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**Document Title: Increasing Efficiency of Forensic DNA Casework
Using Lean Six Sigma Tools**

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Document No.: 235190

Date Received: July 2011

Award Number: 2008-DN-BX-K188

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Louisiana State Police Crime Laboratory

Increasing Efficiency of Forensic DNA Casework Using Lean Six Sigma Tools

Forensic DNA Unit Efficiency Improvement Grant Final Report

June 2011

Increasing Efficiency of Forensic DNA Casework

Using Lean Six Sigma Tools

Award #: 2008-DN-BX-K188

Author: Melinda Richard, MT(ASCP), Louisiana State Police; Timothy D. Kupferschmid, MBA, MFS, Sorenson Forensics

Abstract

It has been documented that the number of DNA requests received in public crime laboratories has increased such that backlogs exist and turn-around-times are extended.¹ Louisiana State Police Crime Laboratory (LSPCL) saw a 22% increase from 2006 to 2007 and a 48% increase from 2008 to 2009 in the number of DNA requests submitted. The completion rate was not increasing at a rate to compensate for the increased submittals and eliminate the backlog of requests that had accumulated.

In October 2008, LSPCL was awarded an NIJ efficiency improvement grant. LSPCL accepted the award in the amount of \$600,000, consisting of a 25% state fund match. The funds were used to hire external consultants to conduct two Lean Six Sigma (LSS) projects, to purchase additional equipment to increase throughput, to validate robotics, and to add tools that facilitate a paperless environment in order to increase efficiency and allow trained DNA analysts to conduct scientific analysis as expeditiously as possible.

LSPCL applied a multi-faceted approach to the problem, using the NIJ's Forensic DNA Efficiency Improvement Grant as a cornerstone to changes that have led to a 134% completion rate in the number of DNA requests completed in 2010. All grant goals and objectives were met, but more importantly, the process has been improved and the culture has been changed such that the LSPCL Forensic DNA Unit has substantially increased its operational efficiency.

There were additional initiatives, funded by other grants or state funding, that affected had a positive impact on the results (outsourcing of over 1000 forensic cases, additional equipment, hiring and external training of additional technicians and analysts); however, the changes made as a result of the efficiency grant funding, primarily the LSS projects, changed the culture and has provided a platform to make the equipment, personnel and available resources more efficient. LSPCL's success has led to LSS projects throughout the state Department of Public Safety Services. While DNA is an ever-changing industry, foundational principles were developed and tools were provided to allow the LSPCL to operate more efficiently and effectively. The agencies and the public are better served today because of this grant project.

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SECTION 1: EXECUTIVE SUMMARY

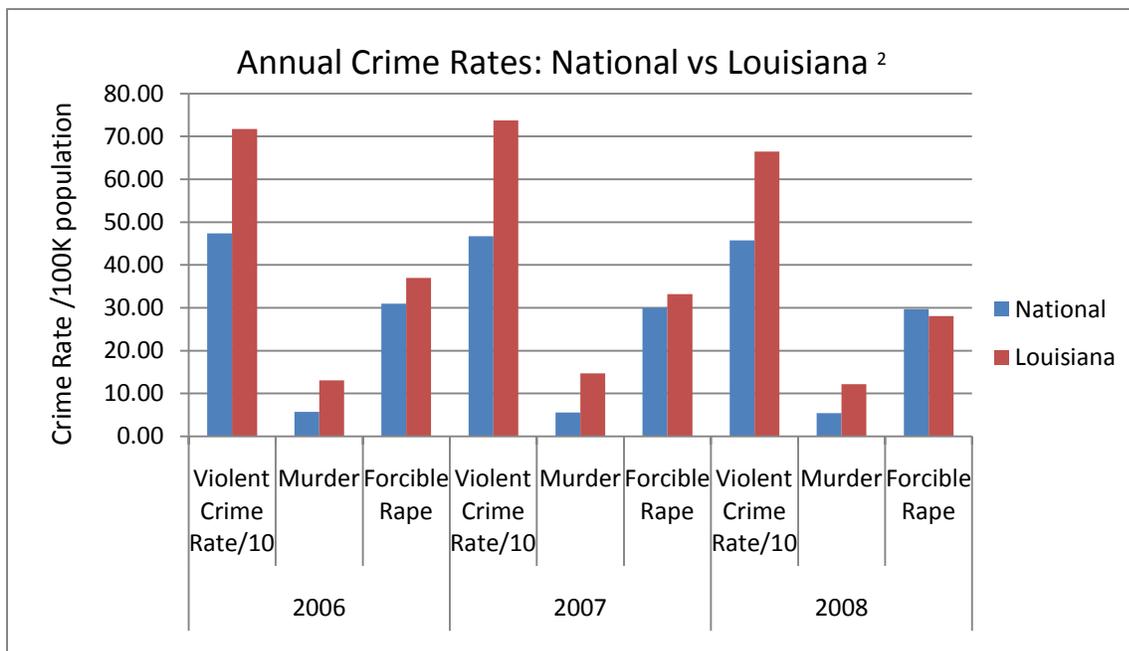
1.1 PROBLEM SYNOPSIS

While Louisiana’s violent crime rates, as well as the nation’s, show decreases over the last several years, they still are substantially higher than the national rates. Louisiana’s violent crime rates are approximately 1.5 times that of the nation and murder rates are more than twice the national rates over several years.² See Table 1 & Figure 1.

Table 1: Crime Rates 2006-2009

Year	Crime Rate per 100,000 population					
	National Violent Crime Rate/ 10	Louisiana Violent Crime Rate/ 10	National Murder Rate	Louisiana Murder Rate	National Forcible Rape Rate	Louisiana Forcible Rape Rate
2006	473.6	717.7	5.7	13.1	31.0	37.0
2007	466.9	737.3	5.6	14.7	30.0	33.2
2008	457.5	664.4	5.4	12.2	29.7	28.1
2009	429.4	620.0	5.0	11.8	28.7	30.3

Figure 1: National vs Louisiana Crime Rates 2006-2008



At a March 2010 “Symposium on Re-Entry” in Baton Rouge, Louisiana, speakers explained that the United States has the highest incarceration per capita rate in the world, and Louisiana has the highest rate in the nation. According to Louisiana’s Department of Corrections, any given day there are 40,000 offenders in Louisiana’s prisons and jails. Each year 15,000 offenders are returned to society. About half will return to prison within a year. Recidivism studies have shown that 67% of the released offenders will have a repeat offense within three years.³ With 40.4% of Louisiana offenders having committed violent crimes⁴ and a recidivism rate in Louisiana of 31.8% (2008)⁵, the need for rapid investigation and resolution to forensic cases is apparent.

DNA analysis has proven to be an important crime solving tool for investigators and prosecutors. As the sensitivity of DNA technology continues to increase, laboratories are able to isolate DNA profiles from very small sample sizes. “Touch” DNA can be obtained from inanimate objects touched by the perpetrator. Coupled with the ever-increasing power of the national CODIS database to produce a CODIS “hit” or investigative lead, the likelihood of DNA forensic analysis yielding assistance to an investigation is growing. However, in order for DNA to provide assistance to investigations, DNA analysis of the evidence in the forensic case must be completed.

The number of DNA requests submitted to crime labs has increased over the past years¹, with Louisiana’s State Police Crime Lab (LSPCL) showing the same trend.

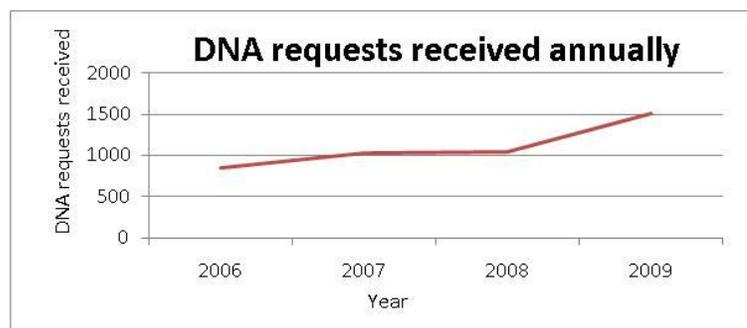
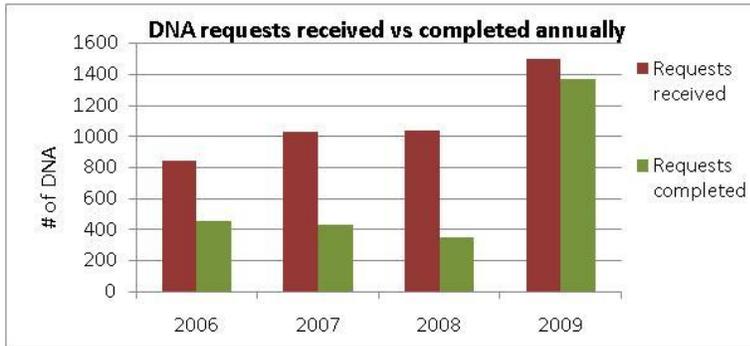


Figure 2: DNA requests received annually

The rate at which crime labs have worked DNA cases has not kept pace with the submissions, thereby creating backlogs. Prior to the efficiency improvement project, LSPCL experienced the same issue. (Figure 3)

Figure 3: DNA requests received vs completed annually by LSPCL



Creating and maintaining a system that increases the rate at which cases are completed, to a level that not only keeps pace with submissions, but allows the lab to “catch up” on the backlogged cases has been a difficult challenge.

The time that a case spends waiting to be worked plus the time for analysis and completion of a case is the “turn-around-time”(TAT) of the request. With TAT’s that exceeded a calendar year, the need for action was clear.

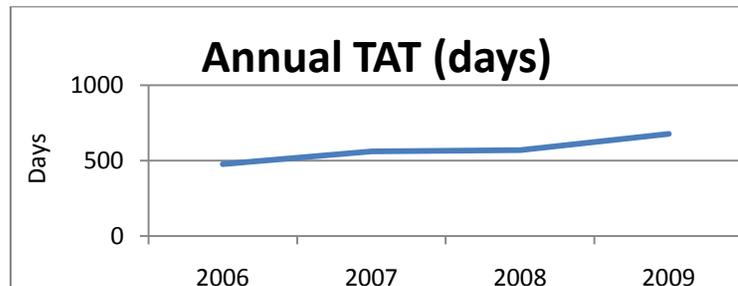
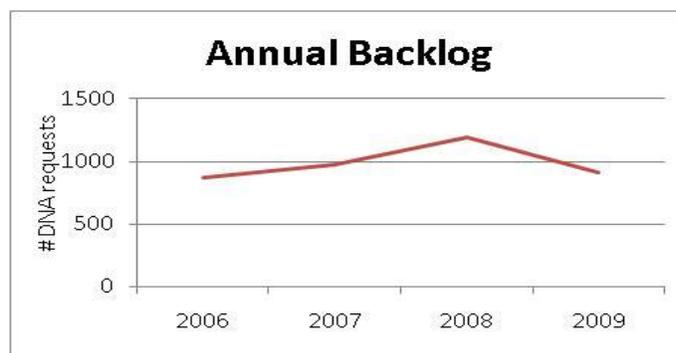


Figure 4: LSPCL TAT (days) by year

At one point in 2007, the backlog at Louisiana State Police Crime Laboratory (LSPCL) was 1700 DNA requests. In 2008, at the time of grant application, it was projected, based on the trend, that the DNA backlog would double within 2 years if action was not taken. The cycle could only be broken by attacking the efficiency of the forensic DNA caseworking laboratory.

Figure 5: LSPCL Annual Backlog



1.2 GRANT PURPOSE

The purpose of the NIJ's Forensic DNA Efficiency Improvement grant was to fund innovative and creative solutions to this nation-wide problem. The grant required a 25% match of federal funds by the state government budget. In October 2008, LSPCL was awarded an NIJ Forensic DNA Efficiency Improvement Grant of \$600,000. With \$450,000 supplied by the federal grant, \$150,000 was funded by state funds. LSPCL used the grant as a cornerstone to make cultural and operational changes.

Louisiana State Police Crime Laboratory engaged in the grant to accomplish goals aimed at eliminating the backlog of DNA forensic casework, reducing the turn-around-time of the cases worked, increasing the productivity of their DNA forensic laboratory, and increasing the number of CODIS hits; thereby providing an increased level of assistance to ongoing criminal investigations and structuring the DNA forensic laboratory process to handle future casework in a timely manner, providing real-time support to investigations.

As the National Institute of Justice (NIJ) provides tools to public forensic DNA laboratories, this study serves as a template for other laboratories to solve their productivity challenges.

1.3 RESEARCH DESIGN

The LSPCL had a multi-pronged approach to the problem of the backlog, extended turn-around-times, and low productivity. The overall goal was to create an efficient business-like structure to the scientific work and focus the scientists on the technical laboratory work of DNA analysis, where the services rendered would then be timely and accurate, meeting the needs of the agencies served. The strategy involved three levels of improvement:

- I. Develop more effective communication between agencies and LSPCL
- II. Outsource as much work as possible to temporarily create more staff resources
- III. Improve the efficiency of the DNA forensic process

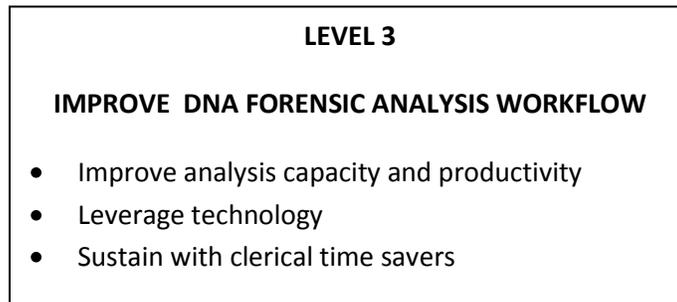
The major workpoints for each level are listed below:

LEVEL 1	LEVEL 2	LEVEL 3
COMMUNICATION	OUTSOURCE	IMPROVE DNA FORENSIC ANALYSIS WORKFLOW
<ul style="list-style-type: none"> • Cancel unneeded cases • Prioritize backlogged cases • Ensure complete submissions • Equip agencies for easier future submissions 	<ul style="list-style-type: none"> • Casework • Training of new DNA analysts • Transfer screening to newly created Forensic Technician positions 	<ul style="list-style-type: none"> • Improve analysis capacity and productivity • Leverage technology • Sustain with clerical time savers

The three phases occurred over 3 years, beginning in September 2008 and involved projects funded by a variety of sources: Louisiana state funding, National Institute of Justice (NIJ) DNA Backlog Reduction and Capacity grant funding, and the NIJ DNA Forensic Efficiency Improvement Grant. The overall success was the product of all the activities, making attributing statistical effect a challenge. However, the activities supported by the NIJ Efficiency Improvement grant occurred at the end of the timeline, so the metrics readily correspond to those timepoints.

The activities of the Efficiency Improvement Grant will be addressed in this report, with comments regarding the Level 1 and Level 2 additional efforts addressed in Section 1.7 Additional Progress Achieved.

LEVEL 3: IMPROVE DNA FORENSIC ANALYSIS WORKFLOW



1. Improve analysis capacity and productivity

As Level 3 was to improve DNA Forensic analysis workflow, the focus was to improve capacity and productivity. Applying business management principles to the laboratory setting was the first step. After researching success of the Lean Six Sigma (LSS) methodology by other laboratories within the same industry (Sorenson Forensics' LSS implementation to the paternity lab work flow and South Carolina's Law Enforcement (SLED) Crime Lab's LSS implementation to address their DNA cycle time), the decision was made to address the workflow through the LSS business model. Consultants that specialize in these efficiency methods were hired for both the DNA analysis process and the purchasing process. Once the bottlenecks were identified, the "choke" points were addressed in a systematic fashion. Schedules were developed to dictate all activities of all persons, with regular accountability meetings. Data was made visual for all to see areas that needed attention. Equipment was purchased to increase capacity or to enable a faster work flow either through decreased waiting time or decreased analysis time. Work spaces were rearranged to reduce the motion and transportation required during the steps of DNA casework analysis. The culture of the organization was changed.

2. Leverage Technology

As the Lean Six Sigma projects progressed, leveraging available technologies became essential. This included purchasing equipment to maximize robotic solutions, to facilitate barcoding of sample tubes wherever possible, and to provide printers where they were needed.

3. Sustain with Clerical Time Savers

The last step was to sustain the efficiency obtained by reducing time spent on clerical tasks. Historically, at LSPCL, it was the responsibility of the DNA analysts and supervisors to complete administrative tasks, such as purchasing supplies, inventory management, grant administration, communicating with vendors, and assuring that budgets

were managed such that supplies were available when needed. This meant the DNA analysts spent a great deal of time on non-laboratory functions. A Business Unit was formed, within the LSPCL, to be a central hub for all of the previously mentioned administrative activities. One of the most time consuming tasks was the purchasing of DNA supplies. To streamline this, such that current clerical staff could absorb this function, a second LSS project was completed. This shifted responsibility for obtaining quotes, negotiating pricing, managing vendors, and tracking delivery and payment, from the DNA analysts and supervisors, to the newly formed Business Unit. The LSS project reduced the staff time spent on purchasing functions, streamlined the process, and reduced the cycle time needed to obtain supplies.

To reduce storage space needed for records and to reduce clerical time and effort spent responding to requests for documentation, an imaging project was conducted to create electronic copies of DNA documents. Historical data was scanned by an external vendor; however, the hardware and software was purchased to provide a system going forward to image, index, and store documents electronically. The documents are stored on an internal network and can be accessed from any workstation (as defined). This created more laboratory time and increased the ability of the DNA staff to focus strictly on casework.

In summary, the initiatives included implementation of Lean Six Sigma principles; the purchase of equipment and tools needed to eliminate bottlenecks, streamline processes, and increase capacity; and an organizational structure that provides a concentrated focus of DNA staff on scientific tasks and casework related duties.

1.4 PROJECT GOALS

Grant goals were as follows:

- Reduce DNA case turn-around-time by 50%
- Double productivity
- Reduce DNA case backlog by 50%
- Increase the number of CODIS hits

Departmental Agency Goals were as follows:

- Eliminate the backlog
- Complete 100% of the cases submitted each year
- Decrease DNA forensic case turn-around-time to 60 days
- Increase the number of CODIS hits obtained

Purchasing LSS process goals were as follows:

- Decrease the average DNA purchasing process cycle time
- Change the mix of purchase types
- Decrease staff time spent performing purchasing tasks

1.5 SPECIFIC PROJECTS AND PURCHASES

1.5.1 Improve DNA Forensic analysis capacity and productivity

1.5.1.1 LSS Consultant- Forensic Analysis

A Request for Proposal competitive bid was conducted and Sorenson Forensics was awarded a professional services contract to conduct a project to process map the current forensic DNA process from receipt of evidence to analysis and reporting, provide measurable data to evaluate current productivity, identify “bottlenecks”, make recommendations and create a plan and assist in the implementation of the improvements adopted by the LSPCL. The vendor selected proposed a Lean Six Sigma method of accomplishing these goals. While some equipment was purchased, the primary focus of this project was consistent procedures, tight scheduling of tasks and the use of the resources without batching or waiting. Moreover, the project focused on modification of the culture of the work environment and the way day-to-day activities were conducted.

1.5.1.2 Equipment to increase Capacity

As productivity increased through the LSS project, the number of samples being analyzed in a given day increased. The “bottlenecks” moved and soon the extraction step became the new “choke point.” **Two EZ1 Advanced XL extraction robots, three thermocyclers, and four thermomixers** were added to increase capacity and decrease wait times. A 3130 genetic analyzer (4 capillary) was replaced with a **3130XL** (16 capillary) to increase analysis capacity. As capacity increased, the ability to add additional services, such as analysis of bone samples, was added. Previously the state lab for missing persons was outsourcing their casework, at an expense to the state. By purchasing **bone extraction equipment**, a bone analysis procedure was added as a new service. The state’s missing persons samples can now be transferred locally and analyzed at no cost to the state’s “sister” lab.

With more evidence moving through the lab in a given day, a need arose to have a location to dry evidence until processing, without taking up the space of a screening lab. **Two evidence drying cabinets** were purchased to facilitate this.

1.5.1.3 Dashboard Development

One of the critical phases of the LSS process is the Control phase. This is the last phase whereby improvements are sustained through the use of proactive management. Daily the productivity and pace of operations are measured, discussed and resources adjusted to keep the operational workflow steady. The data was being manually tallied and graphed and printed daily. While these were critical charts to be reviewed, it consumed training and report development. Large monitors were mounted in the production meeting area to visually display performance metric results, which were being imported and refreshed daily, electronically.

1.5.1.4 Validation Services

In order to keep the DNA analysts analyzing cases, validation services were outsourced for the quantitation and amplification set-up protocols for the Qiagility robots. Additionally, to expedite the use of the Prepfile extraction protocol for the extraction of buccal swabs and non-FTA blood card samples, the validation was outsourced. These were sole source purchases.

1.5.2 Leverage Technology

One of the LSS project improvements was to reduce the movement around the laboratory during steps and between steps to eliminate “motion” and “transportation” waste. **Barcode scanners, a datamax barcode printer, and desktop printers for CODIS** were purchased for this purpose. Additional equipment was purchased, as needed, using other available funding through the state and other grants.

Already addressed above, was the implementation of more robotic solutions, walk away work stations, and electronic data gathering and manipulation. Imaging technology is addressed in 1.5.3 Sustain with Clerical Time Savers.

1.5.3 Sustain with Clerical Time Savers

1.5.3.1 Formation of the Business Unit

Reorganization of the Crime Lab structure formed a Business Unit to assume the responsibilities of most administrative tasks. This allowed the DNA Analysts and Supervisors to focus strictly on forensic casework and technical operations. Staffing was with current staff who were already performing many of the functions already.

1.5.3.2 LSS Consultant- Purchasing of DNA Supplies

A professional service contract was engaged to conduct a second LSS project to increase the efficiency of the DNA supply and services procurement process. This project focus was to provide the DNA staff with the tools they needed to perform their duties without delay and with as little involvement in procurement as possible. With the assistance of the LSS Consultant, steps in the process were addressed to create an easier process and reduce the time from the time the analyst determined that a supply was needed to the product delivery. The net goal was to remove the scientists from engaging in purchasing tasks as much as possible.

1.5.3.3 Scanning Services & Software

The last professional service involved **the imaging of 310,625 historical documents** to create electronic records. The removal of shelves of binders freed up 600 feet of shelving space and 8 file cabinets to be used for additional DNA work space. More importantly it provides rapid availability of the records scanned. The images were scanned, indexed using **Kofax and Content Manager software**, (purchased with Efficiency Improvement Grant funds) and then uploaded to the network server, where staff can access the records as needed from their workstation. In addition to being scanned, all records were OCR processed to allow the “find” feature. Records scanned included the following:

- Quality control records for cases that had been outsourced to vendor labs using previous grant funds
- Analysts training records
- Instrument maintenance & reagent logs
- Validation studies
- DNA extraction, quantitation, and amplification worksheets
- CODIS data review documents
- CODIS sample collection logs and documents- accessed during the hit confirmation process when needed

In addition to contracting a vendor to scan the current records, a **high speed scanner** was purchased to facilitate the staff's continued efforts in generating electronic copies of records, as opposed to storing additional binders or file cabinets of paper. The high speed scanner allows all incoming or newly-created documents to be scanned,

indexed and filed electronically by clerical staff. The technical staff can then reference and provide the necessary documents rapidly and without leaving their workstation, thereby decreasing time needed for this administrative task.

1.5.3.4 Qualtrax Compare Module

Qualtrax Compare software was purchased as an enhancement to the Qualtrax software purchased with prior grant funds. This module allows for documents to be compared electronically with revisions flagged for the reviewer. This decreases the administrative time needed in comparing, reviewing and approving revised procedures, worksheets and policies. Because the DNA Technical Leader is primarily responsible for this function, it creates more time for casework related functions.

1.5.3.5 On-site Store Equipment

While barcode software, computer, and barcode scanners were supplied by the lab consumable vendor, **shelving** was purchased to facilitate the creation of an on-site store or warehouse for DNA supplies. The vendor performs the management of the store and the inventory tracking and refilling, with oversight by the Business Unit.

1.6 FINDINGS

All **Grant goals** were met. (Note: Goal figures were initially established based on statistics at the time of the grant application.)

Table 2: Grant goals

GOAL	Unit of Measure	TARGET	MARCH 2011
Reduce case turn-around time by 50%	Days	129	59
Double Productivity	Requests completed/month	100	175
Decrease Backlog by 50%	Requests	850	152
Increase # of CODIS Hits	Hits for last 12 months	>314	748

Agency goals were advanced as well, accomplishing 3 of the 4 goals stated:

Table 3: Agency goals

GOAL	Unit of Measure	TARGET	MARCH 2011
Eliminate the Backlog	case requests	0	152*
Complete 100% of the cases submitted annually	%	100	134.5%
Decrease TAT to 60 days	Days	60	59
Increase # of CODIS Hits [^]	# hits	580 FY0809	694 FY0910

*While the backlog is not eliminated completely, LSPCL is internally changing the definition of a “backlogged” case. Historically, LSPCL has considered any request that was received in the laboratory, but not yet reported as a “backlogged” case. Now that the workflow is so much more efficient, LSPCL is evolving to a new definition of backlog based on the new increased capacity. Current backlog is 152 requests, with only 8 requests that were received prior to January 2011 (>90 days). If current capacity is 160 requests per month, then the 152 requests are not truly backlog.

[^] Measured by fiscal year (from July 1 to June 30)

All **Purchasing LSS process goals** were met:

Table 4: DNA Purchasing LSS goals

PURCHASING GOALS	Unit of Measure	BEFORE	TARGET	MARCH 2011
Decrease Purchase Cycle Time	work days	40	10	7
Change the mix of purchase types in order of ease of processing (Onsite store/ Lacarte/ Blanket Order/ Purchase Order)	purchases	0 / 75 / 1 / 24	50 / 35 / 10 / 5	73 / 24 / 2 / 1
Decrease staff time spent performing purchasing tasks	Hours/ week	DNA = 21.75	DNA = 5	DNA = 6.93
		Crime Lab = 137.80	Crime Lab = 35	Crime Lab = 58.05

1.7 ADDITIONAL PROGRESS ACHIEVED (not funded by the Efficiency Improvement Grant)

Described earlier as Level 1 and Level 2 initiatives, there were additional activities that occurred during the grant period, that were not **funded or within the scope of the Efficiency Improvement Grant**, but that contributed to the achievement of the grant goals.

LEVEL 1	LEVEL 2
<p>COMMUNICATION</p> <ul style="list-style-type: none"> • Cancel unneeded cases • Prioritize backlogged cases • Ensure complete submissions • Equip agencies for easier future submissions 	<p>OUTSOURCE</p> <ul style="list-style-type: none"> • Casework • Training of new DNA analysts • Transfer screening to Techs

Because they contributed to the overall success of the performance metrics, it is important to mention them. It is difficult to separate the statistical benefit of these efforts from those of the grant projects, as they were all occurring simultaneously. They are discussed below, along with progress achieved in these initiatives.

Communication

LSPCL increased communication with the submitting agencies and judicial entities that submit evidence and are the customers of the reports that are released, including district attorneys and investigators. Customer meetings were conducted with agencies to review the cases in the backlog (through a list generated from the Lab Information Management System, Justice Trax). Each agency was asked to review the case list and indicate whether the case had been solved, closed, or otherwise no longer needed DNA analysis. Cumulatively, hundreds of DNA cases were cancelled from January 2009 to March 2011, as a result of this review project. Today when an agency submits a case for DNA analysis, the case submittal is reviewed at the time of submission. The DNA management team is notified and immediately provides consultation with the submitting agent. This eliminates the need for future communication and allows cases to be assigned without delay. Unable to easily measure the benefit, it is estimated that previously 10-20% of the time spent on a DNA case, by a DNA analyst, could be attributed to communication activities simply to ready a case for analysis.

A new DNA submittal form was created for agencies to use to prioritize their most probative evidence. This supplemental DNA form provides specific DNA information, which had previously been obtained through countless phone calls and email reminders. Through the use of the new form, agencies were asked to prioritize and limit evidence submitted to 5 items for initial testing. Additional information blanks were provided such that investigators could indicate provide notes as to the origin of the samples for determining CODIS eligibility.

Outsource

Outsourced DNA Cases

Included in the backlog numbers were 1000 forensic DNA cases that were outsourced using grant and state funding. The 2004, 2005, and 2006 Backlog DNA grants, as well as the 2007 Backlog Capacity grant, funded much of the outsourcing of forensic DNA cases. In addition, state funding supported outsourcing in 2008, 2009, and 2010. The Efficiency Improvement grant funds were not used for outsourcing. However, while the outsource analysis reduced the analysis backlog, it did create a new backlog of cases to be technically and administratively reviewed. One project, or “kaizen event,” of the LSS project was to “burn down the backlog of review” before a process improvements could be made. The backlog statistics include the cases that were outsourced because they were considered backlog until reported. The backlog statistics reported to the NIJ and to Department of Public Safety Performance Monitoring included all cases received by the Crime Lab, but not yet reported.

Outsourced DNA Training

During the grant period, several DNA analysts were hired using state and other grant funds. The analysts were in training during the entire grant project. Some of the new DNA analysts were trained by an external vendor, off-site, reducing supervisor time needed to train the new staff. The training provided theory and practical laboratory analysis labs. In-house training was still required, but not to the level or time commitment that it would have been without this outside professional assistance.

Outsourced Validations

The Qiagility for sample set-up for the genetic analyzer was paid for by other funding. The use of this robot doubled the productivity for the CODIS laboratory. The validation of the Tecan robot also led to an expedited process of CODIS analysis such that the CODIS laboratory is now working samples in-house, as well as outsourcing. The Tecan validation included the validation for the Identifiler Direct procedure, which eliminated the quantitation step of analysis, thereby shortening analysis cycle time. These validation projects were all funded by other grants.

Other Activities

Staffing

Other grants were used to fund additional temporary positions, including five DNA technician positions. Several local law enforcement agencies invested in additional DNA analyst positions. These analysts are employees of the various agencies, but they are trained and work at the LSPCL, primarily on cases for the agency that is funding their position. The agencies that hired the new analysts paid for their analyst's off-site training. The new analysts spent the grant period in training. The technicians were trained and competency tested to perform maintenance and quality control steps, as well as to screen evidence. Initially the technicians worked side-by-side with analysts, but now they are fully trained and competent and work alone. They are now screening as part of the workflow, but were not at the time the grant metrics were measured.

Equipment Purchases

Equipment was purchased, through funding of other grants and state funds, such as 4 EZ1 robots, 3 Qiagility robots, 1 Tecan robot, 2 BSD punchers, 2 AB 7500 Quantitation instruments, thermomixers, barcode label printers, barcode scanners, desktop scanners, computers, wipe erase boards and refrigerator/freezers. These were important elements to increasing capacity and implementing changes as part of the LSS project.

1.8 SUMMARY STATEMENT

The changes made possible through this grant changed the culture of the DNA Forensic Unit and LSPCL as an organization. The LSS projects provided a platform to make the equipment, personnel and services more effective. LSS principles created production oriented, efficient processes that require accountability. The LSS foundation, to produce quality results at a pace that more than meets the customer's expectations, has opened the possibility of increased services and increased performance goals for the department. It was shown that LSS can be used to improve a technical operation or a clerical process. The future at LSCPL includes LSS projects in all other disciplines of the lab. While DNA is an ever-changing industry, foundational principles were developed and tools were provided that will allow the LSPCL to operate efficiently and effectively, regardless of changes in the industry of Forensic Science. Whatever the new challenge, be it increased submissions or a changing technology, LSS practices will reveal opportunities for improvement, provide for adjustment, and seek a new goal of excellence. The law enforcement agencies, judicial offices, and the public-at-large are better served today because of this grant project.

SECTION 2: TECHNICAL REPORT

2.1 INTRODUCTION

Louisiana State Police Crime Laboratory (LSPCL) is the state funded governmental crime laboratory for Louisiana. LSPCL assists federal and local criminal justice and law enforcement agencies in the DNA analysis of forensic evidence submitted as the result of criminal investigations. While various municipalities support six other labs around the state, most of which also conduct DNA forensic casework, LSPCL serves the entire state. Since the creation of the DNA forensic unit in 2000, there was a backlog of cases due to the collection of evidence in prior years, in anticipation of DNA analysis.

While the number of DNA requests for analysis had increased every year (44.7% more for 2009 compared to 2008), the throughput of casework analysis did not increase proportionately, leaving a backlog of forensic cases needing analysis. See Figure 6 and 7.

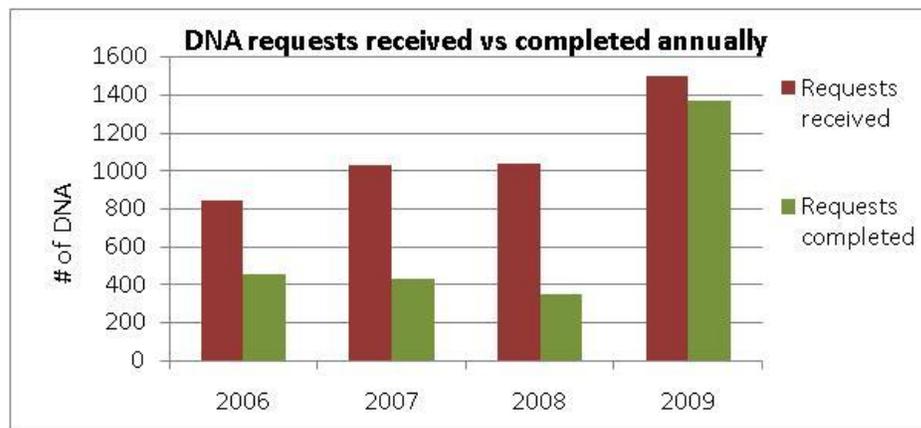


Figure 6: LSPCL DNA requests received and completed annually 2006-2009

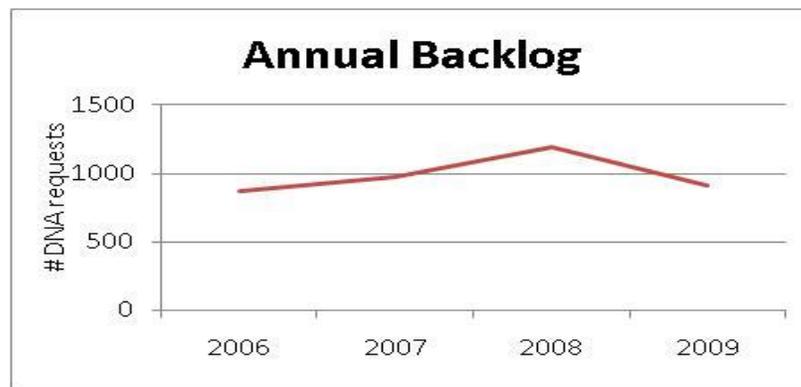


Figure 7: LSPCL Backlog by Year 2006-2009

At LSPCL, the turn-around-time (TAT) is defined as the number of work days that elapse from the date the DNA request is submitted to the LSPCL laboratory to the date the forensic DNA report is released to the agency. In May 2008, TAT was 291 workdays.

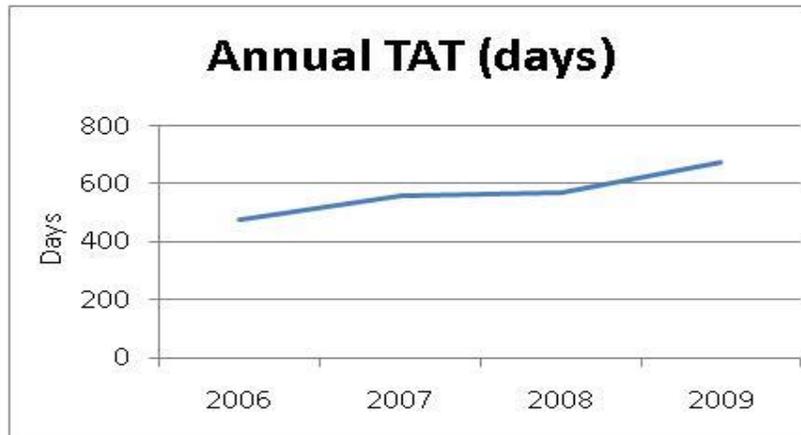


Figure 8: LSPCL Turn-Around-Time by year 2006-2009

In that same year, 2008, LSPCL applied for the DNA Efficiency Improvement Grant.

LSPCL was faced with increasing DNA submittals, increasing turn-around-times, and thus an increasing backlog of DNA cases. See Table 5. At the end of 2009, LSPCL had completed approximately 60% of the cases received over the last four years, yielding a backlog of over 900 cases. While awarded in October 2008, the LSPCL spent 2009 utilizing other grants and planning for Efficiency Improvement Grant spending. The first Efficiency Improvement Grant purchases and projects began in 2010.

Year	# of DNA requests received	% Increase in # of DNA requests from previous year	# of DNA requests completed	% DNA requests completed	TAT*	Backlog as of Dec 31	# of caseworking FTEs
2006	843	-0.6%	458	54%	476	876	11
2007	1032	22.4%	433	42%	561	970	11
2008	1037	0.5%	350	34%	568	1194	8
2009	1501	44.7%	1374	92%	676	910	14
2010	1317	-12.3%	1771	134%	287	286	16+4 trainees

Table 5: Note: Numbers may differ slightly from previously reported statistics due to cancelled requests.

*TATs include cases worked in-house as well as those cases that were outsourced, including quite a few cold cases.

As Figure 9 shows, the number of requests completed varied based on the number of trained analysts. The variation in analysts was partly due to staff turnover and the gap that resulted from the loss of trained analysts. The time needed to train the replacement staff was lengthy due to the complicated nature of the training and the FBI Quality Assurance Standard requirements. While the number of DNA staff at LSPCL is currently 20 FTEs, in 2007 the number was only 11. In 2008, a loss of 3 staff members resulted in a 27% decrease in staffing and a resulting 8% drop in completion rate. Time spent training new staff took analysts away from casework and contributed to backlog growth. While staffing directly affects the capacity to complete cases timely, LSPCL sought to develop a system that was not as critically dependent on staff turnover.

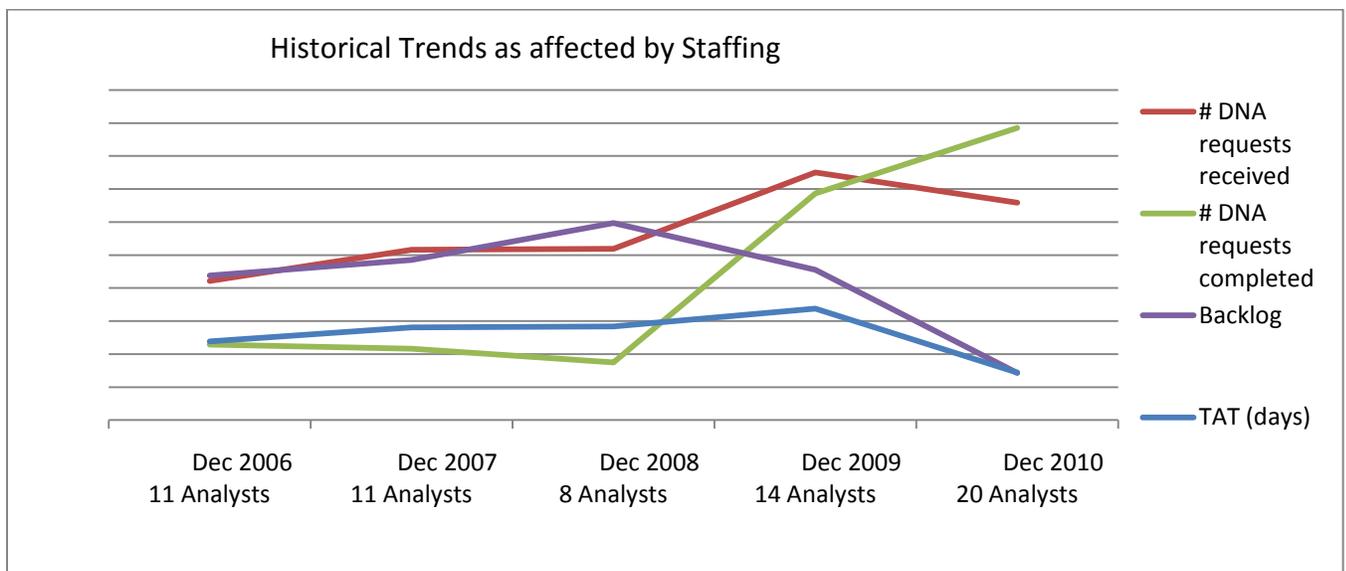


Figure 9: Historical trends as affected by Staffing

Louisiana’s Strategic Operational Plan for 2013 includes a performance goal of the completion of 85% of all DNA requests within 60 days. In 2008, only 4% of the DNA requests were completed in this time frame. A goal of the grant project was to position the DNA Unit to achieve this performance standard as well.

The Louisiana Legislature enacted La. R.S. 15:601-620 to establish a DNA database of biological samples submitted by certain offenders. The DNA database is searched against the profiles obtained from evidence samples to yield investigative leads for law enforcement. The Louisiana DNA database houses over 400,000 DNA profiles, which yielded over 750 hits in 2010 alone. The ability to process more forensic evidence would thereby increase the number of hits obtained.

Outsourcing casework to vendor labs (through other grant and state funding) provided some relief, with over 1000 cases outsourced in 2009. While outsourcing was an effective method of substantially reducing the backlog while new analysts were being trained, this was not a permanent solution as this was funded by federal and state funds that were not necessarily a recurring resource. With 327 cases still needing analysis, there was a need to increase the capacity and efficiency of the internal forensic case working laboratory to complete the cases, sustain capacity, and prevent the formation of additional backlog.

One of the distractions to the laboratory analysis of backlogged cases was the need for the DNA analysts to complete tasks other than labwork. Analysts were required to assist or carry out the purchase of supplies. Time was spent searching vendors and pricing for supplies needed, obtaining quotes and submitting paperwork. Many times the documents were not complete, according to state purchasing regulations, and had to be returned for rework and resubmission. Time was spent responding to legal requests for documents, which required analysts to search for the paper records, make copies or scan and send the requested information to the requesting agency, many times with little lead time. Time was taken from the review of casework for Managers and Supervisors to apply for, manage and document progress of federal grants and for inventory and budget management. Preparations for accreditation inspections required a great deal of staff time to gather binders of lab documents for auditors to review. A great deal of technical staff time was spent performing these administrative tasks.

With regard to the purchasing process, most of the DNA day-to-day supplies were ordered via state contract vendors or through standing orders with specialty vendors that were renewed annually. In general standing orders were placed quarterly and could take 4-6 weeks to be delivered to the laboratory. During the process, if a supply was exhausted, the supervisor could request that a Crime Lab Manager make a credit card purchase for up to \$1000. Anything not on standing order, required that an order be routed through the state's purchasing database process, known as ISIS. Purchase orders were issued and the vendor was notified of the purchase order and the supplies were shipped. Standard practice was that the DNA Unit keep at least 3 months worth of supplies on hand due to lengthy purchasing procedures. During the course of the request to delivery, it was not uncommon for the DNA analysts to have to send several emails as to the status of the requested supply. All emails were routed through their chain-of-command, so a minimum of 3-5 emails per inquiry was not uncommon. In addition, if the analyst was requesting an item not ordered in the past, the analyst was asked to shop the item, its features and give the supervisor the pricing, detailed specifications of the desired supply, and, depending on the cost of the item, several sources where the item might be purchased. In addition to the lengthy process to get the order submitted to the ISIS system, all purchases required approval through the administrative chain-of-command and then to the

Procurement Division for research and issuance of the purchase order. Figure 10 shows data of the turn-around-times (TAT) of a sampling of Crime Lab purchase requests from request submittal (with all pricing, specifications, and order documents) to the issuance of a purchase order, showing the average TAT of 39 workdays to PO issuance.

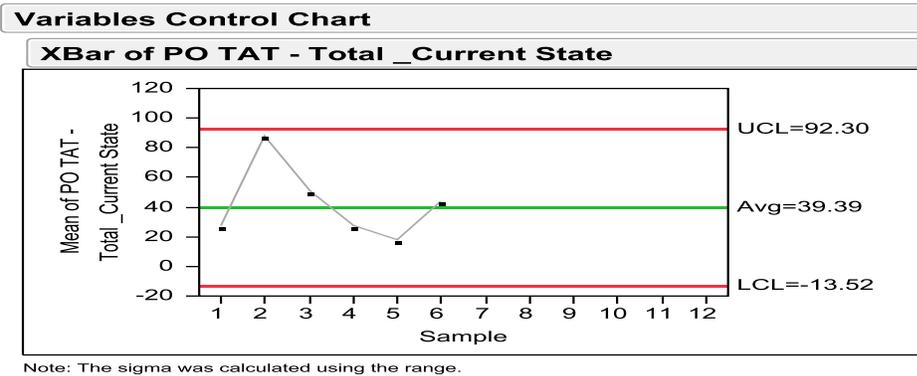


Figure 10: Current State Purchasing TAT

While the average purchase order process TAT was 39 workdays (approximately 8 weeks), the variability in the process was so great that the range could mean that a purchase could require as long as 92 workdays (over 4 months). During the “wait time” much analyst, supervisor and manager time was spent checking status, causing a distraction to the technical laboratory work of casework.

In an effort to improve the service provided to clients, Louisiana applied to a competitive solicitation offered by the U.S. Department of Justice, Office of Justice Programs, National Institute of Justice (NIJ) and was awarded grant funds to complete the Forensic DNA Unit Efficiency Improvement project.

2.2 METHODS

The methods used in this multi-generational project were divided into three cohorts which overlapped: Improve the DNA Forensic Analysis capacity and productivity, Leverage Technology, and Sustain with Clerical Time Savers. The following outline organizes the various projects and purchases within the purposes they served and are described in detail below.

2.2.1 Improve DNA Forensic analysis capacity and productivity

2.2.1.1 LSS Consultant- Forensic Analysis

2.2.1.2 Equipment to increase Capacity

2.2.1.3 Dashboard Development

2.2.2 Leverage Technology

2.2.2.1 Validation Services

2.2.2.2 Equipment and Supplies

2.2.3 Sustain with Clerical Time Savers

2.2.3.1 Formation of the Business Unit

2.2.3.2 LSS Consultant- Purchasing of DNA Supplies

2.2.3.3 Scanning Services & Software

2.2.3.4 Qualtrax Compare Module

2.2.3.5 On-site Store Equipment

2.2.1 Improve DNA Forensic analysis capacity and productivity

LSPCL hired an external consultant to lead the organization through a process mapping improvement project.

2.2.1.1 LSS Consultant- Forensic Analysis

LSPCL's approach to the project included hiring a consultant to:

- Gather baseline data and an understanding of current processes
- Provide process mapping documentation
- Recommend improvements in administrative processes, personnel management, equipment, technology tools and use of all available resources in providing efficient case file management and performance monitoring of all phases of analysis
- Assist the LSPCL staff and management in implementing accepted recommendations
- Assist the LSPCL staff and management in developing management tools to institute performance standard for the analysts and the DNA Unit as a department
- Provide measurable results
- Adjust process improvements as needed to meet performance metric goals as defined below
- Provide a report that details the efficiency improvement methodologies as a model to be considered by other forensic science laboratories.

A request for proposal competitive bid was conducted and Sorenson Forensics was awarded a professional services contract to conduct a project to process map the current forensic DNA process from receipt of evidence to analysis and reporting, provide measurable data to evaluate current productivity, identify "bottlenecks", make recommendations and create a plan and assist in the implementation of the improvements adopted by the LSPCL. The vendor selected, Sorenson Forensics, proposed a Lean Six Sigma method of accomplishing these goals.

Sorenson Forensics Background

Sorenson Forensics, LLC is an internationally accredited (ASCLD/LAB-*International*) private forensic DNA laboratory and consulting company located in Salt Lake City, Utah. Their scientists have diverse experiences obtained from federal, state and local crime laboratories, other private DNA laboratories as well as clinical and academic laboratories. They had expertise in all STR and Y-STR chemistry kits, mtDNA sequencing, every available Quantification kit, and all common instruments used in a forensic DNA laboratory, including liquid handling robots from a variety of manufacturers. Sorenson Forensics employed highly experienced and capable robotic

engineers, process engineers and bioinformatics software development engineers. Sorenson Forensics is a private forensic DNA laboratory with a client base that spans the United States, Asia, Africa, Europe and the Middle East. Sorenson Forensics offered its Executive Director, Tim Kupferschmid as the forensic DNA subject matter expert to head this project. Additionally, Sorenson Forensics offered its long-term Lean Six Sigma Master Black Belt consultant Mr. Dirk Hooiman as the Lean Six Sigma subject matter expert.

Tim had spent his twenty-year career upgrading current and building new forensic DNA laboratories. Tim had recently earned his Six Sigma Green Belt from a project he and his team completed for Sorenson Forensics last year. Tim provided the forensic laboratory experience that was needed to support the technical recommendations.

Dirk Hooiman had over 35 years' experience in leading companies in the improvement process. He was experienced in working with private, military and other public sectors. Dirk was certified by GE and Motorola as a *Six Sigma Master Black Belt* and *Certified in Lean* through Boeing and a *Master in the Toyota Production System* through Yamaha University. His most notable educational experience was studying directly under W. Edwards Deming, Ph.D. and Yamaha University in Japan in the Toyota Production System. His studies have included Organizational Development and Change Management, which are a critical element to assuring longevity in improvement. Additionally he has multiple certifications through the American Society of Quality and the University of Tennessee at the College of Productivity Improvement.

Goals

By utilizing the contractor's recommendations, the goals were as outlined in the awarded grant program, while maintaining or improving the current level of quality and accreditation status.

The goals were:

- Reduce case turn-around-time by 50%
- Double productivity
- Reduce case backlog by 50%
- Increase the number of CODIS hits

Additionally, LSPCL, by utilizing the Contractor's recommendations, expected to develop management tools to institute performance standards for the analysts and the DNA Unit as a department.

Project Timeline

Feb '10	Mar '10	Apr '10	Jun '10	Sep '10
Project Analysis Defined Designed	Project Development: Measure/Analyze	Project Implementation: Transition phase	Project Evaluation Improvements deployed	Adjust & Reevaluate metrics

Figure 11: Forensic DNA LSS Timeline

Lean Team

A team of seven managers and forensic scientists from LSPCL worked with Tim Kupferschmid and Dirk Hooiman, the consultants from Sorenson Forensics, over a period of six months. The LSPCL team consisted of: Layne Barnum, Laboratory Director (at that time); Melinda Richard, DNA CODIS Manager and Project Team Leader; Adam Becnel, Crime Laboratory Manager; Joanie Wilson, Ph.D., DNA Casework Manager; Alyson Saadi, DNA Technical Leader; Jeremy Dubois, DNA Analyst; and Erica Sparacino, DNA Analyst. Additional employees of Sorenson that assisted with the project were Anthony Carter, Ph.D., Paternity Laboratory Director, Kevin Day, Ph.D., Director of Operations and Chris Harmston, MS, Director of Quality and Applied Technologies.

Lean Six Sigma (LSS)

The method approach, for both the Forensic DNA and DNA Purchasing projects, was Lean Six Sigma. Lean Six Sigma can be applied to any process or any industry. LSPCL used this methodology to enhance both a technical scientific process and an administrative clerical process. The DMAIC steps guide the improvement process through specific activities. Using the DMAIC steps ensures that the customer’s needs are met, quality is maintained, and goals are achieved.

DMAIC is an acronym for Define, Measure, Analyze, Improve and Control. By systematically applying LSS principles and foundational principles, a system can be revised to be productive and efficient, removing waste. While numerous tools exist (too many to describe here), some are more appropriate than others, as dictated by the process being improved. There are some tools that are common to all LSS projects. Those fundamental tools are included in the discussion that follows.

Lean Six Sigma is the unique combination of Lean Thinking and Six Sigma process improvement to form a thorough and comprehensive approach to quality improvement, process improvement and the elimination of waste to produce a remarkably efficient and quality driven product, the crime laboratory forensic DNA analysis report.

Introducing Lean Thinking. Lean thinking focused on enhancing value for the customer by improving and smoothing the process flow while simultaneously reducing turnaround time and eliminating waste. Lean thinking has been around since Henry Ford's first production line, but it has been developed and refined by the Toyota Production System. Toyota took Henry Ford's original idea of high volume/low variety and applied it to high variety/low volume processes. It is called "lean" not because it slashes costs or is stripped to the bone, but because it reduces the timeline from when a customer places an order (or submits a piece of evidence) to when the customer receives the product (final case report). It does this primarily by eliminating and reducing non-value added waste. In summary, Lean is:

- A methodology to understand process value from the viewpoint of the customer and eliminate waste – those activities that don't add value for the customer.
- A methodology to increase throughput and create a continuous flow of value-adding activities without adding additional resources.

Introducing Six Sigma. Six Sigma is a systemic approach to quality improvement. Six Sigma focuses on the customer and other key stakeholders. Six Sigma implementation calls for changing the way we think about and manage the organization. In fact, it requires a complete organizational cultural change. Six Sigma cannot be implemented immediately, but over time by working through a number of steps and processes. When Jack Welch, former CEO of General Electric, introduced Six Sigma to his company, he understood this cultural change: "We are going to shift the paradigm from fixing products to fixing and developing processes, so they produce nothing but perfection or close to it." In summary, Six Sigma is:

- A rigorous performance improvement approach,
- A customer-focused, data-driven methodology to understanding process variation and process capability,
- Supportive of ISO/IEC 17025:2005 quality systems through superior process management, tools and sustainability controls.

Lean and Six Sigma together are complimentary – eliminating variation, defects and waste while creating high quality, continuous and value-added flow. This approach is used in all industries from toaster manufacturers to service providers such as banks and accountant offices. Some special considerations for forensic laboratories included our unique accreditation and documentation requirements, our unique input (criminal evidence) and our unique customer requirements. This project's emphasis was on ensuring that process re-engineering identified workflow changes that generate measurable performance improvements and that the constraints of forensic scientists, processes, machines and technology are assessed.

The combination of Lean thinking and Six Sigma variation reduction, when merged together, form seven guiding principles. The principles are (1) focus on the customer, (2) identify and understand how the work gets done, (3) manage, improve and smooth the process flow, (4) remove non-value added steps and waste, (5) manage by fact and reduce variation, (6) involve and equip the people in the process, and (7) undertake improvement activity in a systematic way.

DMAIC Methodology. DMAIC is the acronym that describes the seventh principal. It is a systematic improvement framework, and it is the framework that the Sorenson Forensics / LSPCL team followed to make dramatic efficiency improvements. DMAIC stands for Define, Measure, Analyze, Improve and Control.

DEFINE: The Project Charter determines the project goals and scope based on the customer needs and the processes that need to be improved.

- Output: Project Charter and Business Case, Current State Process Map, SIPOC Chart, and other tools

MEASURE: Data is gathered that measures all of the details and timing of the current processes to establish a performance baseline.

- Output: Detailed Identification and Measurements of Value-Added and Non-Value Added Activities. Queue Time and Process Time measured, identification of predictive measures (process measures) and lagging measures (the output of the process). Development of a Load Balance Chart.

ANALYZE: The Analyze Phase focuses on analyzing the data collected during the Measure Phase and investigating the causes of the problems, bottlenecks, backlogs and defects uncovered during the previous two

phases. The Team was able to use a Load Level Chart to know where to focus improvement efforts. Hypothesis testing of the Root Cause(s) is done. The team begins to see where to focus the improvements.

- Output: Validated Root Cause(s) and “Future State” Process Maps

IMPROVE: Design, build and implement a new process which improves performance as defined by the project charter. Develop, implement and evaluate the solutions targeted at the verified root cause(s). All of the data collection and analysis previously conducted makes the new process simple to visualize. The Improve Phase was performed in three distinct segments that occurred in 3 months: design the new process (1 month); build the new process (1 mo) ; and implement the new process (1 mo pilot).

- Output: 5S, Test and Learn to confirm the solution produces performance that meets the target

CONTROL: Ensure that the problem stays fixed and the new processes can be further improved over time. Control phase is a management system that monitors process variables and performance measures. It enables management to act based on statistical signals and behaviors to drive a culture that sustains the new system promoting continuous improvement

- Output: Production Meetings, GEMBA walks, CAPA Charts, Process Management Plan; Control Charts; Management Dashboard

The Control phase is the most important phase in the process. The lack of a “control” phase is why many other management / process improvement methods have failed to achieve their promised results. The control phase ensures that the improvements’ gained are maintained.

2.2.1.2 Equipment to increase Capacity

Two EZ1 Advanced XL extraction robots, three thermocyclers, and four thermomixers were added to increase capacity and decrease wait times. A 3130 genetic analyzer (4 capillary) was replaced with a **3130XL** (16 capillary) to increase analysis capacity **Two evidence drying cabinets** were purchased to facilitate this.

2.2.1.3 Dashboard Development

A software program, **iDASHBOARDS**, was purchased to create visual graphics to display the performance metrics. The program refreshes the data periodically through interfaces with the LIMS system, Justice Trax, or any other database it is “pointed” to, including Excel spreadsheets. As part of the purchase, on-site training and report design

and development were contracted. Large monitors were mounted in the production meeting area to visually display performance metric results, which are imported and refreshed daily, electronically.

2.2.2 Leverage Technology

2.2.2.1 Validation Services

In order to keep DNA analysts analyzing cases as well as implement robots and liquid handling instrumentation, purchased by other grants and state funding, **validation services were outsourced** for the quantitation and amplification set-up protocols for the Qiagility robots and the validation of the TECAN robot for Prepfil extraction protocols, for the extraction of buccal swabs and non-FTA blood card samples.

Qiagility Validation

In an effort to reduce the amount of time and supplies that DNA analysts spend pipetting samples for the quantitation, amplification and genetic analysis, and to increase the accuracy of pipetting, LSPCL purchased three Qiagility robots, using other federal grant funds. In order to implement the use of the robots, without casework interruption, validation services were purchased for the validation of two Qiagilities (purchased using other grant funding) for quantitation and amplification setup. Applied Biosystems' validation services provided all consumables for the validation analysis, performed the validation of the robots, provided statistical data and the review and evaluation of the data, investigated any outliers in the data, and provided teachback training of all validation protocols, procedures and data. The third Qiagility (for genetic analysis set-up) was validated (using another federal grant) for the process of validating a new Tecan robot for CODIS procedures.

Purchasing approval was obtained to use Applied Biosystems as the vendor. The objective of this validation was to evaluate the QIAgility™ Robotic Workstation Serial Number (SN) Q050940 for PCR set-up, utilizing the Quantifiler® Duo DNA Quantification Kit and AmpFISTR® Profiler Plus®, COfiler®, MiniFiler™, and Yfiler® Amplification Kits. Validation studies were done in accordance with SWGDAM guidelines, and included a Quality Metrics Study, Contamination Study, Precision Study, Sensitivity Study, Concordance Study, and Reproducibility Study. Sixty-eight Quantifiler Duo standard curves (34 human and 34 male) were assessed for slope, y-intercept, and R² values. A total of 34 standard curves were generated by standard dilutions prepared by the QIAgility, and 34 were prepared manually. The QIAgility and manually generated data were compared to demonstrate reliable pipetting of standard can be achieved by the QIAgility. Contamination was assessed by running 36 non-template controls in a checkerboard and zebra pattern on the Quantifiler Duo quantification plate, and 44 negative amplification controls in

a checkerboard and zebra pattern on a Profiler Plus amplification plate. The Precision Study compared the average Ct and standard deviation for all standard dilutions prepared manually versus on the QIAgility. A total of 10 data points for each dilution (i.e. 10 50ng, 10 16.7ng, etc) were compared for manually generated standards, and 10 data points for each dilution were compared for QIAgility prepared standards. The Sensitivity Study assessed the 34 standard curves for the average quantity and Ct values when each standard was defined as "unknown." The Sensitivity Study also compared the average RFU between 44 non-probative samples amplified with Profiler Plus manually versus on the QIAgility. The Concordance Study compared 44 non-probative buccal samples amplified with Profiler Plus manually versus on the QIAgility for concordant STR profiles. Additionally, 50 non-probative samples were amplified using the QIAgility using Profiler Plus and were compared to previously generated STR profiles for concordance. Twenty-five of those samples were amplified with COfiler, MiniFiler, and Yfiler using the QIAgility and were compared to previously generated results, as well as each other (where possible) for concordance. A total of 94 non-probative samples (44 non-probative buccals and 50 non-probatives) were compared for the reproducibility of the quantification results when quantification was done manually versus using the QIAgility.

Prefiler Validation

In an effort to reduce the amount of time and supplies that DNA analysts spend pipetting samples for extraction of buccal swabs (CODIS offender and suspect references) and non-FTA bloodcard samples (as collected from victims of sexual assaults), and to facilitate the processing of samples by the Tecan robot, in plates instead of tubes, LSPCL purchased a Tecan robot (using other federal grant funds). In order to implement the use of the robot for these sample types, without interruption to the analyzing of samples by the DNA Analyst, validation services were purchased from Applied Biosystems to provide all consumables for the validation analysis, perform the validation of the Prefiler extraction, using the Tecan robot, provide statistical data, containing the review and evaluation of the data, investigate any outliers in the data, and provide teachback training of all validation protocols, procedures and data. Applied Biosystems' validation services were purchased to validate two sample types using the Prefiler extraction kit. The other CODIS sample types, FTA bloodcards and the Bode buccal collector, were validated with Identifiler Direct using other grant funding. However, due to the Identifiler Direct methodology, these sample types (buccal swabs and non-FTA bloodcards) required another extraction step. Prefiler was chosen as the method of extraction, hence a second validation for these two sample types was needed.

Purchasing approval was obtained to use Applied Biosystems as the vendor. A script verification was performed extracting 16 buccal swabs in a checkerboard pattern to verify the script was functioning properly with no cross-contamination. A contamination study was performed using 2 different extractions. On one plate, 40 high quality swabs were extracted with 40 reagent blanks in a checkerboard pattern; in another plate 40 high quality swabs were extracted with 40 reagent blanks in a zebra pattern. Forty bloodstains (10 samples punched 4 times each) were extracted, normalized, and amplified with Profiler Plus & COfiler and compared to previously generated results for concordant profiles. The replicate samples were also compared to each other for concordance.

2.2.2.2 Equipment and Supplies

One of the LSS project improvements was to reduce the movement around the laboratory during steps and between steps to eliminate "motion" and "transportation" waste. **Barcode scanners, a Datamax barcode printer, desktop scanners, and desktop printers for CODIS** were purchased for this purpose. Additional equipment was purchased, as needed, using other available funding through the state and other grants.

Already addressed above, was the implementation of more robotic solutions, walk away work stations, and electronic data gathering and manipulation. Imaging technology is addressed in 2.2.3 Sustain with Clerical Time Savers.

2.2.3 Sustain with Clerical Time Savers

2.2.3.1 Formation of the Business Unit

Reorganization of the Crime Lab structure formed a Business Unit to assume the responsibilities of most administrative tasks. The intent was to allow the DNA Analysts and Supervisors the time to focus strictly on forensic casework and technical operations. The Business Unit was staffed with current staff, who were already performing many of the functions already.

2.2.3.2 LSS Consultant- Purchasing of DNA Supplies

A professional service contract was engaged to conduct a second LSS project to increase the efficiency of DNA supplies and services procurement process. This project focus was to provide the DNA staff with the tools they needed to perform their duties without delay and with as little involvement in procurement as possible. With the assistance of the LSS Consultant, steps in the process were addressed to create an easier process and reduce the time from the determination of the supply need to the product delivery. The net goal was to remove the scientists from engaging in purchasing tasks as much as possible.

LSPCL's approach was to hire a consultant to:

- Use the Lean Six Sigma (LSS) methodology to define the current state, make a business case for the need for improvements, gather baseline data and process map the purchasing process from request to issuance of a purchase order
- Make recommendations for improvements to the process through personnel management, procedures, equipment, technology tools, and use of all available resources in providing efficient purchasing management and performance monitoring of all phases of the purchasing process.
- Assist the LSPCL staff and management in the implementation of accepted recommendations to increase efficiency and meet performance metric goals of the project. Any policies and procedures

implemented will be compliant with the Federal Bureau of Investigations (FBI) DNA Quality Assurance Standards (effective July 1, 2009) and American Society of Laboratory Directors Laboratory Accreditation Board International Program (ASCLD/LAB- International) requirements) and current Louisiana State Police and LSPCL lab policy.

- Assist the LSPCL staff and management in developing management tools to institute performance standards for the department
- Assess data and provide measurable result data
- Adjust processes as needed to meet performance metric goals as defined
- Provide materials, instruction and testing to certify an LSPCL staff member as a Lean Six Sigma Black Belt Engineer.
- Provide a final report that details the efficiency improvement methodologies as a model to be considered by other forensic science laboratories

The LSS Black Belt Engineer designation is a title given to an individual who has shown a level of expertise that allows them to lead future LSS projects. To accomplish this level of certification (in LSS's internal structure) the individual must pass a certification exam, complete a project that yields at least \$100,000 in savings and be approved, by the Master Black Belt Instructor, as having designed, launched and executed a LSS project(s) with leadership skills and project management that is worthy of the highest level of certification. A certification exam is also administered. Having their own internal Black Belt Engineer provides LSPCL the ability to conduct additional projects throughout, not only the Crime Lab, but the entire Department. The goal was to increase the efficiency with which the DNA Unit interacts with other departments, as well as globally enhance the way Louisiana does business within state government.

CTQ Consulting Group Background

CTQ Consulting Group works with clients to improve their performance results and ROI (return on investment) through the use of LEAN Six Sigma Engineering. CTQ is an abbreviation of the Six Sigma phrase "Critical to Quality" and describes the process of improving customer delight through process design, execution and

measurable results. Kathi Sill, President of CTQ Consulting Group, has been certified as a Lean Six Sigma Master Black Belt Engineer since 2009 and Lean Six Sigma Black Belt Engineer since 2004. Ms. Sill had recently completed a Process Efficiency Mapping Project at the South Carolina Law Enforcement Division (SLED, Columbia, SC). As a result of this project the SLED laboratory was able to achieve a 78% improvement in DNA casework turnaround time. In addition to HID laboratories, CTQ has also worked with clients in the Manufacturing, Financial, Political, Biotech and Retail industries. Prior to founding CTQ Consulting Group, Ms. Sill enjoyed a 30 year career with Bank of America, retiring as a Senior Vice President of the Corporation and as the Quality and Productivity Executive. While the last 10 years of her career centered in Six Sigma Process Improvement, her first 20 years were spent driving revenue, sales management and customer satisfaction.

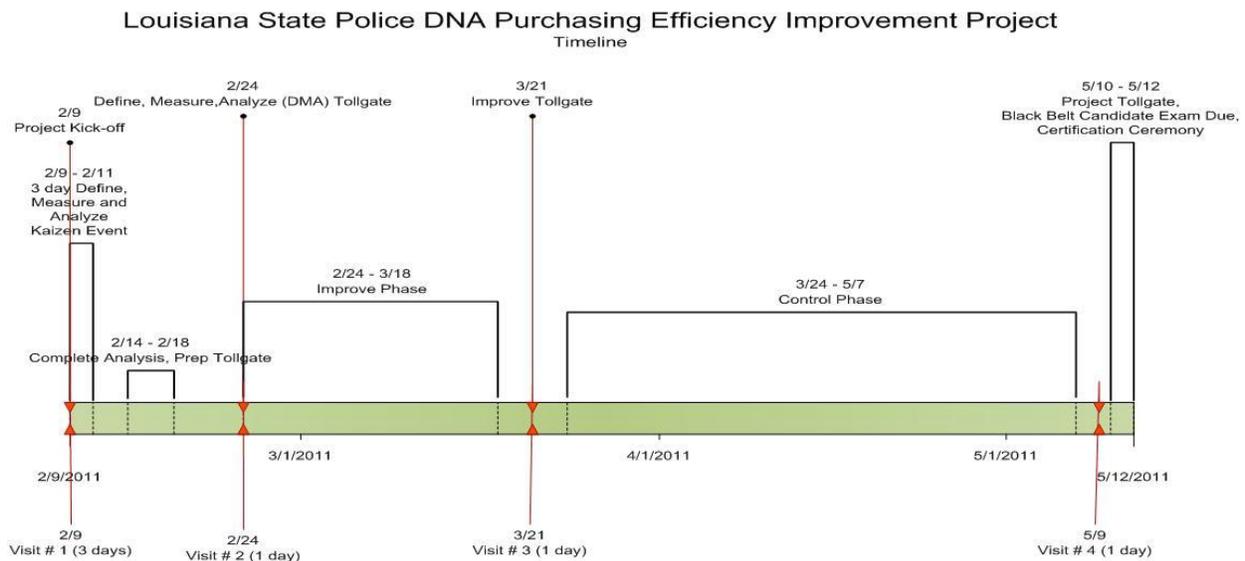
Goals

By utilizing the contractor’s recommendations, the goals were as follows:

- Decrease the average DNA purchasing process cycle time
- Change the mix of purchase types
- Decrease staff time spent performing purchasing tasks

Additionally, LSPCL, by utilizing the Contractor’s recommendations, expected to develop management tools to institute performance standards for the department.

Figure 12: DNA Purchasing LSS Project Timeline



A team of six staff members from LSPCL and the Management and Finance departments worked with Kathi Sill, the consultant from CTQ Consulting Group, over a period of three months on this efficiency project: February 9 through May 11, 2011. The LSPCL team consisted of: Charron Thomas, Deputy Director of the LSP Crime Lab, Melinda Richard, CODIS DNA and Business Unit Manager and Project Team Leader; Christie McCollough, Grants Coordinator and Business Unit staff member, Santina Spears, Business Unit staff member, Erin Bielkiewicz, Management and Finance management; and Marci Herndon, a DNA Analyst. Additional employees of Louisiana State Police were called upon as subject matter experts during the four on-site consultant sessions.

The methodological approach applied by CTQ was the same Lean Six Sigma methodology used in the forensic efficiency project. The DMAIC process was used to Define, Measure, Analyze, Improve, and Control changes that led to achieving the project goals.

2.2.3.3 Scanning Services & Software

The imaging of 310,625 historical documents to create electronic records was the approach to make the binders of paper documents easily referenced by indexes, easily accessed from the network, and backed up nightly. In addition to making records readily available to all staff, the removal of shelves of binders and file cabinets created space to used for additional DNA work space. **Kofax and Content Manager software** were purchased to facilitate imaging, indexing and upload to the network server, where staff can access the records as needed from their workstation. In addition to being scanned, all records were OCR processed to allow the “find” feature. Records included in the scanning project included the following:

- Quality control records for cases that had been outsourced to vendor labs using previous grant funds
- Analysts training records
- Instrument maintenance & reagent logs
- Validation studies
- DNA extraction, quantitation, and amplification worksheets
- CODIS data review documents
- CODIS sample collection logs and CODIS hit confirmation documents

A competitive bid process was conducted under the guidance of the Data Department. Advanced Imaging Solutions was awarded the project.

In addition to contracting a vendor to scan the current records, a **high speed scanner** was purchased to facilitate the staff's continued efforts in generating electronic copies of records going forward, using the same imaging and indexing software. The high speed scanner allows all incoming or newly-created documents to be scanned, indexed and filed electronically by clerical staff. The clerical staff can then reference and provide the necessary documents easily, without leaving their workstation and without interrupting analysts performing casework, thereby decreasing time needed for this administrative task.

2.2.3.4 Qualtrax Compare Module

Qualtrax Compare software was purchased as an enhancement to the Qualtrax software purchased with prior grant funds. This module allows for documents to be compared electronically with revisions flagged for the reviewer. This decreases the administrative time needed in comparing, reviewing and approving revised procedures, worksheets and policies. Because the DNA Technical Leader is primarily responsible for this function, it creates more time for casework related functions.

2.2.3.5 On-site Store Equipment

While barcode software, computer, and barcode scanners were supplied by the lab consumable vendor, **shelving** was for the on-site store was not provided. LSPCL purchased shelving to facilitate the creation of the on-site store/warehouse for DNA supplies. The vendor performs the management of the store and the inventory tracking and refilling, with oversight by the Business Unit.

2.3 RESULTS

Results are discussed in the same outline as the methods, organized by the various projects and purchases within the purposes they served.

2.3.1 Improve DNA Forensic analysis capacity and productivity

2.3.1.1 LSS Consultant- Forensic Analysis

2.3.1.2 Equipment to increase Capacity

2.3.1.3 Dashboard Development

2.3.2 Leverage Technology

2.3.2.1 Validation Services

2.3.2.2 Equipment and Supplies

2.3.3 Sustain with Clerical Time Savers

2.3.3.1 Formation of the Business Unit

2.3.3.2 LSS Consultant- Purchasing of DNA Supplies

2.3.3.3 Scanning Services & Software

2.3.3.4 Qualtrax Compare Module

2.3.3.5 On-site Store Equipment

2.3.1 Improve DNA Forensic analysis capacity and productivity

2.3.1.1 LSS Consultant- Forensic Analysis

The following outlines the discussion on the results of the LSS project focused on improving the DNA Forensic DNA analysis workflow:

Summary of the Project

Schedule

Discussion of DMAIC

Define

- **Project Charter**
- **Current State**
- **Process Map**
- **Spaghetti Maps**
- **SIPOC**
- **Current State Value Stream Map (VSM)**

Measure

- **VAT vs NVAT**
- **Root Cause Analysis**
- **Kaizen Event**
- **CTQ Tree**

Analyze

- **Load Level Charts**

Improve

- **Workflow schedules**

Control

Statistical Results

Summary of the Project

The process improvement team from LSPCL and Sorenson Forensics met for a total of twenty-nine days from April 20, 2010 to September 29, 2010. Below is a brief outline of the lessons taught and the tasks completed during the Laboratory Lean Six Sigma sessions: Then what follows is additional detail to give the reader a concise summary of the project.

Schedule

March 5: Conference call with LSPCL Project and Consultants to initially discuss the project.

- April 20-22: Define Phase. Orientation and assessment of the LSPCL DNA process, its goals and its challenges. Introduction of the DMAIC process, including the concepts of Six Sigma, a waste factory, SWOT analysis, organizational effectiveness, project charter, process map, spaghetti charts, SIPOC chart, value stream map and Gemba walks.
- May 4-5: Measure Phase. Tollgate presentation of Define phase. Stakeholder meeting. Begin Measure Phase.
- May 11-12: Measure Phase. Concepts discussed include takt time, percent load charts, 7-ways, 5-whys tree diagram, story board, balanced scorecard, CTQ tree. Kaizen event to eliminate review backlog was initiated.
- May 25-26: Analyze Phase. Tollgate presentation of Measure phase. Kaizen event to eliminate review backlog. Concepts discussed include management system, leading/lagging indicators, S&OP schedule, and leader standard work.
- June 8-9: Improve Phase. Continue to eliminate review backlog. Begin discussion on building a Future State Map with emphasis on waste reduction / elimination. Start to get entire DNA staff involved in the process. Begin cultural change.
- June 15, 16: Conference calls
- June 22-23: Improve Phase. Continue to eliminate review backlog. CTQ Tree peer review process map discussion, continue to design future state map, level load charts.
- June 28-30: Improve Phase. Define needs for an effective IT solution in the DNA lab. Build future state map.
- July 13, 14: Conference calls
- July 20-21: Improve Phase. Discussion about leadership behaviors, including Herzberg motivation theory, head-hand-heart concept, 5S, PDCA cycle, S&OP schedule. Choreograph the Pilot. Pilot of future state process starts on July 26.
- July 27-28: Improve Phase. Review days 1 and 2 of the pilot – *the good, the bad and the ugly*. Make changes, improvements and tweaks. Leader standard work discussion, case triage discussion, begin “comments sheets” to capture problems/issues. Discussion on team dynamics and composition including

personality – PA/PT (passive aggressive / people task) and Myers Briggs Type Indicator. Discussion on meeting effectiveness and change management.

Aug 4: Conference call

Aug 10-11: Improve Phase. Aug 9 was start of week 3 of pilot. Debrief first two weeks of pilot.

Aug 16: Conference call

Aug 24-25: Improve Phase and introduce control phase. This phase confirms that the proposed solution will meet or exceed the quality improvement goals of the project.

Sept 8-9: Control Phase. Once the project is closed it is not over. If process performance strays out of specification, immediate corrective actions occur to re-adjust and re-monitor to ensure there has not been an over-adjustment.

Sept 20-21: Control Phase continued.

Sept 29: Presentation of final report to all stakeholders.

Discussion of DMAIC

Define Phase

The define phase requires that you define the problem before you can begin to solve it. One of the key outputs from the define phase is the Project Charter. The charter contains the following elements:

- A high level business case providing an explanation of why undertaking the project is important.
- A problem statement defining the issue to be resolved.
- A goal statement describing the objective of the project.
- The project scope defining the parameters and identifying any constraints.
- The CTQs (critical to quality) specifying the problem from the customers' perspective.
- Roles identifying the people involved in and around the project, including their expectations and responsibilities.
- Milestones summarizing the key steps and provisional dates for achieving the goal.

Table 6 : The Project Charter for the LSPCL Lean Six Sigma DNA Laboratory Efficiency Improvement Project.

<p>Project Leader: Melinda Richard</p>	<p>Team Members: Captain Layne Barnum, Adam Becnel, Joanie Wilson, Alyson Saadi, Jeremy Dubois, Erica Sparacino</p>
<p>Business Case: As of 4/20/2010, a 674 DNA request backlog exists. While approximately 2/3 of these cases have been outsourced, 218 are pending analysis. In some cases our own customers have begun to outsource the analysis due to extended turnaround time. Last quarter (Q1 2010), only 18% of the requests met the 60-day turnaround time performance indicator. To date, LSPCL is not aware of any cases where judicial proceedings were missed; however, delays occur and many times cases have to be rushed, leading to greater inefficiency. *While these numbers have changed, the figures listed represented the current state at the time of the Project Charter.</p>	<p>Team Consultants: Tim Kupferschmid, Dirk Hooiman</p>
<p>Problem/Opportunity Statement: Based on performance indicator data and feedback from customers, current turnaround time and throughput has resulted in a backlog of DNA request, which prevents LSPCL from meeting the expectations of its customers and administration.</p>	<p>Goal Statement: To increase throughput, reduce turnaround time and eliminate the backlog of forensic DNA casework analysis.</p>
<p>Project Scope: To address the process of forensic DNA analysis from the receipt of evidence to the return of evidence with the goal to increase throughput and decrease turnaround time of DNA analysis which will reduce the backlog of forensic DNA casework and increase the number of CODIS hits provided to customers.</p>	<p>Stakeholders: Col. Jim Mitchell (LE/Adm), Major Adam White (LE/Adm), Lt. Ike Vavasseur (LE-BRPD), Chief Deputy Jason Ard (LE), Sgt. Todd Morris (LE-EBRSO), Mark Dumaine (ADA), Major Ritchie Johnson (DA Investigator/LE)</p>

Current State

The LSS project addressing the efficiency of the DNA forensic casework process began April 10, 2010.

At the start of the LSS efficiency project the following were the current state statistics:

- Backlog = 738 requests
- Turnaround Time = 124 workdays (this figure includes cold cases)
- CODIS Hits = 715 (2009- An overall average of 59.6 hits/ month.)
- Productivity= 345 (# samples/month)

Equipment & Resources

At the beginning of the Forensic DNA LSS project, the following represented the staff resources in the DNA Unit (including CODIS):

- 17 qualified DNA analysts
- 6 DNA analysts-in-training
- 4 DNA technicians-in-training
- 3 Supervisors
- 1 Manager

At the beginning of the Forensic DNA LSS project the following represented the equipment resources and chemistries of the LSPCL DNA Unit :

Extraction: EZ1 extraction robots (7)

Thermomixers (3) & Incubators (2)

Quantitation: AB 7000 (2) [2- AB 7500s to be traded and validated]

Amplification: Applied Biosystems AmpFSR Profiler and COfiler chemistries

AB 9700 Thermocyclers (6)

Genetic Analyzers: 3130 (3) & 3130XL(1)

3 Qiagility robots (not validated/performance checked) & 1 Tecan robot (not validated/performance checked)

Software: Genemapper ID 3.1 & Justice Trax (LIMS)

Other notes: Extraction and Amplification in tubes, paper case files with screening notes manually recorded,

Evidence photos taken with digital cameras, attached in Justice Trax, but also printed for case file

LSPCL maintains a server network where electronic data and documents can be stored; however, current state is that all worksheets, protocols, pictures and communication logs were printed and stored in the paper case file.

Process Map

An important element of the design phase is the creation of a current state process map. For this project, a “level 2” process map was performed. Level 2 refers to the level of detail. In this case it is at the level of detail of the standard operating procedure (SOP) level. A level 1 process map is a high-level visual representation of the entire process. For example, a level 1 process for forensic DNA processing may be

extraction→quantification→amplification→electrophoresis→analysis→report writing.

Conversely, a level 3 process map is one where the level of detail is down to the work instructions. Below is the level 2 process map of the LSPCL forensic DNA process.

Photograph 1: Photograph of the current state process map constructed by the team. The process map lists the twelve major steps of the process and the major functions under each step.



The rough drawing was typed into an electronic workflow document. There are 3 separate pictures needed to encompass the entire DNA analysis workflow. See Figures 13-15.

Figure 13: Current state process map showing the twelve major process steps and the corresponding detail under each step. Steps 1-3.

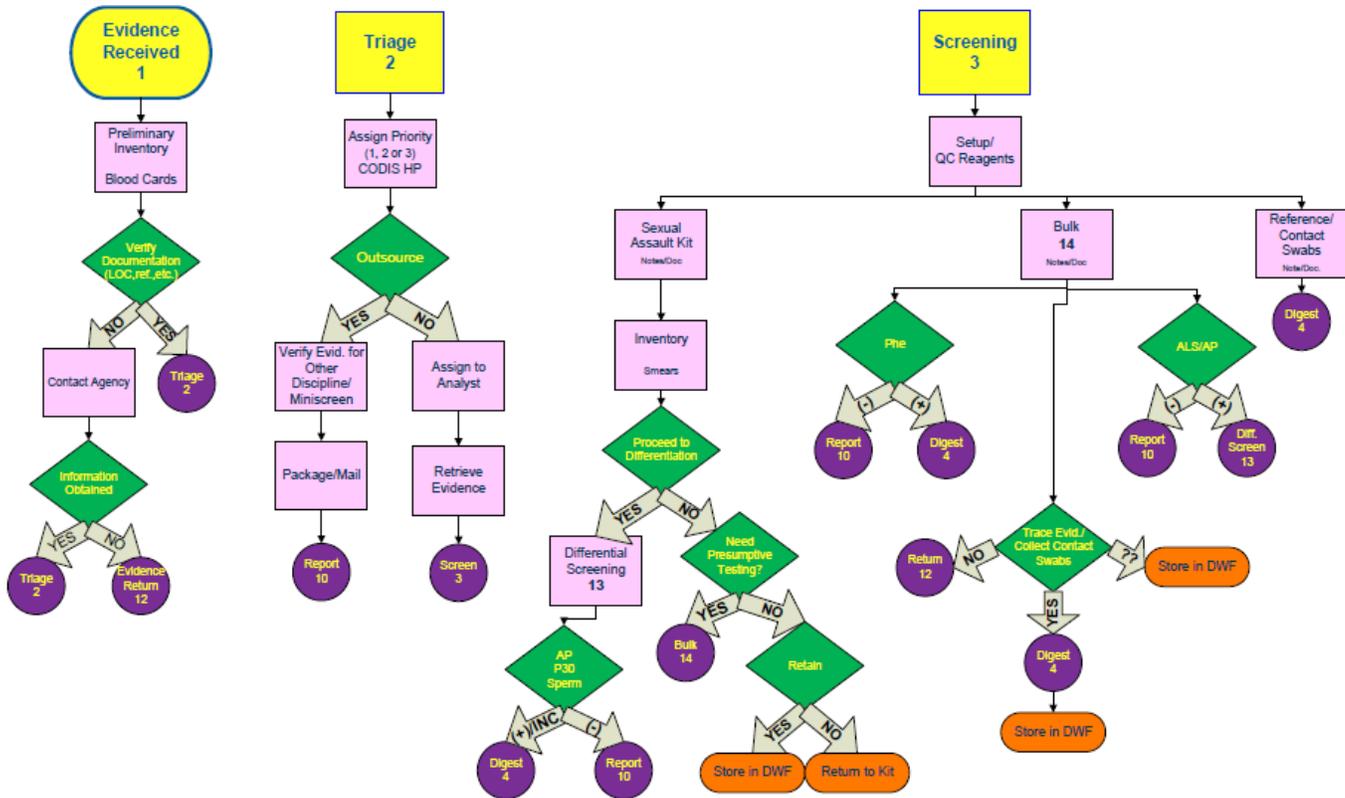


Figure 14: Current state process map showing twelve major process steps and the corresponding detail under each step.

Steps 4-8.

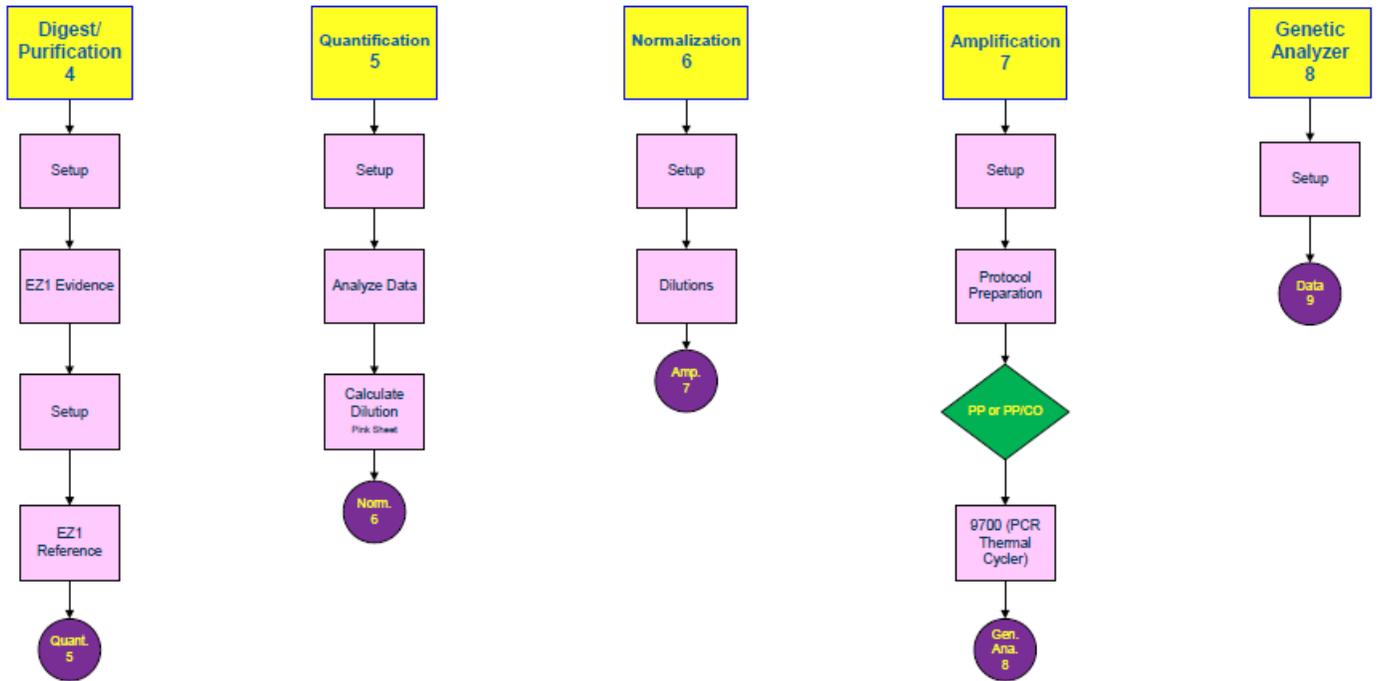
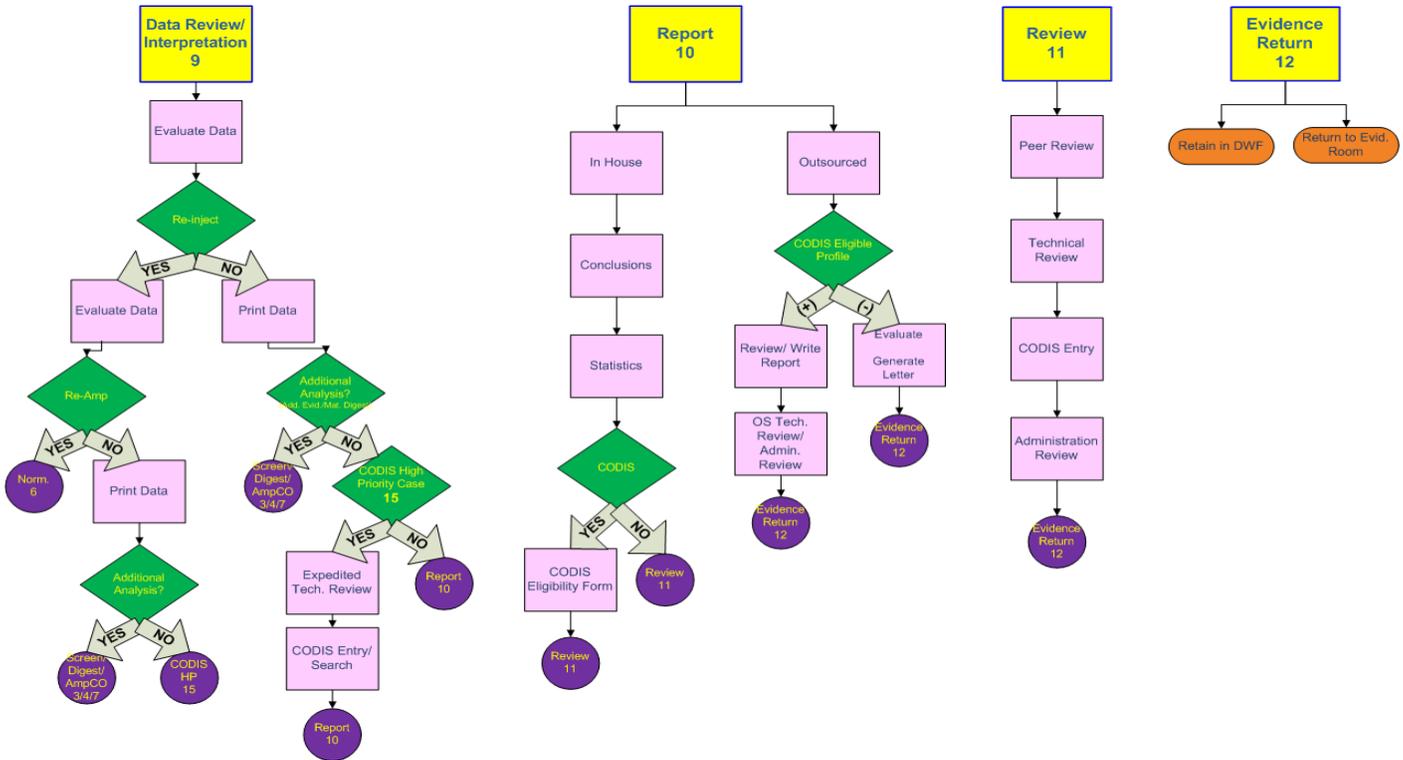


Figure 15: Current state process map showing twelve major process steps and the corresponding detail under each step-

Steps 9-12



Spaghetti Charts

Next, current state spaghetti charts were created. A spaghetti chart is a graphical illustration of the actual physical movement of people and evidence throughout the laboratory. Processes that have not been streamlined are frequently poorly laid out with work taking a path through the work area that looks like a bowl of cooked spaghetti. To create the spaghetti charts, laboratory staff took a scale map of the laboratory and walked and measured the flow of the entire laboratory process. These paths were drawn on the scale map including all processes until the work product exits the work area. Examination of this resulting chart shows where improvements can be made. Below is the spaghetti chart for the case that contains only blood evidence. A total of 8,808 feet are traveled to process this single case. It takes approximately 1 second to travel 2 feet (one step). Thus, 8,808 feet take approximately 73.4 minutes to walk. The different colors represent different processes as described in the process map.



Figure 16: Current state spaghetti chart of a simple blood-only evidence case. A total of 8,808 feet (1.67 miles) were traveled to complete processing this case. Each different color represents a different step of the process.

Below is the spaghetti chart for a typical sexual assault case processed at LSPCL. This type of case travels 12,687 feet, or 2.4 miles for a single case! The time to travel this distance is 106 minutes. If this laboratory processed 400 sexual assault cases one at a time, for instance, the staff would spend 42,400 minutes or 707 hours in a year. A typical working year is 2,080 hours (40 hr/week x 52 weeks/yr). Thus, the motion waste of this process is 34% of an employee's work year.



Figure 17: Current state spaghetti chart of a simple sexual assault case. A total of 12,687 feet (2.4 miles) were traveled to complete processing this case. Each different color represents a different step of the process.

SIPOC

A SIPOC chart is the next tool used during the define phase. SIPOC stands for Suppliers, Inputs, Process, Outputs and Customers. SIPOC charts are created backwards. First, the SIPOC model identifies your customers and the outputs they need. Then, the process is the process map created above. The inputs are listed. Inputs include supplies, consumables, reagents, equipment and personnel. Finally, suppliers are the sources for all of the inputs. In LSPCL’s case, customers (law enforcement officers) are also the suppliers of the raw material (case evidence). Below is the LSPCL’s SIPOC:

Suppliers	Inputs	Process	Outputs	Customers
Law Enforcement Agencies Investigators District Attorneys Defense Attorneys Supply/Consumable Vendors	Case evidence & case information Scientific methods, policies and procedures and training Manpower = analysts, technicians, managers, administration, purchasing, warehouse, evidence receiving dept. Compliance – safety, accreditation, inspections, audits, standards Reagents, supplies, equipment	1. Evidence Received 2. Triage 3. Screening 4. Digest & Purification 5. Quantification 6. Normalization 7. Amplification 8. Genetic Analyzer 9. Data Review & Interpretation 10. Report Writing 11. Review 12. Evidence Return	DNA Scientific Analysis Report Returned evidence and stored retained evidence Expert Testimony	Accurate TAT < 60 days Customer Service Professional, timely expert testimony Support during case challenges

Table 7: SIPOC of the LSPCL DNA case process.

Value Stream Map (current state)

The final input from the Define phase is the backbone of the Current State Value Stream Map. Value stream mapping is a Lean Manufacturing tool used to analyze the flow of materials and information currently required to bring a product or service to a consumer. Essentially, the value stream map (VSM) is an extension of the process map. What differentiates this map is that, during the Measure Phase, it will be populated with data from the current state of the process.

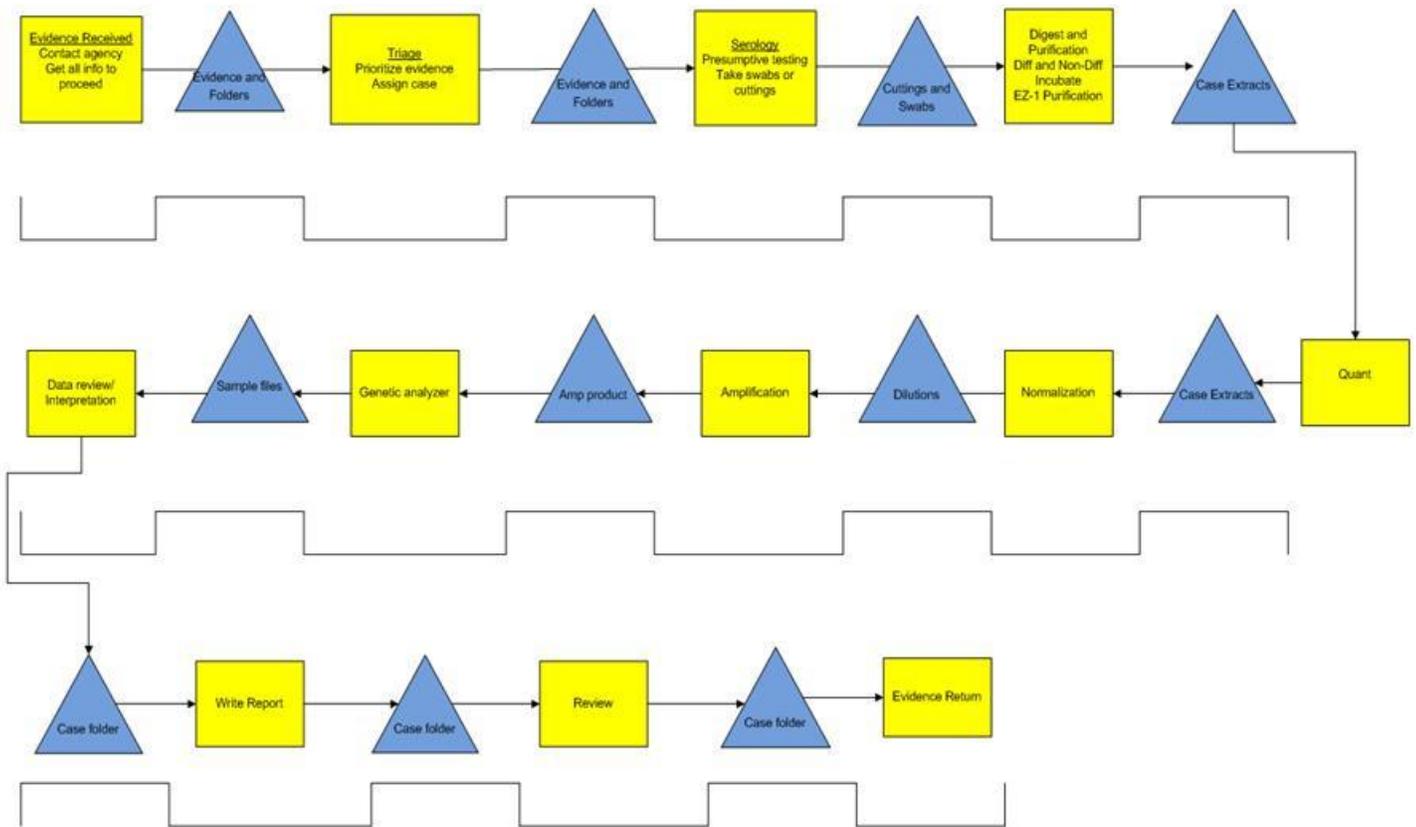
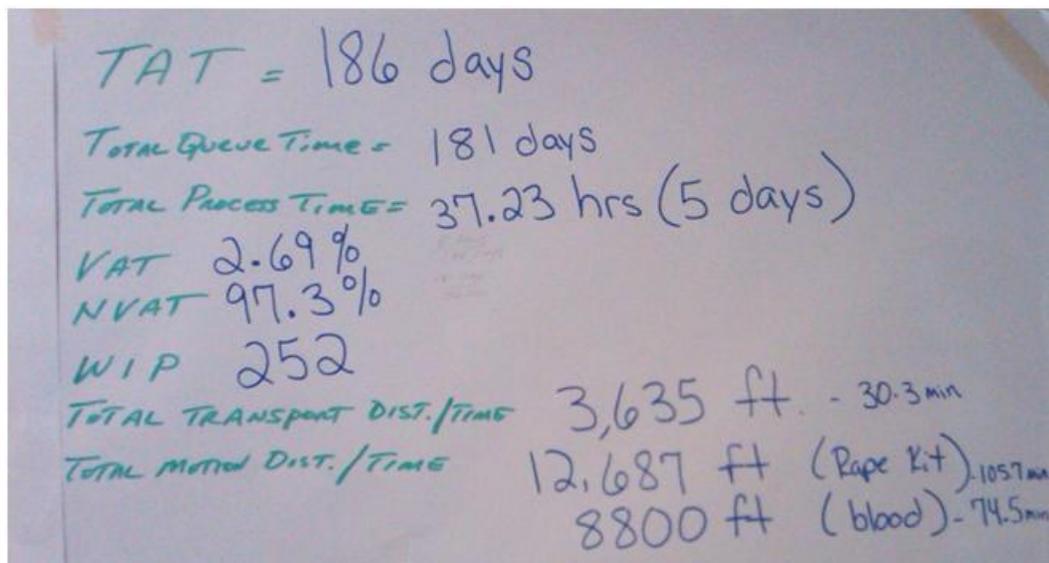


Figure 18: Current state Value Stream Map (VSM) of the LSPCL DNA Process. The rectangles indicate a process that needs to be completed. The triangles indicate a place where inventory or work-in-process (WIP) builds up.

Measure Phase

After the current state of processing DNA cases throughout the laboratory was defined, how and how well the work gets done was clarified. Measurement was a key transitional step in the Lean Six Sigma process.

A major portion of the Measure Phase was spent filling in the value stream map with data. Concepts such as Takt time and cycle time were explained and implemented into the value stream map. Takt time is the amount of time available to perform a task divided by customer demand. For example, if the customer demand is eight cases per day, then the Takt time is one case per hour. Cycle time is the time it takes for the product to move from the beginning to the end of the process. It includes the time the case may spend in a queue. For example, it may take 40 hours (5 days) to work a single case in a manual fashion, however, the actual time (turnaround time) is 60 days because of the case spends 55 days in the backlog queue.



Photograph 2: Measurements from the Current State Value Stream Map (VSM).

The VSM yielded the following measurements of the current state process. TAT stands for turn-around-time; total queue time refers to the amount of time the cases are sitting in a queue waiting to be worked; total process time is the amount of time it takes one case to be processed through the lab without interruption; VAT stands for value added time – the amount of time spent adding what the end customers considers valuable to them; NVAT stands for non-value added time; WIP (work in progress) is the number of cases in progress; total transport/motion distance and time is the distance a case travels throughout the lab and the time it takes to walk those steps.

	<u>May 2010</u>
Turn Around Time (calculated):	186 days
Total Queue Time:	181 days
Total Process Time:	37.2 hours
Value Added Time (VAT):	2.7 %
Non-VAT (NVAT):	97.3%
WIP:	252 cases
Backlog:	768

Figure 19: VAT vs NVAT

Root Cause Analysis

Another Measurement Phase event the team performed was a root cause analysis on other portions of the laboratory process, such as evidence receiving and differential extraction. Below is an example of the root cause analysis, using a fishbone diagram, performed why the evidence receiving step took over 180 min (3hrs) to perform. The fishbone diagram contains four major units – manpower, machines, methods and materials. This analysis shows the following:

- Manpower: Evidence Room Staff not trained to evaluate cases. Sup/Mgr must evaluate cases.
- Materials: No electronic shortcuts in JusticeTrax such as label printing for tubes; Blood card needs to dry faster; No equipment to dry blood cards
- Methods: Retrieval from TC24 is a long distance from lab; drying time takes 1 hr.; SANE nurse doesn't collect the samples; Paperwork (LOC) not scanned; JusticeTrax doesn't electronically print tube labels; JusticeTrax doesn't have helpful tools like electronic flow charts built internal.
- Machine: Work space has to be sterilized using ultraviolet light before and after it is used. This process takes one hour. No equipment is available to speed drying. Presently, there is no way to shut off ultraviolet light automatically.

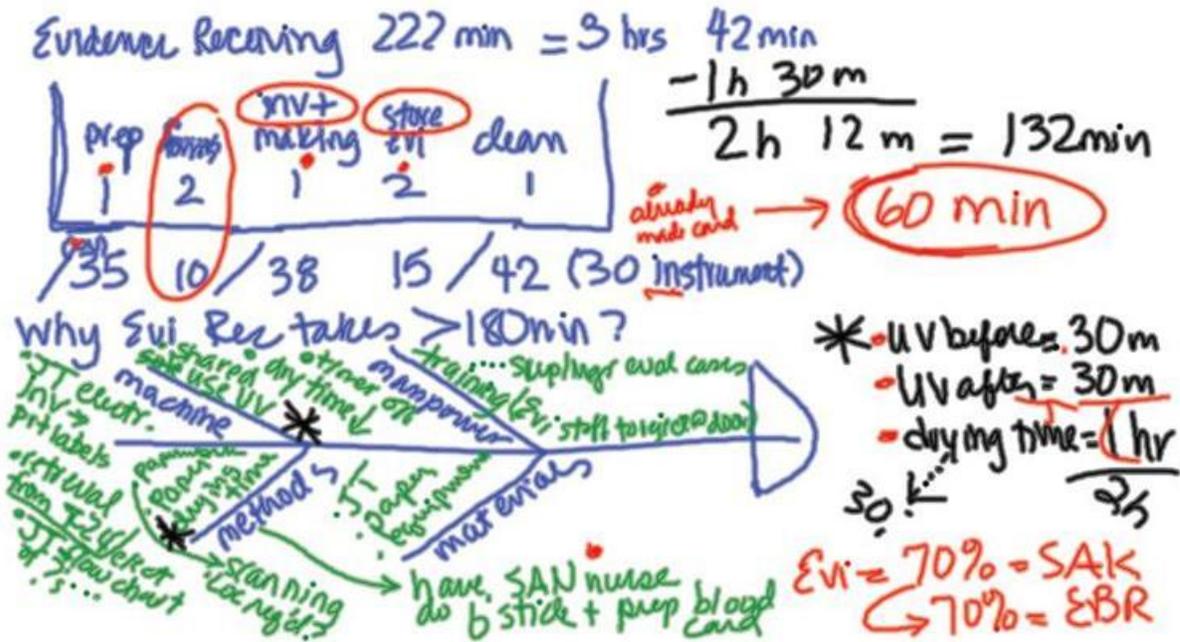


Figure 20: Fishbone diagram of the Evidence Receiving process.

Kaizen Event

A major problem was discovered early in the measure phase. This problem caused the Laboratory Lean Six Sigma project to pause and address it. It was observed, during the measure phase, that there was a tremendous backlog of cases, many of which were analyzed by "outsource labs", that had not been through the review process. At LSPCL, there is a three step review process: (a) Peer Reviews are a review of the case paperwork by a less experienced DNA analyst; (b) Technical Reviews are a review of the data and interpretation of the case performed by a more experienced DNA analysts and (c) Administrative Reviews are a second independent technical review performed by one of four supervisors.

These case reviews consisted of cases that were worked in-house and those that were outsourced to vendor laboratories. On May 11, 2010, during the third visit to the laboratory by the Sorenson team and four weeks into the project, a Kaizen Event was developed to burn-down the case review backlog. A Kaizen Event is a highly focused effort to solve a particular problem.

The overall efficiency improvement project was paused to address this case review backlog because it became apparent that the required productivity and efficiency gains could not be achieved with this huge review backlog in existence. The team held a brainstorming session to determine the best way to attack the case review backlog.

The original plan consisted of a team, or cell, of two peer reviewers, 2 technical reviewers and one administrative reviewer. This cell would sit together in the same room and complete a goal of 18 cases in one day. A great deal was learned from this pilot study. For instance, there must be an effective feedback system with teaching opportunities and possibly the need for retraining within the review process. Flags are marked when a reviewer notes a nonconformance. The team kept track of the types of flags that were being caught in each review step. These flags, in six sigma terms, are called defects. Here we will use the term “flags” as this more closely reflects the actual situation. They were tracked and plotted onto a Pareto chart (see below) and a root cause analysis was performed. Theory suggests that eighty-five percent of all flags are caused by the system, not the individual. Additional tools used during this process were the 5-Whys Tree Diagram, CTQ Tree, and the Balanced Score Card.

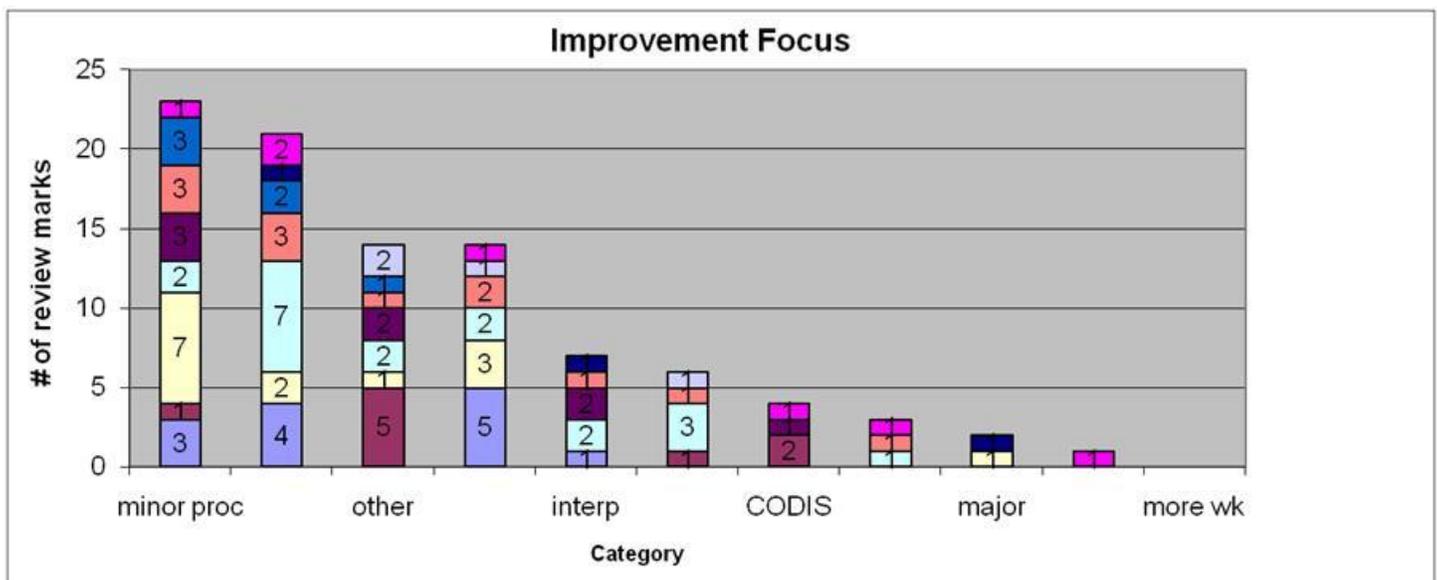


Figure 21: A Pareto diagram of the flags discovered during Peer, Technical and Administrative Reviews. The flag with the most occurrences (clerical errors) is listed first, followed by the remaining flags in order of occurrence.

CTQ Tree

A CTQ Tree (Critical to Quality) are the key measurable characteristics of a product or process whose performance standards or specification limits must be met in order to satisfy the customer. They align improvement or design efforts with customer requirements. To put it in layman's terms, CTQs are what the customer expects of a product. CTQ trees were developed for each step of the case review process.

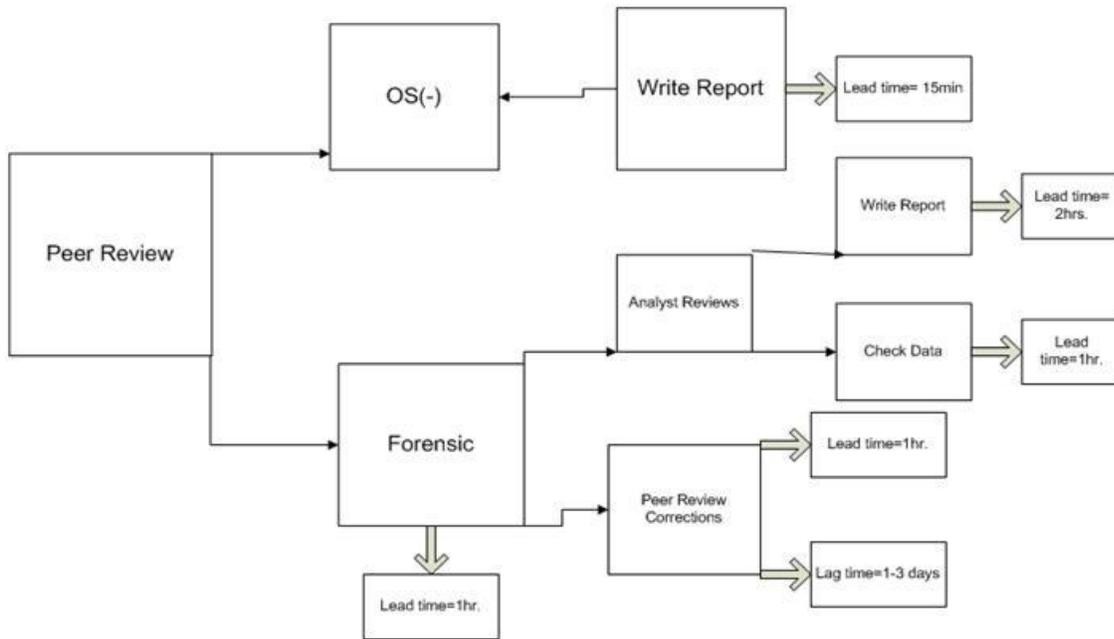


Figure 22: CTQ tree of the Peer Review process.

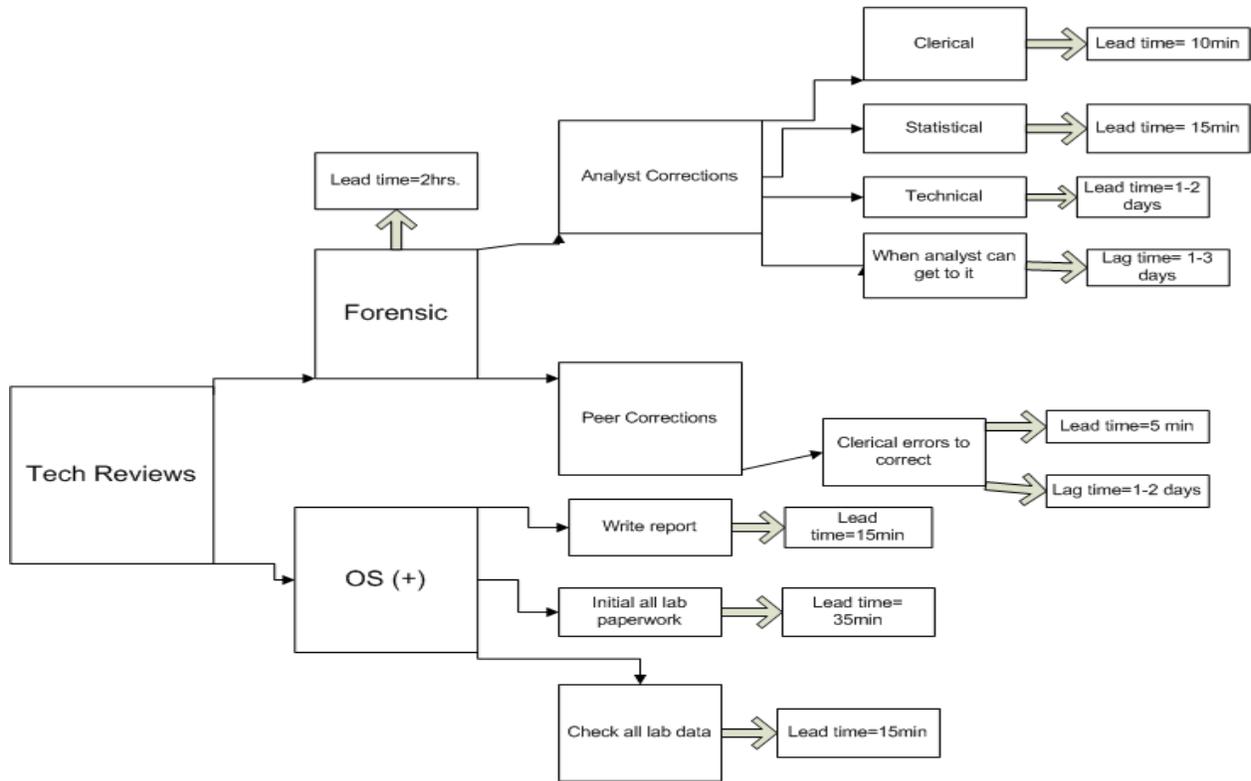


Figure 23: CTQ tree of the Technical Review process.

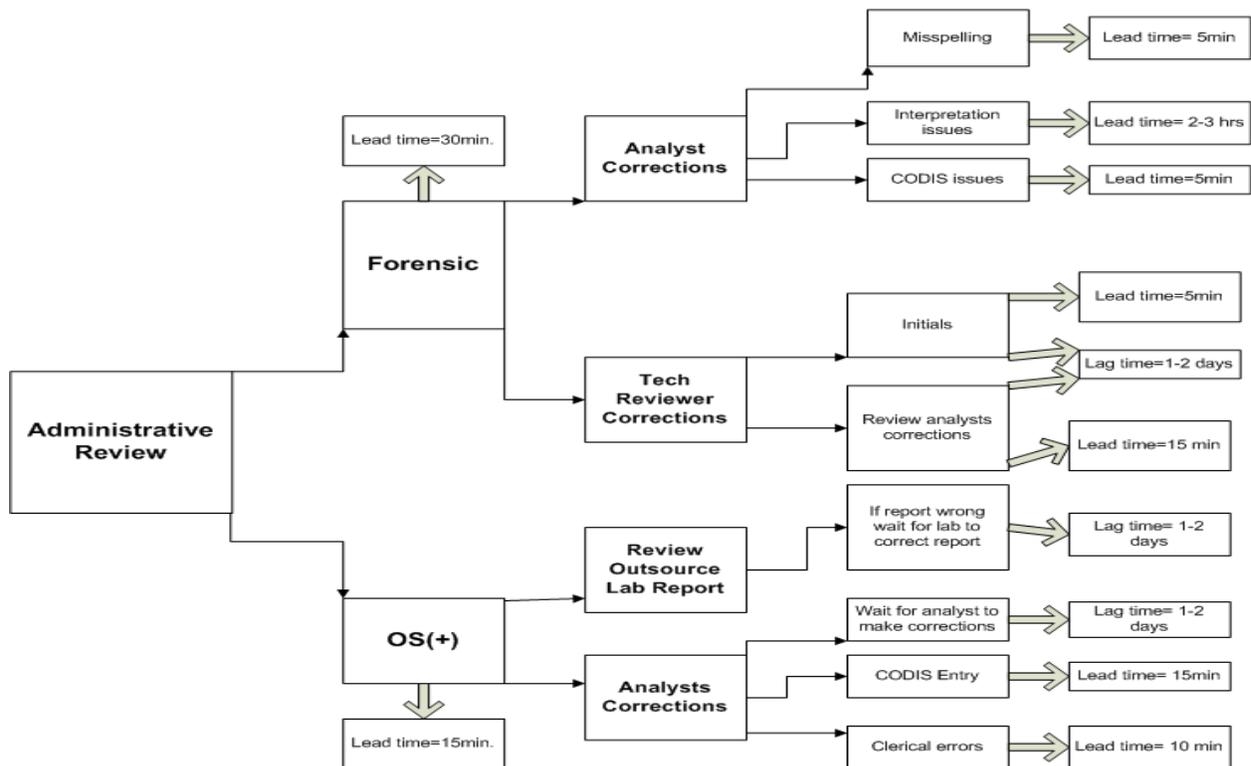


Figure 24: CTQ tree of the Administrative Review process.

The goal of this Kaizen Event was to complete as much of the case reviews as possible. A strict schedule was created for each type of review (peer, technical and administrative). By July, nearly all of the backlogged case reviews had been completed. Below is an example of the visual schedule and the daily goals. The number of cases reviewed each day was charted and displayed for all to see the progress on this project.

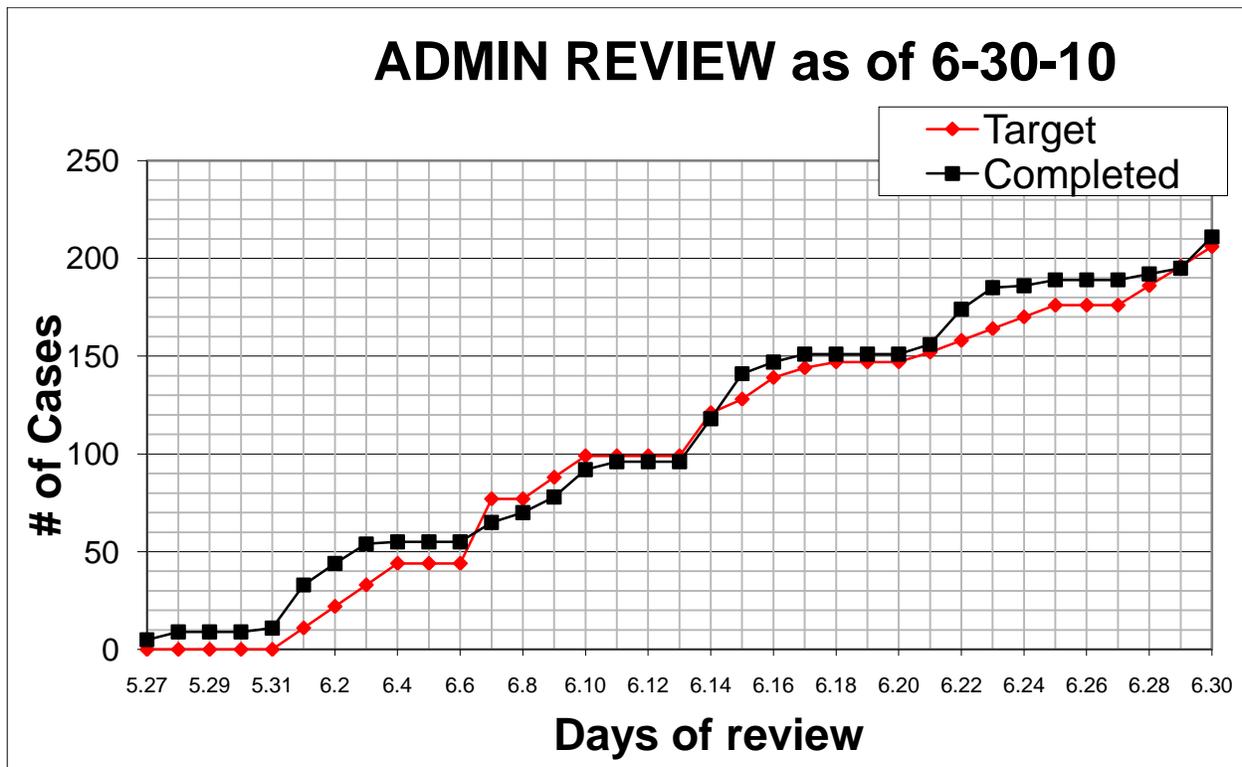


Figure 25: Target and Completed chart of administrative reviews conducted during the last week of May and the month of June 2010. The target of cases reviewed was overachieved this month. A total of 229 cases were administratively reviewed by four scientists during this five week period.

Analyze Phase

The Analyze Phase focuses on analyzing the data collected during the Measure Phase and investigating the causes of the problems, bottlenecks, backlogs and defects uncovered during the previous two phases. Typically, the Analyze Phase involves statistical analysis of the measured data. However, in our case, the majority of the analyze phase involved the construction of a Level Load Chart to help create flow throughout the laboratory. Additionally, the laboratory was continuing to burn down the case review backlog during this phase of the project. Daily Production Meetings were implemented in June to keep track of and maintain the progress being made with the case review backlog. These Daily Production Meetings continued throughout the remainder of the project and has become a permanent activity for LSPCL.

Load Leveling Charts

A Japanese term, Heijunka refers to a system of production designed to provide a more even and consistent flow of work. Heijunka involves smoothing processing and production using leveling and sequencing. Leveling is the smoothing of the volume of production in order to reduce variation and keep a consistent flow. This technique seeks to prevent end-of-period peaks, for example the beginning of the month may be slow but the last days of the month are rushed in order to meet monthly goals. Sequencing involves mixing the kinds of work processed to match customer demand and laboratory capability. At LSPCL, sequencing was accomplished by batching a difficult homicide case with two sexual assault cases and several simple burglary cases. This batching or triage system roughly matches the mix of cases received in the laboratory. As is always the case at LSPCL, crimes against persons are prioritized over all other crimes.

Keeping things balanced and level means the process flows smoother which results in faster processing time. Below is the image of the level load chart that described the processes of the DNA lab and its corresponding time. From these data, a new system was designed so processes could be grouped or additional personnel could be added to make all the processes take a similar amount of time.

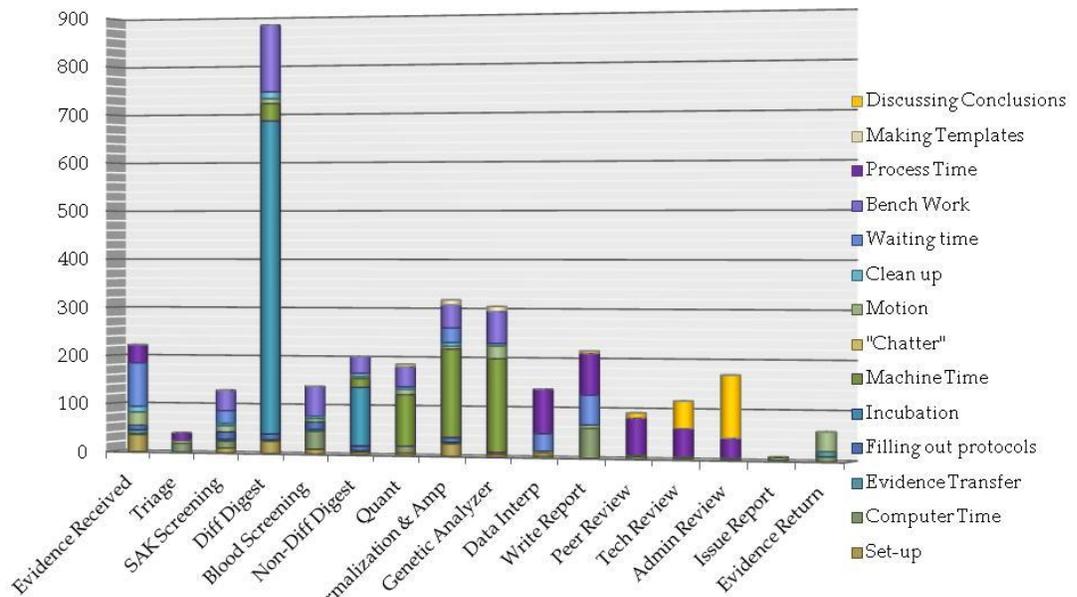


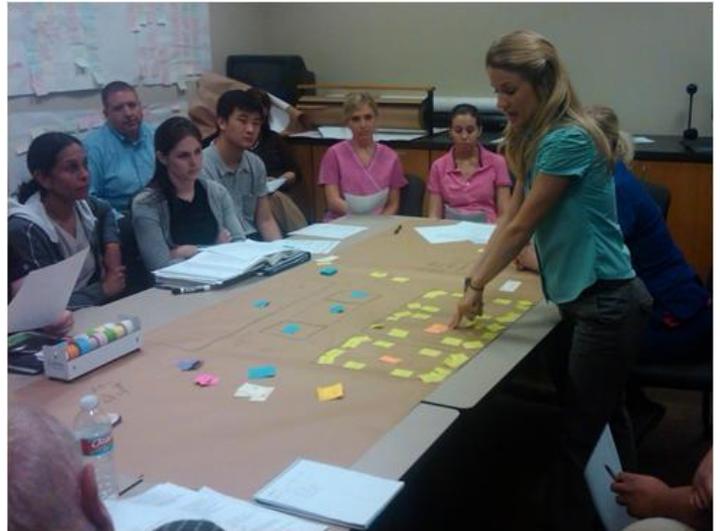
Figure 26: Level load chart of the DNA laboratory process. The x-axis lists the steps of the process while the y-axis is the number of hours each process takes.

Improve Phase

Much data collection and analysis must precede this phase to identify the root cause of the problem. The Improve Phase involves three distinct segments: (a) generate ideas about possible solutions, (b) select the most appropriate solution and (c) plan and test the solution. The majority of June was spent designing the solution (new laboratory process), July was spent building the solution and August was spent implementing the solution. The Control Phase (next section) occurred primarily during the month of September.

Remember, before a new DNA casework production system could be designed, built and implemented, the case review backlog had to be nearly eliminated. Again, this project took the form of a Kaizen Event, a rapid solution to a growing problem (see Kaizen Event section above).

Photograph 3: A tabletop simulation of the new schedule logistics was discussed.



Workflow schedules

The solution discussed, fine-tuned and finally implemented during the pilot study is a five-day laboratory process that consists of four (4) technicians acting in a support role and teams of three (3) DNA analysts performing the majority of the lab work, interpretation, reporting, and quality checks. The technical review was performed by analysts not currently scheduled to work in the lab (see master schedule below).

Concisely, the five day new production process is listed in the photographs below. Work Instructions for each individual are provided. This process was conceived, revised, implemented and revised several additional times to the point where it is today. As problems and roadblocks were encountered, changes, modifications and fixes were implemented.

DAY 1			DAY 2		
PA 1	PA 2	PA 3	PA 1	PA 2	PA 3
SCREEN HARD CASE #1	SCREEN 2 EASY CASES	SCREEN 2 EASY CASES	EZI HARD CASES	EZI REFERENCES	EZI S-FRACTION
SCREEN HARD CASE #2	DIGEST EASY CASE SAMPLES	DIGEST EASY CASE SAMPLES	PEER REVIEW	PEER REVIEW	QUANT
DIGEST HARD CASE SAMPLES	START DIFFERENTIAL	START DIFFERENTIAL	PREP AMP STATION	PREP AMP STATION	PEER REVIEW
	EZI EASY CASES	EZI EASY CASES	QUANT DATA AMP SHEETS	QUANT DATA AMP SHEETS	QUANT DATA AMP SHEETS
	COMPLETE DIFFERENTIAL	COMPLETE DIFFERENTIAL	PEER REVIEW	PEER REVIEW	PEER REVIEW
	EZI E-FRACTION	EZI E-FRACTION	AMP SAMPLES	AMP SAMPLES	AMP SAMPLES
	DIGEST REFERENCE				

DAY 3			DAY 4		
PA 1	PA 2	PA 3	PA 1	PA 2	PA 3
3130-1 TEMPLATE	3130-XL TEMPLATE	3130-3 TEMPLATE	PRINT & EVAL DATA ALL CASES	PRINT & EVAL DATA ALL CASES	PRINT & EVAL DATA ALL CASES
PREP & LOAD 3130-1	PREP & LOAD 3130-XL	PREP & LOAD 3130-3	CHART STRS HARD CASE #1	CHART STRS 2 EASY CASES	CHART STRS 2 EASY CASES
PEER/TECH REVIEW	PEER/TECH REVIEW	PEER/TECH REVIEW	WRITE REPORT HARD CASE #1	WRITE REPORTS 2 EASY CASES	WRITE REPORTS 2 EASY CASES
REVIEW DATA RE-INJECTS	REVIEW DATA RE-INJECTS	REVIEW DATA RE-INJECTS			

DAY 5			TECHS			
PA 1	PA 2	PA 3	TECH 1	TECH 2	TECH 3	TECH 4
CHART STRS HARD CASE #2	CHART STRS SA CASE	CHART STRS SA CASE	PREP EXTRACTION HOODS	RETRIEVE EVID FOR 8 CASES (2 SA, 6 OTHERS)	PREP SCREENING ROOMS	PREP POST-AMP ROOM
WRITE REPORT HARD CASE #2	WRITE REPORT SA CASE	WRITE REPORT SA CASE	ASSIST w/ SCREENING	INVENTORY/SCREEN OF 2 SA KITS	ASSIST PA1 w/ SCREENING	ASSIST PAs in POST AMP ROOM
PEER REVIEW	PEER REVIEW	PEER REVIEW	PREP QUANT HOOD	TRIAGE CASES		CLEAN POST AMP ROOM
RETAIN EXTRAC	RETAIN EXTRACTS	RETAIN EXTRACTS	STOCK AMP SUPPLIES			SCREEN REFERENCES
			CRITICAL REAGENT C			
			STOCK EXTRACTION HOODS			

Photograph 4: The five day laboratory process

Analyst 1

Day 1

- 7:30-11:30 Screen hard case #1 in screening room #1
Inventory evidence against submittal form
Screen evidence
Take pictures
Take notes
Perform serology tests
Fill out extraction protocols and load/label tubes
- 11:30-12:30 Lunch
- 12:30-3 Screen hard case #2 in screening room #1
Inventory evidence against submittal form
Screen evidence
Take pictures
Take notes
Perform serology tests
Fill out extraction protocols and load/label tubes
- 3-4 Digest 2 hard cases in extraction room after screening completed
-If time permits,
EZ1 hard cases
Digest references
EZ1 references
- ### Day 2
- 7:30-9:30 EZ1 hard cases from day 1.
Give analyst 3 the extracts to be quintet.
- 9:30-11 Process peer review for team members
Review screening notes & extraction protocols for analyst 2 (1 SA cases & 2 easy cases)
(If analyst 3 is in a time crunch, also review references paperwork from tech 4/analyst 2)
- 11-11:30 Make labels for amp tubes & put labels on tubes/prepare hood & UV hood
Place labels on all samples in both systems (PP & CO) until implementation of Identifier Plus

- Each analyst should amp their own references
- 11:30-12:30 Lunch
- 12:30-1 Retrieve quant data & print. Put all SP numbers for yourself on 1 pink sheet. Hand write in the EB adjustments. Write all SP #'s on pink sheet, write only SP# pertaining to case on std. curve, plate & report. Highlight samples that pertain to case on pink sheet, plate & report.
- 1-1:30 Fill out PC/AB on amp sheet and write "see DNA 311" for concentrations/adjustments for samples.
- 1:30-2 Process peer review for analyst 2 (quant and first sheet of amp protocols)
- 2- 4 Amp samples (Clean out Amp hood after you're -finished amping)

Day 3

- 7:30 – 8:30 Create template for samples going onto 3130-1
- 8:30 – 9:30 Prepare master mix, pipette samples onto plate & load plate
Ensure 3130 maintenance/reagent records logs are filled out and check injection times on plate

manager

- 9:30 – 11:30 Peer review, tech review or make corrections to your own cases
- 11:30 –12:30 Lunch
- 12:30 – 3:30 Peer review, tech review or make corrections to your own cases
- 3:30 – 4 Review data and do re-injects

Day 4

- 7:30 – 10:30 Evaluate data & print data for both hard cases (1 printer per analyst)
- 10:30 – 12:30 Chart STRs for hard case #1
- 12:30 – 1:30 Lunch
- 1:30 – 4 Hard case #1
Write reports, perform stats, CODIS eligibility, deduced profile sheets

Day 5

- 7:30 – 9:30 Chart STRs for hard case #2
- 9:30 – 12:30 Hard case #2
Write reports, perform stats, CODIS eligibility, deduced profile sheets
- 12:30 – 1:30 Lunch
- 1:30 – 4 Complete peer review for analyst 2's cases (2 easy & 1 SA)
Retain Extracts for cases worked during this batch

Analyst 2

Day 1

- 7:30 – 9:30 Screen in screening room #2 the 2 easy cases & digest samples in extraction room
- 9:30- 10:30 PBS wash for differential
- 10:30 - 11:30 Presumptive tests (Prepare slides, AP, look at slides & p30 if needed)
Let tech 4 know if the references for the sexual assault requires screening
- 11:30 - 12 Prepare E fraction for digest (put in incubator at 12 so they are ready for 2pm)
- 12-2:00 Digest E fraction
- 12-1 Lunch
- 1-2 EZ1 two easy cases/coordinate with analyst 3 regarding EZ1 usage
- 2-3 Sperm washes
- 3 - O/N Digest S fraction
- 3- 4 EZ1 E fraction after sperm washes are complete & then digest references that tech 4 screened
-Flexible on screening/differential start times – analyst can follow schedule or start differential first then screen easy cases during PBS soak of differential.

Day

- 7:30– 9:30 EZ1 references then give extracts to analyst 3 for quant
Remove extracts from freezer (2 easy cases & E fractions) & give them to analyst 3 for quant
- 9:30 – 11 Process peer review
Screening notes and extraction protocols for analyst 3 (2 easy cases & 1 SA)
(If analyst 3 is in a time crunch, also review 1 of analyst 1's hard cases)
- 11-11:30 Make labels for amp tubes & put labels on tubes/prepare hood & UV hood
Place labels on all samples in both systems (PP & CO) until implementation of Identifier Plus
Each analyst should amp their own references
- 11:30-12:30 Lunch
- 12:30-1 Retrieve quant data & print. Put all SP numbers for yourself on 1 pink sheet. Hand write in the EB adjustments. Write all SP #'s on pink sheet, write only SP# pertaining to case on std. curve, plate & report. Highlight samples that pertain to case on pink sheet, plate & report.
- 1-1:30 Fill out PC/AB on amp sheet and write "see DNA 311" for concentrations/adjustments for samples.
- 1:30-2 Process peer review for analyst 3 (quant and first sheet of amp protocols)
- 2- 4 Amp samples (Clean out Amp hood after you're -finished amping)

Day 3

7:30 - 8:30 Create template for samples going onto 3130-XL
8:30 - 9:30 Prepare master mix, pipette samples onto plate & load plate
Ensure 3130 maintenance/reagent records logs are filled out and check injection times on plate manager
9:30 - 11:30 Peer review, tech review or make corrections to your own cases
11:30- 12:30 Lunch
12:30 - 3:30 Peer review, tech review or make corrections to your own cases
3:30-4 Review data and do re-injects

Day 4

7:30-10:30 Evaluate data & print data for all cases (1 printer per analyst)
10:30- 12:30 Chart STRs for 2 easy cases
12:30 –1:30 Lunch
1:30-4 Write reports, perform stats, CODIS eligibility, deduced profile sheets for 2 easy cases

Day 5

7:30 – 9:30 Chart STRs for SA case
9:30-11:30 Write reports, perform stats, CODIS eligibility, deduced profile sheets for SA case
11:30 – 12:30 Lunch
12 – 4 Complete peer review for analyst 3's cases (2 easy & 1 SA)
Retain Extracts for cases worked during this batch

Analyst 3

Day 1

7:30- 9:30 Screen in screening room #2 the 2 easy cases & digest samples in extraction room
9:30-10:30 PBS wash for differential
10:30-11:30 Presumptive tests (Prepare slides, AP, look at slides & p30 if needed)
Let tech 4 know if the references for the sexual assault requires screening
11:30-12 Prepare E fraction for digest
12-2:00 Digest E fraction
12-1 Lunch
1-2 EZ1 two easy cases/coordinate with analyst 2 regarding EZ1 usage
2-3 Sperm wash

3 - O/N Digest S fraction
3- 4 EZ1 E fraction
-Flexible on screening/differential start times – analyst can follow schedule or start differential first then screen easy cases during PBS soak of differential.

Day 2

7:30– 9 EZ1 all S fractions from both analyst’s diff’s
Remove extracts from freezer (2 easy cases & E fractions)
9 – 10:30 Prepare quant sample sheet
Prepare master mix & standards
Pipette plate & have put it on by 10:30 (plate should be finished by 12:15)
10:30 – 11 Process peer review
Screening notes and extraction protocols for analyst 1 (2 hard cases)
Screening notes and extraction protocol for tech 4/analyst 2 (references)
(If time crunch, can give 1 hard case paperwork for review to analyst 2 and/or give reference paperwork for review to analyst 1)
11 – 11:30 Make labels for amp tubes & put labels on tubes/prepare hood & UV hood
Amp all samples in both systems (PP & CO) until implementation of Identifier Plus
Each analyst should amp their own references
11:30 -12:30 Lunch
12:30 –1 Retrieve quant data & print. Put all SP numbers for yourself on 1 pink sheet. Hand write in the EB adjustments. Write all SP #'s on pink sheet, write only SP# pertaining to case on std. curve, plate & report. Highlight samples that pertain to case on pink sheet, plate & report.
1-1:30 Fill out PC/AB on amp sheet and write “see DNA 311” for concentrations/adjustments for samples.
1:30- 2 Process peer review analyst 1’s quant and amp protocols
2-4 Amp samples (Clean out Amp hood after finished amping)
Day 3
7:30 – 8:30 Create template for samples going onto 3130-3
8:30 – 9:30 Prepare master mix, pipette samples onto plate & load plate
Ensure 3130 maintenance/reagent records logs are filled out and check injection times on plate manager
9:30 – 11:30 Peer review, tech review or make corrections to your own cases

11:30 – 12:30	Lunch
12:30 – 3:30	Peer review, tech review or make corrections to your own cases
3:30 - 4	Review data and do re-injects
Day 4	
7:30-10:30	Evaluate data & print data for all cases (1 printer per analyst)
10:30- 12:30	Chart STRs for 2 easy cases
12:30 –1:30	Lunch
1:30-4	Write reports, perform stats, CODIS eligibility, deduced profile sheets for 2 easy cases
Day 5	
7:30 – 9:30	Chart STRs for SA case
9:30-11:30	Write reports, perform stats, CODIS eligibility, deduced profile sheets for SA case
11:30 – 12:30	Lunch
12 – 4	Complete peer review for analyst 1's cases (2 hard cases) Retain Extracts for cases worked during this batch

Tech Review

Batch goes to Tech review & case goes back to analyst for any corrections. The goal is to have the batch of 8 tech reviewed & corrected by the end of day. Time for corrections in the process is still being worked out.

The tech reviewer cycling out the process as well as a tech reviewer who is on their day 3 (after putting 3130 run on) would be able to tech review. Total tech review time = 12.5 hours for 8 cases. That's 1.5 hours a case.

Admin Review

8 cases a day and 4 admin reviewers = 2 admin reviews per admin reviewer per day

The goal is to have the batch of 8 admin reviewed & corrected by the end of day.

Table 7: Work Instructions for each of the three analysts on the laboratory processing team.

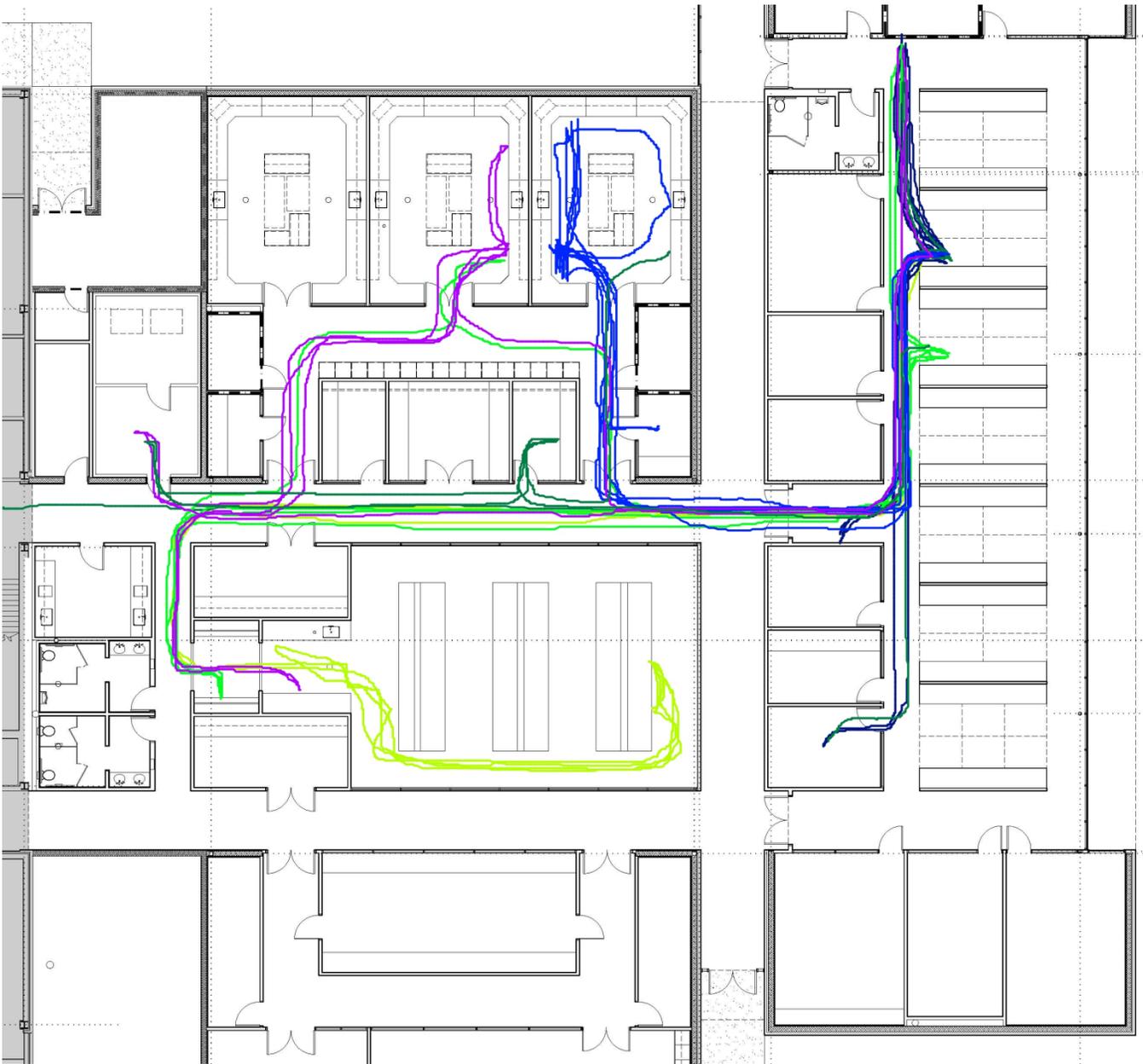
During the pilot study, a number of modifications were made to immediately address the issues that were encountered. At first, the scientists had difficulty adjusting to the rigorous schedule. The batch size was decreased from 10 cases to 8 cases. The number was moved back to 10 cases as the scientists got proficient at the new way of doing business. The screening of references was moved from Day 2 to Day 1 because it was learned that Day 2 was the most rushed of all the days in the schedule. In Lean Six Sigma terms, this is called *level loading*. Finally, peer review was incorporated into the process, eliminating a bottleneck that existed in the original process map.

Over a dozen other improvements were made during this phase. For instance, lab processes and equipment were relocated to reduce motion waste; the concept of 5S (sort, straighten, shine, standardize and sustain) was implemented at the workstations so that every workstation was identical in layout and cleanliness to every other workstation; barcodes were printed to replace manual tube labeling; laboratory doors were removed to ease movement to and from lab spaces; unnecessary procedural steps were removed from the Standard Operating Procedures; a master schedule was implemented so that every scientist knew exactly what they would be doing today and three weeks into the future; and correction flags in case folders were made much more consistent from scientist to scientist.

In the Define Phase, the transportation and motion of the DNA process for a sexual assault case was measured (see Figure 10 above). After the laboratory underwent the 5S process and a few other improvements, the transportation and motion of processing a sexual assault was measured again. Transportation and motion of a sexual assault case decreased by nearly one mile.

The new current state is now approximately 7879 feet, or about 1.5 miles. See map below:

Figure 27: New process spaghetti map for a sexual assault case (7879 feet)



Control Phase

The last phase of DMAIC is the Control Phase. The processes were controlled to ensure they continued to work well, produce desired output results, and maintain quality levels. The control phase enabled the laboratory to continually monitor its outputs and to adjust its operation when the data clearly indicates or when the customer's requirements change.

The Control Phase puts in place a Management System to maintain the process. Without this, the new process and improvements may revert to its previous state, undermining the gains achieved and making the progress for naught. The question is: "How do we prevent backsliding?" The way to prevent a boulder that you have pushed up hill from rolling backwards is to put a wedge behind it. The Control Phase wedge has several components. One of the most important, of which, is a dashboard to look at process measures and performance measures. These measures, if out of specification, will result in action to return them to specification. Positive behaviors are reinforced by the dashboard.

Another purpose of the Control Phase is the creation of, and measurement against, a production schedule. The production schedule sets the employees performance expectations. Daily production meetings occur to report on progress and obstacles, if they exist. Further, the teams report on performance and the implementation of Leader Standard Work through the "Gemba Walk". Gemba is the Japanese word for "actual place, or place where the real action occurs." Coincidentally, Japanese detectives refer to a crime scene as the Gemba. A Gemba walk occurs when the leadership team walks through each area on a daily basis reviewing performance, identifying opportunities and ensuring that each team is resolving their issues.

To sustain the improvement measures along with appropriate leadership behaviors is referred to as Leader Standard Work. Through Leader Standard Work, employees are accountable for their process. Instead of employees presenting problems to management for resolution, the employee makes recommendations and takes ownership of resolving the issue. This process is known as CAPA (Corrective Action Preventive Action).

Statistical Results

While the grant was applied for and awarded in 2008; the efficiency consultant project started in April of 2010 and ended in September 2010. Therefore, several data points regarding turnaround time, number of CODIS hits, backlog and productivity will be provided to give the reader a good understanding of the DNA unit from 2006 to today.

Turn-around-Time: The goal of the project was to cut the DNA Request turnaround time (TAT) in half, from 258 days (TAT in May 2008 at the time of grant application) to 129 days. While the metrics are calculated from the receipt of the request to reporting. The scope of the project focused specifically on the TAT as measured from case assignment to release.

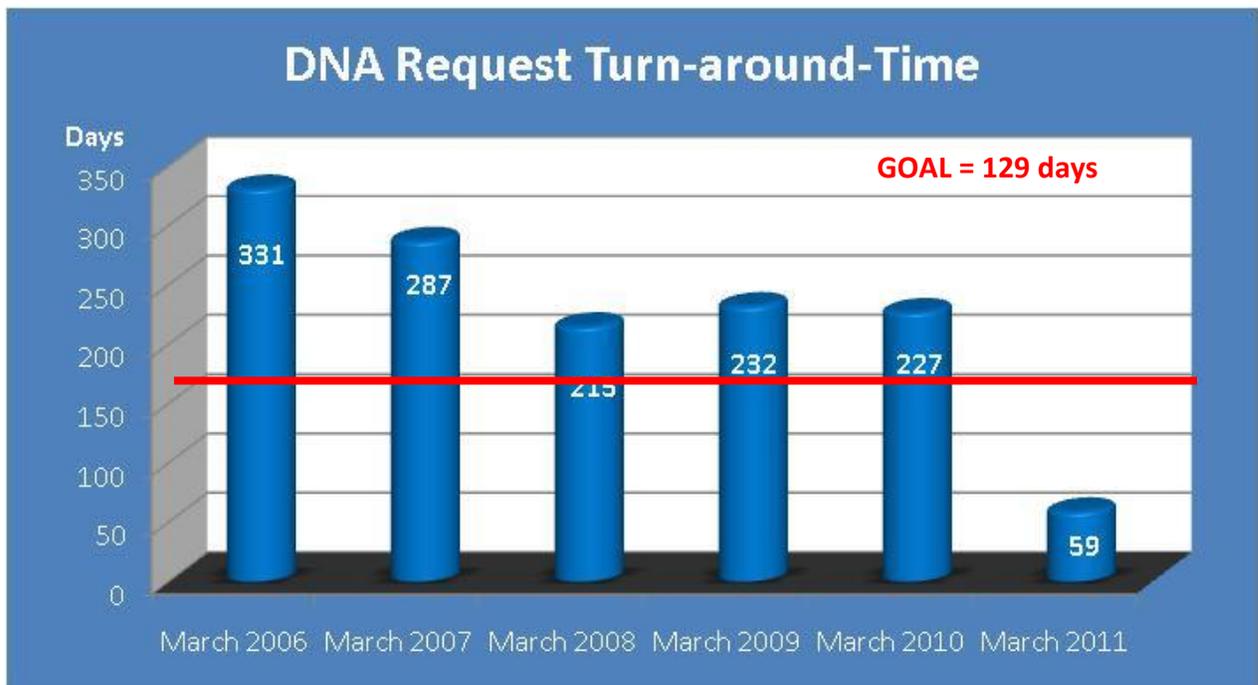


Figure 28: DNA Request TAT. The red bar indicates the goal of 129 days. During the pilot project, the TAT for pilot cases was 22 days.

Number of CODIS hits: The number of CODIS hits achieved is a measure of the effectiveness of the casework laboratory and the CODIS database to assist in the solving of no-suspect crimes. As can be observed in Figure 29, the number of CODIS hits obtained by the State of Louisiana has increased substantially since May 2008. This trend will undoubtedly continue as the backlog is eliminated and the productivity of the laboratory is increased.

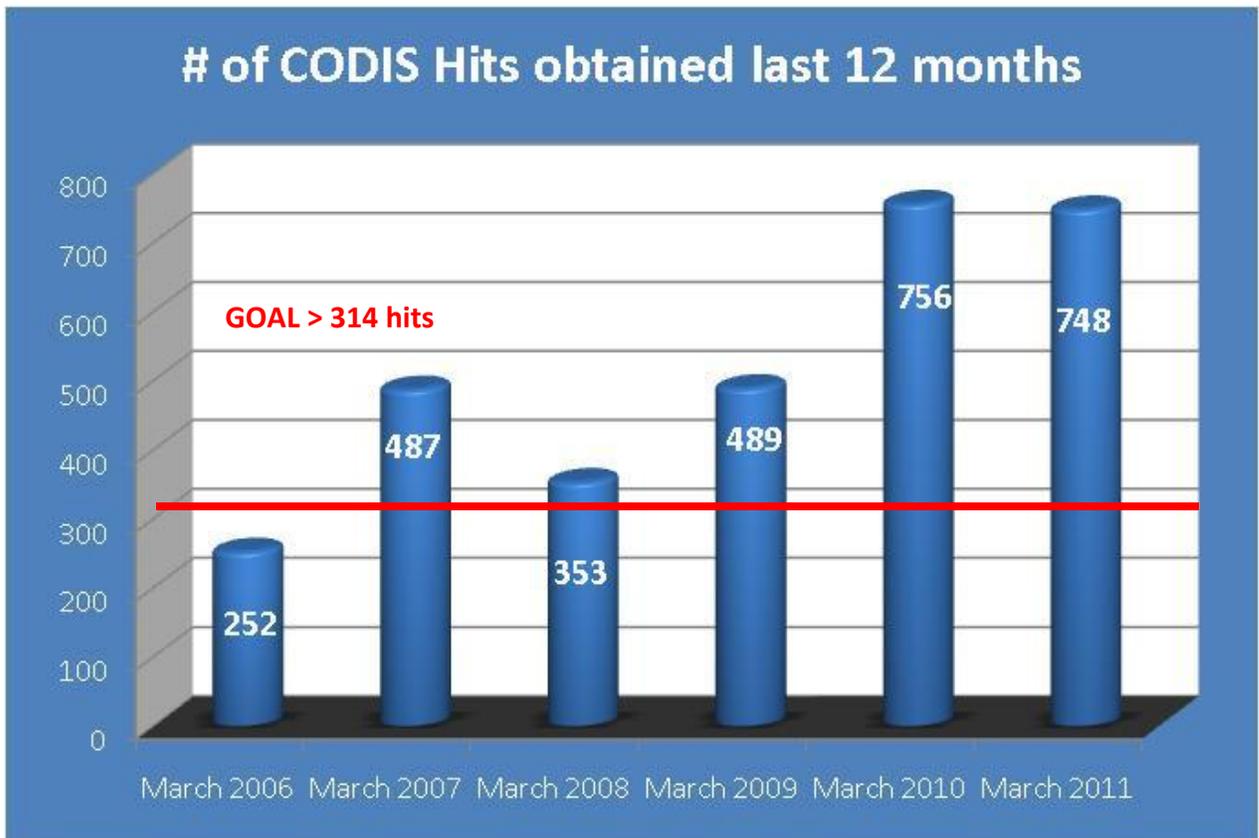


Figure 29: This figure displays the number of CODIS hits obtained for the previous 12 months. As the number of CODIS hits increases, so does the number of no-suspect cases that are potentially solved. This is one performance metric that is an indirect byproduct of laboratory productivity.

Backlog: Forensic DNA laboratories define case backlog slightly differently. The LSPCL defines backlog as DNA requests that have been received but not reported. It does not include “pending” cases. Cases are “pending” if evidence has been submitted, but the submitting agency has not provided enough information to begin working it. In May of 2008, at the time of the grant application, the backlog reached a high of 1700 requests. The backlog number was decreased through the use of outsourcing to private DNA laboratories and by cancelling cases as directed by the submitting agencies or prosecutors. The rear graph includes the outsourced cases and the internally analyzed cases. The outsourced cases required data review, a report written, technical review and administrative review. See Figure 30. The front graph is internal backlog only. See Figure 30.

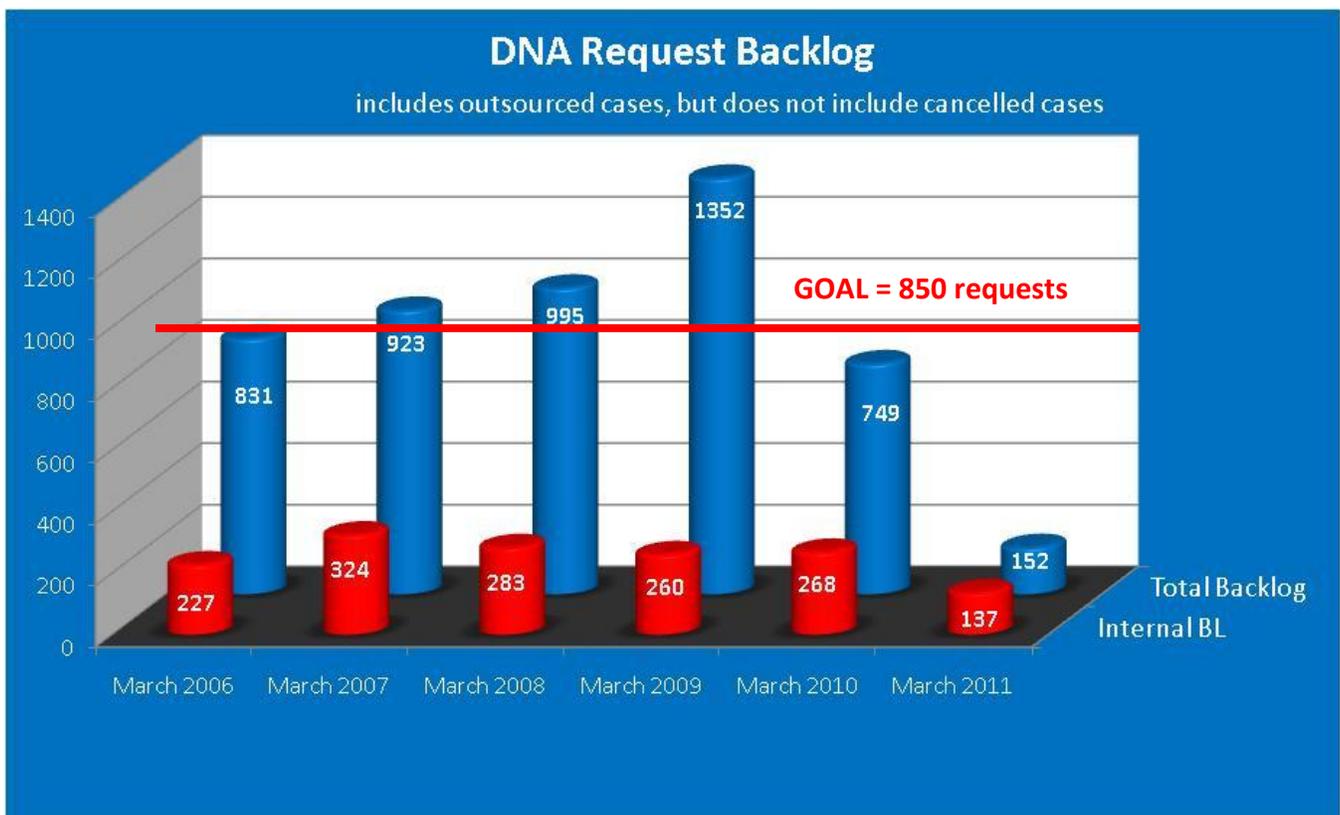


Figure 30: DNA Request backlog. Total Backlog includes outsourced cases. Internal Backlog does not.

While the outsourcing efforts affected the overall backlog, it did not increase the efficiency or productivity of the internal operations. It wasn't until the LSS project began that the internal backlog began to show improvement.

Productivity: The final measure of the success of the efficiency project is the productivity of the LSPCL forensic DNA unit. The entire Lean Six Sigma project was focused around increasing the flow through the laboratory. The solution was that four teams of three DNA Analysts will process approximately 75 samples (roughly 10 cases) per batch. This translates to 40 cases per week throughput (or 160 cases/month). Currently, LSPCL experiences a case submission rate of approximately 110-125 requests/month. The capacity of the laboratory will accommodate the current level of submissions and allow for 28% increase with current staffing levels and equipment capacity.

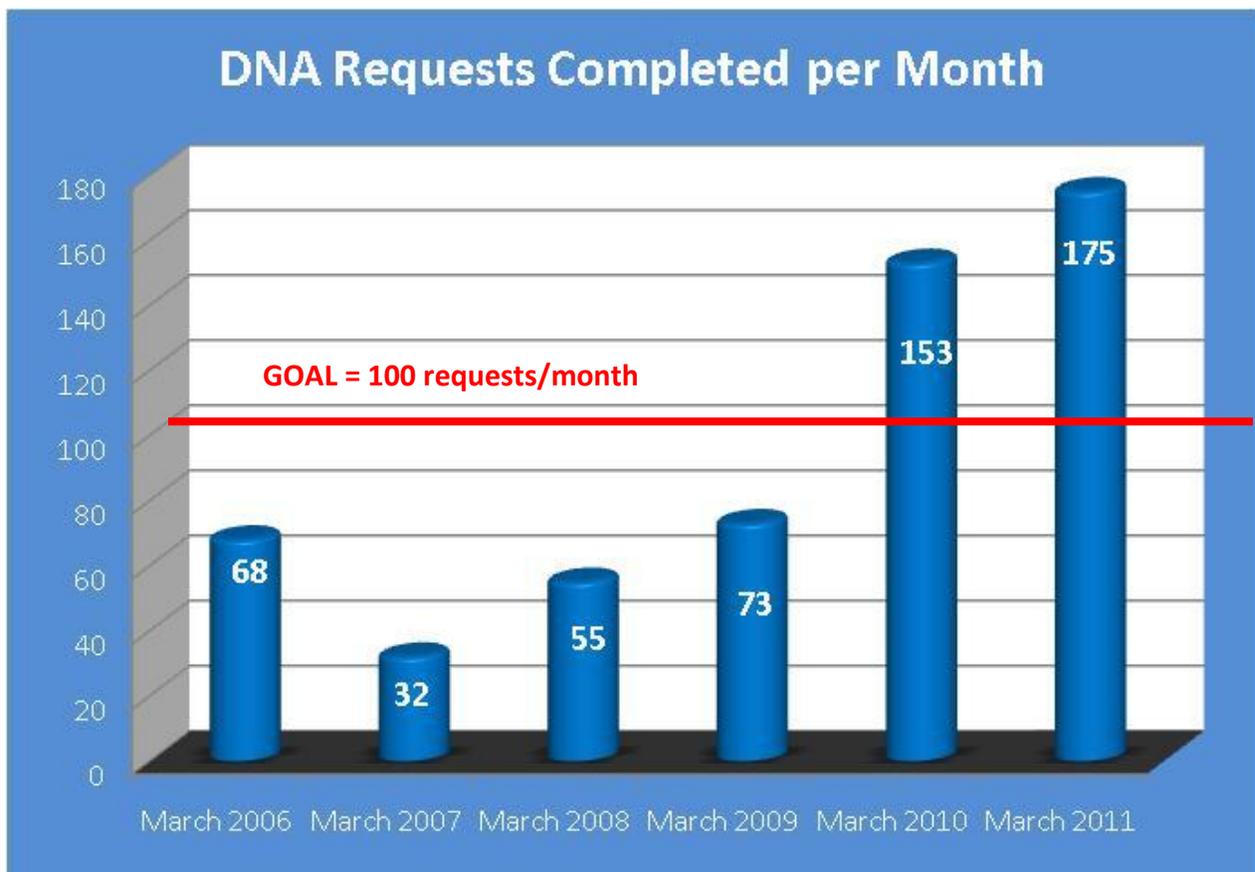


Figure 31: DNA Requests Completed per month.

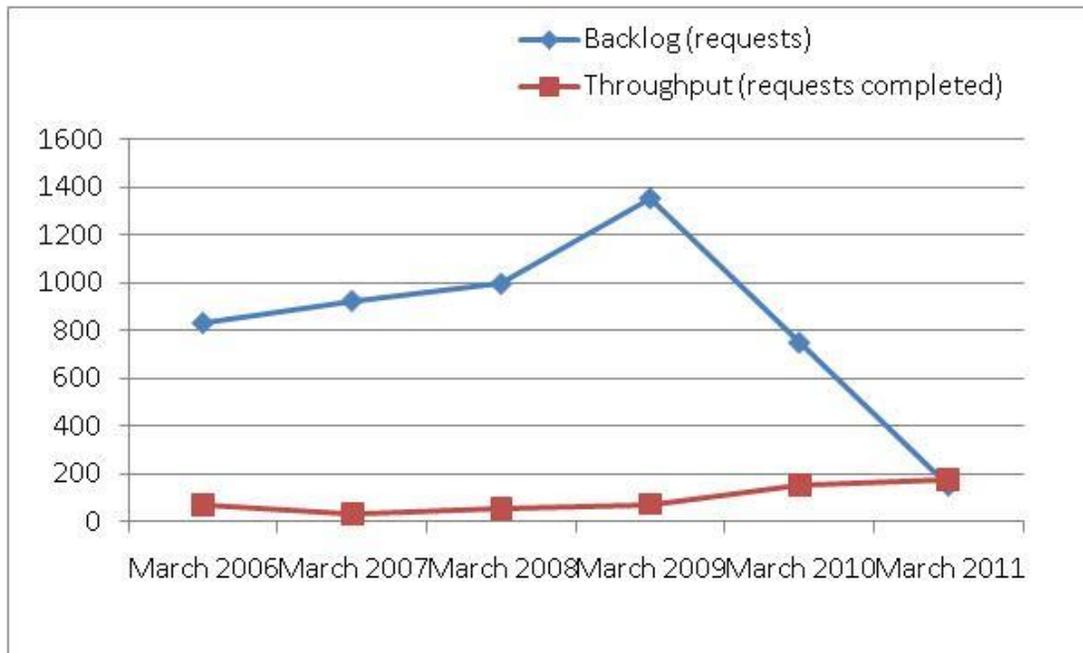


Figure 32: Throughput in relation to Backlog. In 2011 throughput exceeds backlog. LSPCL will redefine “Backlog” from “requests received but not reported” to the number of “requests received but not reported after 30 days.”

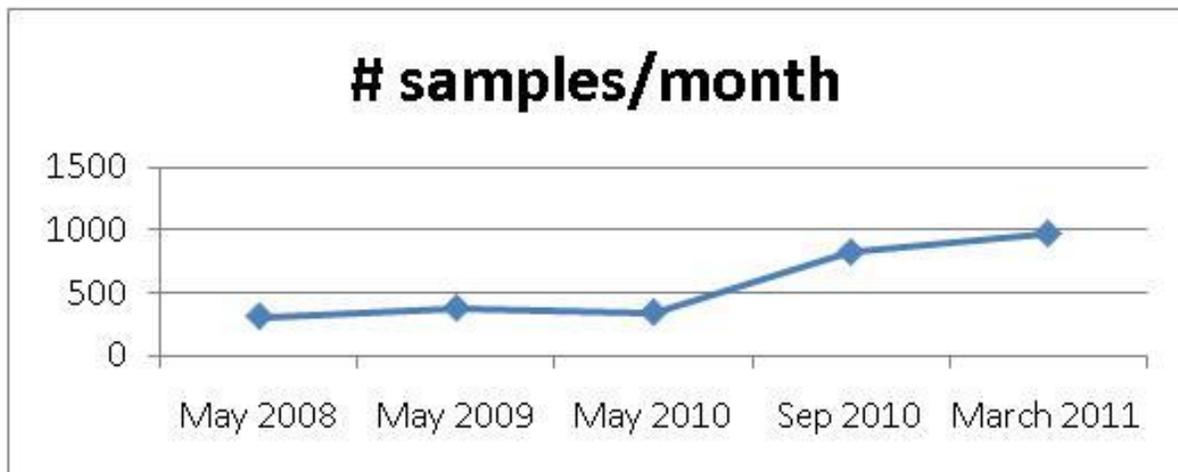


Figure 33: This graph depicts the number of samples processed each month. The LSS project had the most dramatic effect on this variable. Productivity increased from the mid-300 samples per month to over 979 samples per month, a 280% increase from the beginning to the end of the grant period.

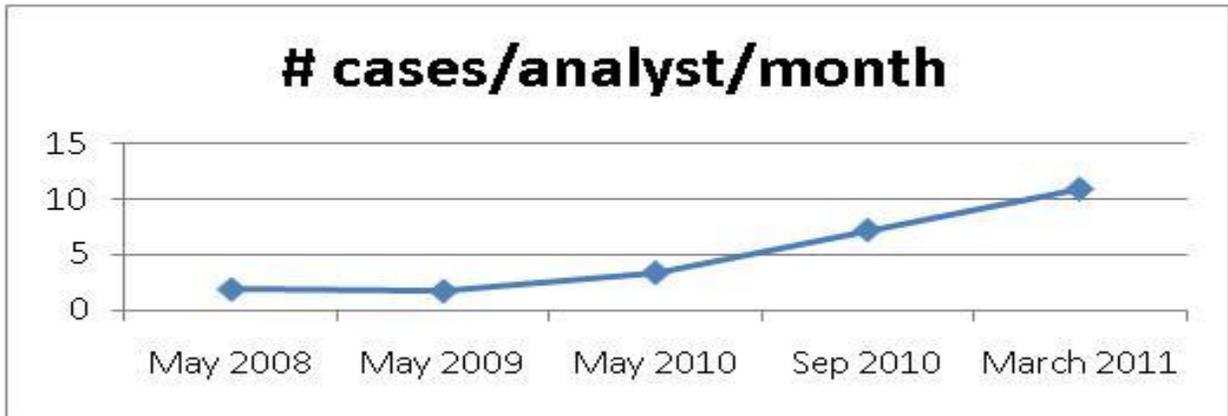


Figure 34: The DNA requests completed per month increased from 3.4 cases per analyst per month at the start of the LSS project in May 2010 to over 10 cases per month at the end of the grant period.

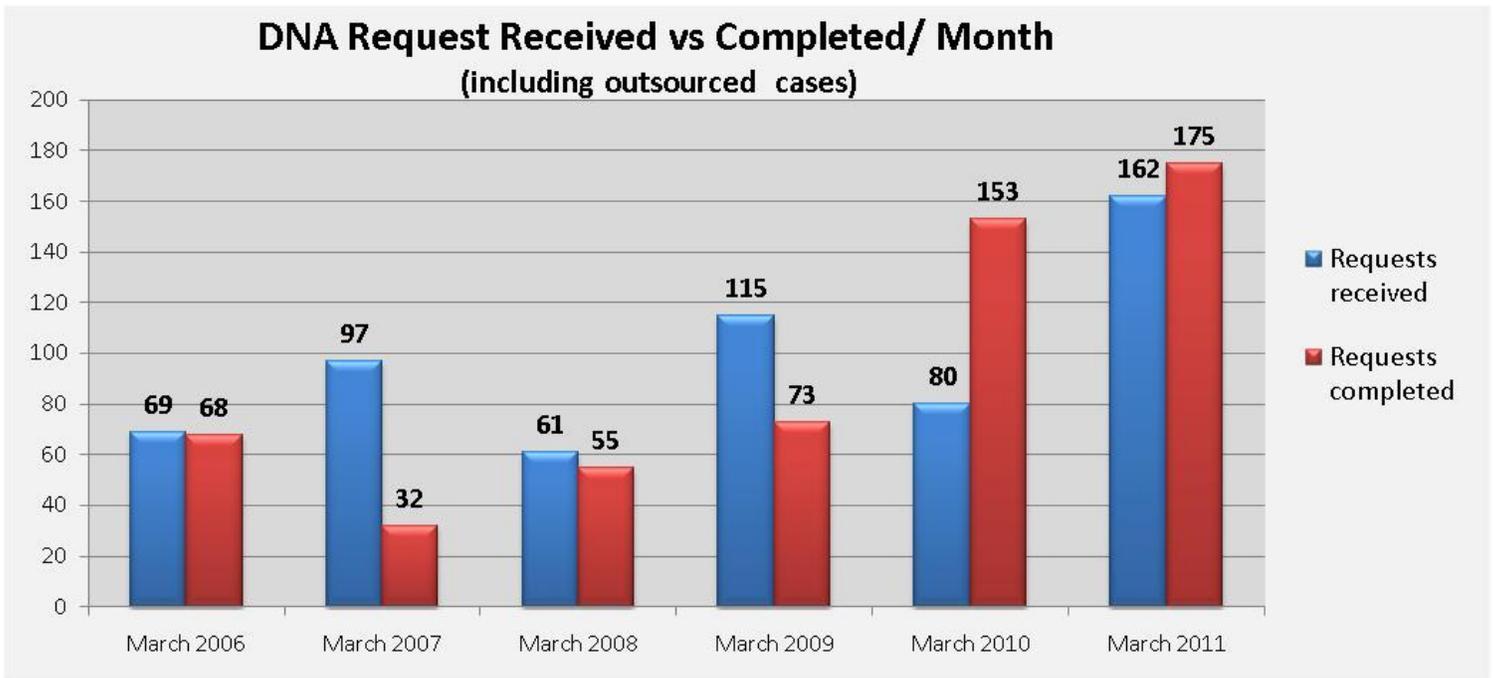


Figure 35: This chart depicts the number of cases received (blue) versus the number of cases reported (red). The backlog grew in 2008 and 2009 (more cases were received than reported). In 2010, that trend was reversed and the LSPCL essentially has no backlog in 2011. These statistics include the outsourced cases, which were data reviewed, reports written, technically reviewed, and administratively reviewed.

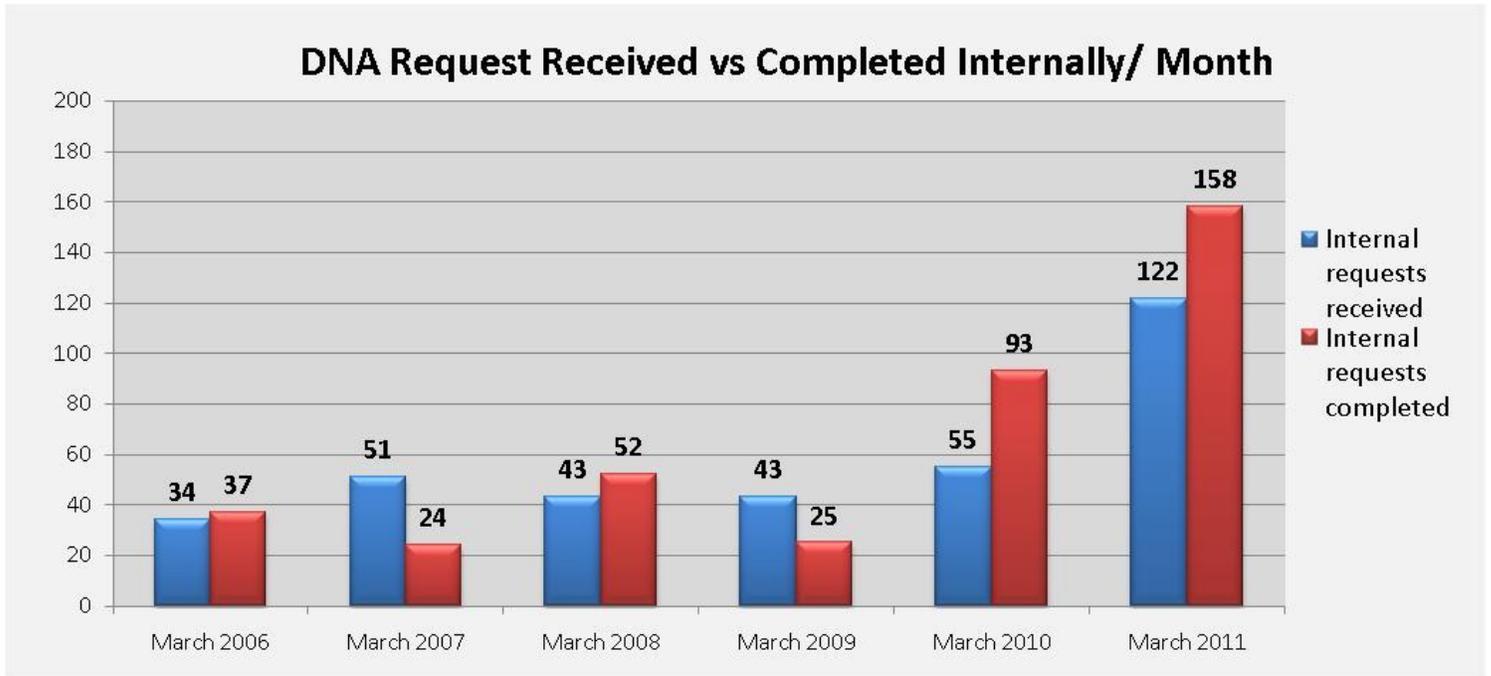


Figure 36: This figure shows the same trend. In 2010, LSPCL began to complete more cases internally than were assigned. There was no outsourcing of LSPCL forensic cases after September of 2010.

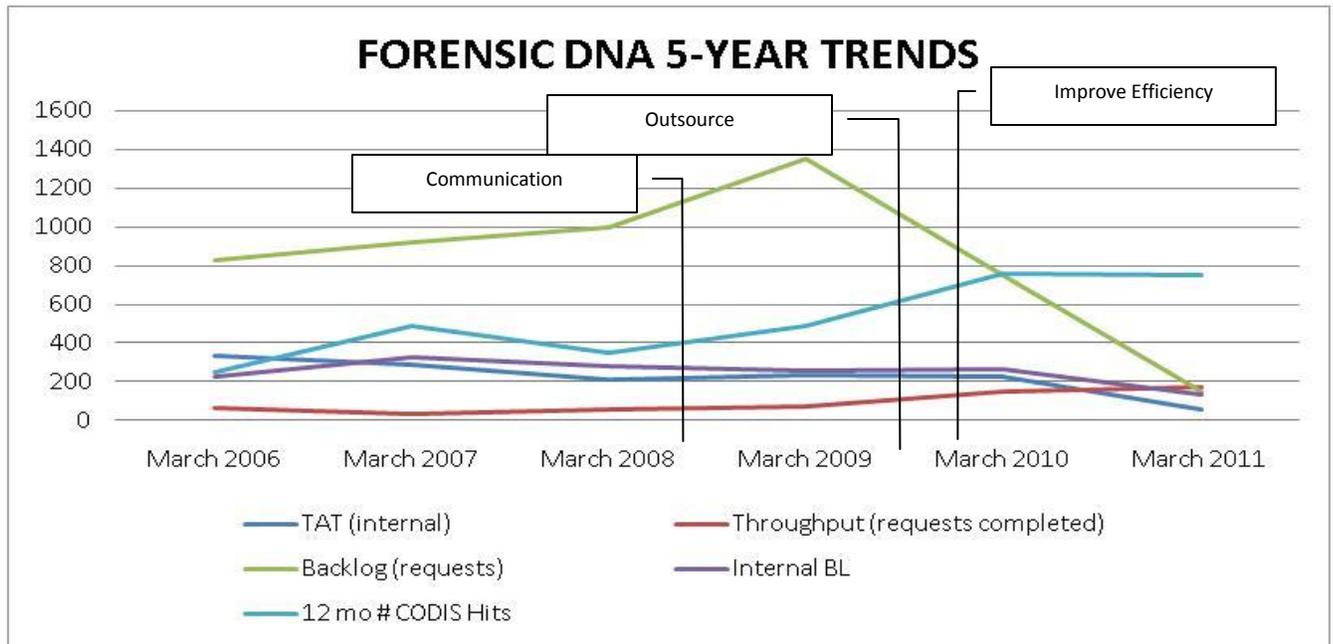


Figure 37: The timeline shows performance metrics over the past 5 years. Phases of improvements are noted. While the decline in Backlog in 2009 is attributed to the outsourcing of 1000 cases (not efficiency grant funded), (which also led to the rise in CODIS hits), the most notable decrease in turn-around-time and increase in productivity occurred after March 2010.

	<u>May 2010</u>	<u>Sept 2010</u>
Turn Around Time (calculated):	186 days	115 days
Total Queue Time:	181 days	11.6 days
Total Process Time:	37.2 hours	6.6 hours (8 cases in 53 hrs)
Value Added Time (VAT):	2.7 %	37.9 %
Non-VAT (NVAT):	97.3%	62.1 %
WIP:	252 cases	89 cases
Backlog:	768	408

Figure 38: This figure shows the improvements of several different metrics from the start of the efficiency project to the end of the Improve Phase in August 2010. Of particular note is the total queue time or time a case is being processed decreased from 181 days to 11.6 days. This exemplifies the “flow” that was created by the LSS Process. Secondly, the value added time, a measure of lean efficiency, increased from 2.7% to 37.9%.

2.3.1.2 Equipment to increase Capacity

As the LSS improved process began to develop the “bottlenecks” became apparent. A 3130 Genetic Analyzer was **replaced with a 3130XL** to afford 16 capillaries instead of 4. The appropriate performance checks were completed. This increased the capacity by 25%. This supported the analysis of larger batches of samples daily.

LSPCL extracts samples using Qiagen’s EZ1 extraction robots. Reference samples and case samples are extracted on separate robots. Currently, LSPCL does not extract more than one case at a time on the evidence robot. This caused a bottleneck for the batch sizes that were being processed. An additional **two EZ1 Advanced XL robots** were purchased to provide additional extraction capacity. While this has afforded the flow of samples to meet the schedule designed, the LSPCL plans to purchase 3 more robots to add to the extraction step capacity.

Three thermocyclers and four thermomixers were purchased to prevent analysts having to “wait” for equipment.

LSPCL has a separate laboratory for the preparation and extraction of CODIS offender and confirmation samples. The success and workflow of the CODIS laboratory indirectly affects the forensic analysis workflow, as they share most equipment. To increase capacity of the CODIS laboratories and afford the LSPCL to begin analyzing offender samples in-house, LSPCL purchased a TECAN EVO 150 robot, using state funding. Previously, other grant funding supported the validation of the TECAN robot for two samples types: FTA blood cards and the Bode buccal collector, using Identifiler Direct, eliminating the quantitation step of analysis.

The **bone extraction equipment and supplies** purchased afforded LSPCL to update their bone extraction protocol. Due to the backlog, LSPCL had ceased to perform bone sample analysis. The state has a progressive missing persons program in Louisiana State University’s Forensic Anthropology and Computer Enhancement Services (FACES) Laboratory. The FACES lab has been outsourcing their DNA bone analysis to other laboratories at a cost to the state. With the service once again available at LSPCL, these outsource funds can be redirected to other projects.

In the past, when LSPCL received evidence that was wet and needed to dry before screening, it was quarantined in a screening lab, with no other casework being performed until it could be processed. With the LSS rearrangement of lab work spaces, all three screening labs are needed continuously for the workflow to meet the schedule. LSPCL purchased **two evidence drying cabinets** to support this need. They have already been used on many occasions and have artificially created more lab space for the unit.

The effect of these equipment purchases to increase capacity are most readily seen in the data for the number of samples analyzed each month and the number of DNA requests completed each month, as reported in the LSS results section above. Because there were additional DNA analysts and technicians hired during the timeline of the LSS project, data on the number of samples analyzed per analyst per month should be reviewed.

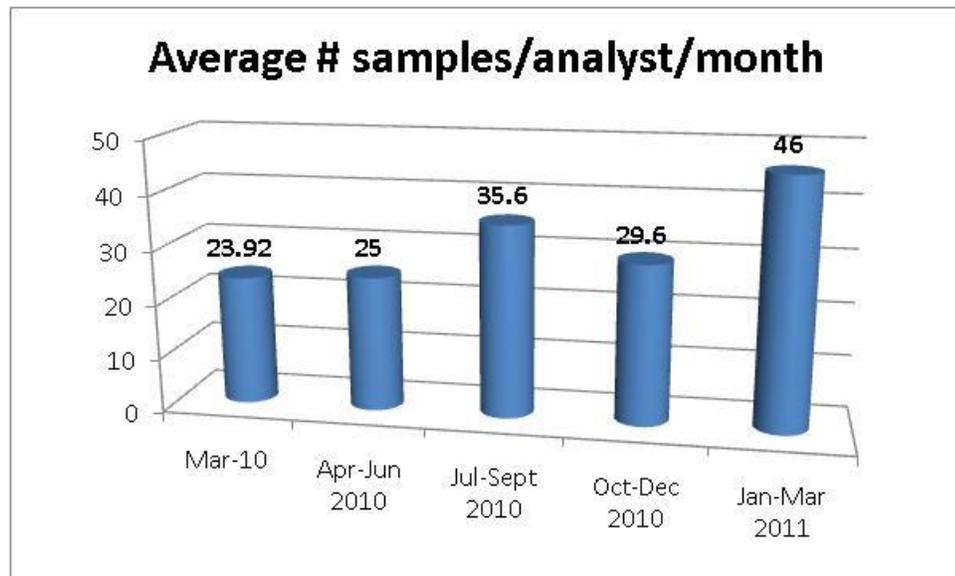


Figure 39: The average number of samples extracted and processed per analyst per month. The quarter showing a decrease at the conclusion of the LSS project was due to two experienced analysts leaving for other employment. New analysts were hired, but they were in training.

Overall, the LSS project resulted in the two-fold increase in the number of samples processed per analyst per month.

2.2.1.3 Dashboard Development

The iDashboard software was purchased and installed. The onsite training was conducted, along with report design. A team of DNA analysts and management, Crime Lab management, and the Data Department staff learned the software and developed the “views” needed to link the Justice Trax LIMS system or any excel spreadsheets to the reports. Three large monitors were purchased and mounted in the hallways and administrative areas of the DNA Unit. They are being connected with network wiring and then they will be broadcasting the reports developed in a cyclical presentation. The software affords a wealth of information, with drill down ability, in visually pleasing graphics. The design of the screens was moderately easy, but the creation of the views required

computer programming assistance. LSPCL anticipates the visual presentations being a part of the daily DNA production meetings within the next few weeks.

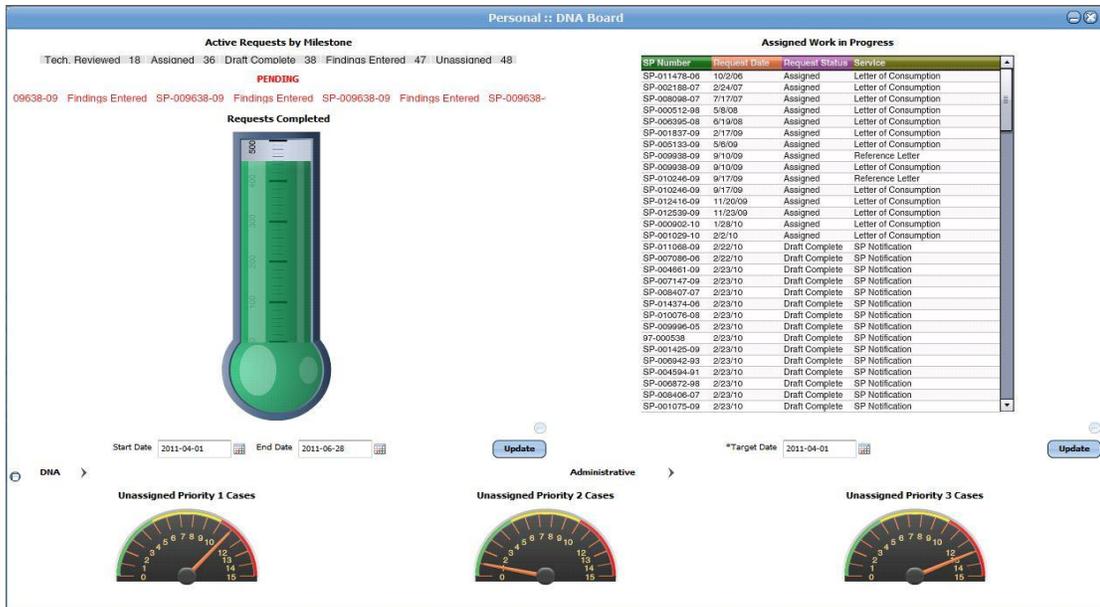


Figure 40: Sample dashboards created for the monitoring of work in progress by milestone and priority (above) and for monitoring requests completed, weekly TATs, and weekly Backlog status (below) using the IDashboard product.



2.3.2 Leverage Technology

2.3.2.1 Validation Services

Qiagility Validation

Three Qiagen Qiagilities were purchased (using other grant funds). The intention was for one to be used for set-up for Quantitation; one for set-up of Amplification, and one for set-up for genetic analysis. Applied Biosystems was hired to perform the **validation of two of the three robots: quantitation and amplification**. The validation for genetic analysis set-up was funded by another grant. The validations were performed. Validation studies results were completed and reviewed. The implementation is pending. The validation to allow the conversion from Profiler/Cofiler to Identifiler Plus, as well as the conversion to amplification in plates instead of tubes, was a higher priority and thus has delayed implementation of these two robots. It is anticipated that they will be brought online within the next three months. The Qiagility for the set-up of genetic analysis was validated as part of another grant project. It has doubled the number of samples that can be run by the CODIS staff and the same effect is expected for the forensic unit.

Prefiler Validation

Additional validation studies were needed for the extraction of non-FTA blood cards and buccal swabs, using the TECAN and Qiagility liquid handling systems, to be able to process them on the robot using the Prefiler extraction kit and the Identifiler Direct amplification kit. The efficiency grant funded this additional validation with Applied Biosystems. LSPCL will be able to perform all extractions for confirmations and offender testing in-house. The validation studies were performed, reviewed, approved, and a teachback was delivered. LSPCL has implemented the in-house analysis of the prior validation for the first two sample types, the FTA blood card and the Bode collector, and is now performing convicted offender samples in-house. The second phase for the remaining two sample types will follow. The CODIS staff are in the process of updating procedures for this protocol and implementation is anticipated in July.

2.3.2.2 Equipment and Supplies

LSPCL purchased 7 **barcode scanners** to equip lab workstations with barcoding capability. A **Datamax barcode printer**, used to print barcodes from the Justice Trax LIMS system was also purchased. Two **desktop scanners** were provided for the clerical staff handling purchasing tasks for the DNA Unit and the Crime Lab. This enabled

them to scan documents related to the purchase and payment of supplies for electronic attachment in the new Sharepoint workflow program. A **desktop printer was purchased for CODIS** to facilitate the printing of fingerprint records for juvenile offenders. Previously these were only able to be printed in another department, which was 50 feet away. This printer placement reduced the transportation in this process and expedited the accessioning and confirmation steps of the CODIS process. All other equipment needed when making LSS improvements (such as tube label printers, refrigerator/freezers, etc) were purchased, as needed, using other available funding through the state and other grants.

2.3.3 Sustain with Clerical Time Savers

2.3.3.1 Formation of the Business Unit

The results of the formation of the Business Unit are not as easily quantified as the other improvements. The biggest impact has been demonstrated by the results of the Purchasing LSS project, which showed a decrease in DNA staff time spent on purchasing activities alone of 68%. Other activities that were previously the responsibility of the DNA Forensic Unit, that are now the responsibility of the Business Unit, include the following:

- Budget planning
Includes review of budget authority and management of appropriated funds, both state and grant, and make recommendations for purchase requests and projects based on available funding.
- Purchasing tasks
Includes management of on-site stores for office supplies and lab consumables, management of blanket orders for supplies and services, locating vendors to supply requested items, obtain multiple quotes for best pricing, vendor negotiation, obtain necessary documents for submission, complete purchasing process, coordinate delivery of purchase, verify receipt and process invoice requests.
- Contract execution
Includes contract development, obtaining signatures, tracking progress of approvals, verification of receipt of services or completion of projects, and processing invoice requests.
- Grant management
Includes grants application and grant management documentation through the GMS system, as well as the administration of all sub-grantees. DNA Forensic is only responsible for performance metric submission twice a year.

The Business Unit is comprised of a Crime Lab Manager, who also manages another technical area, and two Administrative staff members. Since February 2010, the Business Unit currently serves these functions, as well as payroll and administrative support, for the entire Crime Lab.

2.3.3.2 LSS Consultant- Purchasing of DNA Supplies

The following outlines the discussion on the results of the LSS project focused on improving the DNA Purchasing Process workflow:

Summary of the Project

Schedule

Discussion of DMAIC

Define

- **Project Charter**
- **Current State**
- **Process Map**
- **SIPOC**

Measure

- **Purchase Data- type and milestone TATs**
- **Employee Time Survey**

Analyze

- **Hypothesis Testing**

Improve

- **Approval chain**
- **Lacarte**
- **Sharepoint**
- **On-site stores**
- **Vendor Management**

Control

- **Data Collection**
- **On-site store management**
- **Blanket orders**
- **Vendor management**

Statistical Results

Summary of the Project

- **Unexpected Benefits**
- **Lessons Learned**

Summary of the Project

DNA Purchasing LSS Project

A second LSS project was conducted from February 9 to May 11, 2011 to increase the efficiency of the DNA supply and services procurement processes. Four on-site visits were conducted by the CTQ Consultant over the course of 3 months to complete the LSS project and certify a member of the LSPCL team as a LSS Black Belt Engineer. Steps in the purchasing process were changed or eliminated to create an easier, faster, better quality process. The net result was that the DNA scientists were removed from the task of securing supplies and services and the time to delivery was greatly reduced. All project goals were met.

Schedule

Visit #1	2/9/11	Project Kickoff
Visit #2	2/24/11	Define, Measure, Analyze (DMA) Phases completed and Tollgated
Visit #3	3/21/11	Improve Phase completed and Tollgated
Visit #4	5/09/11	Control Phase completed and Tollgated
	5/12/11	Final Presentation and Certification Presentation

Discussion of DMAIC

DMAIC represents an acronym for the 5 phases of the LSS process that leads the team to reach the goals defined. D- Define, M- Measure, A- Analyze, I- Improve, and C- Control. A tollgate presentation is conducted at the conclusion of the phases to review the conclusions, seek guidance on administrative decisions that need to be made, and to garner support to move to the next phase. Due to the limited time of this project, the DMA phases were done together, with the Improve and Control phases following later. The sections below describe the activities that were included in the work of each phase. During each LSS project, there are a multitude of tools that can be utilized in gathering data, as well as in analyzing data. Each project has its own unique characteristics and data sets. The data determines what tools are appropriate to use in evaluation of the data. The reader will notice that many, but not all, of the tools used in the DNA Forensic LSS project are the same. There are some tools used in this project, that were not used in the previous project as well.

Define Phase

The Define Phase is discussed earlier in the DNA Forensic LSS Project. The concept and purpose is the same for both projects. That is, to define the project, make a business case for why the project is needed, articulate what the customer needs are that the project needs to ensure is provided, and to evaluate the potential for success of the project if engaged.

Project Charter

As the project is initiated a Project Charter was completed to determine scope, team members, Executive Stakeholders, timelines and project purpose and goals.

Project Charter (Instructions embedded in each column header)						Return to Main Screen																															
Project Leader	Project Name	Project Coach	Project Champion	Process	LOB	Project Type	QPC #																														
Mendy Richard	LSP DNA Purchasing Efficiency Improvement Project	Kathi Sill	Layne Barnum	Purchasing	DNA	Improvement	2/1/2011																														
Problem Statement																																					
The current DNA Purchasing Process does not meet expectations and does not enhance the efficiency of the DNA department. Today, the DNA Purchasing Process has limited inventory management, sporadic cost analysis, requires too many POs, and takes, on average, 8 weeks to obtain a purchase order. Additionally, management team members, as well as DNA analysts, are frequently called upon to rework, touch or wait on purchase orders in process. This wasted effort, as well as the 8 week cycle time, causes backlogs in work processes as well as wastes valuable time and resources. By improving key process inputs and developing a control plan for sustained process execution, this project will improve productivity by \$14,000 (15 DNA man-hours). DNA analysts will be able to focus on casework instead of engaging in the extended purchase process. As other operations are improved \$100,000 savings are projected.																																					
Business Case				Project Scope																																	
Cycle Time Waste Productivity Touches				In Scope: DNA Purchasing Process from request to purchase order issuance, DNA Purchase receipt of goods to payment, Budget Management System, Exception Alerts (control plan) Out of Scope: Prior to purchase request submission, purchase fulfillment by vendor.																																	
Project Goal Statement				Project Team																																	
Project Goals are to: o Reduce the number of steps in the purchasing process o Decrease the average DNA purchasing process turn-around-time o Decrease the average internal (Crime Lab) purchasing approval steps turn-around-time o Decrease staff time and touches needed to perform tasks of the purchasing process o Ensure that 95% of purchases meet all milestone delivery deadlines o Explore an inventory management process Additionally, LSPCL, by utilizing the Contractor's recommendations, expects to develop management tools to institute performance standards for the department.				<table border="1"> <thead> <tr> <th>Role</th> <th>Name</th> <th>Organization</th> </tr> </thead> <tbody> <tr> <td>Project Leader</td> <td>Mendy Richard</td> <td>CODIS DNA & Biz Unit Mgr</td> </tr> <tr> <td>Project Champion</td> <td>Layne Barnum</td> <td>Lab Director LSP CL James McGuane</td> </tr> <tr> <td>Project Coach</td> <td>Kathi Sill</td> <td>CTO</td> </tr> <tr> <td>Process Owner</td> <td>Mendy Richard</td> <td>CODIS DNA & Biz Unit Mgr</td> </tr> <tr> <td>Team Member</td> <td>Charron Thomas</td> <td>Deputy Director LSP CL</td> </tr> <tr> <td>Team Member</td> <td>Christie McCollough</td> <td>Grants, Biz Unit Staff</td> </tr> <tr> <td>Team Member</td> <td>Santina Spears</td> <td>Business Unit Staff</td> </tr> <tr> <td>Team Member</td> <td>Erin Bielkiewicz</td> <td>Mgt & Finance Mgt</td> </tr> <tr> <td>Team Member</td> <td>Marci Herndon</td> <td>DNA Analyst III</td> </tr> </tbody> </table>				Role	Name	Organization	Project Leader	Mendy Richard	CODIS DNA & Biz Unit Mgr	Project Champion	Layne Barnum	Lab Director LSP CL James McGuane	Project Coach	Kathi Sill	CTO	Process Owner	Mendy Richard	CODIS DNA & Biz Unit Mgr	Team Member	Charron Thomas	Deputy Director LSP CL	Team Member	Christie McCollough	Grants, Biz Unit Staff	Team Member	Santina Spears	Business Unit Staff	Team Member	Erin Bielkiewicz	Mgt & Finance Mgt	Team Member	Marci Herndon	DNA Analyst III
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Team Member	Marci Herndon	DNA Analyst III																																			
Project Plan Summary																																					
		2011						2012																													
Phase	Start	Finish	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan																							
Define	2/9/2011	2/11/2011	█																																		
Measure	2/9/2011	2/11/2011	█																																		
Analyze	2/9/2011	2/11/2011	█																																		
Improve	2/24/2011	3/18/2011		█																																	
Control	3/21/2011	4/18/2011			█																																

Figure 41: DNA Purchasing LSS Project Charter defined the problem, the scope and goals of the project.

Current State

The current state of purchasing involves three segments of processing in this order:

- Activities and approvals that occur at LSPCL
- Approvals that occur externally as part of LSP, but outside of LSPCL
- Activities and approvals that occur in the Purchasing Department

To measure the current state, data was collected on the number and type of purchase that were involved in purchasing activities from the beginning of the LSPCL fiscal year, July 2010, through January 2011 for a total of 207 purchasing events. Purchase types were defined by the process used in making the purchase as defined below:

- Lacarte (LC) – The state’s VISA charge card used for rapid purchases not to exceed \$1000 per purchase. Designated cardholders within the laboratory had a monthly limit of \$5000 of purchases. Purchases for office supplies up to \$100 could be made without approval, but all other charges must be approved at the LSPCL internally before purchase. No external approvals or Purchasing Dept. activities are required.
- Standing Order/Blanket Order (BO) – This is the purchase type used to obtain one purchase order to be used during the fiscal year in increments. The price is secured at the beginning of the year, either through the bid process, state contract rates, or sole source approval. The funds are encumbered at the beginning of the year, but partial payments are not made until the partial order of supplies are received. The initial process mimics a Purchase Order in process steps, ISIS entry, and required approvals.
- Purchase Order (PO) – This purchase type is used for those items not able to be purchased by Lacarte. Multiple quotes and bid processes are required for purchases exceeding certain dollar amounts. This requires all levels of approval and is entered into the state’s purchasing software program, ISIS. The purchase order process is the same for Blanket Orders as it is for Purchase Orders and is the process that contributes to the long cycle time.

Initial sampling showed the process cycle times as follows:

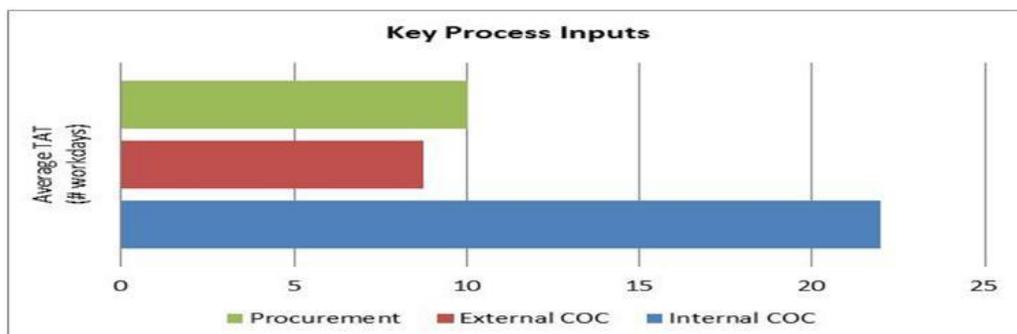
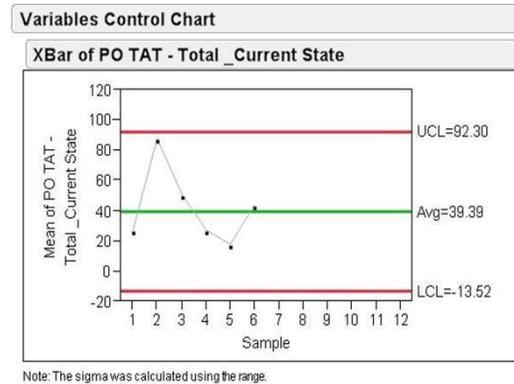


Figure 42: DNA Purchasing TATs by phase

Current processes meant that the purchase order process would take an average of 39 workdays. However, there was such variability in the process that, to have a 95% confidence level that a supply or service could be procured, one would have to allow 92 workdays.

Figure 43: Variability of the Purchasing process in its current state.



The 3 phases involved in obtaining a purchase order are depicted in the following Pareto chart, showing the longest delay in processing within the internal activities and approvals performed at the LSPCL.

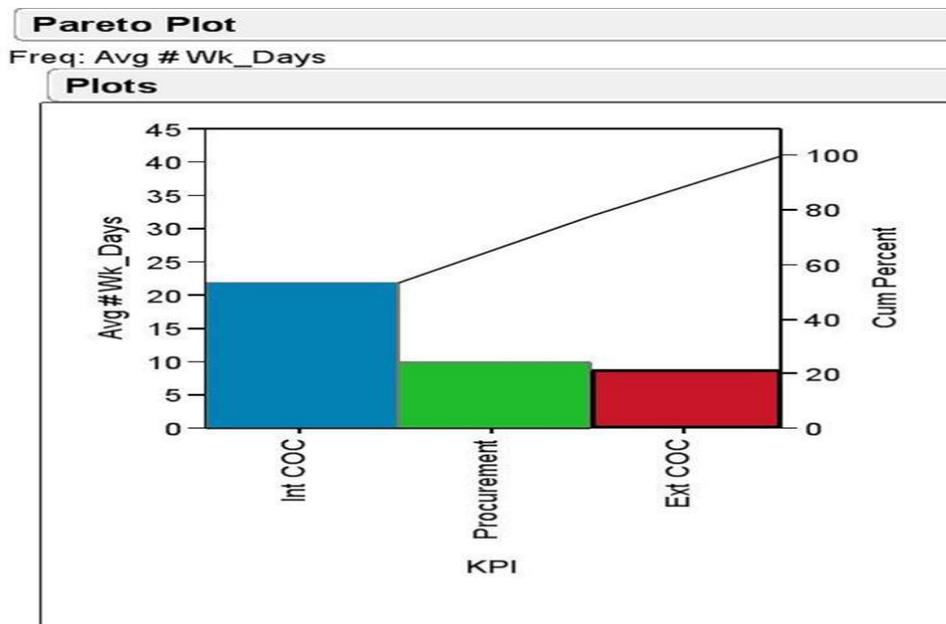


Figure 44: Pareto Chart of TAT by phase of the process showing the Internal process took the most time of the cycle.

By using the Key Process Input (KPI) distribution of data, a review of the 25% performance level revealed that the process was capable, but had too much variation to meet targets. The conclusion was that the process needs improvement rather than redesign.

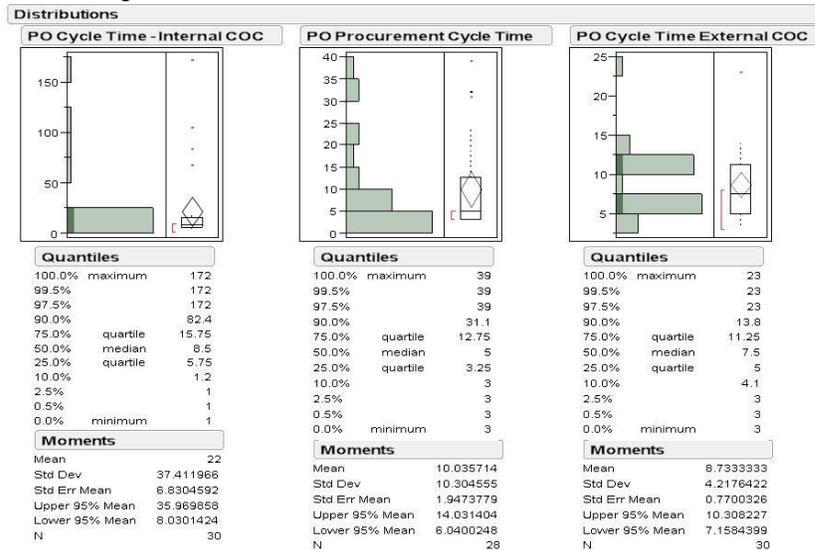


Figure 45: KPI distribution of initial sampling of purchasing data

Process Map

The team detailed all of the steps within the purchasing process, using “sticky notes” which could be moved as new steps were remembered or detailed. This visual map was then converted to a “should be” process map, both on the butcher paper and electronically.



Photograph 5: Photograph of the “As is” process map for purchasing supplies or services.

High Level "AS IS" Process Map – LSPCL DNA Purchasing Project

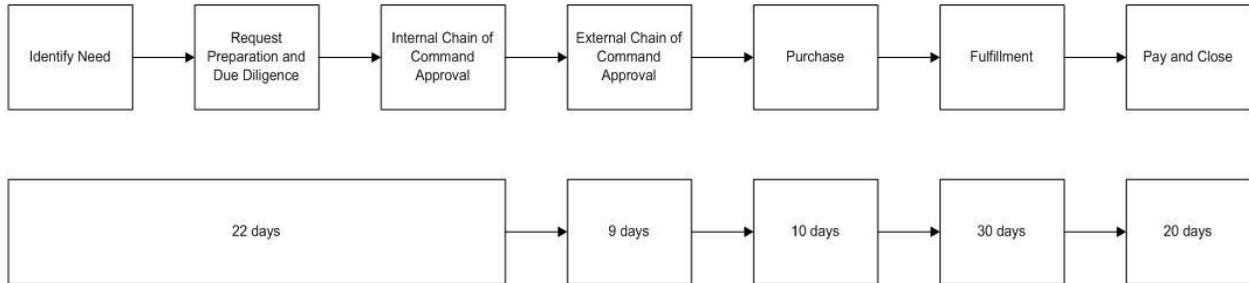


Figure 46: High Level, Level 1, "As is" process map for purchasing supplies or services, showing 7 basic steps to processing a purchase from "Identify Need" to "Pay & Close."

Process cycle times revealed that the activities that occur at the LSPCL took over half of the entire purchase cycle time.

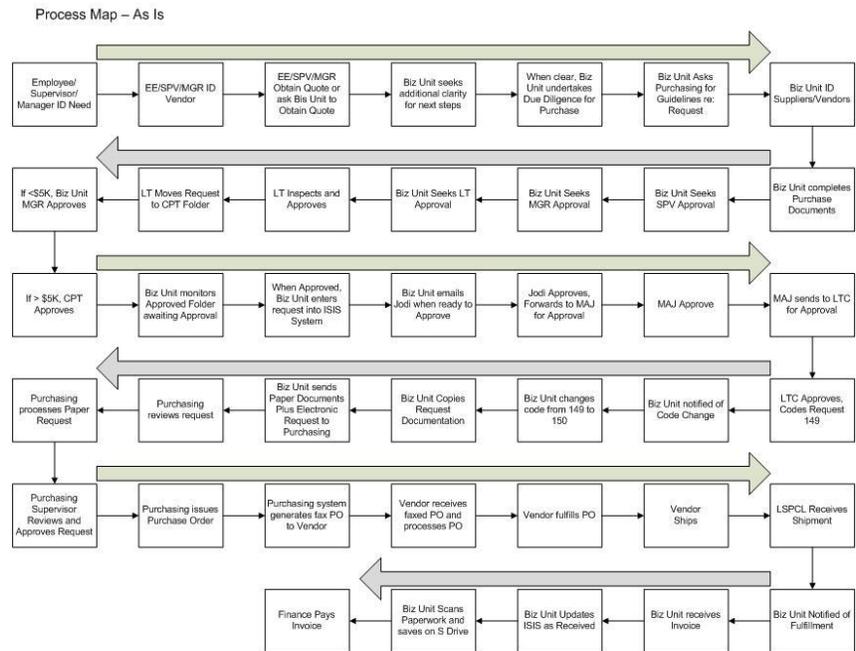


Figure 47: Level 2 "As is" process map for purchasing supplies or services.

After the process was recorded in a visual way, the steps of the process could be more easily evaluated.

A second project was spawned as a result of this work. The Purchasing Department also engaged in a LSS project, under the leadership of one of the members of the DNA Purchasing LSS Team. Process mapping and LSS activities began in that department as well. Their project is not discussed here, but is worthy to mention as it speaks to the contagious nature of the LSS methodology.

One of the key elements of LSS is intently listening to the customer. By recording the voice of the customer the process can be designed to ensure quality and delight the customer.

Voice of the Customer- Delighters						
Project Title: LSS DNA Purchasing Efficiency Improvement Project						
Project Leader: Mendy Richard						
CL Employees	Business Unit	Purchasing Staff	COC	Vendors	Agencies	Public
Timely issue of purchase orders	Unit has complete structure to purchasing	Zero retouches between CL and Purchasing	Reduce # of COC approvals	Timely payments	Never casework downtime due to lack of supplies	Solve a crime for a victim/family, prevent other crimes
Supplies always available	PO issued without any intervention	No reworks on PO paperwork	Spending least money for products	This is the way keep and grow your business	Reports go out in a timely fashion	Confidence in budget spending
Get what I order	PO returned consistently within 2 weeks	Internal approval process approved in 5 days	Proper documents for audit	Regular or exclusive provider	Work more cases faster and cost efficiently	Very efficient, a pleasure to do business with
Established Policies & Procedures	All department communication for no downtime is purchase process	Always having perfect supporting documentation	Not have to be in the process and & employees get supplies		Agencies never have to wait on results (due to supplies)	
Never wait on supplies	Business unit receives perfect request for supplies					
Never having to run out of supplies	Purchase items requested are specifically described					
Not having to spend more than 10 minutes to fill out a form to request a purchase	Reduce internal COC approvals					
Analyst not involved as much						
Increase vendor quote deadlines						
This is wonderful. So glad you have improved on getting our products to us.						

Figure 48: Voice of the Customer analysis.

Stakeholders are individuals invited to participate in the project at a high level, advisory capacity. Stakeholders for this project were the Undersecretary of the Department of Public Safety Services (Corporate Financial Officer), the Director of the Crime Lab, and the Support Major that oversees the Crime Lab at an organizational and administrative level. By involving and seeking guidance at the tollgates of these high level executives, improvements are more likely to be permitted, supported, and sustained after the project is complete. It gives a

level of support that ensures cooperation at all levels of the organization and gives credibility to the project. It was essential to some of the changes that were implemented within this project.

Conducting a Stakeholder's Analysis in the DEFINE phase also reveals what the current levels of support are and potential obstacles or concerns that need to be addressed in the planning stages.

		STAKEHOLDER ANALYSIS (instructions are embedded in each column heading)				Return to Main Screen		
Project Leader	Project Name	QPC #	Date	Project Type		Project Coach		
Mendy Richard	LSP DNA Purchasing E	2/1/2011		Improvement		Kathi Still		
Stakeholder Role	Stakeholder Name and Contact Information	REQUIRED LEVEL OF SUPPORT	CURRENT LEVEL OF SUPPORT	Project Failure if Desired Level of support not Achieved	Stakeholder Risk Rating	Stakeholder's Issues/Concerns about the proposed change	WHAT HAS TO OCCUR from the Stakeholder view TO MOVE TO DESIRED LEVEL OF SUPPORT	DETAILED INFLUENCE STRATEGY
public		3	3	1	0			
agencies		3	3	1	0			
vendors		1	2	3	3	vendor protocol inflexibility	sampling of vendors - SME for hypothesis discussion	
DNA crime lab employees	Marci Herndon	2	3	1	1			
other department	Undersecretary Boudrea	1	1	5	0			
grantors		3	3	5	0			
legislators		2	2	1	0			
state purchasing	Denise Lea	3	3	1	0			
legal		3	3	1	0			
chain of command - internal	Capt Barnum	1	1	5	0			
chain of command - external	Maj White	1	1	5	0			
subgrantees	Christie	2	3	1	1			
project team	Mendy	1	1	5	0			
non DNA Crime Lab Employ	??	2	3	1	1			
					0			

Figure 49: Stakeholder analysis

The only issue that was of concern, rated as a Stakeholder Risk Rating of 3, was the vendor protocol inflexibility. Due to state purchasing regulations, there was concern that some improvements would be prohibited by policies that would not be able to be changed by the LSS team or Stakeholders. It was decided that sampling key vendors to get more information would likely allow the issues to be overcome while still staying in compliance with state regulations.

SIPOC

The SIPOC analysis affords the team the ability to review the inputs and outputs of the process. The suppliers are key to the cycle, as well as the customers who receive the outputs. This exercise allows the team to see how their day to day activities fit with those that they interact with to maximize the efficiencies of those interactions.

SIPOC Analysis and Map				
Project Title: LSS DNA Purchasing Efficiency Improvement Project				
Project Leader: Mendy Richard				
Suppliers	Inputs	Process	Outputs	Customers
Employees	Need, Requests, due diligence, paperwork	1) Identify need 2) Due diligence 3) Internal approval 4) External approval 5) Purchasing 6) Fulfillment 7) Pay and Close	Supplies	Agencies, Public, Management
Vendors	Quotes, documents, productivity/success		Money	Us
Purchasing Staff	PO, Check & Inspect, Information guide, Liason to State Purchasing		Documents bill	Crime Lab employees, Business Unit
Chain of Command	Approve/Deny, budget reconciliation		Production, Happy Staff, Mission accomplished	Executive and Legislative Branches Employee, Public
Business Unit	Admin, due diligence, inspect document		Production, Happy Staff, Mission accomplished	Purchasing, Crime Lab, COC, Vendors
ISIS System	Solution/computer Platform to advance/inspect			Users
State Purchasing	Guidelines, approve, support		Mission accomplished, Documents reconcile	State agency, LLA

Figure 50: SIPOC Analysis and Map

Measure Phase

Purchase Data- type and milestone TATs

Data was collected from the beginning of the current fiscal year (July 1, 2010) to present (through January 2011) to understand the types of purchases made, the amount of money used in purchasing these items, the turn-around-time of the various milestones. The purchase type dictates the milestones, so the focus was on the longest process, the purchase order process. Because Lacarte (credit card) purchases only require in lab approval, they are a shorter process and do not require the external chain-of-command approval steps or the Purchasing

Department's involvement. Purchase orders also must be entered and tracked with the state's purchasing software, known as ISIS. With restricted use and predetermined required approval steps, this was incorporated into the milestone turn-around-times.

The milestones were as follows:

- Request to ISIS Entry
- ISIS Entry to ISIS Internal Approval
- Internal ISIS Approval to External ISIS Approval
- External ISIS Approval to Purchase Order Issue
- Purchase Order Issue to Receipt of Goods
- Receipt of Goods to Payment and Close

Larger timeframes were also reviewed, such as from request to PO issue, which incorporates all three phases, but excludes the delivery of goods. After a great deal of discussion as to whether the scope of the project should include delivery of goods, as the Crime Lab has little control on the delivery by a vendor, it was decided to measure the results both ways, but that it would be incorporated into the Improve Phase as it directly affects how long the DNA Analyst has to wait for their supply and it affects whether the DNA Analyst has to spend time inquiring as to the whereabouts of the supply.

Likewise, the step from receipt to payment is also vendor dependent, with the issuing of invoices often taking several contact attempts by the Crime Lab to get an invoice from the vendor to pay. Again, it was decided to include this step in the improvements, as it is a function of the overall process and is an investment of staff time if it is not efficient.

Data showed that 207 purchasing events occurred from July 2010 through January 2011, with the following characteristics:

Purchasing type	# of events	# Office Supplies	# < \$5000	# >=\$5000
Lacarte	155	115	155	0
Purchase Order	52	2	29	23

Table 8: Purchasing Data overview

The milestone turn-around times were as follows:

Milestone	TAT (days)	
	“as is”	“should be”
Request to ISIS Entry	17.37	2
ISIS Entry to ISIS Internal Approval	3.88	1
Internal ISIS Approval to External ISIS Approval	10.8	0
External ISIS Approval to Purchase Order Issue	9.51	1
Purchase Order Issue to Receipt of Goods	24.43	20
Receipt of Goods to Payment and Close	21.37	2
	87.36	26

Table 9: Milestone TATs for a Purchase Order

Once the data was tabulated, the team began to analyze the data and formulate the “Should Be” process map and associated turn-around-times. The last column represents the “should be” TATs. The initial target was extended to 50 days, to allow for practical delays. Additionally the Project Charter was updated to specify more objectively, the project goals.

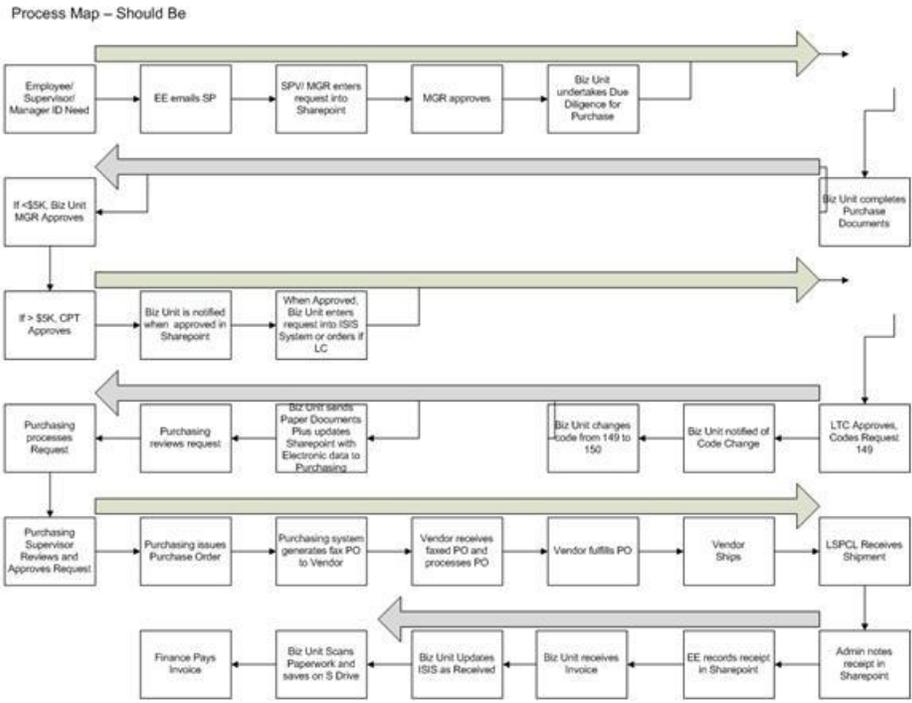


Figure 51: “Should be” Process Map. Notice the eliminated steps that occurred during streamlining the processes.

GOAL	Unit of measure	TARGET
Decrease TAT: Request-PO	days	10
Decrease TAT: Request-payment	days	50
Change purchase type mix in order of ease of process: Onsite store/ Lacarte/ blanket order/ PO	% of purchases	50/ 35/ 10/ 5
Reduce staff time spent on purchasing (DNA/Crime Lab)	hours/ week	5/ 40

Figure 52: DNA Purchasing Project Goals

Employee Time Survey

Another measurement that was taken was a survey of Crime Lab employees, both DNA and non-DNA areas, for the time that they spent each week on purchasing tasks. This included any shopping vendors, obtaining quote, and even checking on the progress of purchases.

The results indicated that 21.75 hours a week of DNA staff time was being spent on purchasing activities. While this was a self reported estimate, it did verify what the DNA management felt was truly the case. Additionally, the

rest of the Crime Lab was surveyed and the entire Crime Lab reported 137.80 hours per week being spent on purchasing tasks. The potential savings in salary, if this were eliminated, was projected to be upwards of \$32,000 for DNA and \$175,000 for the entire Crime Lab. The salary estimates were rough and only represented a sampling, but the message was clear. A great deal of staff resources were being used on marshalling the purchase of supplies and services, only to have the process take approximately 40 business days (8 weeks) to occur.

ISS Purchasing Metrics -									
							Time on Purchases		
							(minutes per week)		
Name	Tech	Analyst	Supervisor	Manager	Other	Total			
Total minutes a week for DNA	314	97	1080	75	53	1305			
Total hours a week for DNA	5.23	1.62	18.00	1.25	0.88	21.75	Hours/Yr - DNA	1131	0.5 FTE
Total minutes a week for Crime Lab	314	1077	1500	2115	3262	8268			
Total hours a week for Crime Lab	5.23	17.95	25.00	35.25	54.37	137.80	Hours/Yr - Crime Lab	7165.6	3.4 FTE
Avg \$/manhour	\$ 15.00	\$ 20.00	\$ 25.00	\$ 35.00	\$ 20.00				
Labor Cost Crime Lab - As Is	\$ 78.50	\$ 359.00	\$ 625.00	\$ 1,233.75	\$ 1,087.33	\$ 3,383.58	Salary/Yr Crime Lab	\$ 175,946.33	
Labor Cost DNA Dept - As Is	\$ 78.50	\$ 32.33	\$ 450.00	\$ 43.75	\$ 17.67	\$ 622.25	Salary/Yr DNA	\$ 32,357.00	

Figure 53: Staff Survey of Time Spent on Purchasing Activities

Analyze Phase

The Analyze Phase involved several evaluations. The statistical data showed that the process had the potential to be improved and that redesign was not necessary.

Hypothesis Testing

By reviewing the purchase data, it was proposed to change the “mix” of the purchase types and the impact of that change was analyzed. Several questions were asked:

- What % of the purchases could be converted to Blanket Orders?
 - Answer= 75%
- What % of the purchases could be “Lacarted” if the limit were raised from \$1000 to \$5000 per purchase?
 - Answer =18.5%
- With these two improvements, what % of the purchases would still require a Purchase Order to be issued?
 - Answer = 6.5%
- What would be the resulting % of the purchase “mix” between Lacarte, Blanket Order, and Purchase Order?
 - 75% Blanket Orders/ 18.5% Lacarte/ 6.5% Purchase Order

The current purchase process had a Sigma Value of 2.67. By implementing the improved approach designed by the Project Team was expected to have a Sigma Value of 4.70 and represented a process yield improvement of 90.96%. The weighted average TAT – including Vendor Fulfillment (which remained out of LSPCL direct control) would be 9.05 days, an improvement of 30 days. Crime Lab-wide the calculations projected an improvement of 79.6% in TAT by changing the purchase mix, increasing the Lacarte limits, and creating an on-site office supply store.

Within the past two years, office supplies no longer were being distributed at an organizational level. Departments, like the Crime Lab, had to develop their own systems for purchasing their own office supply items. Because so many Lacarte purchases represented trips to office supply, creating an in-house supply closet/store was suggested.

TYPE OF PURCHASE (FULL END TO END)	CURRENT PURCHASE ORDERS	CURRENT BLANKET ORDERS	CURRENT VWR/FISHER CONSUMABLES	CURRENT LACARTE (EX VWR/FISHER & OFFICE SUPPLIES)	CURRENT LACARTE/OFFICE SUPPLIES	NEW PO	NEW BO	NEW VWR/FISHER STORE	NEW LACARTE	NEW OFFICE SUPPLIES STORE	Current State (TAT* Frequency)	Improved State (TAT* Frequency)	Change (DELTA) in TAT Days	Improvement (%)
TAT	125	60	12	12	12	37	37	1	12	1				
2223	3	1	2	4	40	0	1	2	7	40	987	163	824	83.49%
2225	12	1	2	14	13	5	1	2	17	17	1908	445	1463	76.68%
2226	14	0	0	5	25	1	2	0	16	25	2110	328	1782	84.45%
2227	4	0	7	10	3	0	3	7	10	4	740	242	498	67.30%
2228	6	0	1	3	10	1	5	4	0	10	918	236	682	74.29%
2229	10	0	2	1	13	3	1	3	6	13	1442	236	1206	83.63%
TOTAL	49	2	14	37	104	10	13	18	56	109	8105	1690	6415	79.64%

Figure 54: Projected TATs based on suggested changes. Improvement was projected to be 79.6% labwide, 76.7% for Forensic DNA and 83.5% for CODIS DNA.

Improve Phase

Based on the analysis of the data, the following improvements were accomplished:

1. Eliminating non-value added steps in the current process
 - Eliminated External Chain of Command Approval
 - Increased Purchase Limits on LaCarte
2. Developing an automated 'conveyor' system that moves the process at the desired tact time
 - SHAREPOINT
3. Managing vendor relationships to deliver optimal TAT, including strategic use of blanket orders, on-site stores and service level agreements (SLAs)
 - Met with 9 different vendors to negotiate pricing and SLA
 - On-Site stores for Lab Consumables and Office Supplies
4. Well defined 'handshake' between Purchasing, Finance and Crime Lab Management team to improve the feedback and information flow
 - Routine monthly meetings currently between Finance and Crime Lab re: budget/spending
 - More work to do to pass information to Crime Lab Management team

More discussion on the improvements follows:

1. Eliminating non-value added steps in the current process
 - Eliminated External Chain of Command Approval
 - Increased Purchase Limits on LaCarte

The External Approval phase of the purchase process was eliminated. It was determined that the chain-of-command relied on the judgement of the Director of the Crime Lab on determining whether a purchase was needed and moreover, if there was budget in place to support the purchase. There were no cases where a purchase had

been denied. This required a change be made to ISIS to no longer require those steps. This eliminated 3 approvals within the ISIS approval process and totally eliminated phase 2 of the process.

The Lacarte limits were increased to \$5000 for a single purchase, with a monthly limit of \$20,000. Lacarte card holders at the Crime Lab included several managers and supervisors. These cardholders were left in place at the previous spending levels, in case of emergency purchasing needs. The Business Unit, comprised of a Crime Lab Manager and two Administrative staff, were approved for the higher limit purchasing power. Approval was issued from the Undersecretary's Office that the higher Lacarte limits would not require any additional approvals, but management of the purchases would remain with the Director of the Crime Lab, with the intention that the Lacarte would be used for supply and operational purchases. The \$5000 did not exceed the level that the State Purchasing regulations allowed for a purchase to be made without a bid process. After further research, it was learned that several agencies across the state were utilizing this additional limit level and that the risk of misuse had not proven to be a problem.

2. Developing an automated 'conveyor' system that moves the process at the desired tact time

- SHAREPOINT

A Sharepoint workflow was developed by the Data Department to create a conveyor belt program that would allow the request to be entered by a Supervisor, approved by the respective Manager, approved by the Captain or designee, and forwarded to Purchasing. All steps triggered email notifications to the next person in the workflow, as well as all documents could be attached electronically. All members of the Crime Lab could see the progress of their requested purchases, with status updates as it moved through the process. This required six generations of revisions meet the needs of the process. The team worked closely with Data to make changes quickly.

Communication Brief

3.16.11

Lean Six Sigma Purchasing Improvement Project

Goal

The goal of this project is to provide the Crime Lab staff the tools they need to perform their duties without delay and with as little involvement in procurement as possible. The focus is directed on DNA procurement, with extrapolated benefits throughout the Crime Lab expected.

Performance Metrics

1. Decrease Purchasing Cycle time to
 - 5 business days (1 week) from request to internal approval (ISIS entry)
 - 10 business days (2 weeks) from request to Purchase Order issuance
 - 30 days from request to receipt
 - 40 days from request to payment to vendor
2. Change the mix of purchase types to
 - 50% in-house store
 - 35% Lacarte purchase
 - 10% blanket order
 - 5% purchase order
3. Reduce the time spent on purchasing activities by 75%. Goal is reduce participation to 40 hrs per week, Crime Lab wide. 35 hrs/wk Criminalistics and 5 hrs/wk DNA.

Interesting Data (July 2010 thru Feb 2011)

Did you know that we spend 3.445 FTEs on purchasing activities?

Did you know that we made 154 trips for Office Supplies?

Did you know that of the 206 purchase orders we processed, if we institute our recommended improvements, we would only have needed 11 PO's?

Improvements Focus Points

- Streamline Purchase Process
- Agency Best Practices
- Better Partner Communication
- Vendor Management

Figure 56: Communication between the LSS Team and the Crime Lab Management and Staff was crucial.

The system now drives the activities of the Business Unit and provides complete visibility to all purchasing activities. This reduced the number of emails and correspondence that was needed between units and the Business Unit, as well as between the Crime Lab and the Purchasing Department. ISIS still is required, but the Sharepoint workflow requires that the requisition # be entered, which is a safety net to ensure that the purchase was entered into the ISIS system.

PURCHASE ORDER

Initiator → Manager Approved → Business Unit → Captain Approved → Business Unit → Lieutenant Approved → Pending Purchasing Processing Purchasing

Initialize Date: 03/16/2011 Purchase Request Id: 2011-1

Purchasing Type: Purchase Order

Requested by: Melinda_Richard Requisition Vendor:

Department: Grant Cost Center: SGR2

Description: Evidence Drying Cabinet: Purchase on Efficiency Improvement Grant Justification: to dry evidence in stand alone cabinets instead of using up a screening room

Click here to insert a hyperlink

Submit for Approval to: Melinda_Richard Attachment:

- DNA purch reqst Fisher evidence drying cabinets 3.14.11.pdf 461.32 KB
- Misonix 32W evidence drying cabinet 3.11.11.docx 39.67 KB
- Misonix evidence cabinet 3.11.11.docx 40.18 KB

Insert Attachment

Fiscal Year: 2011-2012 Requisition Cost: \$14,995.27

Object Type: SGR2 Object Code Desc: Other Charges- Acquisitions/Major Repairs

Object Code: X750 Reporting Category: 4955

Sub Object Code: 01

URAC:

Work Order: Category:

Type: Quantity:

Requisition: 1337986 Requisition Date: 3/16/2011

PO: PO Attachment: Click here to attach a file

PO Price: PO Date: PO Amount Remaining:

Package has arrived: All Partial Attach Package Slip: Click here to attach a file

Supply Received: Goods Passed Inspection: Yes No All Items Received Date: Insert Attachment

Invoice Received: Yes No Invoice: Invoice

Invoice Sent to Finance: Yes No Invoice Paid:

Property Tag Needed: Yes No

Serial Numbers: Date Warranty:

DPS Property Control Number: Purchases Completed:

Note:

Figure 57: Production model screen shot of Purchasing Sharepoint.

3. Managing vendor relationships to deliver optimal TAT, including strategic use of blanket orders, on-site stores and service level agreements (SLAs)

- Met with 9 different vendors to negotiate pricing and SLA
- On-Site stores for Lab Consumables and Office Supplies

Vendor meetings were held to review historical purchasing data and discuss discounts that could be offered. Details, such as including the Purchase Order # on the exterior of the package, is an example of some of the requests that we discussed. This enables the receptionist to notify the unit of the receipt of a purchase. In the past, boxes may sit in the foyer several days while it is being determined where to deliver it. The PO # can be referenced in Sharepoint and email notification is triggered when received. VWR and Fisher are the two vendors who maintain state contracts for lab consumables. Both vendors offer blanket discounts, but upon discussions, it was realized that there was some additional discounting that could be applied to frequently ordered items, over and above the state contract pricing. It was learned that while state contracts create an easier purchase approval route, they do not yield the best pricing.

Discussions have been initiated to further explore additional discount arrangements that may be allowed through the National Association of State Procurement Officials (NASPO). While potential improvements have to be vetted against state purchasing laws and regulations, it appears that some “hot list” pricing may be able to be applied that could provide higher discounts to frequently used items. It was learned that, while many states are utilizing this purchasing tool for lab consumable purchasing, Louisiana has not. While pricing was outside the scope of this project, it did show that vendor management can lead to purchasing strategy education and potential savings. The Business Unit plans to collaborate with the DPS Office of Management Finance to further research this arrangement.

Besides pricing, vendor meetings led to bundling of reagents to reduce the number of purchased items. By ordering in larger, bundled volumes, these sole source vendors were able to discount pricing even further.

The table below shows the vendor meetings that were held and the outcome of those meetings.

VENDOR	IMPACT	COST SAVINGS
APPLIED BIOSYSTEMS	BUNDLED REAGENTS	\$65,900
QIAGEN	BUNDLED REAGENTS	TBD
SIEMENS	COMMUNICATION	NONE
FISHER	COMMUNICATION	NASPO VENDOR
VWR	INVENTORY MANAGEMENT (GSS) BAR CODING	NASPO VENDOR HOT LIST PRICING
ALLOMETRICS	CONSOLIDATING 5 PURCHASE ORDERS INTO 2 (PIPETTES + ALL OTHER) ADDITIONAL QC (ISO REQUIREMENTS)	TBD PIPETTES FOR TOX NO LONGER NEED TO BE PERFORMANCE CHECKED
SOUTHPOINT	CONSOLIDATING 3 PURCHASE ORDERS INTO 1	\$3,600
STERI-CYCLE	CONSOLIDATING BIO-HAZARD AND CHEMICAL WASTE BIDS INTO SINGLE BID	TBD
SAFETY-KLEEN	CONSOLIDATING BIO-HAZARD, PHOTOLAB AND CHEMICAL WASTE BIDS INTO SINGLE BID	TBD

Table 10: Vendor impact

Through discussions with the vendors, it was also learned that the state contract vendors offer, at no additional charge, a vendor management service. The management service is a third party company that makes weekly visits to assess inventory, review usage, and restock, based on the predetermined minimum and maximum inventory levels decided upon by the customer. Large industrial companies use this service to manage their huge inventory of laboratory supplies. Likewise, the state contracted office supply vendor, when asked, agreed to do the same.

An on-site store was set up for office supplies, basing inventory on the items ordered within the current fiscal year. The Business Unit opens the store three times a week for 30 minutes to allow all Crime Lab employees to pick up supplies as needed. Eventually, the store will be unlocked for access at all times, but, for management purposes, it was decided that initially the Business Unit would “host” the store only at certain times during the week. This gives the staff an opportunity to learn which supplies are needed that are not in inventory, as well as which supplies seem to be available in a version that doesn’t quite work for the end user. An overhead announcement is made to notify the Crime Lab that the store will be open. During the first 14 days that the office supply store was open, 178 visits were logged and 105 different office supply items were issued. The store is resupplied using Lacarte purchases, as with frequent replenishment the purchase amounts do not exceed the Lacarte \$5000 limit.

An On-Site store was set up for the DNA Unit’s lab consumables. The vendor supplied a computer, with inventory management software, and barcode scanning equipment. A Business Process Consultant, an employee provided by the vendor at no charge, met with the Business Unit and designed the best process for the on-site delivery of supplies and resupply. The vendor provided training and set up the barcode labeling for all supplies in the warehouse. To start, only the DNA Forensic Technicians retrieve supplies for the DNA Unit. If a DNA Analyst needs a supply, and a Technician is not available, they merely write what they took on a wipe erase board and a Business Unit staff member logs it in the system. Previously, the DNA Unit ordered the bulk of their lab consumables on a quarterly basis. This led to storage issues and hoarding of supplies in some areas. An inventory of \$14,000, consisting of 34 different part numbers and 695 items was frequented 10 times during the 5 week pilot. The useage averaged around \$650 worth of supplies issued per week. This is expected to increase with time as the overstocking in laboratories is used up. The on-site store concept has resulted in less inventory on hand and an environment that provides what is needed, as it is needed, with no involvement of the DNA Analysts or Supervisors. The vendor allows other vendor supplies to be stocked, up to 25% of the inventory. As this concept is expanded to include the rest of the Crime Lab, we anticipate increased price discounting and a more centralized purchase system, with little staff involvement.

In summary, the vendor relation building yielded more services for no extra charge, the opportunity to maximize buying power, and education regarding mechanisms already in place to afford better pricing. Through the store pilots, the lab was able to experience the benefits of managing less inventory while maintaining immediate access to supplies, without the effort of counting and ordering. The stores concept will continue to be replenished using the Lacarte system. The rest of the Crime Lab is anxious to experience the convenience of the lab consumable store and training is underway to acquaint staff with the system.

A staff survey revealed an 81% satisfaction rating with the stores. Additionally, all Crime Lab staff were asked the following questions:

- Has having the office supply store been beneficial for you to perform your job duties better/faster?
- How much time would you estimate (per week) that it has saved you or cost you?
- Are the days and times convenient?

Adjustments in how the store operates were made based on the feedback received from the comments.

4. Well defined 'handshake' between Purchasing, Finance and Crime Lab Management team to improve the feedback and information flow

- Routine monthly meetings currently between Finance and Crime Lab re: budget/spending
- More work to do to pass information to Crime Lab Management team

Monthly meetings involving the Chain-of-Command, the Finance team and the Business Unit has been very beneficial in managing the funds that remained in the final months of the state fiscal year (ending June). It allowed the Business Unit to provide feedback so that accurate projections could be entered and freed up budgeted money for other uses, if it would otherwise not be used as projected. Additionally, coding errors were discovered which attribute expenses to the various categories. This has downstream affect on how future budgets are allocated, so making the current fiscal year expenditures was important. Communication Briefs and emails have been the mode of communication thus far, but more formal monthly budget reports with only practical, pertinent data will be designed and delivered to the managers of the respective units going forward.

Control

Data Collection

The Data Collection plan is a guide that provides a tool to tally the results and measure them against the objective goals established. The following template was designed to assist LSPCL in continuing to gather and evaluate data:

#	ELEMENT	BASELINE	TARGET	TARGET %	AFTER	AFTER %
1	PROCESS CYCLE TIME	SHAREPOINT				
1A	ID NEED TO ISIS ENTRY	17.37	4		1	
1B	ISIS ENTRY TO ISIS APPROVAL	3.9	1		1	
1C	ISIS INTERNAL TO ISIS EXTERNAL APPROVAL	10.8	0		0	
1D	ISIS APPROVAL TO PO DATE	9.5	5		8*	
1E	PO REQUEST DATE TO PO ISSUE DATE	39.7	10		10	
1F	PO ISSUE TO RECEIPT OF ORDER	24.4	20		22	
1G	RECEIPT TO PO PAID	21.3	10		11	
		126.97	50		45	
2	PURCHASE TYPE MIX	SHAREPOINT & ISIS				
2A	BLANKET ORDER	2	21	10.194%	2	0.735%
2B	LACARTE	155	69	33.495%	63	23.162%
2C	ONSITE STORE	0	105	50.971%	201	73.897%
	Office Supply	178 people visited over 14 days open				
	Lab Consumables (?)	max 23 visits				
2D	PURCHASE ORDER	49	11	5.340%	5	1.838%
	OTHER	0	0	0	1	0.368%
		206	206	100.000%	272	100.000%
3	TIME SPENT ON PURCHASING (HRS PER WK)	SURVEY PRE/POST				
3A	CRIME LAB	137.8	35		58.05	58.05
3B	DNA	21.75	5		6.93	6.93
		159.55	40		64.98	64.98
	CRIME LAB FTE	3.54	0.875		1.45	1.45
	DNA FTE	0.54	0.125		0.17	0.17
	CRIME LAB \$	\$184,056			\$72,589	\$72,589
	DNA FTE \$	\$37,275			\$11,248	\$11,248
	CRIME LAB \$ SAVINGS				\$111,467	
	DNA \$ SAVINGS				\$26,027	
	Adoption (85 of 94 lack adoption)				90.43%	90.43%
4	ON-SITE STORES	ACTUAL (Y/N) & DATA ANALYSIS, STORE USAGE BY DEPT				
4A	OFFICE SUPPLIES	N	Y		Y	All
4B	DNA CONSUMABLES	N	Y		Y	DNA
4C	CRIMINALISTICS CONSUMABLES	N	N		N	
5	VENDOR RELATIONS	MANUAL TRACKING/BLANKET ORDERS, STORES				
5A	PRICE NEGOTIATED SAVINGS				\$67,917.61	
5B	FULFILLMENT CYCLE TIME	24.4	20		22	
5C	DELIVERY INSTRUCTIONS					
6	FINANCIAL/BUDGET PLANNING ROUTINES	MANUAL TRACKING				
6A	MANAGEMENT TEAM - PROJECT					
6B	MANAGEMENT TEAM - CRIME LAB					
6C	BLANKET ORDER STAGING					
7	ADOPTION	DATA ANALYSIS/PURCHASE BEHAVIORS				
7A	CRIMINALISTICS					
7B	DNA					
7C	ADMIN					

Figure 58: Data Collection Plan

Currently a few Sharepoint reports have been developed which allow the monitoring of the # of purchases, type of purchase, # completed and \$ amounts associated with all. The milestone turn-around-time data report is still being developed. Additionally, a custom dashboard is being developed using the iDashboard software to pull current data from Sharepoint, refreshing the data daily. The initial design is below:

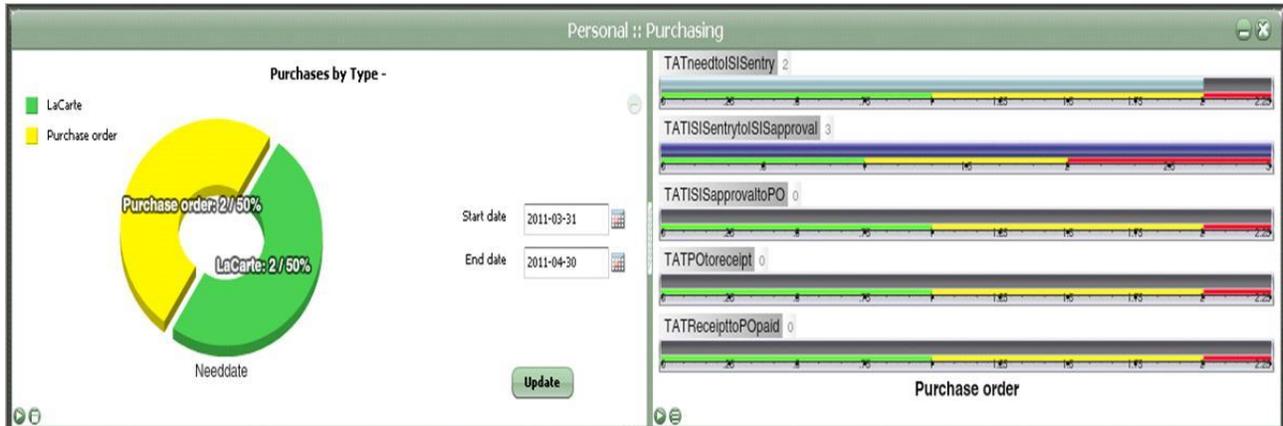


Figure 59: Dashboard visually depicting the purchase mix and current TATs for the various Purchase Order milestones.

On-site store management

With the help of the vendors and the inventory management processes, the stores have required little to no time to manage. Future activities include monitoring the cost of products supplied, working to lower cost without compromising quality; acquiring more supplies in the lab consumable store; expanding the units that use the lab store; and having stores open at all times without the need for the Business Unit staff to host the activities. Reports from the barcoding software will enable the Business Unit to manage the inventory and adjust minimum and maximum stocking levels once historical data is available. As the vendor allows other vendor products to be stocked, the inventory will be expanded to the commonly used supplies, even those not supplied by the current VWR vendor. The reports will make the annual blanket ordering projections much more accurate and easier to project.

Blanket orders

One of the improvement focus points, in changing the purchase mix, was to develop as many Blanket Orders as possible at the beginning of the new fiscal year. Blanket (or Standing) Orders follow the same approval process as a Purchase Order; however, once the money is encumbered, it can be ordered from in increments, only being charged for the portion of the order that was requested. This had been done with a couple of sole source vendors in the past, but the concept was evaluated throughout the DNA Unit and the rest of the Crime Lab. There were services in various units that could be consolidated into one order or one vendor, where there had been many,

which ultimately resulted in additional savings. A plan was developed to develop as many Blanket Orders as possible at the beginning of the fiscal year. It was determined that 14 orders could be developed. At this time 10 of the 14 have been submitted. These will continue to be monitored and adjusted as needed to meet the needs of the units. The setup of a Blanket order requires vendor meetings where services are detailed, quotes obtained and depending on the total value of the order, the prices are competitively bid.

Vendor management

LSPCL has become much more interactive with not just a few vendors, but with as many vendors as offer the products used by the LSPCL. Communication has increased and additional services have been requested of vendors that have not been asked before. These direct conversations will continue to be arranged, with additional education on the state's purchasing arrangements with vendors that are already in place, but not utilized by the LSPCL.

Statistical Results

The goals, target and results are given below. All goals were met, except in the area of staff time spent on purchasing activities. The target was 5 hours/week for DNA and 40 hours/week for the entire Crime Lab. The results were slightly higher, but showed a marked decrease from before the project. This is believed to be due, in part, to the short pilot time. It took some time for staff behavior to change and to convert purchases to the new process. There were still purchases that were pending when the pilot began, which continued to require staff time to complete them.

During the pilot, LSPCL processed more purchase orders than blanket orders. This is because the project occurred at the end of the fiscal year and most blanket orders are processed at the beginning of a fiscal year. However, the results for the onsite stores exceeded the target, resulting in fewer Lacartes than targeted.

GOAL	Unit of measure	TARGET	RESULTS
Decrease TAT: Request-PO	days	10	3
Decrease TAT: Request-payment	days	40	7
Change purchase type mix- (in order of ease to process: Onsite store/ Lacarte/ Blanket order/ PO)	% of purchases	50/ 35/ 10/ 5	73/ 24/ 1/ 2
Reduce staff time spent on purchasing (DNA/ Crime Lab)	hours/ week	5/ 40	6.93/ 58.05

Table

11: DNA Purchasing LSS Project Goals, Target values and Results

Reduce Purchase Process Cycle Time

Cycle times were reduced. With a target of 10 workdays (2 weeks) from the time the need was identified until the Purchase order was issued, the results averaged 3 days. The entire cycle time for a purchase to be completed was an average of 7 days, far exceeding the 40 day target.

MILESTONE	TARGET	ACTUAL AVG	% MET TARGET
Need to PO/Order	10	3	95.7 %
PO/Order to Receive	20	3	100%
Receive to Pay & Close	10	1	98.5%
Entire TAT- Need to Pay & Close	40	7	

Table 12: Milestone TATs in workdays.

The graphs below show that, before the improvements were made, there was a 57.92% chance that the purchase process cycle would be completed within 45 days from request to invoice payment. After the improvements, the new system means that there is a 98.75% that the process will be completed within 45 days.

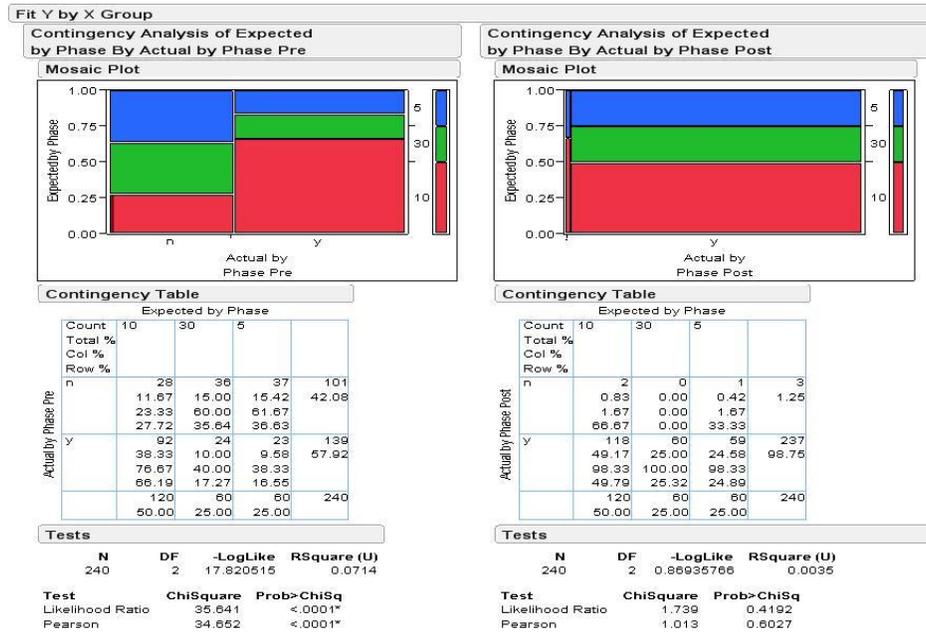


Figure 60: Improvement of Cycle Time predictability

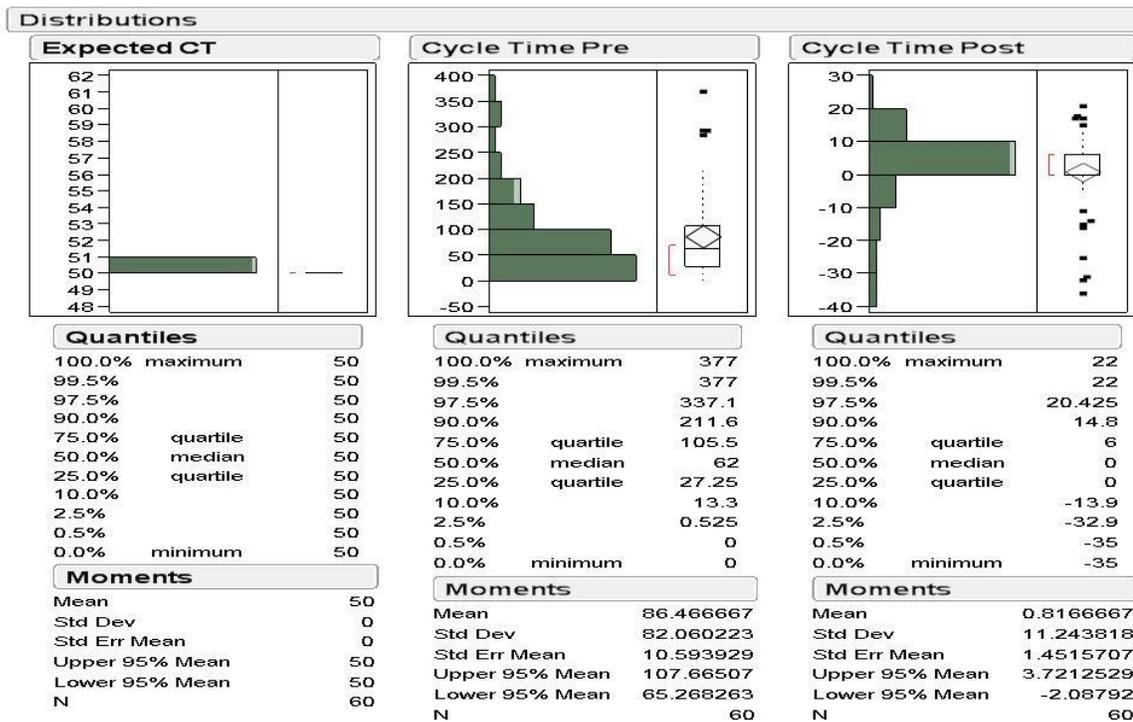


Figure 61: Target, Pre and Post Cycle Time distributions.

The charts above show the distributions of the cycle times from request to payment. Initially the target was 50 days, which includes 10 days for the internal lab processing and issuance of the purchase order, 30 days for fulfillment, and 10 days to pay and close. It was later adjusted to only allow 20 days for fulfillment and thus the target was moved to 40 work days for the entire process.

Change the Purchase Type Mix

As changing the purchase mix was a key objective, moving purchases to the easier processes, the following results were observed during the pilot process.

Table 13: Purchase Type Mix Results

Purchase Type	% BEFORE	% TARGET	% AFTER
Blanket Order	1.0	10	0.8
Purchase Order	23.8	5.5	1.9
LaCarte	75.2	33.5	24.3
Onsite Store	0	51.0	72.6
Other	0	0	0.4

Figure 62 : Purchase Mix BEFORE LSS

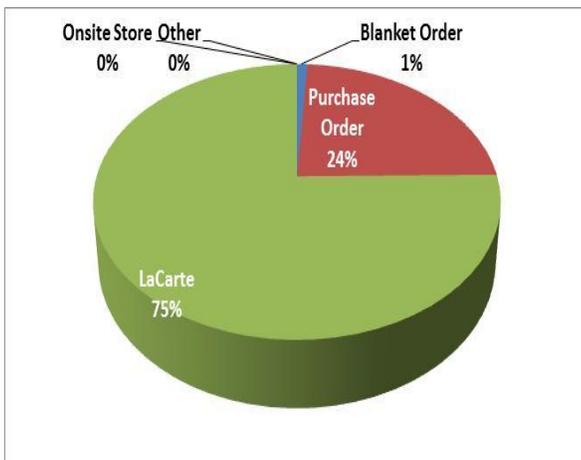
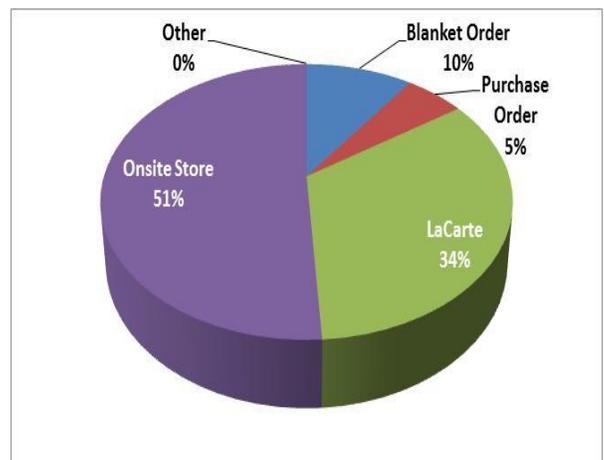
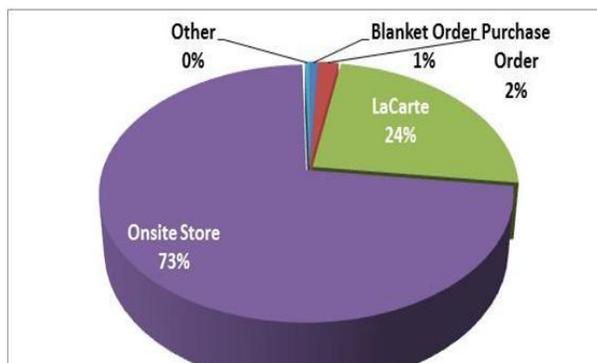


Figure 63: Purchase Mix TARGET of LSS



Order of Ease of Processing: Onsite Store > Lacarte > Blanket Order > Purchase Order

Figure 64: Purchase Mix AFTER LSS



Reduce the staff time spent on purchasing activities

Staff time was reduced in the DNA Unit, as well as across the Crime Lab. As there are 3 Business Unit members, not entirely dedicated to purchasing alone, the target of 40 hours (spread across the 3 of them) was the goal. Actual post improvement shows approximately 55 hours spent weekly. 5 hours for DNA and 40 hours total within the Crime Lab wide was an ambitious target, but should be attainable as the process is perfected.

Tables 14-16: DNA and Crime Lab

Staff Time Spent on Purchasing

BEFORE	Hours/Week	FTE	\$ Annual
DNA	21.75	.54	\$37,275
CRIME LAB	137.80	3.45	\$184,056

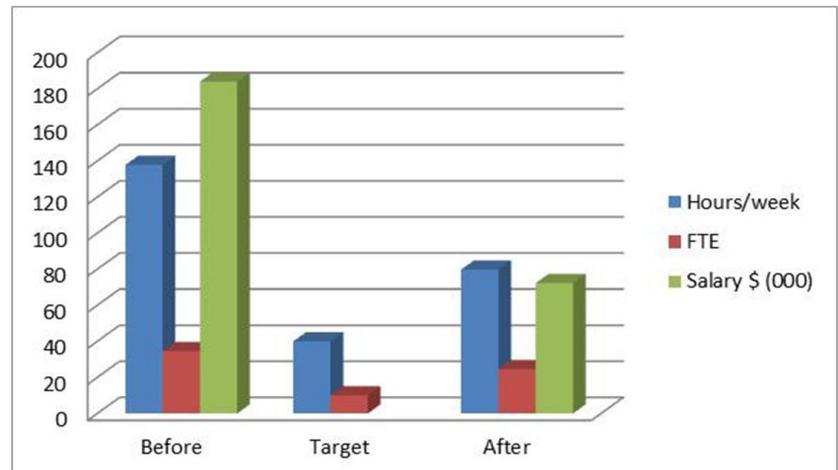
Before and After and Projected Savings.

AFTER	Target	Hours/Week	FTE	\$ Annual
DNA	5	6.93	.17	\$11,248
CRIME LAB	35	58.05	1.45	\$72,589

SAVINGS	Hours/Week	FTE	\$ Annual
DNA	14.82	.37	\$26,027
CRIME LAB	79.75	2.00	\$111,467

Figure 65: Time Spent on Purchasing

Before, Target and After LSS



The Team conducted a survey of CL employees to assess the adoption rate using self reported data on reported time spent on Purchasing activities.

- ▶ 94 employees sampled
- ▶ 85 (90.43%) spending appropriate time on Purchasing activities
- ▶ 9 (9.57%) report significant time spent (outliers) on Purchasing activities. This is believed to be due to special types of purchases made (keys copied) and the fact that some personalities take longer than the pilot to adopt and consistently change their behavior.

Summary of the Project

Unintended Benefits & Consequences

Benefits

- LSPCL realized financial and process impact in consolidating purchases between departments.
- LSPCL realized additional quality, routine maintenance , increased technology opportunities through vendor discussions.
- The visibility of Sharepoint seemed to reduce unnecessary purchases.
- Less approval levels made managers more cautious in approval.
- The Business Unit learned more about the processes of Purchasing and Budget through monthly face to face meetings.
- Processes across units were standardized. Previously some units ordered supplies as groups, others let individual staff members get their own supplies.

While outside the scope of the project, some cost savings were projected:

SAVINGS	\$
Vendor Management Savings	\$69,500
CRIME LAB Employees time spent on purchasing	\$111,467
TOTAL	\$180,967

Tables 17: Crime Lab Projected Effect Savings

Consequences

- The ease of spending may lead to more spending and must be monitored closely.
- The need for better/real time internal communication of budget status became more critical than ever.

Lessons Learned

As with any project, there were lessons that the Team learned during the LSS project that will be applied to future LSS projects.

- A longer pilot is needed when software development. Much of the pilot time for the Sharepoint system was spent revising the function of the software.
- One-on-one training is required with any new software. The Team conducted classes, but later found members that attended the class still were not comfortable using the product.
- The Team felt that more frequent, structured project briefing meetings with leadership would have increased satisfaction and adoption.
- The In-store concept led to less inventory and ease of order management more than what was expected.
- State contracts are not necessarily the lowest prices.
- There is additional opportunity to benefit from NASPO contracts.
- When regulating store hours, overhead announcements that office supply store was open is necessary.

Summary of the Project

By changing the types of purchases, streamlining purchase approvals, increasing spending authority, while increasing accountability, the ease with which the DNA Unit, and the LSPCL, purchases goods and services was greatly improved. The increase in efficiency affords the lab the ability to delegate these functions primarily to a Business Unit specialized in conducting this business of the laboratory, leaving the scientific staff to focus on casework. By automating processes and leveraging technology, the purchasing cycle time was decreased from an average of 8 weeks to 2 weeks, showing consistency in achieving that cycle time, as well as the process was made easier to accomplish by the Business Unit staff alone.

2.3.3.3 Scanning Services & Software

Advanced Imaging Solutions imaged, indexed and archived 310,625 historical laboratory documents for the DNA Unit. Remaining consistent with Louisiana Department of Public Safety Services practice already in place, Kofax was the imaging software utilized in scanning the documents. In addition to being scanned, all records were OCR processed to allow the “find” feature. Likewise, Content Manager software was used to index the documents into categories to facilitate rapid recall. The scanned images are stored on the network server and are backed up nightly. Because they are available on the server, they are readily available to all networked computer workstations throughout the lab. Quality checks are being performed to randomly verify that the paper documents scanned can be accessed electronically. So far there have been some discrepancies, which will require rescanning by the vendor. This is scheduled to take place over the course of the next several months. Meanwhile, LSPCL is working to develop a retention policy that will afford the DNA Unit the ability to destroy the paper documents, once they are confident that all scanned documents are accurately imaged, indexed and archived. The scanning of the over 300 thousand documents was performed within approximately 5 weeks. LSPCL provided 3 networked workstations at the Crime Lab in a conference room which was secured. Daily two to three vendor staff members, who had been background checked, worked on-site to perform the scanning activities. LSPCL worked closely with the Data Department to reconcile any imaging issues that arose. Color documents were scanned in color and file labeling questions were directed to technical staff, to ensure that they would be indexed properly.

Records included in the scanning project included the following:

- Quality control records for cases that had been outsourced to vendor labs using previous grant funds
- Analysts training records
- Instrument maintenance & reagent logs
- Validation studies
- DNA extraction, quantitation, and amplification worksheets
- CODIS data review documents
- CODIS sample collection logs and CODIS hit confirmation documents

The binders were removed from the shelving and are being stored in temporary storage areas until quality checks are completed and destruction can be approved. The space that was relinquished by the over 600 feet of shelving has created additional DNA work space. These areas are used to review casework and conduct other business of the DNA Forensic Unit.

In addition to contracting a vendor to scan the historical records, a **high speed scanner** was purchased to facilitate the staff's continued efforts in generating electronic copies of records going forward, using the same imaging and indexing software. The high speed scanner allows all incoming or newly-created documents to be scanned, indexed and filed electronically by clerical staff. The clerical staff can then reference and provide the necessary documents easily, without leaving their workstation and without interrupting analysts performing casework, thereby decreasing time needed for this administrative task. Training has been conducted for key staff members, with continued training occurring in groups until all staff members are able to scan, index, and retrieve documents.

2.3.3.4 Qualtrax Compare Module

LSPCL purchased the Qualtrax software to electronically store and track the Crime Lab's procedure manuals using a previous grant. An auxiliary module, the "**Compare Module**" was purchased by this grant to further facilitate rapid comparison between procedural documents. The DNA Technical Leader reviews a minimum of 70 procedures annually, as well as any time during the year revisions are made. This module affords her the ability to rapidly compare the previous to revised documents and see what revisions have been made. It is estimated that over 25 hours annually will be saved by using this software. Additionally the analysts can rapidly see what changes were made in procedures.

LSPCL achieved ASCLD/LAB- International accreditation in April 2011. An administrative decision was made to postpone the conversion of all procedures into Qualtrax until after the new accreditation process was complete. Therefore, LSPCL is now in the process of implementing this software. Installation and on-site training had already been completed, with several DNA staff members receiving training. The next phase will involve the upload of all accreditation standards, all procedures, and all controlled documents. Completion of the project is expected to take several more months.

2.3.3.5 On-site Store Equipment

An improvement activity of the DNA Purchasing LSS project was to stand up an on-site store for both office supplies and lab consumables. For the lab consumable on-site store, LSPCL chose to use available space. A storage room was set up using wire shelving that would maximize the storage space of the room. This grant funded the shelving that allowed the DNA lab consumables to be stocked on-site and managed by the vendor. The

supplies included in the storeroom were initially specified and determined by DNA staff. The replenishment of supplies occurs based on predetermined minimum and maximum volumes. DNA Unit staff are no longer involved with requesting or purchasing lab consumables or office supplies. They are only required to know how to use the barcode “guns” to scan what supplies were taken from the storeroom. At this time the Forensic Technicians perform all restocking and are the primary users of the consumable on-site store. The time saved and employee satisfaction with the concept was incorporated in the measurements taken as part of the DNA Purchasing LSS project.

2.4 CONCLUSIONS

The overall objective of all projects within this grant project never changed: provide tools and operational structure to increase efficiency in DNA forensic casework and maintain that efficiency.

In review, the funds were used to hire professional services, such as external consultants to conduct validation projects, conduct Lean Six Sigma (LSS) projects and to train LSPCL staff to conduct future LSS projects to ensure continued improvements. Funds were also used to purchase additional equipment to increase capacity, reduce analysis time, offer additional services, validate robotics, and add tools that facilitate a paperless environment. External professionals were also hired to create electronic dashboards to automate control feedback systems and make records electronically available to allow analysts to continue scientific analysis with as little interruption as possible. The dual approach of creating a lean process and culture and focusing the scientists on casework proved very beneficial for LSPCL. While the improvements may be a custom set of solutions that must be derived by each laboratory for themselves, the tools and the concepts can be shared and replicated. A readiness for change by the organization leadership, and a commitment to see the project to completion, are essential. However, if those elements are present, the process works.

By completing the third (of three) phase of improvements aimed at improving the workflow of the forensic DNA casework laboratory, the LSPCL has moved from a condition of maintaining to excelling. The LSS projects changed the culture and the way of doing business at the Crime Lab. The increased use of technology and restructuring of the administrative functions of the laboratory have led to even more efficiencies and have enabled the forensic unit to control and improve further the processes put in place. In an economic time that requires all businesses to do more with less resources, LSPCL has found a mechanism to increase efficiency. The funding that was received by the NIJ was the cornerstone to a change in culture and expectations at LSPCL. This grant project was a success and the customers of the LSPCL and the Department of Public Safety Services in Louisiana have benefited from the outcome through better service, which equates to a safer community.

Future Expectations

The improvements in the efficiency of the LSPCL laboratory were truly remarkable. However, now that cultural change has occurred and much waste eliminated, efficiency improvements are part of every scientist's thinking. There is additional work to be done. Technical review and administrative review could be completed more quickly. These steps are being included in the workflow schedule. In order to minimize review time and increase quality, a "corrections" tracking and feedback system is being implemented. Procedural changes are underway to continually "shave" time from the process steps. Dashboards are being designed for control of processes.

A DNA Module for the Laboratory Information Management System (LIMS) is desired. Currently, there is no electronic tracking of samples through the laboratory. Chemistry changes will enable a greater amount of information to be obtained in the same or less amount of time. Applied Biosystems' Identifiler Plus is being validated and competency testing performed to increase sensitivity and reduce the number of test reactions per case. Processing in plates instead of tubes is also being implemented in the forensic lab.

Staff retention and low turnover was not within the scope of this project; however, it has been recognized as a key component to the success of any lean system. LSPCL has begun initiatives in the area of salary studies and benefit reviews to enhance the ability of the DNA management to retain current, trained analysts.

The focus and mission of the LSPCL has remained steadfast: to provide "Quality, Integrity, Commitment, and Service" to the agencies and citizens of Louisiana. This grant, this project, the staff and the support of our administration allowed the LSPCL to achieve the goals set forth in the grant application in making our laboratory more efficient in performing forensic DNA casework.

Finally, other departments of the LSPCL laboratory have observed what has occurred in the DNA department. All departments within the LSPCL have begun Lean Six Sigma initiatives, with great results. This has helped transform other laboratory departments to operate as a lean facility. Through this project and the certification of a Black Belt LSS Engineer, the Department of Public Safety Services is undertaking a department wide program for the next twelve months to engage in four additional LSS projects and train a team of Green Belt LSS Engineers to continue the work in their respective areas.

2.5 REFERENCES

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2.6 DESSIMINATION OF RESEARCH FINDINGS

The project and findings of this project will be disseminated in the following manner:

- 1) Presented during the 38th Annual ASCLD, Baltimore, MD
- 2) Poster presentation at the 21st Annual International Symposium on Human Identification, San Antonio, TX
- 3) Distributed via email to the other crime laboratories in Louisiana
- 4) Distributed via email to the ASCLD membership
- 5) Provided upon request via email.
- 6) 2011 Louisiana Association of Forensic Scientists Spring Symposium
- 7) Poster presentation 2011 NIJ Grantees Summit

Additionally, we hope to be invited to present our project at the following upcoming events:

- 8) 2011 22nd International Symposium on Human Identification