
- Critical particulate monitoring for clean rooms and subassembly areas to identify particulate contamination issues before they become problems,

- Quantitative analysis of the radioactive constituents of samples primarily in support of Neutron Tube and Neutron Generator production, and
- Surface analysis on critical Neutron Tube materials, piece parts, and subcomponents to evaluate the level of contamination (cleanliness) of Neutron Tube components.

In addition to routine production work, ATD is involved in technical problems providing valuable on-site analysis with quick turn-around working directly with the customer. By working closely with the customers, the analysts can truly understand the problem and use their expertise to determine the appropriate analysis to solve the problem. This contribution allows for timely data for decision making and actions.

Continuous Improvement

Data from analyses are captured and reported to the customer. In addition, some data are trended to provide more information on production processes. Recently, the metallurgy lab, which tests weld samples regularly, identified a downward trend in the weld quality and penetration in the Neutron Tube closure weld. Although welds were still within specification, the lab alerted the production group to the change and the problem was investigated. A leak in the weld gas tank was found and fixed before any out of specification parts were made.

As the ATD transitions to providing a higher degree of value added services, internal customer input is required. This year, ATD conducted a voice of the customer event during which an affinity diagram was created (see Figure 46). The affinity diagram showed that the customer interface needed updating. A kaizen event was used to develop requirements for a new tool that would improve customer interface by automating and tracking: work acceptance, work prioritization and scheduling, and work progress and status.

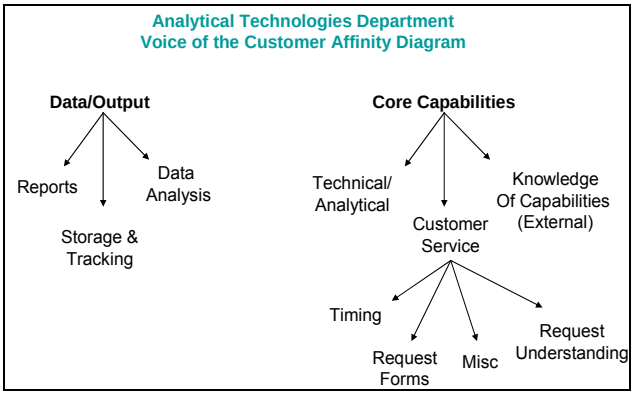


Figure 46. Affinity Diagram for Analytical Technologies Department

The quality of the information provided by ATD is critical for decision making on the production floor and capability maturation activities, hence the need to ensure that proper equipment and analysis processes are being used and improved when necessary. An example is the thin film analysis process. The chemistry lab identified the need to increase productivity and precision of the erbium analysis. The erbium (Er) thin film analysis has been preformed predominately by Atomic Absorption Spectroscopy (AAS) as a routine sample to ensure quality of the targets used in the Neutron Tube. AAS is an old technology which requires constant monitoring during flame operation, is not as sensitive as newer techniques, does not allow for drift correction, and can have matrix interference problems. One of the analysts in the chemistry lab used this opportunity to apply the Lean methodology and achieve his Green Belt certification. The goals of the project were the following:

- Develop and qualify an improved method for analyzing erbium films,
- Increase productivity through the new (faster) method, and
- Improve precision of the erbium metal analysis.

Research showed that the Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES) was the best way to perform the erbium analysis (see Figure 47).

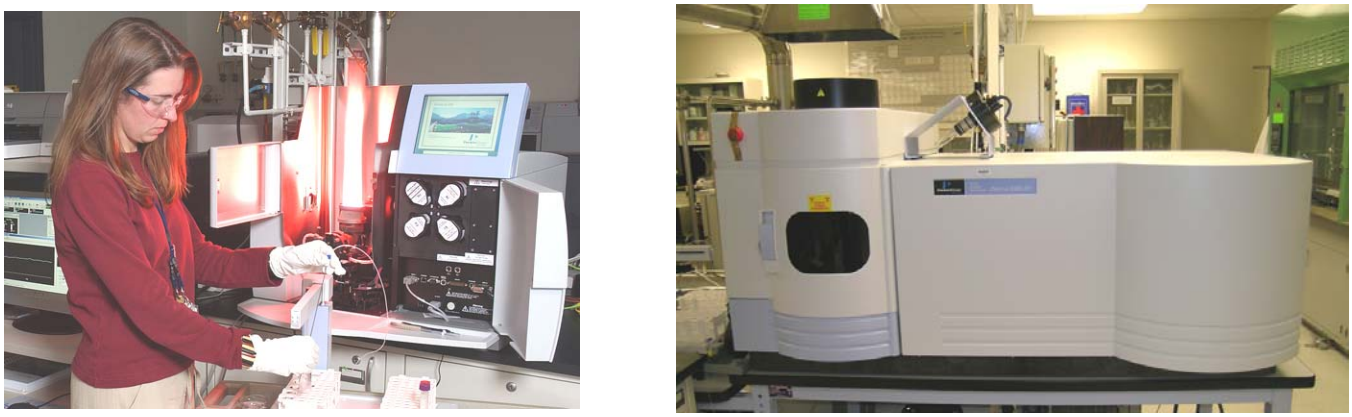


Figure 47. AAS Process (left), ICO Process (right)

This new process increased productivity and quality in the work performed by the chemistry lab (see Table 12 and Figure 48). In addition, the ICP-OES process is a safer method as there is less handling of tritium samples and no exposure to the flame.

Table 12. Process Improvement Results for Analysis of Er Targets

Metric	AAS	ICP-OES
Touch Time (4 samples)	4.5 hr	2 hr
Span Time (4 samples)	6.75 hr	4.5 hr
Total uncertainty at 3σ	1.84%	0.91%

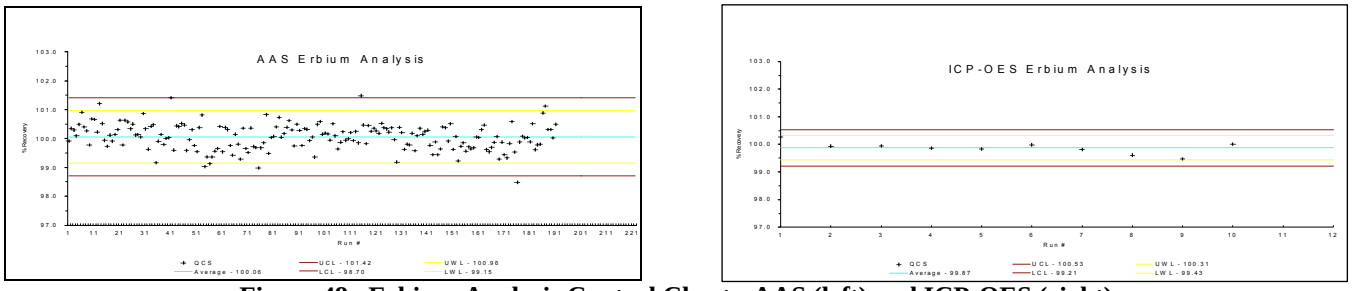


Figure 48. Erbium Analysis Control Chart: AAS (left) and ICP-OES (right)

In an effort to support the Center's responsiveness and cost reduction efforts, the ATD is focusing in right-sizing the department. To increase responsiveness and value to the Center, the ATD is cross-training the analysts. Results are starting to pay off. Last year five people were needed to support three laboratories (NT Defect Analysis, NG Defect Analysis, and Metallurgy). After implementing process

improvements and cross training, three analysts support the same three laboratories. Furthermore, the ATD now has a part time Black Belt in the department to apply continuous improvement methodology to work with a more systematic approach.

The radiochemistry lab is another example of how productivity is increased by cross-training and process improvements. Previously, one full time employee (FTE) was required to run the lab. Today, 20% of an FTE is sufficient to run the lab. This was accomplished through process improvements that included training radiological control technicians (RCTs) to initiate urgent radiological samples, and implementing a schedule for routine samples. Analysis is now performed three times a day without impacting any product flow, rather than throughout the day.

The role of the analyst is also changing as the Center transforms to become more responsive. In the past, the analyst's role was more of a contractor performing analyses for the production floor or S&T. Today, they are members of cross-functional, problem solving teams, who engage early on in product or process issues to provide a quicker solution. This new approach enables learning which is then shared with the rest of the department members at weekly department meetings.

3. Consistent Lean Enterprise Culture

3.1. Enterprise Thinking

In 2006, agreements were made to reorganize several Centers to better align and consolidate functions, making each Center more responsive and cost effective. Center 2700 took on Design S&T, NG Design, and Surveillance. These added missions resulted in Center 2700 containing the entire lifecycle of the Neutron Generators. (See new scope of Center 2700 depicted in purple box *S&T, Design, Development, Production, Surveillance* of Figure 3 in Introduction.) The leadership team agreed that to better integrate these new functions, the Center value stream analysis needed to be redone. The outside-the-box thinking during that event generated a future state map that would enable responsiveness, cost efficiency, and better customer engagement. Associated with the future state map was an action plan that required significant changes in the way the Center was performing work. The leadership team identified the need to create a cross-functional, dedicated team (Transformation Team) to implement the changes in 4 months. The results of the transformation activity were the Center Value Stream Map (see Figure 49), its associated standard work (see Enterprise Model, Figure 10), and an internal Center 2700 reorganization to better support our work (see Figure 50).

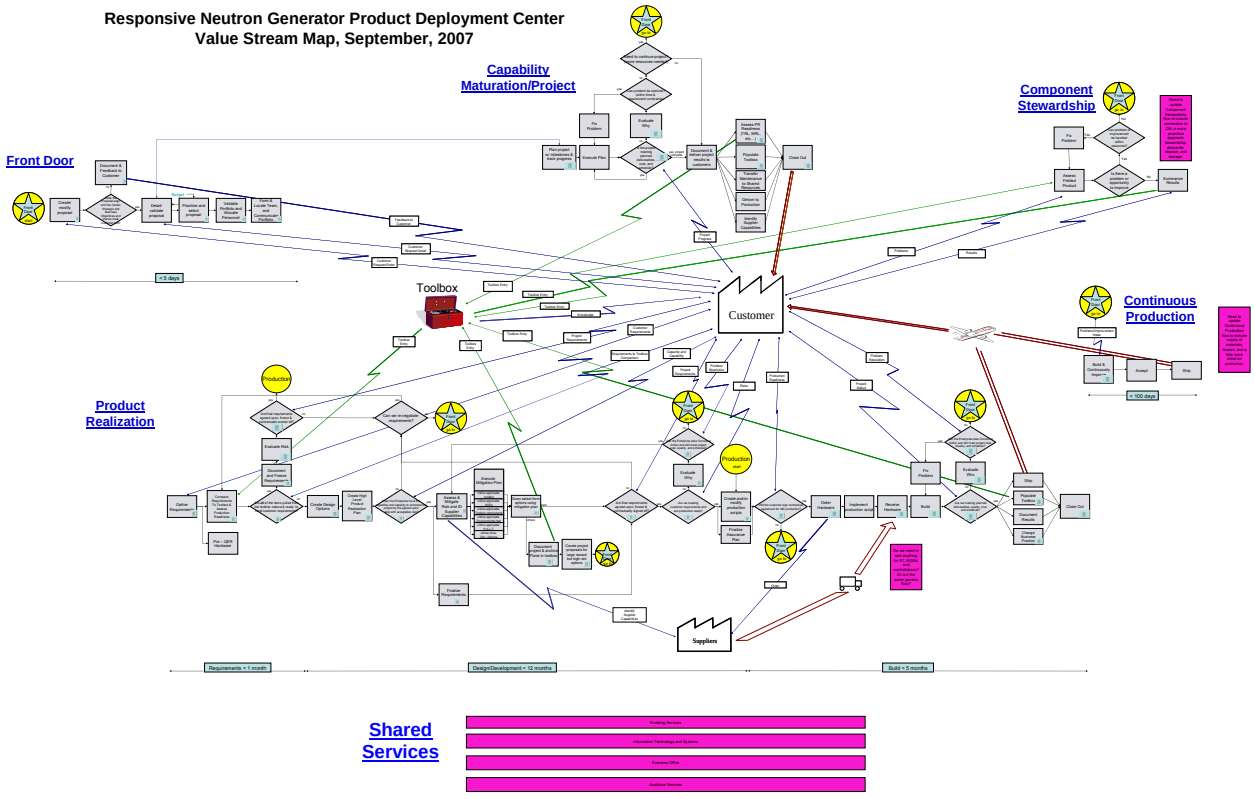


Figure 49. Center 2700 Value Stream Map

Transformation actions were implemented by February 2007. Several communication sessions took place during this timeframe to share with Center employees, customers, and partners, the new way of doing business in the Center.

The new Center-wide Value Stream Map enabled the accomplishment of our responsiveness and cost reduction goals by seamlessly integrating the entire NG lifecycle, separating capability maturation and product realization activities, performing science-enabled product realization to further increase our

product understanding, and instituting a formal process and tool for knowledge management (our Toolbox). The Center Value Stream Map better emphasizes customer engagement (as seen by the multiple lines in the map connecting to the customer) to increase value and customer satisfaction. This new Center Value Stream Map also places great importance on the evaluation of our Product Assurance Model to reduce waste (along with its associated costs) and increase quality. Furthermore, it increases the focus of work in the Center with the implementation of a Portfolio Management System that prioritizes work and reduces employee fractionation (average number of active projects per person). In summary, the transformation enabled holistic, dynamic, and closed-loop enterprise thinking:

- Holistic: NG lifecycle, from S&T, Design and Development, Production, Surveillance to Retirement.
- Dynamic: Center Value Creation Process that includes reviewing our changing environment, engaging the customer, Center Portfolio, reviewing progress/metrics to achieving Strategic Objectives at our Management Reviews, developing and listening to our employees.
- Closed-Loop: Plan-Do-Check-Act systems continually applied throughout the Center.

The Center value stream deliverables are accomplished by performing two main types of work: project work and value stream work. Both types of work adhere to our continuous improvement philosophy, as described in Section 2.1. We reorganized to better support the work and to improve the flow of products, services, and information.

Figure 50 shows the Center's organizational structure. Departments in green perform or integrate their work with Value Streams, departments in purple perform project work, and departments with both colors perform both value stream and project work.

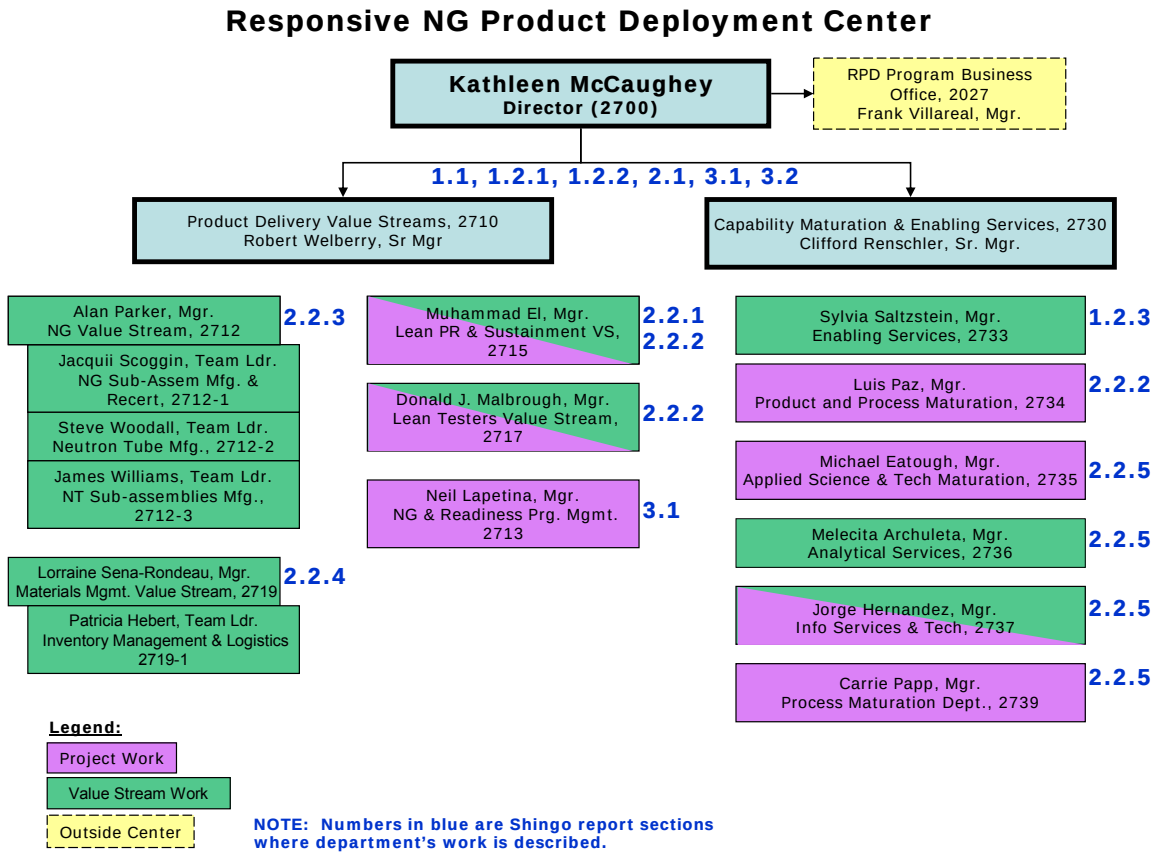


Figure 50. Center 2700 Organizational Structure

In this new organization structure we now have eleven departments.

Four Value Streams to deliver product and/or knowledge to our customers:

- Neutron Generator Production Value Stream
- Materials Value Stream
- Testers Value Stream
- Product Realization and Sustainment Value Stream

Three Shared Services departments integrated with the above Value Streams to reduce waste, improve flow of product and information, integrate safety and security in all work, and provide services to the Center to perform work more efficiently:

- Information Services and Technology Department
- Analytical Technologies Department
- Enabling Services (ESS&H) Department

Three Capability Maturation departments that deliver (to internal and external customers) new products, product knowledge, process knowledge, and create readiness for future customer requests:

- Applied Science and Technology Department
- Product and Process Capability Maturation Department
- Process Capability Maturation Department

One Program Management department (NG Readiness and Program Management) to lead the Customer Engagement and the Portfolio Management Systems.

All the departments just mentioned have been described in previous sections except for the NG Readiness and Program Management Department, called the NG Front Door, which is described below.

NG Front Door

The NG Front Door prioritizes work in the Center in support of the Portfolio Management System, manages the Customer Engagement System, owns the toolbox, and provides program management support. By working closely with our senior leadership, the NG Front Door is the mechanism to ensure holistic Enterprise Thinking in the Center by integrating and aligning all work within the Center.

Under tight schedule constraints, the team deployed the Portfolio Management and Customer Engagement Systems throughout Center 2700, and led the creation of the FY07 and FY08 Portfolios aligned to the our Strategic Objectives while meeting all Corporate requirements. The Center now has the foundation to further focus its work on improving product and process knowledge, product performance, and production efficiencies, as budget fluctuates. The Center also has a better understanding of our customer's perspectives and expectations. Through successful implementation of the Portfolio Management System, the Center can now account for all work within the NG Enterprise and show alignment with the Strategic Objectives. We improved our focus and effectiveness working on critical work, as measured by a reduction in the number of active projects being worked within the Center and by reducing the fractionation as shown in Figure 51 below. The number of projects is a watch indicator for the Center (therefore there is no goal associated with it) as it is dependent on funding and number of people in the Center. The Center prioritizes work and only funds projects with high priorities and dedicated resources in order to responsively deliver. Fractionation is a metric, and its associated goal is two projects per person at any point in time. There is no data for fractionation for 2006 but it was significantly higher than 2.3 in 2007 given that the number of projects in 2006 was 184. As a result of this new Portfolio Management System, the Center is on track to reduce its cost by 25% over a three year period (FY07-09); see Figure 72 in Section 4.

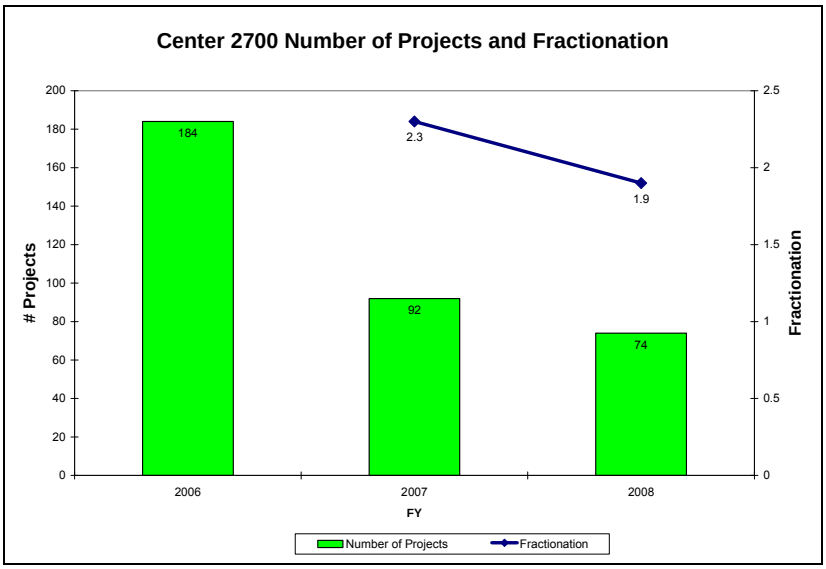


Figure 51. Center 2700 Number of Projects and Fractionation

The Center's Portfolio is accessible online (Enterprise Model). All Center employees can view funded projects, their status (cost, schedule, and performance), and their alignment with the Strategic Objectives (see Figure 52 for a section of the FY08 Center 2700 Portfolio). Portfolio project performance, schedule, and cost status are reviewed at the Tactical Management Reviews. During these reviews, any issues are worked by the leadership team in real time.

Title	Manager	Lead	Cost	Schedule	Performance	Comments/ Pathforward	SO Alignment
Ion Source and Related Tube Interactions	Eatough	Elizondo-Decanini				Project underspent. Recovery plan exists. Will give back to PMB $118K.	Know
QMU - Phase 2	Eatough	Neugebauer				Project underspent.	Know
Ferroelectric Power Supply Knowledge Capture	Eatough	Scofield					Learn

Figure 52. FY08 Center 2700 Portfolio (section)

As part of the responsibility to lead the Customer Engagement System, the Front Door Department has completed the initial round of updated customer surveys and completed the resulting corrective actions (see Figure 75, Figure 76, and Figure 77 in Section 4.6). The customer survey feedback is reviewed quarterly through the Strategic Management Reviews, where improvement actions are identified if needed. At this meeting, customer schedules are also reviewed, and closure of corrective action items is tracked.

Continuous Improvement

In October 2007, the leadership team held an event to review and adjust the Center Value Stream Map based on lessons learned during the first 9 months of implementation. Following our Center Value Creation Process (see Figure 7), the Center value stream analysis triggered lower level value stream activities in the Center that ensured integration and alignment at all levels of the organization.

The leadership team’s objective is to continue executing and improving its Value Creation Process and Center-wide Value Stream Map to ensure that all activities are integrated and contributing to the achievement of the Strategic Objectives, mission, and vision, in an effort to seek perfection.

3.2. Policy Deployment

The Center leadership team uses a formal strategic planning process developed by Alan Brache to create the Hoshin-Kanri as depicted in Figure 6. The process begins with an environmental scan of current and anticipated future customer requirements, and funding scenarios. This environmental scan was at the heart of the Center's formulation of its vision of the future and the needed transformation of the Center's work and management systems to achieve that vision. We continue to update our environmental scan on a quarterly basis as part of our Strategic Management Reviews.

The Center's Value Creation process (discussed in Section 1.1) describes how Strategic Objectives are formulated and flowed down, via a value stream analysis, to Business Objectives, and ultimately to authorized and resourced work. The Value Creation Process includes a feedback loop for periodic management reviews against metrics, and adjustment of resources as needed.

The Value Creation Process shows that Business Objectives are produced annually in support of each of the strategic directives. We then produce an A3 chart for each of the Strategic Objectives, in which the Business Objectives are listed as current year goals. Those goals are further broken down into activities, and progress toward them is tracked on a monthly basis. Space will not allow us to reproduce all five of these charts here, but the A3 for the Know Strategic Objective (Understand Our Products) is shown in Figure 53.

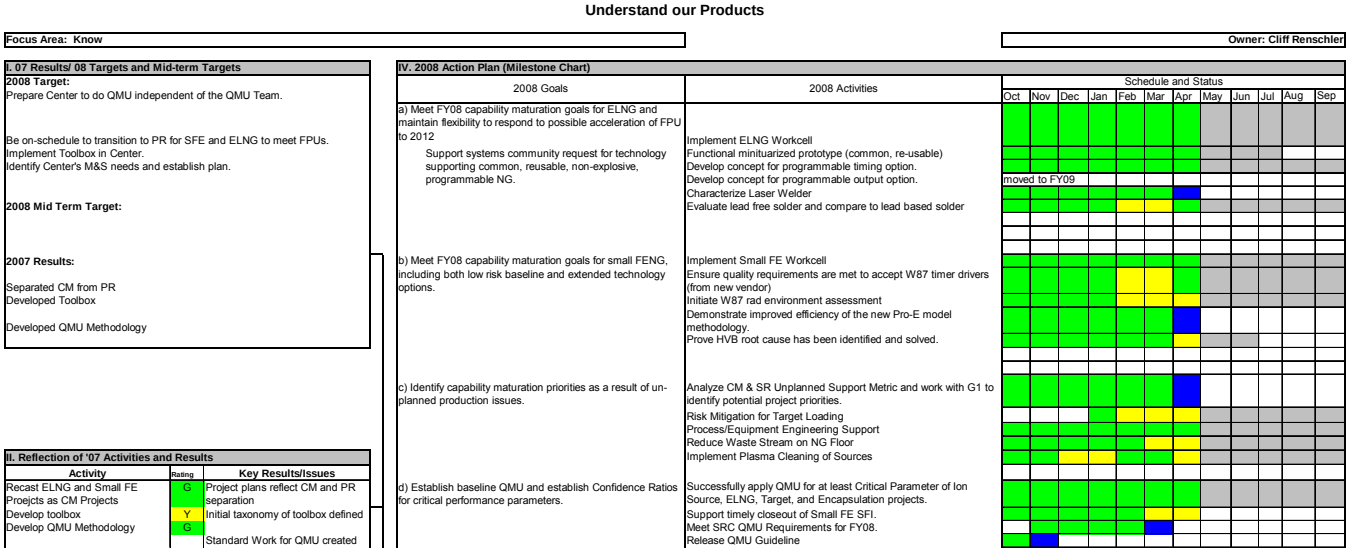


Figure 53. Know A3

One can see at a glance the status of the collection of major activities supporting the given Strategic Objective. For the one shown, the Business Objectives and supporting activities are aligned to the broad objective of obtaining and maintaining the knowledge base and technical maturity to support current and anticipated future products. Listed are specific future product technologies under development, projects to enhance fundamental understanding of subcomponents and materials that cause yield issues in current product, and broad projects to enhance our effectiveness such as increased modeling and simulation.

It is straightforward to map the Strategic Objectives shown in Figure 6 to the Center Value Stream Map (see Figure 49): Know maps to Capability Maturation; Deliver maps to Product Realization and Continuous Production; Think maps to all the activities but especially Component Stewardship; Learn to the enterprise as a whole; and Improve links to the Center Value Stream Map and to the other production Centers within Sandia.

To translate the Center Business Objectives into Center work, we created a Portfolio Management System. Several key principles were incorporated into this system to enable more cost-effective and responsive operations: transparency, focus and prioritization based on alignment with Center Business Objectives, and reduced fractionation of our intellectual capital. Work proposals are initially routed through the Front Door. During each annual cycle, the Portfolio Management System assesses all the work proposed to be done in the following year against eight dimensions of value. Scores are assigned and the work ranked from highest total value to lowest. Work is then authorized and resourced based on its value to the Center's mission and vision. Table 13 shows the scoring criteria used to assess work value. These projects are formally reviewed on at least an annual basis, and their progress is assessed by the increase in TRLs for the technology or capability being matured. That progress is captured in our capability archive, known as the Toolbox. By populating the Toolbox with evidence of enhanced capability, the Capability Maturation projects ensure that required technology is available when needed.

Table 13. Portfolio Management System Prioritization Criteria

Category	High (4)	Med-High (3)	Med-Low (2)	Low (1)	N/A (0)
Customer Satisfaction What a customer (external to the center) is willing to support	Center Deliverable; Customer eagerly awaiting it	Expecting	Will Use	Accepting but disinterested	Does not/would not care
Payback Period Monetary Savings from Project Results	Payback in Less than 1 year	Payback in 1-2 years	Payback period > 2 years	Savings not calculated/ estimated	No cost savings
Risk Reduction What risk(s) are being addressed? (Consequence & Probability)	Major impact on a high risk	Moderate impact on high risk/ High impact on moderate risk	Small impact on High risk	Addresses a low risk	No impact on a significant risk
QMU Increase margins; Reduce Uncertainties. "Change unknowns into knowns"	Will improve confidence ratio of a sensitive or critical performance parameter beyond the sufficient level	Will establish or improve margin, uncertainty, or confidence ratio of a sensitive or critical performance parameter	Will establish or improve a QMU variable for a performance parameter	Will improve margin or reduce uncertainty, but the effect is not quantified.	No QMU implications
Responsiveness Speed for Something New (18-month PR, 12-month SFI resolution, 100-day Span Time)	Major advance in demonstrating ability to meet timelines	Moderate impact on demonstrating ability to meet timelines		Small impact on ability to demonstrably meet timelines	No impact or negative impact
Capability Maturation What is the current maturity level (not always TRL)	Matures a capability more than one level	Matures capability 1 full level	Matures capability to the next level	Matures capability partway to next level	Matures no capabilities
Meeting Schedules Hardware, Documents, QER, FPU, Data; customer visible	Schedule will not be met if this project is not successful	Schedule will be difficult to meet if this project is not successful		small impact on meeting schedule	This project does not affect a delivery to a customer
Product Quality How does this project improve/maintain the quality of the products we deliver?	Addresses an urgent & significant quality issue by a large quantitative amount	Addresses a known quality issue by a quantitative amount (e.g. mistakeproofing)		Small or unquantified impact on known product quality issue	No known impact on Product Quality

The output of the Portfolio Management System is the Center's authorized work. We use Sandia's performance management system to formalize alignment of Center work with individual work objectives for every employee.

The Center Value Creation Process shows a regular review of metrics that are intended to track the progress of our work, and to highlight areas of concern early enough for the leadership team to take effective action when needed. The Center tracks metrics against all our work, supporting all five Strategic Objectives. Metrics are maintained at the Strategic and Tactical Management Reviews, and in the case of Deliver (manufacturing operations) at the weekly operational meetings. Section 4 discusses each of these in more detail.

4. Business Results

In its search for perfection, Center 2700 has always been a data driven organization that uses metrics to assess the health of the business, analyze performance, make decisions, and take actions (Plan-Do-Check-Act) to accomplish goals. In the past, the Center used metrics to measure many activities at a tactical and operational level without alignment and integration. Since we started using the Hoshin-Kanri Strategy policy deployment system, metrics alignment has significantly improved. In March 2007, the Center held a kaizen event to review all of its metrics, determine which were value-added, and identify gaps. During this event, we aligned metrics to our Strategic Objectives (see Table 14) and Management Reviews by structuring them in three levels: Strategic (True North), Tactical, and Operation. These metrics are transparent to the organization and communicate the progress we are making toward achieving the Strategic Objectives. Besides reviewing these metrics at management reviews, they are posted in the main hallway of our building as well as on the Enterprise Model webpage.

Table 14. Center 2700 Metrics Structure, Aligned to Hoshin-Kanri

Center 2700 Metrics Structure Aligned to Strategic Objectives						
Management Review	Strateic Objective	Realize Neutron Generators, Monitors & Switch Tubes Better	Grow our People	Understand our Products	Manage our Risks Cost Effectively	Create & Deploy One Production System for the Lab
	Area	DELIVER	LEARN	KNOW	THINK	IMPROVE
Strategic Management Review	Strategic True North Metrics	Development - 18 month Product Realization Span Time (4.6) Delivery - Takt Driven Inventory Levels (4.4) - 100 day Span Time (4.3) - No Stoppages (4.3)	- No Core Competency Gaps (4.1) - 50% Increase in Employee Satisfaction Focused Area (4.1)	- No shortfalls against Qualification of Margins & Uncertainty Requirements (4.6) - 100% availability of Tool Box elements when needed (4.6)	- Projects Delivered Trouble Free (3.1) - No Assurance Waste/ Cost of Quality (4.2) - Products Delivered Trouble Free (4.2)	- Responsive and Cost Effective Product Delivery System (4.6) - Enterprise Cost (4.5)
	Watch Indicators				**Customer Satisfaction (4.6)**	
Tactical Management Review	Tactical Metrics	1) NG & NT Span time (4.3) 2) Stoppages (2.2.3) 3) Inventory Turns (4.4)	1) Core Competencies Index (*) 2) Employee Satisfaction Index (*)	See projects (3.1)	1) Span time & defects for Sandia Acceptance (4.2) 2) Defects for NGSA pre-qaip (*)	See projects (3.1)
	Watch Indicators	**On-time deliveries (4.3)**			**Product Cost (4.5)** **No Injuries or incidents (4.1)** **EMS Goals (4.1)**	
		Project Status Board: Cost, Schedule, Performance & Risk, G,Y,R (3.1)				
Operational Management Review	Operational Metrics	(*) 1) Product Realization: -MC4300 & W76-1 -W76/W78 Monitors -Testers 2) Material VS: -Receipt-stock -Inventory- Total & Turns -Material delivery issues 3) AC product flow stoppages 4) Timers stoppages 4) NG product flow stoppages 5) Maint./Calib. stoppages	Training (1.2.1) Safety (1.2.3) Security (4.1)			

NOTE: Metrics with a (*) next to them indicate that they exist but are not included in this report. The intent was to show in the report the True North Metrics.

In the following sections, we will describe our **Key Metrics** (aligned with our Strategic Objectives that drive action in the Center), as well as our **Watch Indicators** (metrics that we track to make sure that with time they do not move in the wrong direction). Table 14 shows in parentheses, next to each metric, the section in this report where it is discussed. Other metrics presented in this section are included mainly to call attention to the progress we have made in our continuous improvement journey.

Note: All metrics are calculated to April 2008 and therefore don't show year-end performance.

4.1. People Development

Employee Development

Why: Ensure the Center has employees with the right competency base to succeed in the future and achieve Center Strategic Objectives.

How: Employee Development Program helps to identify the under skilled areas and provide focus for career growth developmental plans.

Goal: No Center competency gaps.

Discussion: Figure 54 summarizes the current under skilled gaps that if not addressed could lead to competency gaps. This information was used to focus Center developmental opportunities. This will be the second year using the EDP tool. The plan is to track under skilled competency gaps.

	Analyst			Engineer			ESS&H			IT/Tester			Project Ld			Reqmts			Scientist			Tech			1's	2's	3's	4's	Total
Analytical Skills		1	2	1	7	2				2	1			1	1	1	1			1	1	2	6		0	4	19	7	30
Center Fundamentals				5	7	3	1	1		6	1		1	4	9	5	2	2				6	1	3	1	24	21	11	57
High Perf Teamwork					4	3				2	1		1	7	2		2			3		1	6	2	0	2	24	8	34
Interpersonnel Comm		1			8	1				3	3			7	6	1	4					2	5	1	0	3	28	11	42
Self Management		3		1	6	2		1		1				8	1							1	2	2	0	2	21	5	28
Software Tools/Apps	1	2		3	5	2							5	5	1		3		1	1		4	8		0	14	24	3	41
Tech Documentaton	2		1		6	1				2			2	11	1	2	1		1	2		2	7	1	0	9	29	4	42
Product/Process Dev		1	2	4	11	5		1			3						5	2			2	4	3	6	0	12	26	11	49
Ops and Support	1	1	2	2	3	1		2			1							2		1			1	3	1	0	5	12	4	21
Research & Design	1	1	2																	1	4	1				0	2	5	3	10
Sustainment																										0	0	0	0	0
Simulation				1	10															6						1	16	0	0	17
ESS&H Admin																										0	0	0	0	0
Tester Hardware Dev																										0	0	0	0	0
IT Software Dev																										0	0	0	0	0
Project Planning																										0	0	0	0	0
Project Execution																										0	0	0	0	0
Supply Management																										0	0	0	0	0
	0	5	10	9	1	26	57	20	0	1	5	0	0	6	15	5	1	12	48	17	0	11	17	0	0	10	13	6	0	22	44	10	

Figure 54. Under Skilled Competency Gaps for the Center

(How to read Figure 54: 42 employees are under skilled in *Interpersonal Communication* across varying roles of Analyst, Engineer, IT/Tester, etc. Of these, 11 employees are at a Stage 3 development, and need to be at Stage 4.)

Employee Satisfaction

Why: Empowered employees increase Center responsiveness.

How: Employee survey system is used to measure specific responses in areas that drive the Center towards achieving Strategic Objectives.

Goal: 50% increase in employee satisfaction focused areas.

Discussion: Empowered employees are a key enabler for the success of the Center. Figure 55 shows responses and trends in several key areas. Employees have a better understanding of Center strategies, increase of 121 %. Employees believe they have the right skills and required resources to perform the work, increases of 16% and 61% respectively. Employees believe they are more able to do their job efficiently, increase of 101 %. Note: We redid our survey prior to the start of the FY07 year, and by doing so are only able to compare some number of questions over the last 6 years. Figure 55 shows an upward trend on all of these consistent questions.

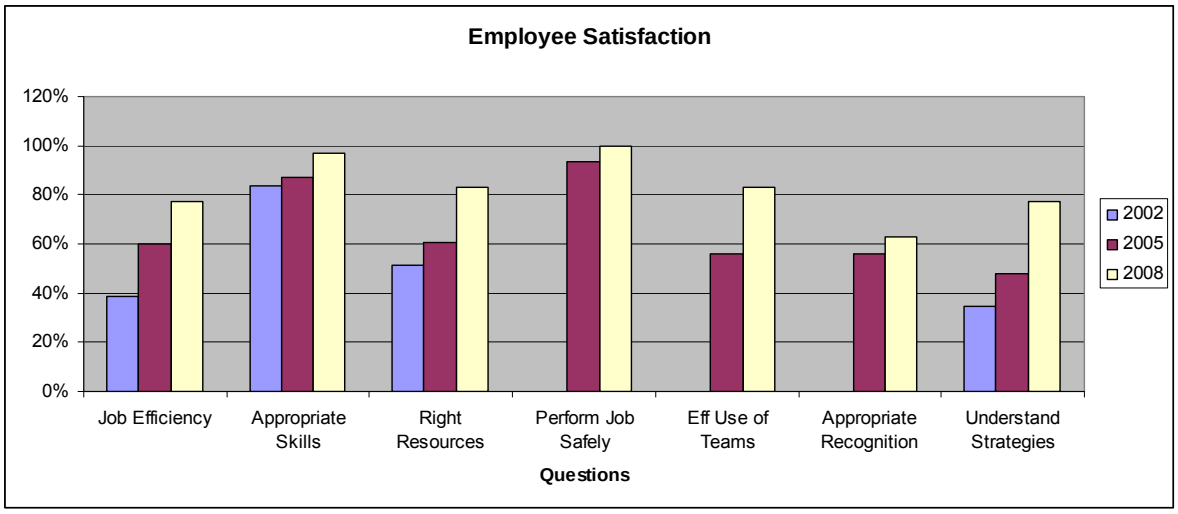


Figure 55. Employee Satisfaction Questions Trends for 6 Years

Employee Safety and Security

Why: Center leadership team strives for, and the customer expects, a safe and secure workplace.

How: ISMS integrates ESS&H into all mission work. Education and awareness and continuous improvement help us to achieve our goals.

Goal: Zero injuries and zero security incidents.

Discussion: Figure 56 shows the Recordable and Non Recordable Safety Incidents, the Days Away Case Rate, and the Total Recordable Case Rate for the past 5 years in the Center.

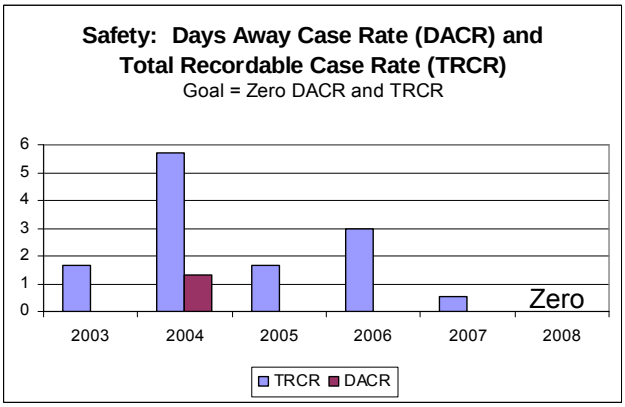


Figure 56. Recordable & Non Recordable Safety Incidents (left) and Days Away & Total Recordable Case Rates (right).

Figure 57 shows the trend in security incidents and infractions (subset of incidents that are identified as more severe) in the Center. Most of the incidents and infractions are for two main causes: bringing cell phones (prohibited articles) into technical areas and mistakes in operating Vault Type Rooms (VTRs). Actions to improve these metrics are continually being worked, such as applying BBS to cell phone behaviors and mistake proofing events to prevent recurrent VTR incidents.

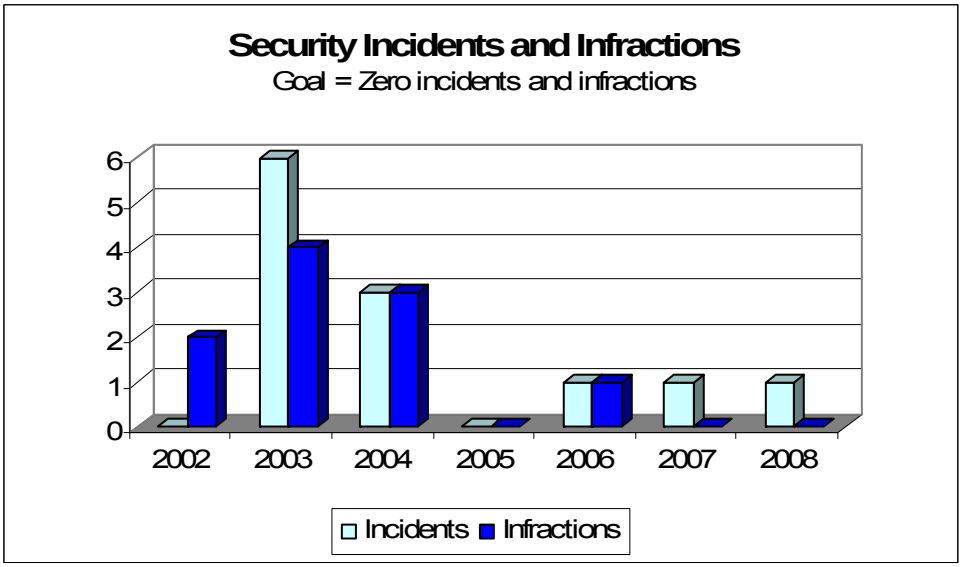


Figure 57. Security Incidents and Infractions

EMS Goals: Environmental Health

Why: The Center is respectful of the environment where we work.

How: ISMS integrates ESS&H into all mission work. Education and awareness and continuous improvement help us to achieve our goals.

Goal: The Center goal aligns with the Division and Corporate Environmental Management System goal to reduce the amount of hazardous waste generated by 10%.

Discussion: See Figure 58. The Center has achieved a 36% reduction in hazardous waste generated over 4 years. In 2005, the Division established the goal of reducing the amount of hazardous waste generated by 10%. The Center contributed to the achievement of the goal by accomplishing a reduction of 32% from 2005 to 2006, and a reduction of 5% from 2006 to 2007. In late 2006, the Center added work that increased a hazardous waste stream and we still continued to achieve an overall reduction in hazardous waste generated.

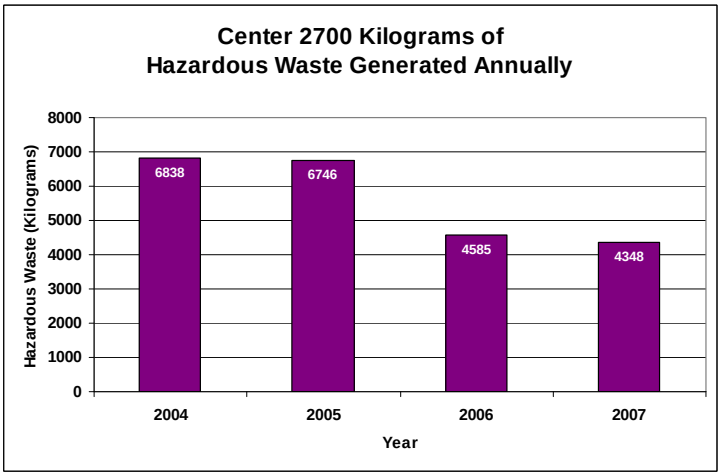


Figure 58. Kilograms of Hazardous Waste Generated Annually

4.2. Quality

Internal Results

No Assurance Waste/ Cost of Quality

Why: Ensure that we have cost effective product assurance activities that consistently deliver high quality products to our customer.

How: Monitor quality costs.

Goal: No goal at this time.

Discussion: To achieve "no product assurance waste" we have redesigned a metric to help us monitor quality costs and achieve a proper balance between appraisal and prevention costs. Figure 59 depicts information on the cost of quality. The abnormally high appraisal cost for 3rd QTR FY07 was due to the cost of qualifying the NG for a new weapon system. One positive trend is the growth of prevention related activities. This was due to the emphasis on product improvement initiatives authorized for the FY08 Portfolio. Since this metric was restarted in FY07 Quarter 3, we have not yet established goals. Our intent is to monitor this metric at management reviews and set targets at a future date to help drive improvement in achieving our goal of no product assurance waste.

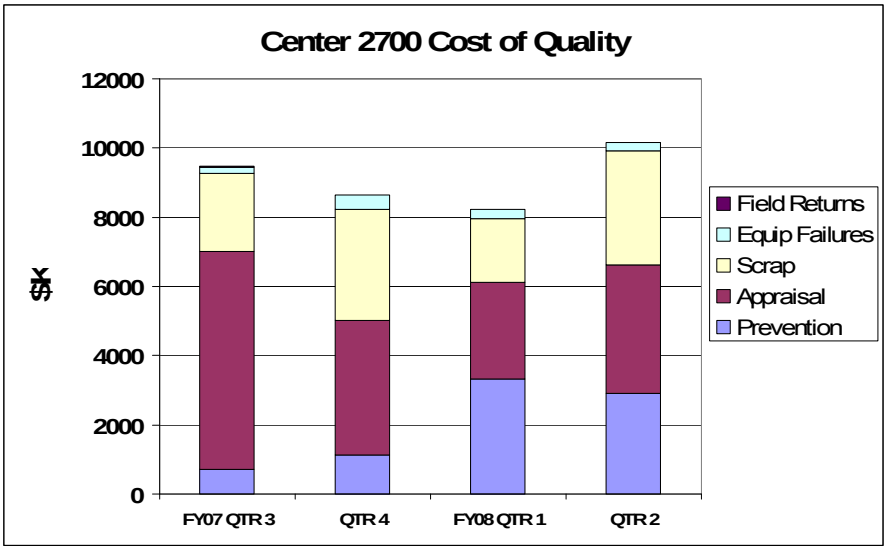


Figure 59. Cost of Quality

Yields

Why: Ensure that we have cost effective product assurance activities that consistently deliver high quality products to our customer.

How: Monitor internal product yield.

Goal: 90% minimum yield for high value components.

Discussion: Figure 60 depicts yield trends for the Neutron Generator (NG) and its three main components. As can be seen in the charts, the NG yields are maintained at a very high level. The next most costly component is the Neutron Generator Subassembly (NGSA). Significant efforts in FY06 and FY07 have eliminated some failure modes (mostly human error based) and have stabilized the yield

above 90%. The main remaining problem, accounting for 20% of the scrap, can only be addressed through a comprehensive technology development program. A project to do this is currently being planned for FY09. The next highest priority is the Neutron Tube (NT). Currently a technology development effort on the physics of the tube is underway. This effort is required to guide the process changes necessary to reduce certain types of tube failures. In addition, two Production Stability projects specifically for NT yield are in process. The Rod and Power Supply is generally maintained above the goal of 90%.

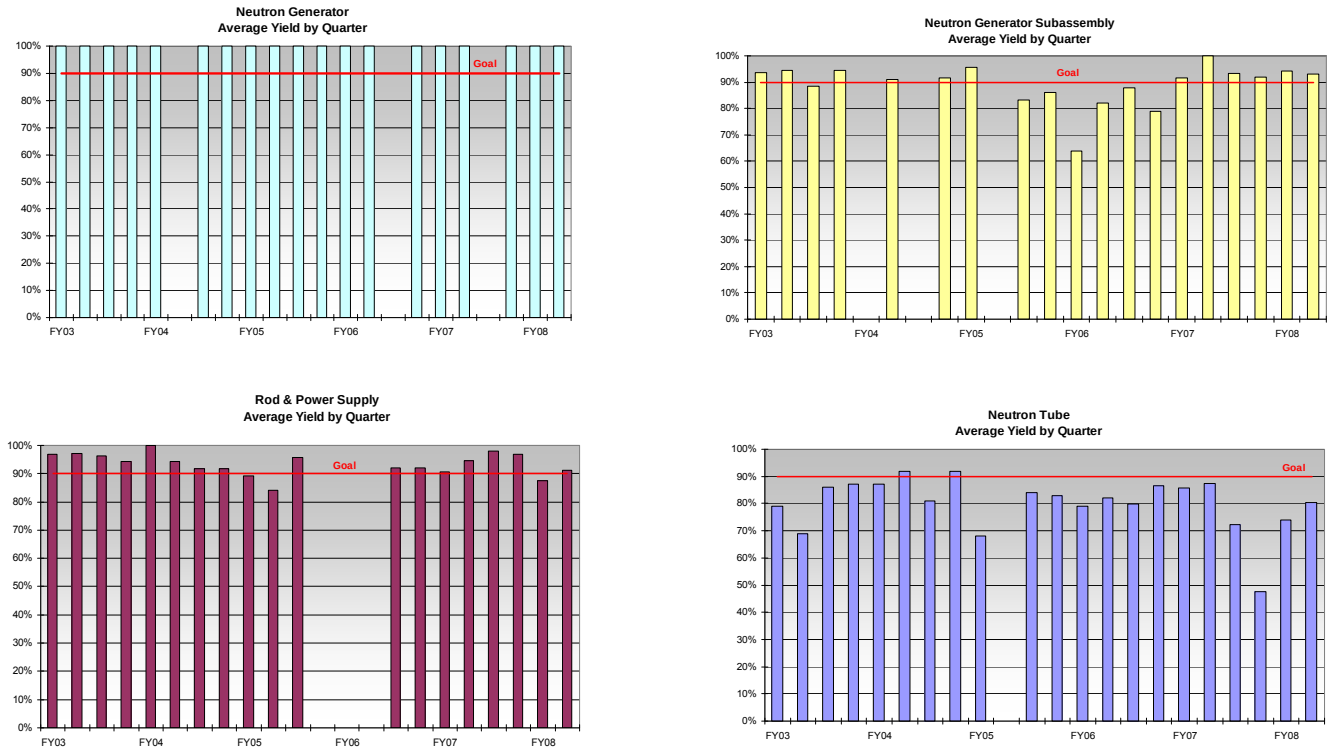


Figure 60. NG, NGSA, R&PS, and NT Yields by Quarter

External Results

First Time Sandia Acceptance

Why: Ensure that we have cost effective product assurance activities that consistently deliver high quality products to our customer.

How: Monitor first time acceptance by the customer.

Goal: 100% first time acceptance.

Discussion: Figure 61 depicts the history of product acceptance by our customer. We have had a very good record with this metric; however in 2005, we had a single lot rejected by the customer. This was due to an unexpected change in the format of the data certification package. No hardware defects were involved and the format was quickly rectified.

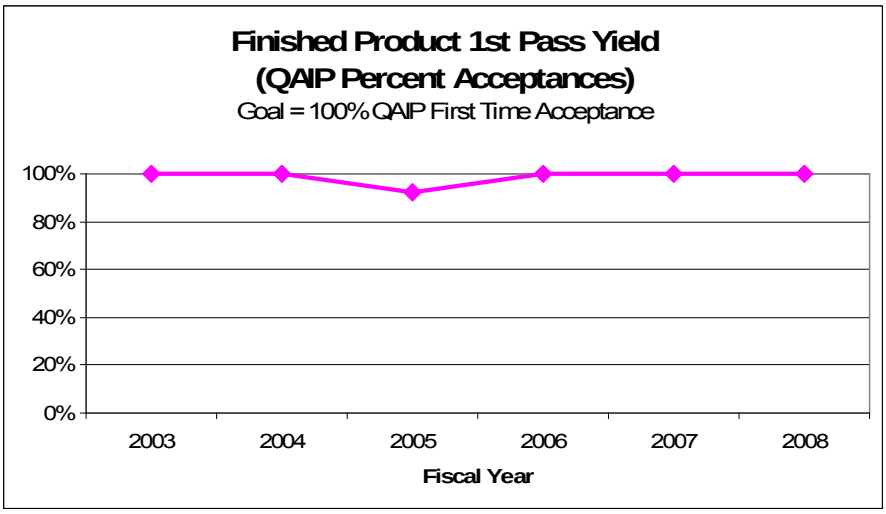


Figure 61. First Time Acceptance

Products Delivered Trouble Free: Returns from the Field

Why: Ensure that we have cost effective product assurance activities that consistently deliver high quality products to our customer.

How: Monitor products returned from the field.

Goal: Zero field returns.

Discussion: When product that has been shipped to our customer is found to be defective it is returned to Sandia. This of course is a very serious issue, given the nature of our product. Since we started delivering Neutron Generators in FY00, we have had one component returned out of 4566 shipments (219 ppm). In this case a screw (one of three) was missing from the assembly. We performed an analysis of the defect and its potential effect on reliability, conducted a root cause investigation, and implemented countermeasures to prevent the defect in the future. The analysis of the defect indicated that there was still high confidence that the Neutron Generator would have functioned normally. Figure 62 shows the percent returned items from the field by year. Note: Scale in the chart is zero to one percent.

Figure 62. Quality, Returns from the Field

4.3. Delivery

Manufacturing Span Time

Why: Ensure that our customer has a responsive source of Neutron Generators to maintain a safe, secure, and reliable nuclear deterrent.

How: Monitor production span times for our main product.

Goal: Our span time goal is to achieve 135 day span time in FY08 and 100 day span time in FY09.

Discussion: To achieve responsiveness, we have set targets to reduce the span time of our production operation. The targets are based on the total elapsed time from the issuance of raw materials to the stocking of the final product in finished goods.

The span time history for the three major components, the Neutron Tube, the Neutron Generator Subassembly, and the Neutron Generator is depicted in Figure 63. Over this period there are some notable events that have driven growth in span time and initiatives to drive it lower in an effort to improve our responsiveness. The dramatic growth in span for the NGSA in the period from FY04 thru FY06 is due to persistent problems with information flow and accuracy that were uncovered in the Product Acceptance process. Data errors found at this point in the process are very difficult to correct because of the long time between when an error occurs and when it is found. This results in an overload of Product Acceptance personnel and exceptionally long times to resolve data issues. An improvement event to analyze the sources of and types of data errors being generated was held in June 2004. The actions from this event focused on information validation at the time of generation. Production jobs started after this event have shown a 50% decrease in the time it takes to prepare for and perform Product Acceptance. Another event was held in early FY06 that identified further improvements in eliminating the source of errors through mistake proofing. Efforts to reduce errors in data continue to this day.

In June of 2006 a pull system was implemented on the NGSA floor and significant reductions in span time have taken place as a result of these changes. These efforts resulted in our nearly meeting the FY07 goal of 151 days as the cumulative sum of the span of the three main components. Further initiatives were identified in late FY07 and early FY08. These included the creation of a stoppage system (to collect data on production line stoppages), a combined NT, NGSA, and NG value stream analysis event, and the implementation of the Production Stability project. As can be seen from the graph, span times have been driven to historic lows.

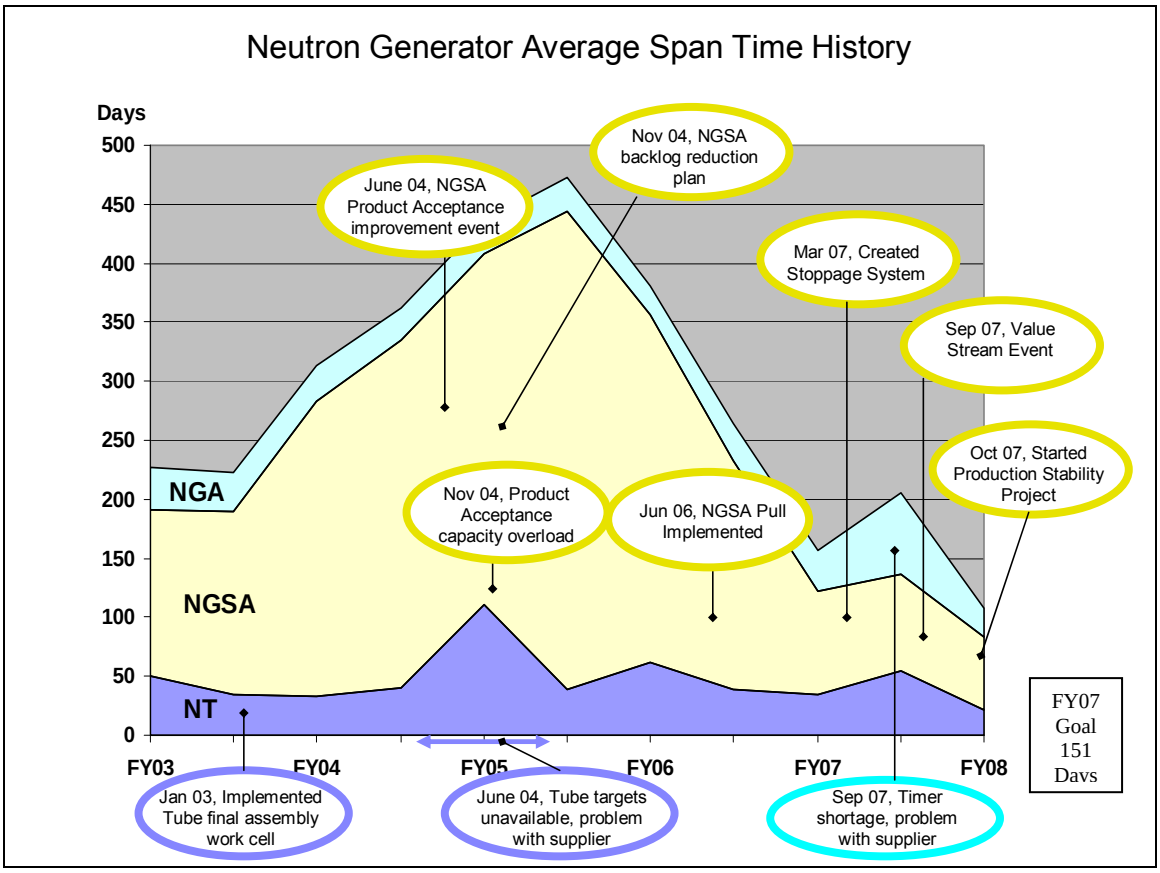


Figure 63. NG Span Time

Also starting in FY08 our span time metric was redefined. Previously span time did not include the production of piece parts and subassemblies or the time that the NT and NGSA resided in inventory. The new metric includes these additional times and the FY08 year-to-date information is presented in Figure 64. The effect of the different measuring approaches can be understood by noting the fact that the last data point of Figure 63 (first 6 months of FY08) is the same period of time covered in Figure 64. The new metric is about 80% higher than the old metric for the same time period. We believe this new approach is superior because, by including the additional process time of piece parts and subassemblies as well as inventory residence times, it is a better indicator of the overall responsiveness of the production line. It is apparent from the trend for FY08 that we are making continuous progress toward our FY08 span time goal of 135 days. Our progress is currently being hampered by the shortage of a major component that is procured thru another Center at Sandia. Significant efforts are being expended to alleviate this problem but it is likely that this situation will keep us from meeting the FY08 goal. Our plan is to drive down the span in all the other areas to position ourselves to quickly meet the span goals when this situation is resolved. Figure 64 shows our progress in driving down span time in the areas not affected by this component shortage.

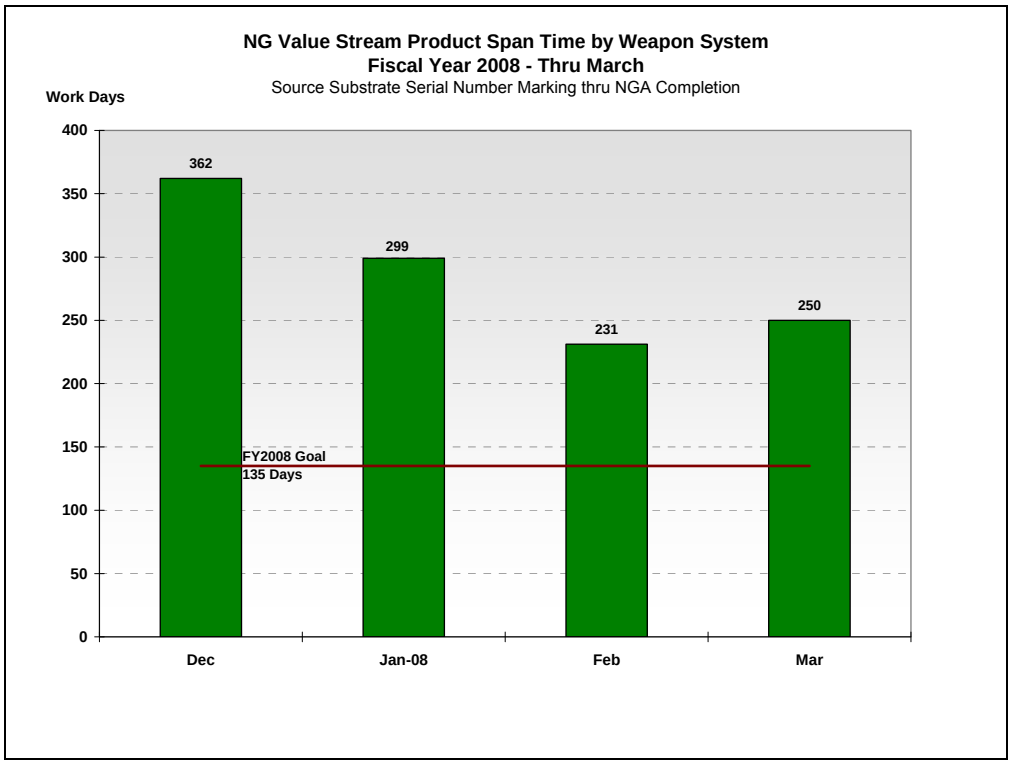


Figure 64. NG Value Stream Product Span Time FY08

No Production Floor Stoppages

Why: Ensure that our customer has a responsive source of Neutron Generators to maintain a safe, secure, and reliable nuclear deterrent.

How: Monitor production line stoppages.

Goal: Our goal for production line stoppages is zero.

Discussion: Achieving span time and delivery targets requires the rapid response to and elimination of production line stoppages. In FY07 we set up a system to record production line stoppages and set a goal for the elimination of all stoppages that last more than a single shift. Figure 65 depicts the number of these stoppages and their cumulative duration. The increasing trend in the number of stoppages is thought to be due to the learning curve on reporting stoppages in the first couple of months. It appears that increased focus on timely stoppage resolution is leading to a downward slope in the cumulative duration of stoppages, but it is too early to be sure.

While it has been beneficial to focus on quickly resolving stoppages, significant, sustainable improvement can only be accomplished through preventing stoppages and achieving stable production. Data from the causes of stoppages helps us set the stage for launching Production Stability projects.

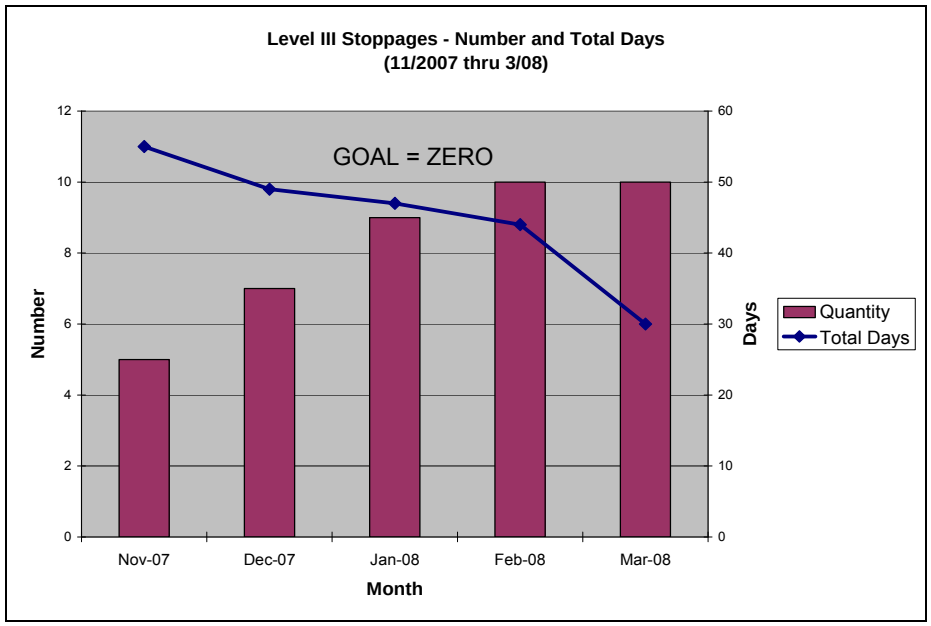


Figure 65. Stoppage Trend

On Time Deliveries

Why: Ensure that our customer has a responsive source of Neutron Generators to maintain a safe, secure, and reliable nuclear deterrent.

How: Monitor delivery performance.

Goal: Our delivery goal is 100% on time delivery of all products.

Discussion: Our customer provides a long range visibility of delivery requirements in monthly increments, and is subject to minor to moderate adjustment. To buffer these adjustments we make shipments from an inventory of finished goods. The Center has consistently delivered product on time as shown in Figure 66. We measure our delivery performance in two ways. First we look at performance to our original ship schedule and second we look at a metric based on dates renegotiated with the customer. These renegotiated dates represent situations where we may miss our original commitment but still provide our product with no adverse impact on our customer. As can be seen in Figure 66 we have generally met our original ship schedule. We missed our goal of 100% on time shipments in FY06 and FY07. These misses were primarily due to one time demands for non routine items, such as trainers. In every case, a new delivery schedule was negotiated so that there would be no impact on the customer. Therefore, our metric based on renegotiated dates is consistently 100%. There is currently an effort to gain better visibility to the non routine items in an effort to prevent this from happening. Figure 67 shows that, in FY08, there have been no misses.

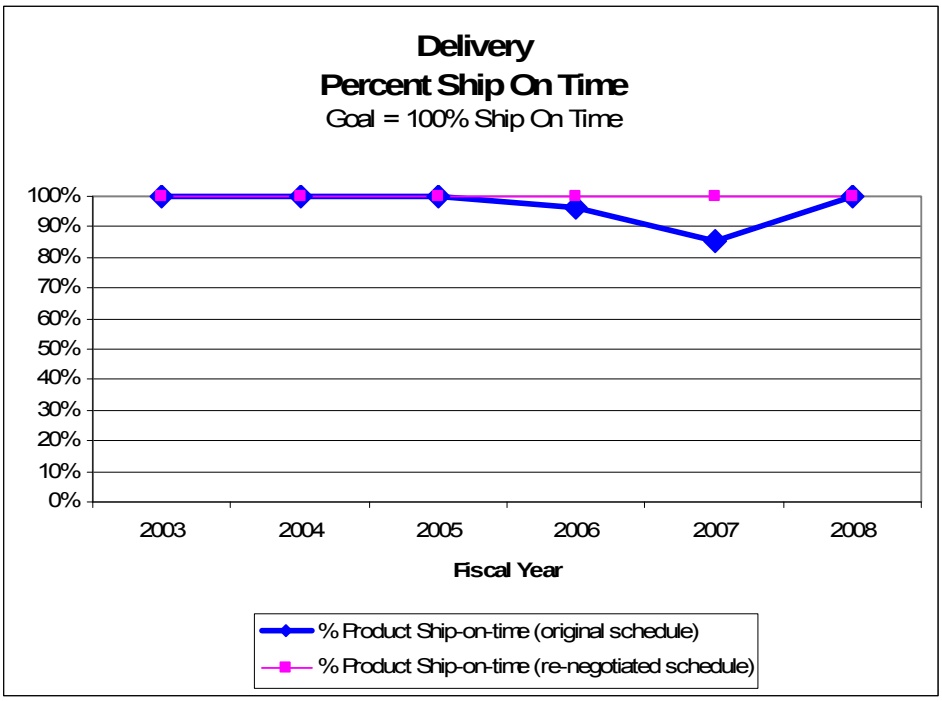


Figure 66. Delivery, Percent Ship On Time

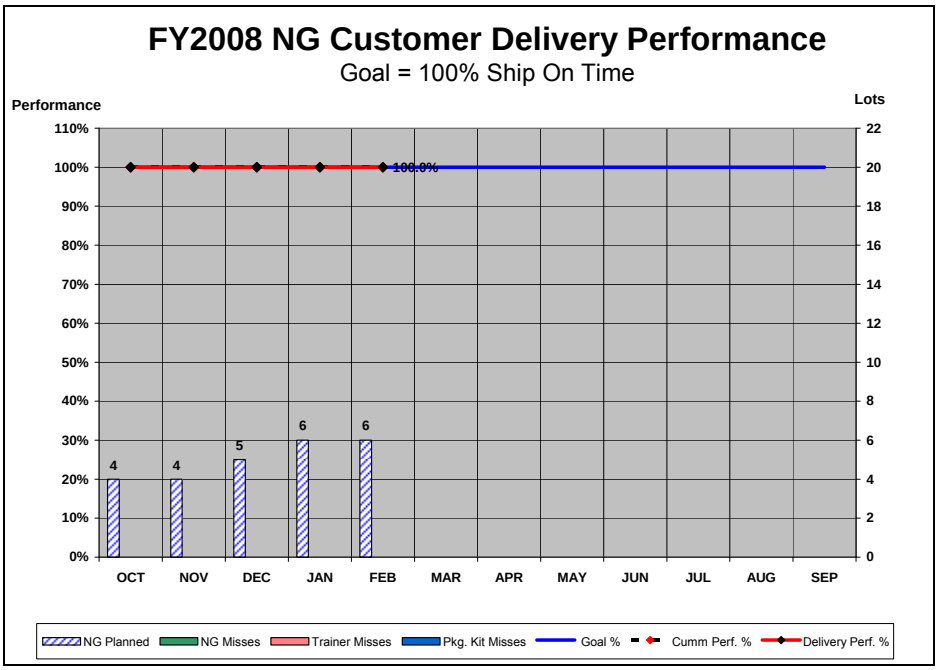


Figure 67. NG Deliveries for FY08

4.4. Cost

Finished Goods Inventory Turns

Why: Deliver products with greater responsiveness at lower costs.

How: Monitor finished goods inventory turns.

Goal: 4-6 month inventory level of finished goods.

Discussion: Figure 68 shows inventory turns for the MC4380A Neutron Generator, the main product shipped to our customer over the past 5 years. The customer expects Center 2700 to maintain a 4 to 6 month inventory of products to buffer against risk. Prior to 2005, the buffer inventory was maintained as subassemblies (NGSAs). In 2005, the strategy was changed and all inventory was moved to be ship-ready. This allows us to be more responsive to customer demand changes without excessive inventory levels. At the same time a backlog of NGSAs was building up at product acceptance (this is discussed in the span paragraph of Section 4.3). The result was a decrease in inventory turns in 2005 and 2006 as a result of these backlogs. In 2007 inventory turns returned to previous levels as these problems were resolved and the NGSAs were completed and stocked as finished goods.

In 2008 a new problem has surfaced that has caused us to revise this strategy. Because of the unavailability of another major component purchased through another Center at Sandia, we will be unable to continue with the strategy of buffering only at the finished goods level. This will cause our finished goods level to fall below the 4 month (3 turn) target in FY08 while this supply problem is resolved.

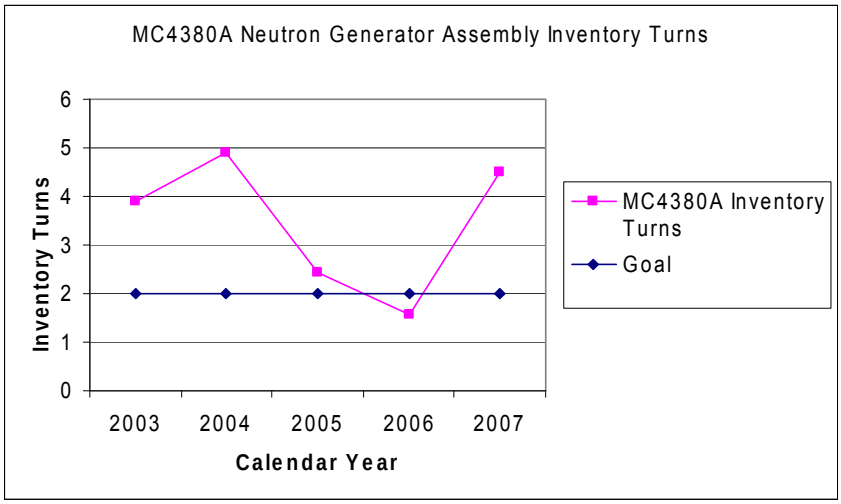


Figure 68. Finished Goods Inventory Turns

Takt Time Driven Inventory Levels

Why: Maintain adequate inventory to mitigate risk to our customer without excess inventory.

How: Monitor inventory levels of the NGSA and NT components.

Goal: Zero NGSA inventory for just-in-time delivery to finished goods; one week NT inventory for uninterrupted flow to NGSA.

Discussion: In FY08 we set new targets for the inventory levels of the two major components to the Neutron Generator, the NGSA and the NT. Figure 69 depicts our inventory history for FY08. The NGSA levels are significantly high (the FY08 plan for is component is zero). This condition is due to

the unavailability of another major component discussed above in the finished goods section. Significant efforts are underway to solve this problem, but it will be some time before it is resolved. In the meantime, we have adjusted our strategy to carry inventory at the NGSA level so to minimize the potential impact on the customer.

The second component we track is the NT. In this case we have been below our planned buffer levels. We originally started FY08 with a 2 to 3 week planned inventory level for this part. Major stoppages at the end of last year have delayed us from achieving these targets. As mentioned in section 2.2 we have been focusing on eliminating or mitigating the impact of stoppages. As we have gained confidence in our ability to deal with stoppages we decided to reduce this inventory level. In February of 2008, we changed the target to approximately one week of inventory. We are making steady progress toward that goal. Our intention is to revisit this target at the end of the FY and reduce it further to be consistent with the level of production stability we have achieved.

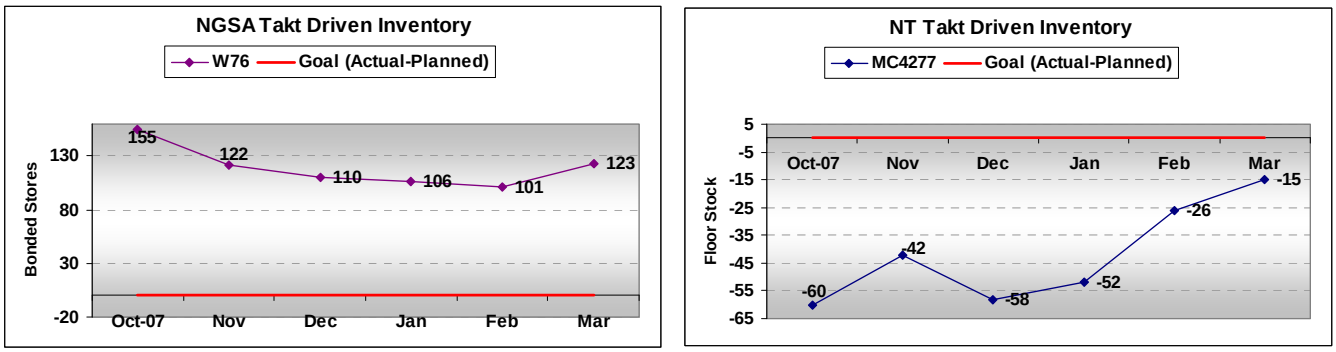


Figure 69. Inventory for Major Components

WIP

Why: Establish production stability to achieve greater responsiveness at lower costs.

How: Monitor WIP.

Goal: Minimize WIP by reducing span time and eliminating stoppages. Goal will be set in 2009.

Discussion: The WIP history, Figure 70, shows a continual reduction in WIP as Lean initiatives took effect. Overall WIP dropped to historic lows in FY08. Starting in FY07 and continuing in FY08, the main strategic focus has been on span time reduction thru production stability (mainly stoppage elimination/mitigation). Improvements in WIP are a natural result of progress in those areas since less span time directly leads to less WIP. Also, more stable production provides the confidence to reduce buffer inventories and safety stocks. We have consciously chosen to forego specific goals for WIP for FY08. We believe that by focusing on reducing span time and eliminating stoppages there is little need to establish a separate goal for WIP at this time. Our intent is to monitor this metric at management reviews. When we have achieved a greater level of production stability as evidenced by consistent span performance and reduced stoppages, we will set WIP targets to help drive further improvements in flow.

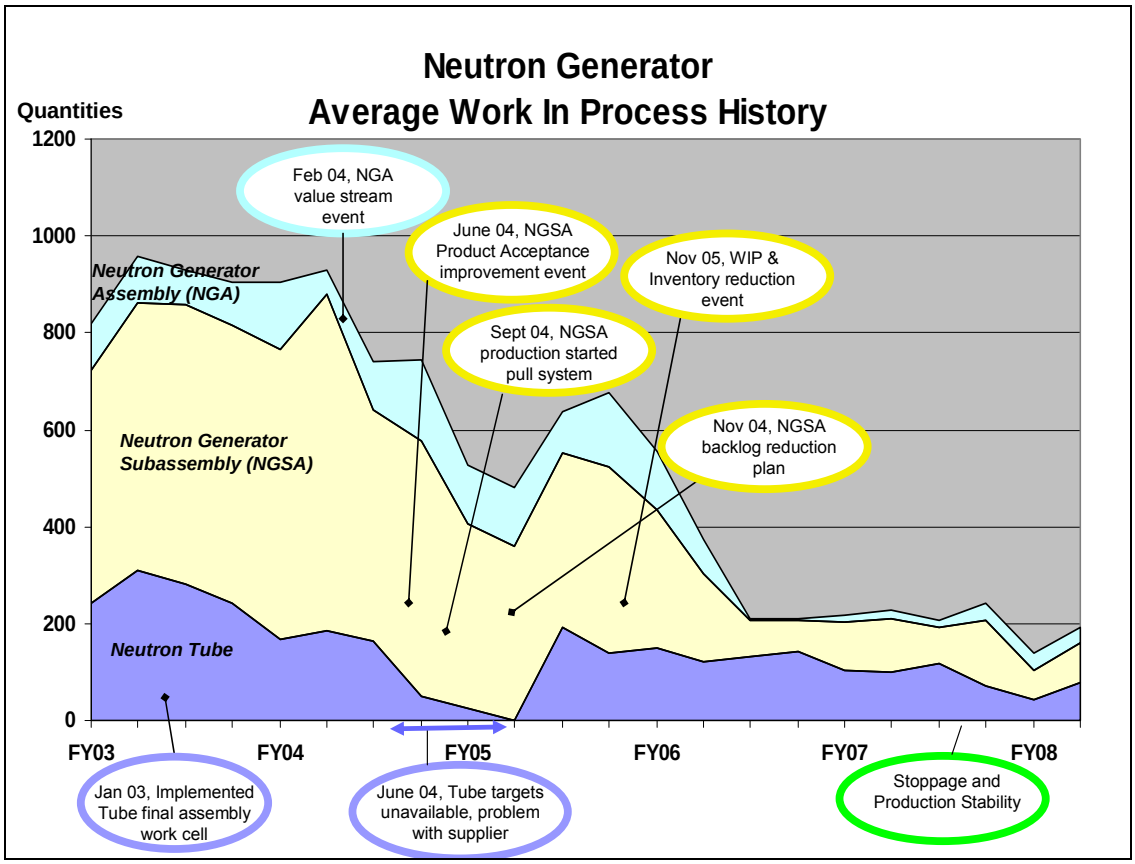


Figure 70. NG WIP History

Labor Productivity

Why: Assure cost effective and responsive product delivery.

How: Monitor labor productivity as the number of NG assemblies built per operator.

Goal: Drive labor productivity up through the elimination of production stoppages while maintaining customer required capacity. Goal will be set in 2009.

Discussion: The last 5 years of Direct Labor Productivity is depicted in Figure 71. Starting in FY04 there were significant reductions in customer demand for the product. Because of the costs of workforce realignment and the expectation of the customer that a level of capacity be maintained, the workforce was allowed to drop due to attrition only, i.e. no layoffs. In FY07 the schedule returned to the FY03 level and is expected to rise from there for the next several years, therefore some of the employee losses (but not all) were replaced in FY07. The net result is that at the end of FY07 there are approximately 28% fewer direct labor employees when compared to FY03, while the product demand returned to the FY03 level. In addition, a concerted effort was launched in 2007 to eliminate/mitigate stoppages in the production line. Our analysis of the situation indicated that stoppage elimination/mitigation would lead directly to higher employee productivity, without increased WIP. The success of this strategy can be seen by the high level of productivity in FY07 shown in Figure 71 and the historic low level of WIP in FY07 shown in Figure 70. The initial effort at stoppage elimination/mitigation has grown into the Production Stability project launched in FY08. At this time we have not set a goal for this metric. After production stability is achieved, we will set targets for this metric to drive further improvement.

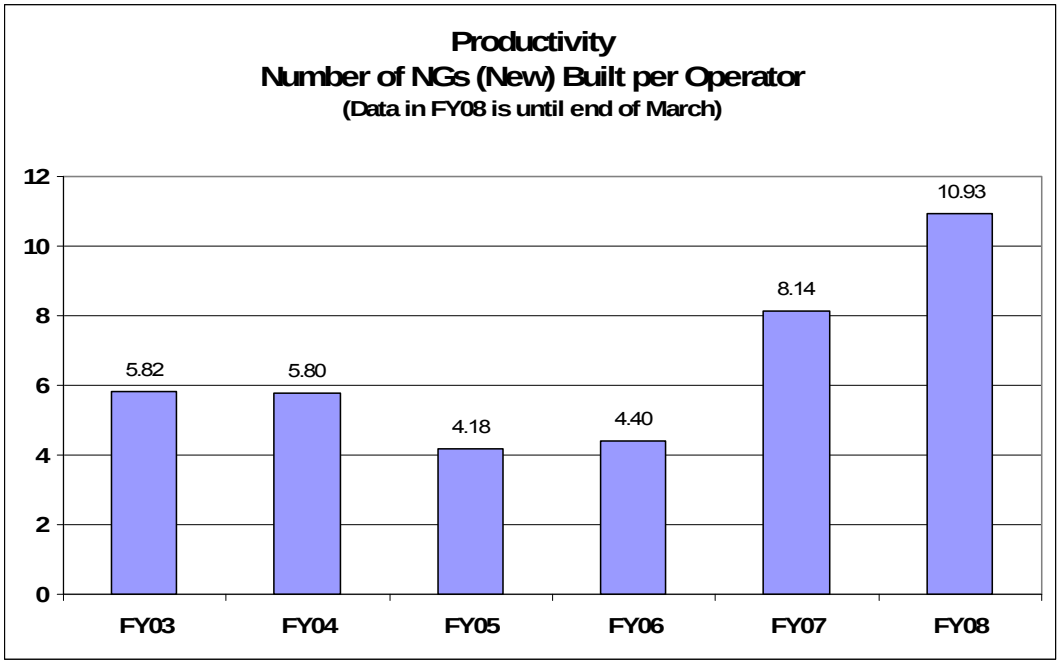


Figure 71. Productivity (Direct Labor), Number of NGs (New) Built per Operator

4.5. Financial Impact

Enterprise Cost

Why: To meet the Customer and Center Strategic Objectives to be more cost effective.

How: Hoshin-Kanri and Policy Deployment.

Goal: Reduce our enterprise cost by 25% over three years starting in FY07.

Discussion: Product Cost was originally used as a measure to determine effectiveness of continuous improvement activities. Originally this was a requirement from the customer to report and achieve annualized savings. Initially with our Lean journey, the Center was focused on yields, 6S, and other activities that didn't directly impact product cost. In FY06, when manufacturing overhead increased, we realized that our focus needed to change from product cost to enterprise cost measurement. During an environmental scan, there were a number of events going on: we had just completed our Center value stream analysis, our customer projected a cash flow problem that would result in tighter budgets, and we were not seeing the right trend in our overhead. The leadership team set a goal to reduce our enterprise cost starting in FY07. Cost savings were achieved of 5.3% in FY07 and on track to realized 11.2% for FY08. These savings do not include the costs for Active Ceramics, Timers, and Detonators because they are outside the scope of our Center value stream. Focusing on enterprise costs drove the changes to Portfolio resulting in less, more focused projects and reduction of assurance waste, e.g. PAM. Freeing up these dollars in FY08 allowed the Center to make capital investments that we hadn't be able to make, and reduce total employee counts. Not all potential cost savings have been realized due to increasing missions.

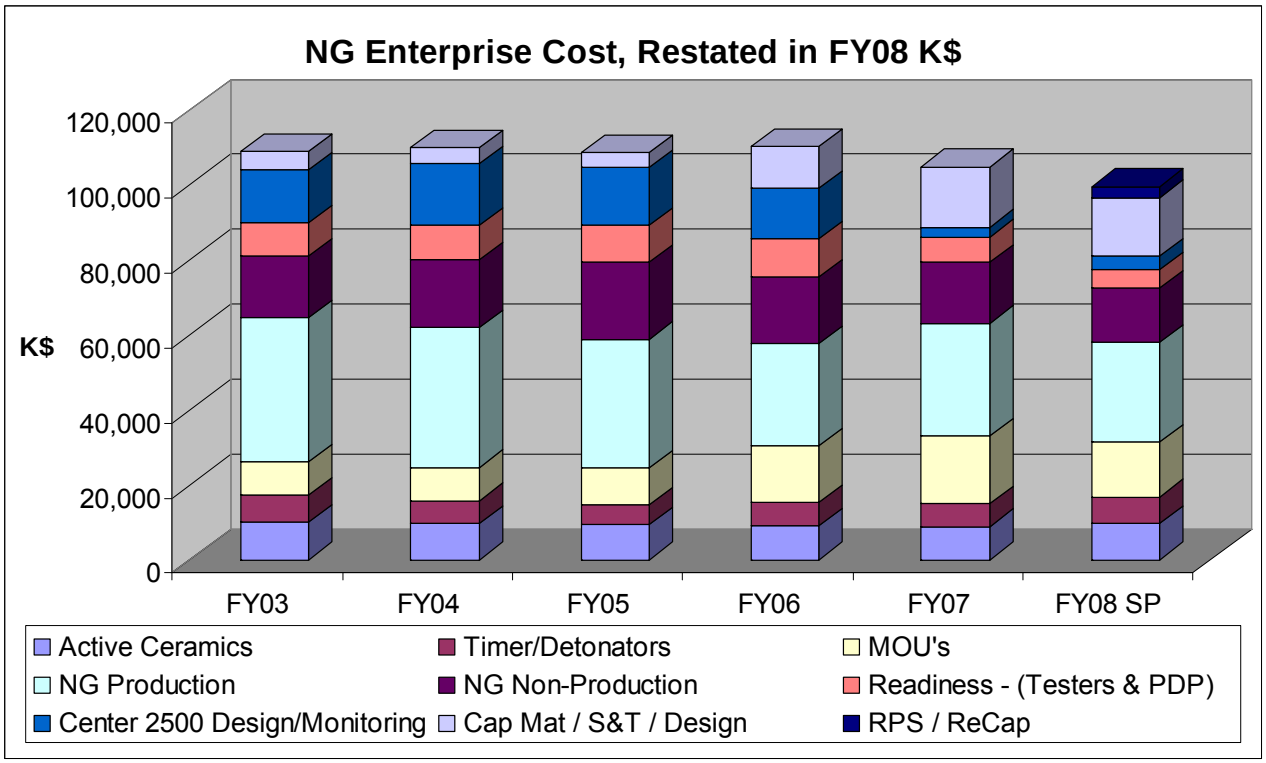


Figure 72. NG Enterprise Cost

Note: NG Enterprise Cost = 2700 Enterprise Cost (Table 1) + Active Ceramics + Timers + Detonators

Product Cost

Why: To meet the Customer and Center Strategic Objectives to be more cost effective.

How: Hoshin-Kanri and Policy Deployment.

Goal: Product Cost is a watch indicator that is reviewed quarterly to assure no adverse trends.

Discussion: The increased focus on enterprise cost has resulted in a corresponding 12.4% decrease in product cost.

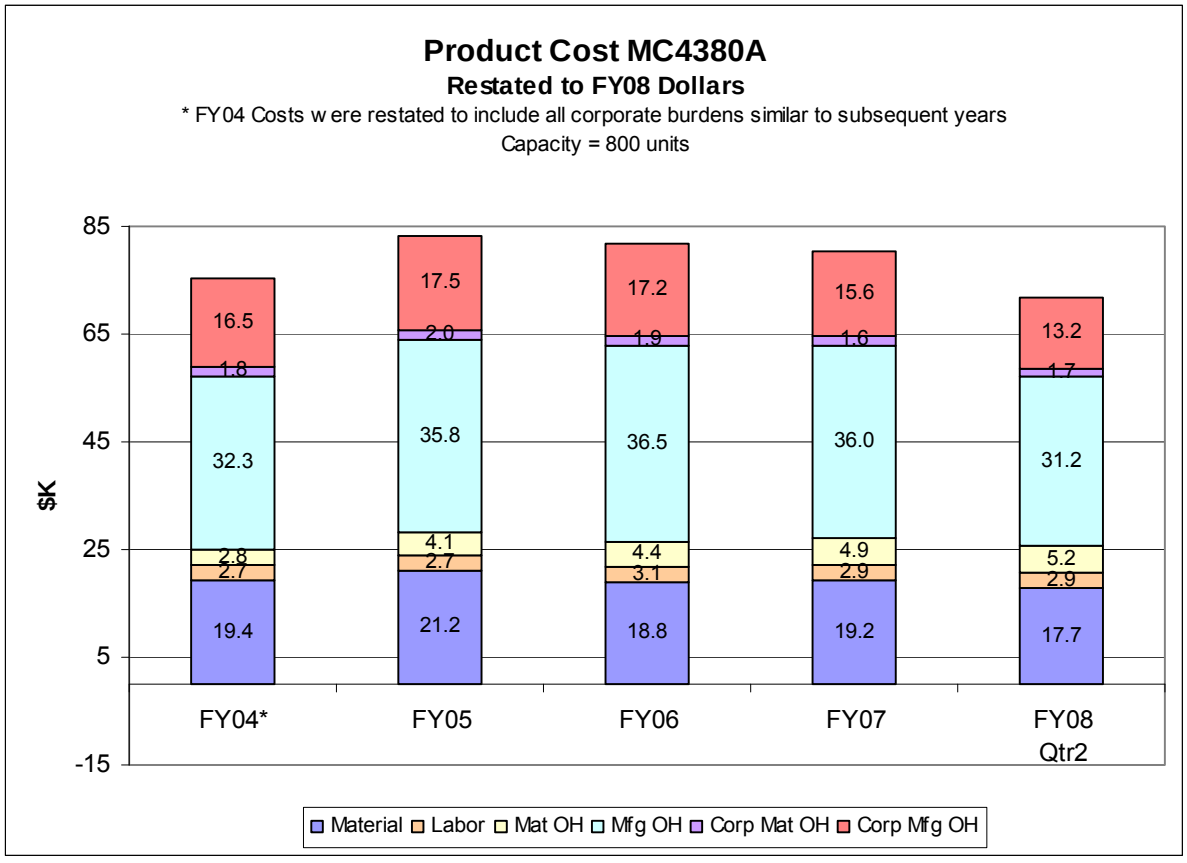


Figure 73. Product Cost Metric

Performance to Budget

Why: Financial management as required by Corporate and NWSMU policies and procedures.

How: Portfolio Management.

Goal: Watch Indicator. Intent is to keep below 100% and give back uncosted dollars as savings are realized.

Discussion: NWSMU releases budget targets each spring prior to fiscal year start. Our FY08 budget was developed in FY06 as a part of the federal FY06-FY10 budget cycle. Our budget forecasts for FY07 and FY08 were based on budget needs from previous years plus inflation and did not include realized efficiencies. Our budget forecast overestimated Center needs. Not all savings are reflected in this chart; budget is given back throughout the year as needed by other programs. For example in FY07, 6% of our budget at year end was carried over into the next fiscal year and available for redeployment to benefit other programs. See Figure 74.

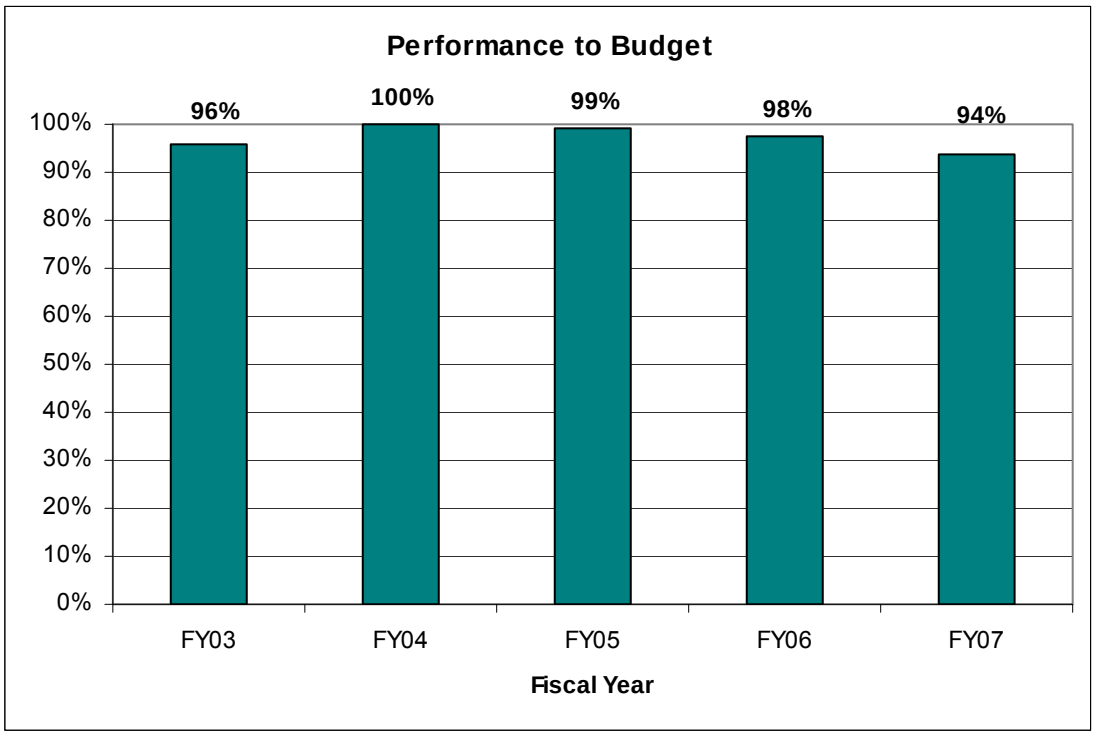


Figure 74. Performance to Budget

4.6. Competitive Impact

The Responsive Neutron Generator Product Deployment Center does not operate in a market with traditional competitive pressures. The critical question we constantly ask ourselves is "What do we need to do to deliver superior mission performance and be more responsive and cost effective?" and not "How much money do we make?" or "How can we grow our business?" We are not motivated by profit but by maintaining the purity of our mission and using our unique capabilities to distinctively impact Sandia, the NWC, and the Nation, over a long period of time. Some of our outputs defy measurement but we can still measure our success, to some degree, in whether or not our customers feel an increasing need for us and are satisfied with our performance.

Customer Satisfaction

Why: Ensure we are providing value to our customers from their perspective.

How: Conduct customer satisfaction surveys.

Goal: Continuously improve customer relations and their satisfaction with our performance.

Discussion: To measure the impact of our efforts to improve relations and measure satisfaction across our broad customer base, we conduct customer satisfaction surveys. Figure 75 shows that our efforts to engage and communicate more frequently with the customer are paying off. There is no data in FY07 Q3 since, during that quarter, action items from the previous two surveys were being implemented. FY07 Q4 responses show an increase in all areas of the survey; however, for those areas that are still low, action items are being worked to improve customer satisfaction.

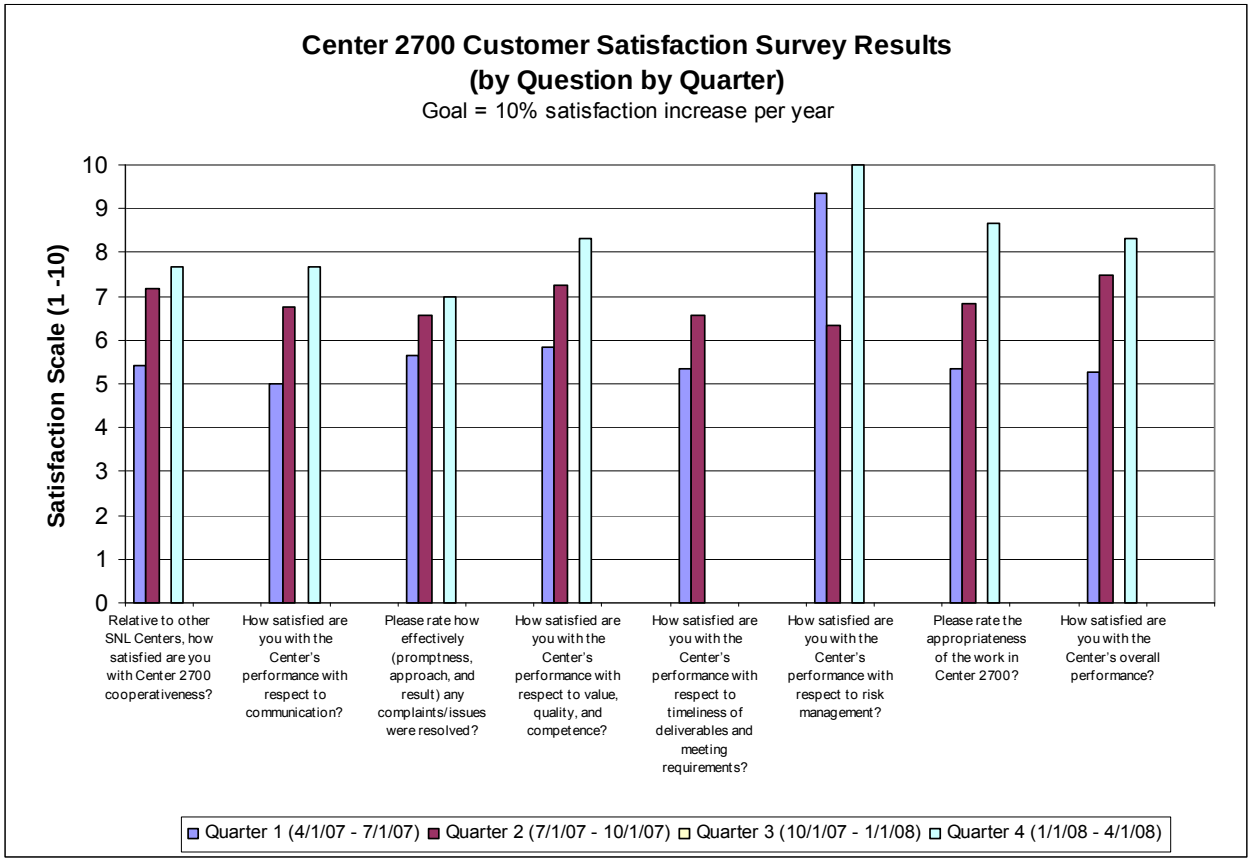


Figure 75. Customer Satisfaction Results by Question by Quarter

Currently, our customer satisfaction is 8.24 on a scale 1 to 10 as can be seen in Figure 76, where 1 is very unsatisfied and 10 is highly satisfied. A score of 8.2 indicates that there is still room for improvement, especially because in our continuous improvement philosophy, we believe that the foundation to seek perfection is the value from the customer's perspective. Therefore, the Center will continue to survey the customer and implement Lean systems in place to provide maximum value and responsiveness.

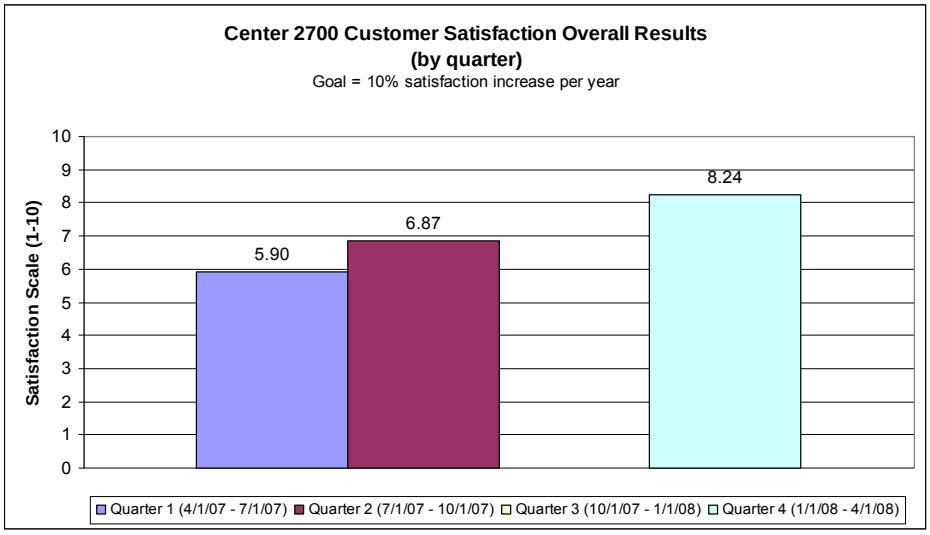


Figure 76. Customer Satisfaction Results (Overall) by Quarter

Figure 77 shows that our customers believe that the Center's performance this year is "Better (4)" than last year's. These results encourage the Center to continue performing Plan-Do-Check-Act cycles by surveying the customer, analyzing the data, presenting at management reviews, identifying action items, implementing action items, and starting over, so that the goal of "Much Better (5)" can be achieved. This process ensures periodic communication with the customers, and a validation of our actions.

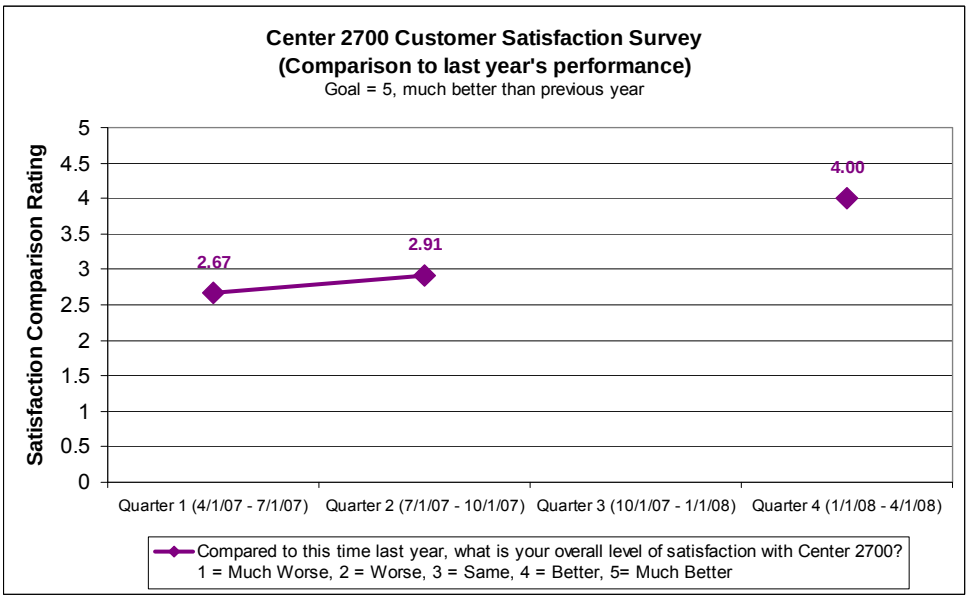


Figure 77. Customer Satisfaction Results, comparison to last year's performance

Recent ES&H Audit Results

Why: A safe and secure workplace is a foundational expectation of our customer.

How: Independent Audits and Assessments.

Goal: No findings, exceptional scores on all independent ESS&H Audits and Assessments.

Discussion: ES&H performance factors can result in extremely high costs for a NWC site. Our strategy is to use our ES&H performance as a key measure for mission success. During a recent Independent Oversight Inspection of the Environment, Safety, and Health programs at Sandia, our Center was the only inspected Center that was rated *Effective Performance* (the highest rating) across all areas. A key quote pulled from their report stated, "*Effective ISM implementation is also evident at the Responsive Neutron Generator Product Deployment Center, where management has adopted a state-of-the-art manufacturing work control process and effectively integrated activity level hazard analysis and control while maintaining production needs. Key to this success is extensive worker involvement and effective use of Technical Work Documents to rigorously and effectively control task level activities and associated hazards.*" See Table 15.

Table 15. February 2008 Independent Oversight Inspection of ES&H Results

Work Planning and Control				
Activity	Core Function Ratings			
	Core Function #1 - Define the Scope	Core Function #2 - Analyze the Hazards	Core Function #3 - Develop and Implement Controls	Core Function #4 - Perform work within Controls
R&D at MESA	Effective Performance	Needs Improvement	Needs Improvement	Needs Improvement
Responsive NG Product Deployement Center (Center 2700)	Effective Performance	Effective Performance	Effective Performance	Effective Performance
Waste Management Operations at RWNMD	Effective Performance	Effective Performance	Needs Improvement	Effective Performance
Maintenance	Effective Performance	Needs Improvement	Needs Improvement	Effective Performance
Construction	Effective Performance	Needs Improvement	Effective Performance	Effective Performance
Essential System Functionality				
Engineering Design and Authorization Basis			Needs Improvement	
Configuration Management			Needs Improvement	
Operations and Surveillance Testing			Needs Improvement	
Maintenance			Needs Improvement	
System Engineering and Oversight			Needs Improvement	
Feedback and Continuous Improvement - Core Function #5				
SSO Feedback and Continuous Improvement Processes			Needs Improvement	
SNL/NM Feedback and Continuous Improvement Processes			Needs Improvement	

New Mission Assignments

Why: Increase our opportunities to deliver products to our customers with greater responsiveness at lower costs.

How: Successfully perform on new mission assignments and apply our capabilities into new areas when our customers have the need.

Goal: Through high performance, demonstrate our ability to accept new mission assignments and increase our responsiveness and cost effectiveness in new areas.

Discussion: Mission assignments awarded to the Center result in more work, but more importantly, demonstrate the impact of our performance and ability to be more responsive. Through efficiency gains throughout our Lean journey, we have been able to take on new mission assignments at no additional

cost to the customer. The customer has agreed to moving work to the Center, and has reduced budgets at other sites as a result. Figure 78 shows our increasing missions with time. Starting in FY05, we have brought in new missions: target loading and explosives packaging. Changes to FY06 are described below in the reorganization discussion. In FY07, we added switch tubes and Supply Chain management for all of the NWSMU. In FY08, we added Qualification Drivers and Manganin® Foil Gauge that support Timer and Detonator qualification activities.

To contrast with increasing missions, the total number of Center employees is also plotted. As discussed in the Introduction, Figure 3, the Center reorganized to bring all of Science & Technology, Design & Development, Production, and Surveillance together. We also removed some functions. Program responsibility for Concurrent Design and Manufacturing was aligned with another Center that had the majority of this product. We also consolidated all of Maintenance & Calibration into one group and Weapon Quality into one group, within Sandia, to help standardize procedures and practices across the lab. These last two changes reduced Center employee counts. However, all three of these changes resulted in a net increase of employees within the Center, the "Reorg 2006" data point in Figure 78. Since then, we have continued to increase our efficiency, resulting in an overall downward trend for the Center.

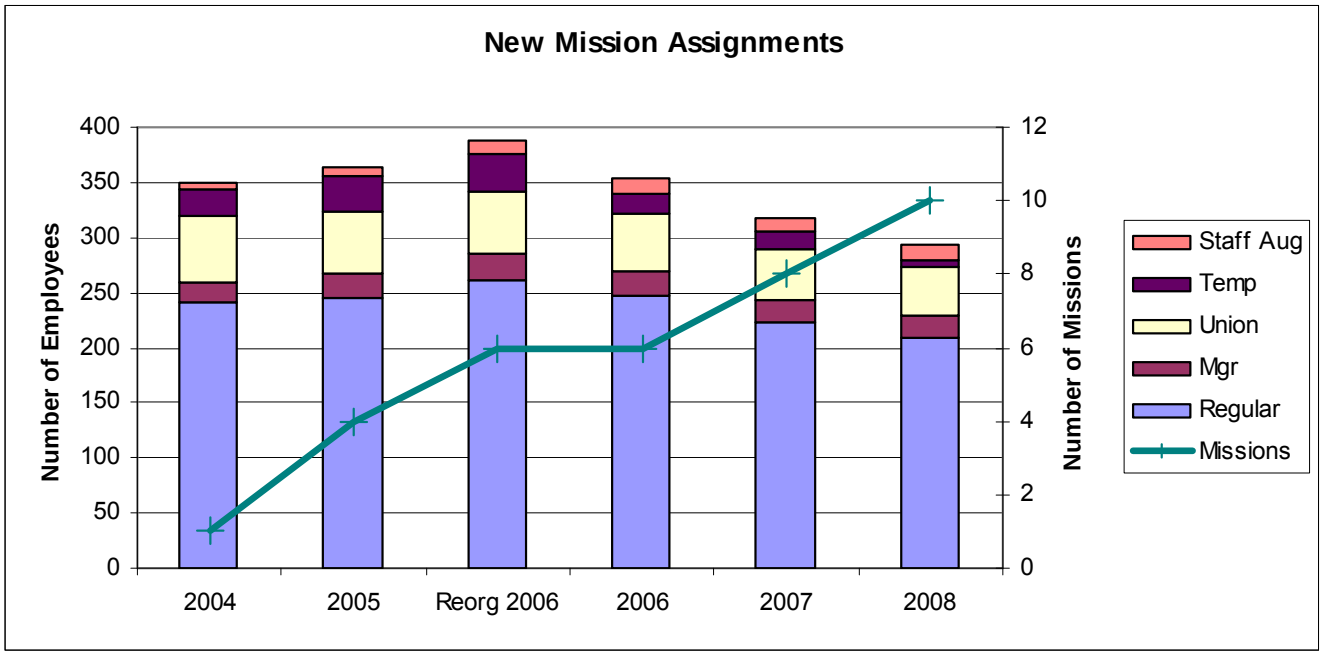


Figure 78. Employee Counts and Center Mission Assignments

Additional Mission Assignment

Why: Increase our impact on Sandia, NWC and the Nation.

How: Integrate our expertise across Sandia and the NWC.

Goal: Achieve a more cost effective and efficient production system across Sandia.

Discussion: The Responsive Production System, which we lead, charters projects each year with the end goal of achieving *one production system* for Sandia, which is more cost effective and efficient. Last year, the RPS team chartered the Materials Management Responsive Infrastructure project. The goal was to integrate the materials functions across all the Nuclear Weapons production groups by:

standardizing the planning, procurement, and acceptance processes for incoming materials and finished goods used for weapon component production. The project began by documenting the current state of the eight production groups participating in the effort. With a clear understanding of the current state, a combined future state was created. The future state was built heavily on the Center 2700 system because the MVS had the most defined and robust process. A vertical value stream in August 2006 established the plan for the implementation of the future state. The future state was piloted with several different types of parts and the final implementation of all parts was completed in April 2007. With the consolidation of the materials functions, 1 FTE (outside Center 2700) was redeployed. The total acquisition costs for production materials across Sandia decreased by 50%. Figure 79 shows the unique parts purchased trend for the Center. You will note the recent increase from 900 to 1160 parts due to this new line of business in Center 2700. We were able to take on this new role with no additional resources due to the overall efficiencies realized by this same team in reduced inspection costs.

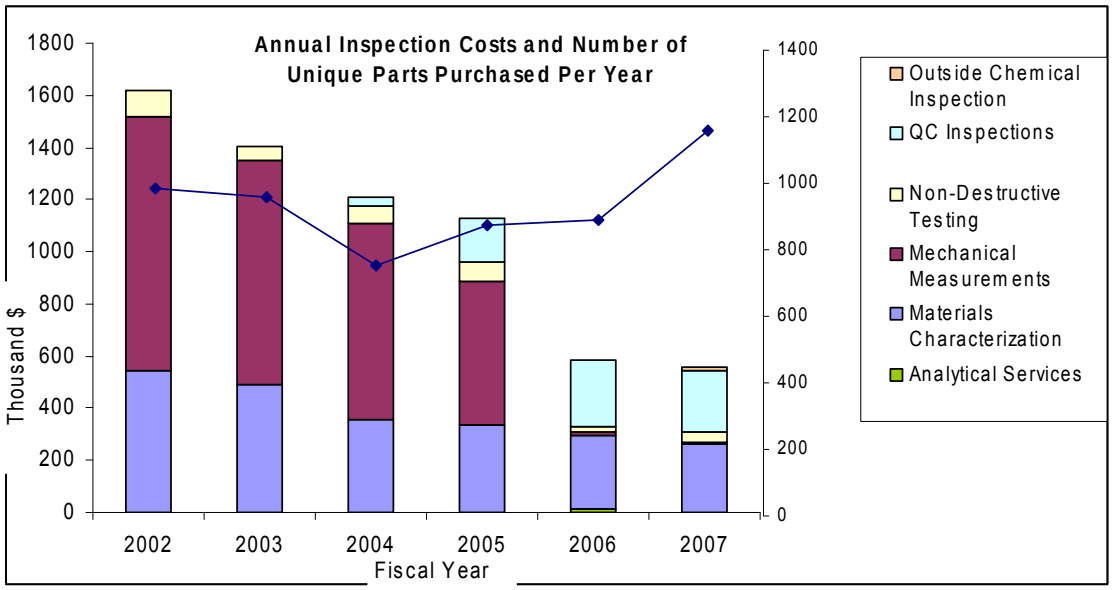


Figure 79. Annual Inspection Costs and Number of Unique Parts Purchased Per Year

Responsiveness

Understand Our Product Strategic Objective

Why: Ensure we are providing value to our customer from their perspective.

How: Use the scientific intellectual capital available in the Center and Sandia to increase our product and process knowledge.

Goal: Achieve 100% availability of knowledge and capability toolbox elements, and no shortfalls against Quantification of Margins and Uncertainty requirements.

Discussion: As stated in section 3.1, a key concept required to be responsive to customer needs and to be the model for the Complex of the future is: "Science-enabled product realization to further increase our product understanding, product yields, and reduce issue resolution time for floor stoppages." The Center has developed two True North metrics in this arena. The first is "Achieve 100% Availability of Toolbox Elements When Needed." The Toolbox is our virtual repository of product, process, materials, and modeling knowledge and capability. As our knowledge work achieves its objectives, the results are documented in the Toolbox. Our six largest projects with the most impact have each taken from their

respective vertical value streams the major knowledge deliverables they have committed to over the next three years. We track these deliverables, and roll up our performance against those commitments to a composite metric, as shown in Figure 80. We are currently behind schedule in meeting our 2008 goal due to supporting higher priority SFI work (see Figure 32 in Section 2.2.2) but intend to meet year-end goal.

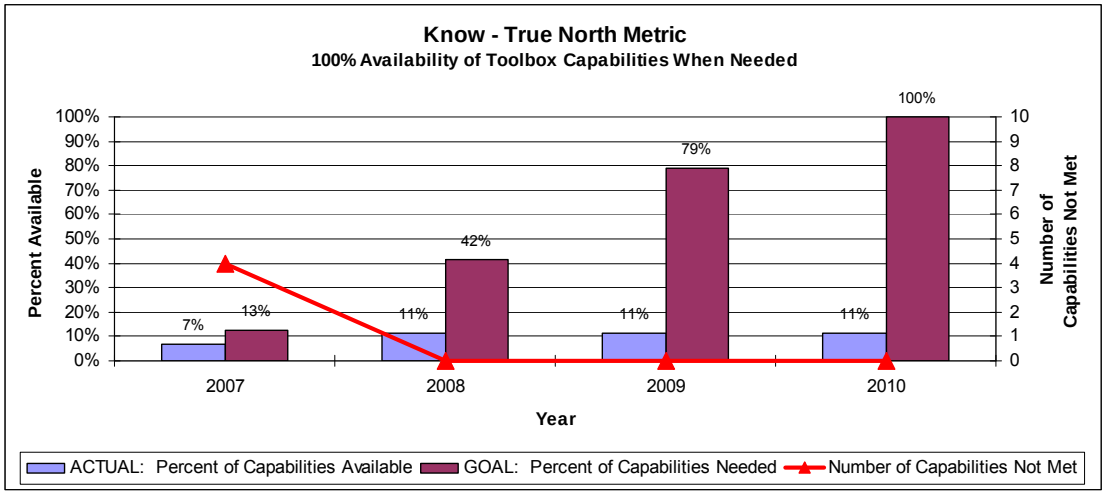


Figure 80. Understand Our Product True North Metric
Achieve 100% Availability of Toolbox Elements When Needed

The second True North metric for the Understand Our Product Strategic Objective is "No Shortfalls Against Quantification of Margins and Uncertainty (QMU) Requirements." QMU is the methodology adopted by the NWC to understand and describe in a quantitative way our level of product and process understanding. We believe that successful implementation of QMU principles and analysis is critical to the success of our knowledge work. We have charted the deliverables needed to ensure that success, including the development of standard work for the application of generally accepted QMU principles to our product, training of the workforce in these principles, and the completion of key initial QMU analyses for specific products and processes. With the roll-up of these deliverables to a True North metric, we track our progress against QMU commitments, as shown in Figure 81.

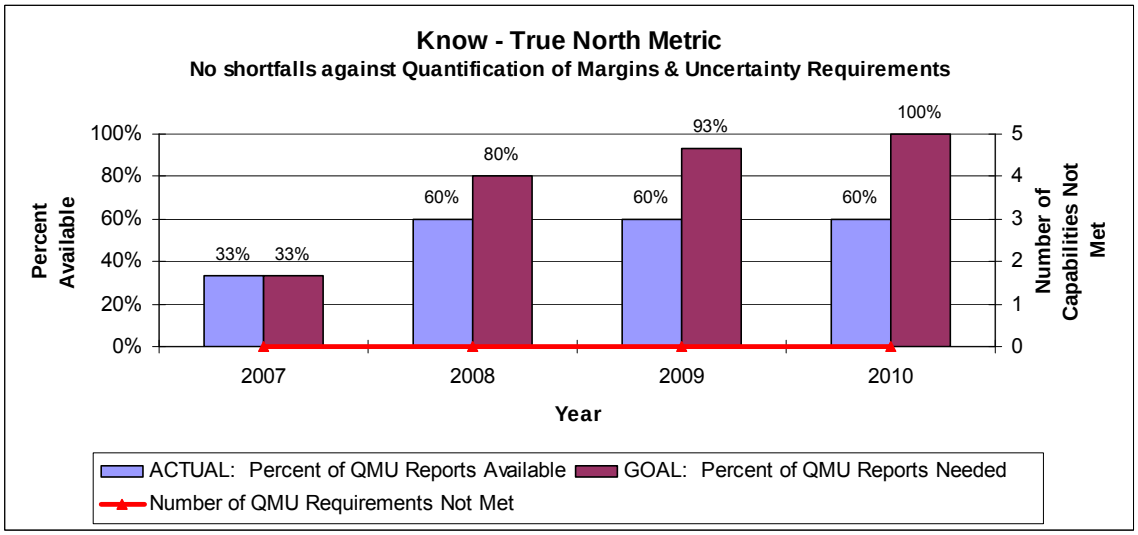


Figure 81. Understand Our Product True North Metric
No Shortfalls Against Quantification of Margins and Uncertainty Requirements

Product Realization Span Time

Why: Demonstrate improvements in responsiveness and cost effectiveness.

How: Measure product realization span times.

Goal: Achieve product realization span times of 18 months or less.

Discussion: There are three types of new products developed in the Center: Neutron Generators, tester hardware, and tester software. In the past, when there was no emphasis or driver to reduce the cost of projects, product realization span times were very long. Today, because of reduced budgets and customer needs for responsiveness, the Center has established a True North Metric to track product realization span times with an associated goal of 18 months as part of the Deliver Strategic Objective. Figure 82 below shows the trend in product realization span time throughout the years for Neutron Generators. The MC4380C project will be the first time that we demonstrate the Center's ability to realize products in 18 months. The project is on track to be completed in 16.5 months.

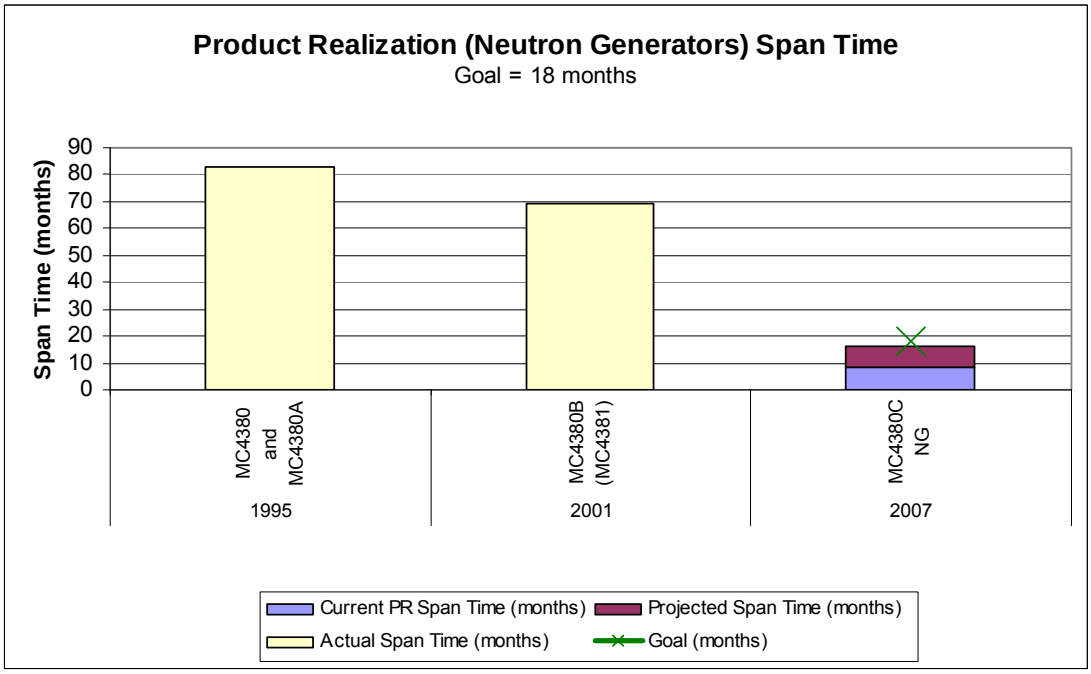


Figure 82. Neutron Generator Product Realization Span Time

Neutron Generator Tester Hardware is another product that used to take long times in development, as shown in Figure 83. With the Tester's Value Stream new approach to realize product (modularization and standardization), new testers are being delivered to customers in less than 18 months. The same is true for tester software development, as Figure 84 depicts.

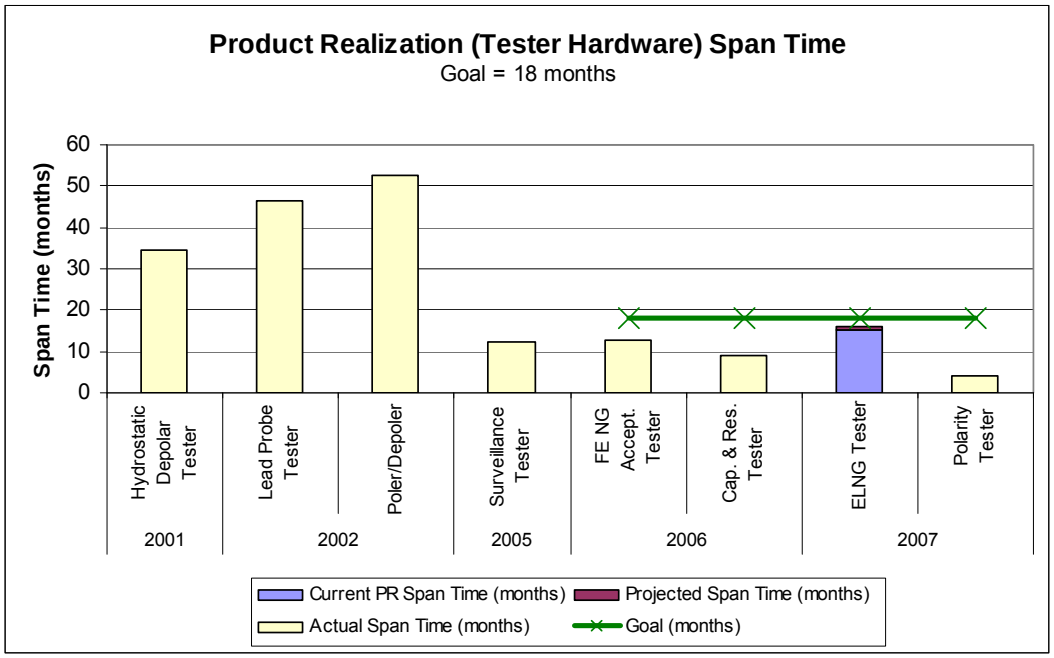


Figure 83. Tester Hardware Product Realization Span Time

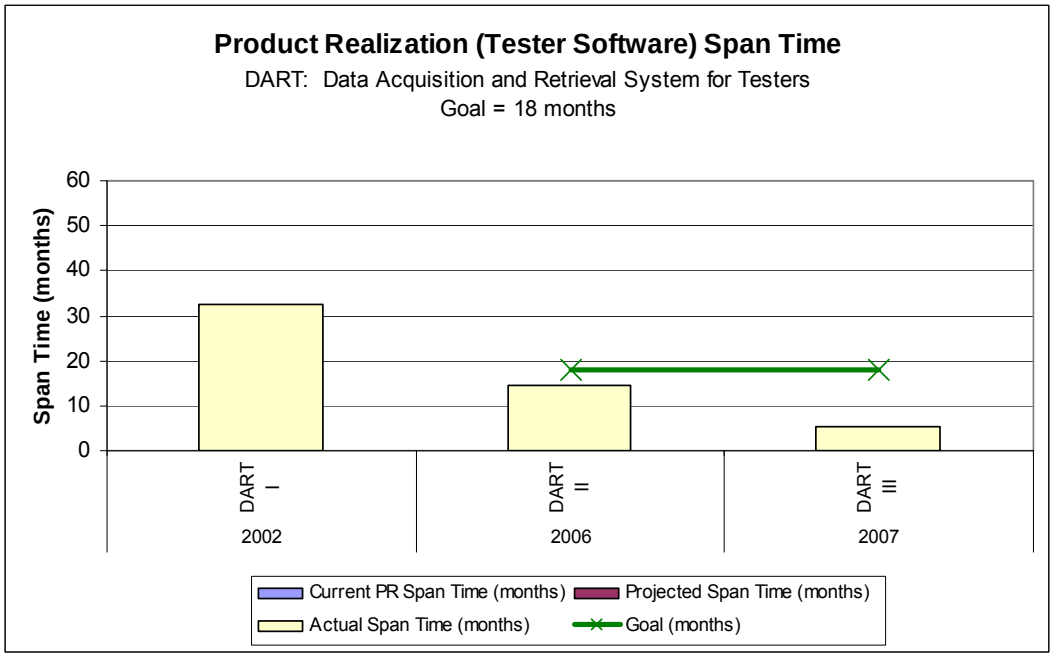


Figure 84. Tester Software Product Realization Span Time

Against the backdrop of a rapidly changing environment, our vision of *Be the Model* is critical to our strategy for leveraging customer decisions that recognize our leadership throughout the NWC. We want strong and mutually beneficial relationships with our customers, high mission performance, and being responsive and cost effective to be the basis for those decisions.

Appendix A: NG Shingo Lingo

Shingo Lingo	Function	Characteristics	NG Examples
Principles/ Philosophy	What		• Lean Six Sigma Principles • LM21 Pyramid of Operational Excellence: Value from the Customer's Perspective, Value Stream, Flow, Pull, Seek Perfection
Enablers	What		• Leadership Commitment • Integration of ESS&H into work • Intellectual Capital • Empowered Culture
Principle Based Systems	How		• VCP: Value Creation Process • VCP-HR: Human Resources • PAM: Product Assurance Model • Production Stability • Customer Engagement • ISO/QMS • Lean S&T
Systems	How	It is the sum of Process, Tool, Approach, and Measure	• Portfolio Management • ISMS: Integrated Safety Management System • Intellectual recapitalization • Supply Chain Management • Performance Management • Employee Satisfaction
Approach/ Practice/ Methods	How		• Center Value Stream • QMU: Quantification of Margins & Uncertainties • Scientific Method • PDCA: Plan-Do-Check-Act • Standard Work
Tools / Techniques	How		• Value Stream Analysis • Kaizen • 3P • 6S • Kepner-Tregoe • Root Cause Analysis • Mistake Proofing • Design of Experiments • Vertical Value Stream • Enterprise Model • Problem Solving A3s • Strategy Deployment A3s
Programs	What	Have results and outcomes	• BBS: Behavior Based Safety • ESSP: Employee Safety and Security Program • EDP: Employee Development Program • Employee Recognition Program
Projects	What	Have deliverables	• The Center 2700 Portfolio

Appendix B: Glossary

A3 – Tool used to denote a one page problem solving format (based on paper size).

DOE – The U.S. Department of Energy, a cabinet level department of the executive branch of the US government responsible for the research, development and production of all nuclear weapons for the US stockpile and the US Air Force and Navy.

ERA – The Sandia Employee Recognition Awards program which annually recognizes individuals and teams for their contribution to the organization. Anyone can nominate anyone else or any team.

ES&H – Environmental, Safety, and Health.

ESS&H – Environmental, Safety, Security, and Health.

LM21 – Lockheed Martin Century 21 continuous improvement program.

NG – Neutron Generator, a miniature particle accelerator that is part of every nuclear weapon.

NNSA – National Nuclear Security Agency, a part of the US Department of Energy responsible for oversight of the nuclear weapons program, a major responsibility of the US Department of Energy.

NWC – The Nuclear Weapons Complex is DOE/NNSA's set of three national laboratories and four production facilities and one test site located in California, Missouri, Tennessee, South Carolina, Texas, New Mexico, and Nevada.

NWSMU – One of five Strategic Management Units (SMUs) at Sandia that manage the direct-funded mission work and its associated customer interfaces. One of these is the Nuclear Weapons SMU.

PER – Performance Evaluation Report. Sandia's annual feedback from NNSA; determines contractual fee.

PHS – Primary Hazard Screening. Corporate tool to analyze work hazards.

PMB – Portfolio Management Board. Subset of the leadership team that manages the Center Portfolio Management System.

QMU – Quantification of Margins and Uncertainties. QMU is a collective set of tools and methodologies to account, monitor, and analyze margins and uncertainties in the Nuclear Weapons Complex.

RCT – Radiological Control Technicians. Trained radiological workers assist the Center in measuring and controlling tritium and other radiological hazards.

SFI – Significant Finding Investigation. Notable quality issue for a weapon system/component in the field.

SSC – Sustainment Steering Committee. Cross-functional team to manage the Center's sustainment activities.


NG
SHINGO