Session No. 631

Designing an Emergency Management Program Utilizing Lean Six Sigma

Mark Shirley, MS, CSP, REA
Environmental Risk Consultant
Sutter Health
Sacramento, California

Background

Sutter Health is a not-for-profit network of 26 acute care hospitals, eight physician organizations as well as other health care service providers serving over 100 communities located primarily in California's north coast and central valley. Collectively, over 43,000 employees and 3500 physician partners are aligned with Sutter Health. While each member organization operates independently, affiliation with Sutter Health provides access to shared resources and expertise. Similarly, each organization has an internal emergency management plan developed in cooperation with community partners and is supported by Sutter Health through consultative services and a network of shared best practices.

Recognizing the Need for a System Level Emergency Management Program

The events of Katrina and the unique natural hazards facing central and northern California (flood, earthquake and wildfire) emphasized the need for development of a system-level emergency management program to best support the Sutter Health network and the communities it serves. In September 2006, Sutter Health leadership convened a cross-functional team tasked with designing a system-level emergency management program. This team included 26 individuals representing various disciplines from across the organization. One of the first steps for the team was the identification of critical operations that would be stressed during a disaster situation, generating an overwhelming number of issues. The team quickly recognized that these issues were broad in scope, not equally important and could not all be addressed in the near future.

In 2005, Sutter Health began working with the Juran Institute on a variety of process-improvement projects. The Juran Institute is a recognized leader in quality management, Lean

and Six Sigma. In late 2006, given the success of previous projects, the cross-functional team contracted with Juran to facilitate the design phase of this project.

An Overview of Lean Six Sigma

The Juran Institute defines Lean Six Sigma as an overall quality improvement, waste reduction, and cycle time reduction methodology that seeks to minimize the resources required for designing, producing, marketing, and delivering a product to customers by eliminating wastes that inflate costs, lead times and inventory.[1] Lean Six Sigma combines two process improvement methodologies: Lean Manufacturing and Six Sigma. The combination of the two produces a better quality project in a quicker amount of time.

Lean Manufacturing was derived in large part from the Toyota Production System (TPS). The goal of Lean Manufacturing is to speed production, reduce cost and improve quality through waste elimination, and a reduction of process variation.

Six Sigma is a set of practices originally developed by Motorola to systematically improve quality by eliminating defects. Six Sigma is a metric, a methodology and a management tool. As a metric, any process achieving Six Sigma will yield less than 3.4 defects per 1 million opportunities. As a methodology the focus is less on the literal achievement of the metric, rather on refinement of the processes used to achieve the metric. Finally, as a management tool, Six Sigma aligns process improvement activities and business strategy to ensure sustained success over time.[2]

Juran utilizes 2 key methodologies in facilitation of Lean Six Sigma projects: DMAIC and DMADV, both inspired by Deming's Plan, Do, Check, Act Cycle. DMAIC is used to improve an existing process and DMADV is used to create a new process. In guiding team efforts to build a new Emergency Management Program for Sutter Health, Juran employed the DMADV methodology. This is a five step process[3]:

- *Define* the project goals and identify customers
- *Measure* and identify customer's critical to quality needs (CTQs)
- *Analyze* the information collected to define the features that will be needed to meet customer needs
- *Design* solution details, optimize the design and test process features
- *Verify* the design through pilot runs, implement the new process and handover to the process owners

---

[1] Joseph A. De Feo & William W Barnard. *JURAN Institute's Six Sigma Breakthrough and Beyond - Quality Performance Breakthrough Methods*, Tata McGraw-Hill Publishing Company Limited, 2005.
[2] Motorola University http://www.motorola.com/motorolauniversity.jsp (2007)
[3] Joseph A. De Feo & William W Barnard. *JURAN Institute's Six Sigma Breakthrough and Beyond - Quality Performance Breakthrough Methods*, Tata McGraw-Hill Publishing Company Limited, 2005.

The Define Phase

While the cross-functional team had developed a project charter, the first step in the define phase included validation of the project goals and scope. After some refinement of project goals and scope, a fresh look at team membership was needed. Finally, a high-level process map was built outlining the steps of an emergency management process.

Goal Statement

Develop and implement a Sutter Health Emergency Management System (SHEMS) to: support Sutter Health affiliate(s) in maintaining optimal patient care in the event of affiliate disability or incapacity due to a catastrophic event, gather intelligence at a system level for resource allocation and decision-making, and initiate the process of recovery to ensure the desired level of business continuity.

- Ensure continuity of mission during and following catastrophes
- Minimize costs associated with regaining business
- Provide patient/employee/physician/community support
- Establish a process for timely decision making
- Support affiliate self reliance for 96+ hours following the on-set of disaster
- Design and implement a system-level Incident Command System
- Build a system-level written plan with standards for mitigation, preparedness, response, and recovery
- Include Flu Pandemic Response in written plans
- Identify, quantify & mitigate vulnerabilities

Project Scope

The following was considered to be in scope:

- System-level incident command structure
- System-level response and recovery plans
- System level MOUs and contracts
- Assessment of affiliate readiness for a disaster
- Quantification of potential business interruption / property losses from high-risk events
- Guidance documents and template policies for affiliate use

The following was considered to be out of scope:

- Affiliate plans
- Community plans

Team Membership & Resources

Initially, team membership included 26 individuals; however, involvement of this number individuals in the core activities was determined to be inefficient and unnecessary. Therefore, a core group of eight individuals was selected from the 26 and others were assigned as subject matter experts to be involved on an as needed basis. The core group included:

- Environmental Risk Consultant (myself) – Project Lead
- Director of Human Resources
- Manager of Financial Operations, System Procurement
- Director of Diversified Risk
- Healthcare Risk Consultant
- Director of Regulatory Affairs, Facilities Planning and Development
- Systems Analyst Manager, Information Systems
- An Affiliate based Emergency Preparedness Coordinator
- Lean Six Sigma Master Blackbelt from The Juran Institute.

Customers

The identification of our customers was the third step of the define phase. The following categories of individuals were identified:

Internal

- Affiliate Leadership (CEOs, CFOs, COOs, CNOs, HR Directors)
- Affiliate Emergency Preparedness Coordinators
- Affiliate Support Services (Dietary, Pharmacy, Procurement, Laundry, Biomed, etc.)
- Affiliate Plant Operations Directors
- Affiliate Communications & Marketing
- Affiliate Infection Control
- Affiliate Clinical (Physicians, RNs, RTs)
- Foundations (Physicians, CEOs, Risk Managers, Safety Officers)
- System level (Leadership, Finance, IT, HR, Legal, SHU, Communications, Procurement)
- Affiliate based community board of director members

External

- Community Partners (CA Hospital Assn., Local OES, State OES, Red Cross)
- Agencies & Regulators (DHS, Joint Commission, local EMS, OSHPD)
- Peer Groups (KP, Catholic Healthcare West, UC Hospitals, etc.)
- Non-HC Industry EP planners
- Vendors (Pharm, transportation, supplies)
- Utility Providers (data / voice transmission, power, water, etc.)
- Insurers

The Process (SIPOC) Map

A SIPOC map is a six sigma tool used to identify all relevant steps in a process. The tool name prompts the team to consider the Suppliers of the process, the Inputs to the process, the actual Process, the Outputs of the process, and the Customers that receive the process outputs. Each step of the process must be designed to meet customer needs and add value to the end product. Traditionally, emergency management programs are built around a mitigate, prepare, respond and recover model. Since the team was designing, not refining, a new process, an assumption was made that the process map, or SIPOC, would follow this traditional model. The team projected the probable details of various scenarios and plugged them into the SIPOC model (see Table 1. *SIPOC model example*). SIPOC details were continuously revised throughout the project as the team built knowledge and a better understanding of the final product.

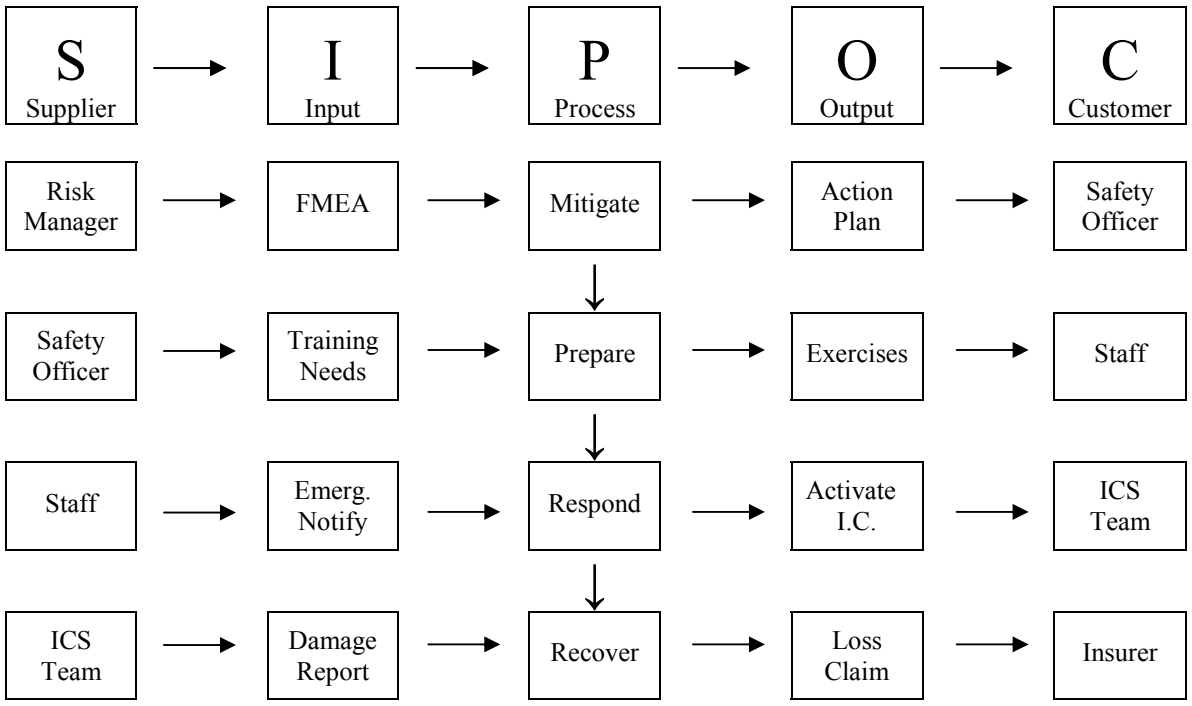

Table 1. SIPOC model example.

The Measure Phase

The customer groups identified in the define stage were organized into like categories and customized questionnaires were developed to help extract needs from each customer category. Specific individuals were then identified for each category and members of the team were assigned to carry out the interviews. Over a three-week period 71 individuals from the following categories were interviewed generating 570 "Voice of the Customer" responses:

- 24 - Affiliate Leaders
- 21 - System Leaders
- 6 - Community Partners
- 6 - Vendors
- 5 - Utility Providers
- 4 - Peers
- 3 - Insurers
- 2 - Regulators

The Analyze Phase

During the Analyze phase the team examined data gathered in Measure to help identify high level features (solutions) that would need to be included in the new emergency management program.

CTQs and Affinity Groups

Initially, each literal Voice of the Customer (VOC) was translated to a Critical To Quality (CTQ). CTQs represent the service characteristics as defined by the customer that must be met by the final product. Similar voices were translated to a common CTQ whenever possible in order to narrow the field to the vital few. A total of 88 vital CTQs were identified. The 88 CTQs were then sorted into 12 Affinity Groups. Table 2 (below) outlines some VOC and CTQ examples.

Customer	Voice of the Customer	Affinity Group	CTQ
SM – Sacramento Utility District	"Focus on preparation and mitigation and scenario specific planning is key"	Planning and Training	Hazard assessments are regularly conducted and results are included in plans
BW – Affiliate IS Manager	"Current Contact Lists are key to having all of the right resources involved"	Communication	Master database of emergency contacts is current, in place and accessible for internal and external contacts
CH - PG&E	"Whether it is ICS or some form of emergency management structure, it is critical to have the right people and sufficient backup personnel, trained in the roles in responsibilities of managing disasters"	Planning and Training	ICS educated, trained and competent staff at affiliate & System level
JR - Biomedical Engineer	"Reliability of back-up power is critical to sustaining Biomed operations"	Building Design	Facility design standards must be in place to mitigate out hazards including redundancies for critical systems
LB – SH Risk Services	"Employees need to know that their families, (children, spouses, pets, etc) are safe or they will not leave them to come to work"	Staffing	Mechanism and resources to train employee in family preparedness
LB - Affiliate Pharmacist	"Our just-in-time pharmacy inventory is one of our greatest vulnerabilities"	Supplies	Confirm back-up supplies for disasters stored by vendors
DR – Insurance Carrier	"Lack of proper documentation may result in less reimbursement, i.e. FEMA. "	Finance	Document systems are consistent with (e.g. FEMA, insurer) requirements to track disaster expenses
DC – SH Healthcare Facilities Planner	"Damage assessment and mitigation for life-safety conditions requires licensed design professionals and contractors familiar with the facility to ensure the fullest understanding of building usability or time to recovery"	Physical Site Recovery	Rapid assessment and gov't clearance of potentially damaged buildings

Table 2. VOC & CTQ examples

Once CTQs were sorted into Affinity Groups, the groups were ranked against one another to determine which would have the most impact on meeting customer needs. The following is a list of the Affinity groups in ranked order:

1. Communications
2. Planning & Training
3. Supplies
4. Physical Site Recovery
5. Alternate Care Site
6. IT & Telecom
7. Finance
8. Staffing
9. Building Design
10. Legal
11. Transportation
12. Alternate Workplace

High-Level Features

Finally, the team evaluated each of the 88 CTQs and identified the high-level features required to meet each CTQ and consequently the customer need. In most cases each CTQ required several features in order to be fulfilled. Some of these high-level features became "Quick Hits" and others required a more detailed design.

A small number of high-level features were clear, straightforward and could immediately proceed to implementation. These became "Quick Hits". Below is an en example from the Communication Affinity group:

- **VOC:** "Current Contact Lists are key to having all of the right resources involved"
- **CTQ:** Master database of emergency contacts is current, in place and accessible for internal and external contacts
- **High-Level Feature / Quick Hit:** Sutter Health has a current and comprehensive database of emergency contacts for all key stakeholders including: affiliates, medical foundations, government agencies, vendors, community partners, NGOs, media, utility providers and others.

Most high-level features lacked the specificity needed for implementation and required additional design work. Below is an example from the building design affinity group:

- **VOC:** "Reliability of back-up power is critical to sustaining Biomed operations"
- **CTQ:** Facility design standards must be in place to mitigate out hazards including redundancies for critical systems
- **High-Level Feature:** High reliability design standards (beyond compliance) for Sutter Health facilities are in place and will decrease the potential of critical utility failures during disasters.

This High-Level Feature describes what must be in place to meet customer requirements; however, the specific steps needed to identify and implement the design standards required more

investigation. Initially an assessment was needed to identify critical utility systems and determine if current building codes adequately protect those systems. This assessment led to identification of gaps and ultimately a list of design standards that exceed current building code requirements.

Design Phase

As apparent from above, the focus of the design phase was the further development of feature details and implementation of quick hits. In September of 2007 twelve detail design teams were recruited to carry out these tasks. Each of the twelve teams was led by a member from the original team and supported by a risk consultant as well as content experts.

CTQ Trees

The first step for each of the 12 detail design teams was to build out CTQ and feature trees. These trees are an effective means of outlining the steps necessary to realizing customer needs. A difficult component of this exercise for most of the 12 teams was the assignment of metrics to each CTQ. Many metrics revolved around the 96 hour benchmark of self sufficiency as established in The Joint Commissions 2008 Emergency Management standards. Other metrics simply stated that the CTQ would be in place or available "100% of the time". Exhibit 1 (below) is an example of a CTQ tree from the Supplies Team.

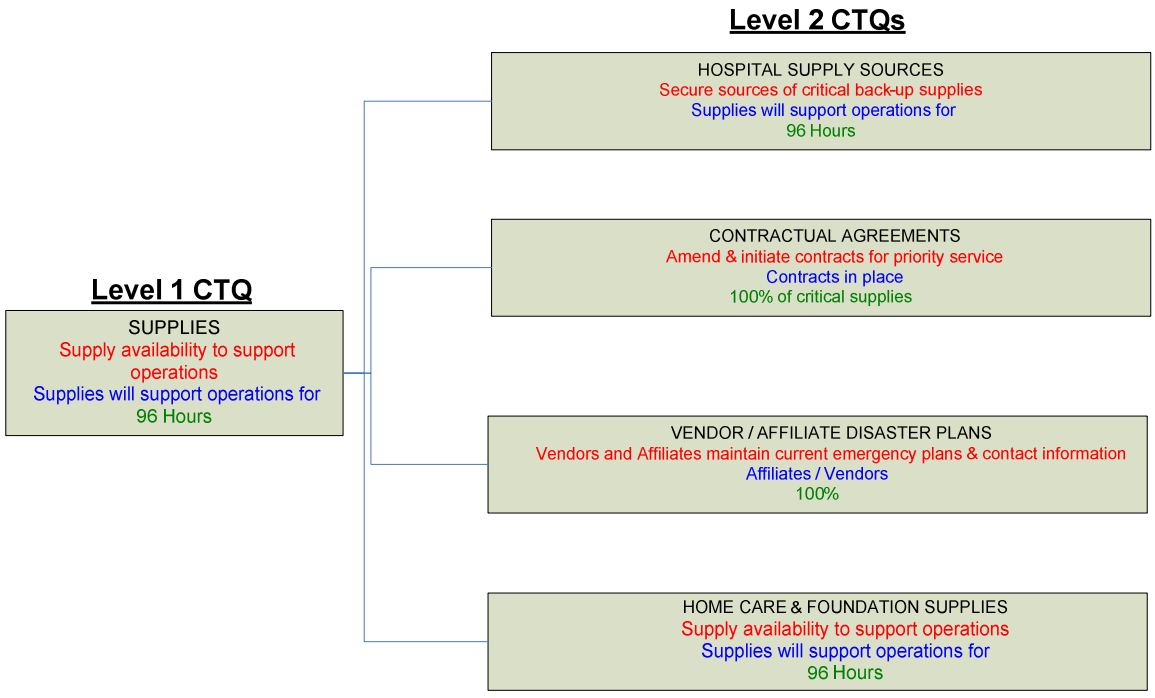

Exhibit 1. Supplies Team CTQ Tree

Feature Trees

Upon completion of the CTQ trees, teams took the high-level features for each of the 88 CTQs and began construction of feature trees. As opposed to CTQ trees, each element in the feature

trees was given a specification and assigned an owner. Creation of these trees were essential for teams to "test back" the features they suspected would fulfill CTQ requirements. The "test back" exercise identified missing elements, redundancies and ultimately led to a more refined and clear path forward. Exhibit 2 (below) is an example from the Supplies team and outlines the features associated with the Hospital Supplies Sources CTQ branch.

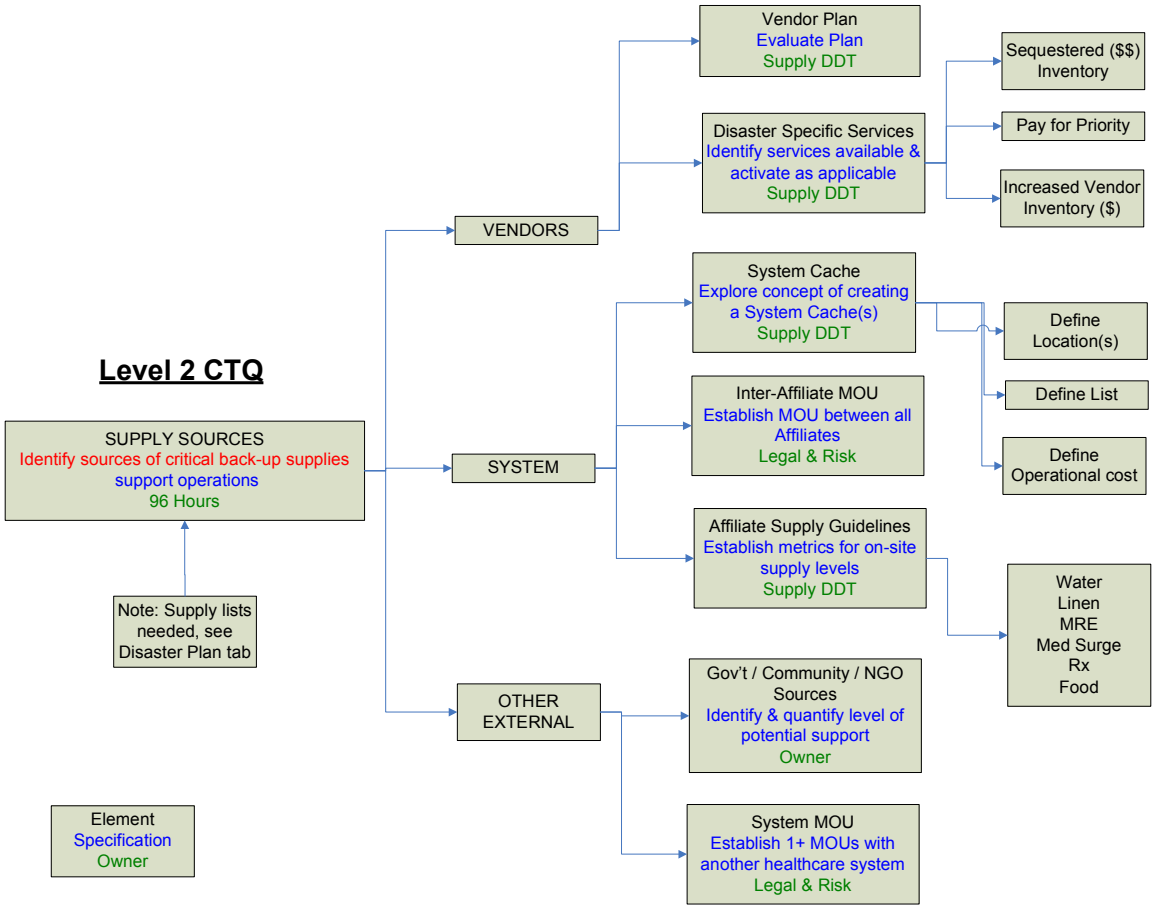

Exhibit 2. Supply Sources Feature Tree

Action Planning & Implementation

An obvious benefit of the feature trees is the clear transition to action planning and implementation. Pacing and delivery of the emergency management program's features was inconsistent due to the variable complexity of each team's activities. In some instances, implementation required a thorough cost benefit analysis, generation of a business case and application of significant due diligence in product selection. Therefore, some teams were able to complete their project within a few months; others will remain active for a year or longer. It is important to note that as opposed to a typical DFSS project many of this project's features could be implemented independently as an emergency management programs are a combination of complimentary processes from diverse and loosely connected areas.

Teams began action planning and implementation in early January 2008, around the time this article was being authored. Certain components of the program including: a system-level incident command system, leadership disaster training, building design standards, vendor agreements, and contact lists had been or were in process of being implemented. It is expected that implementation and verification will continue through 2009.

Verify Phase

As various features become ready for implementation they are passed to process owners. This often involves training owners and users on the feature's standard operating procedures as well as defining and agreeing upon control measures. Additionally, since emergency management programs are dynamic processes, all features must be regularly reviewed and evaluated for effectiveness.

An important component of the verify phase is testing the program through pilot runs. The State of California holds healthcare disaster exercises each fall. On October 25, 2007, The Sutter Health Emergency Management System was exercised in conjunction with a majority of Sutter Health affiliated hospitals. Some of the lessons learned from the exercise included:

- Communication flow is complicated. It needs to be clear and practiced regularly.
- Electronic tools are preferable to manual documents
- Thorough training of roles, responsibilities and use of tools is crucial
- Intelligence gathering regarding status of affiliates and communities is critical
- Dedicated scribes for effective documentation are helpful

Sutter Health is committed to testing and exercising this new emergency management program with its affiliates and community partners at least twice each year. As more features are implemented their effectiveness will be tested. Improvements will continuously be made based upon test results and the emergence of new technologies. This program will remain an integral component of Sutter Health's mission to: "enhance the well being of the people in the communities we serve through a not-for-profit commitment to compassion and excellence in health care services."