Forensic Technology
CENTER OF EXCELLENCE
A program of the National Institute of Justice

Published: January 2019

FTCoE Contact:
John Morgan, PhD
Director, FTCoE
RTI International
jmorgan@rti.org

NIJ Contact:
Gerald LaPorte, MSFS
Director, Office of Investigative and Forensic Sciences
gerald.laporte@usdoj.gov

Technical Contacts:
Rudi Luyendijk, PhD
Midwest Forensics Resource Center
Ames Laboratory (former)
Rudi.Luyendijk@gmail.com

Joseph Brancaccio
The Brazos Group
brazosgroup@hotmail.com

Ashley Cochran, MS
RTI International
acochran@rti.org

This project was supported by Award No. 2016-MU-BX-K110, awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this publication/program/ exhibition are those of the author(s) and do not necessarily reflect those of the Department of Justice.

TECHNICAL NOTE

Conducting a Forensic Facility Needs Assessment Using Lean Facility Design: A Case Example

Overview

A facility needs assessment is paramount to (1) remodeling an existing forensic facility or building a new one and (2) identifying operational and workflow inefficiencies. This type of assessment is used as a planning tool and may be conducted for one of the following reasons: (1) the forensic facility is unable to meet its client's forensic needs (or there is concern that this may occur), (2) the forensic facility can no longer provide their services in a cost-effective manner, or (3) the forensic facility wants to improve operational efficiency [1].

Traditionally, a facility needs assessment involves completing surveys, conducting interviews, and touring comparable facilities to assess what is needed to improve the facility. This report details the steps for using a lean facility design (LFD) approach to conduct a needs assessment in a forensic facility. LFD is a strategy that is used to optimize the flow of information, work, and people through a facility [2].

In addition to detailing the steps for conducting an LFD assessment, this report also provides a short case example. The National Institute of Justice's Forensic Technology Center of Excellence (FTCoE) collaborated with the Midwest Forensics Resource Center (MFRC) to conduct an LFD needs assessment at the Broward County Sheriff's Office (BSO), in Fort Lauderdale, Florida.

Objectives

► Provide readers with an overview of LFD and its role during a forensic facility needs assessment.

► Evaluate the impact that a facility needs assessment has on a forensic laboratory.

► Explain lean processes and how to conduct an operational needs assessment using LFD in a forensic facility.

► Learn how to identify bottlenecks and non-value added activities (NVAs) in workflow.

► Provide a case example of a facility needs assessment conducted at the Broward County Sheriff's Office (BSO).

Introduction

What is LFD?

LFD is a strategy that optimizes the logical and systematic flow of work, people, and information through a facility. This strategy can ultimately improve work processes; ensure quality products; and determine the configuration of physical spaces, such as forensic facilities [2].

In the past, LFD has been applied mainly to healthcare facilities, but this approach is now being used in different fields, such as forensic science. In healthcare facilities, this approach proved useful for remodeling facilities, building new facilities, upgrading equipment, improving process flow, and implementing new equipment and procedures [1]. A successful LFD assessment in a forensic facility may require collaboration among laboratory staff, including the director and individuals from each unit; a representative from the agency completing the evaluation; a process management consultant; an architect; and engineers [2].

LFD Assessment at the BSO

In 2016, the BSO requested a facility needs assessment for its crime laboratory to evaluate the current facility's condition, limitations, and challenges to ensure that casework would be completed in the most efficient way. The BSO also wanted to determine whether a facility renovation would suffice or if the construction of a new facility would be necessary to address the findings of the assessment.

Two separate needs assessments were conducted: (1) a facility space needs assessment to determine whether construction of a new facility was necessary and (2) a facility operational needs assessment to identify obstacles to achieving the mission of the BSO crime laboratory. Collectively, these two needs assessments determined the current and future needs of the BSO forensic facility.

This report focuses solely on the results of the operational needs assessment (i.e., assessment two) conducted by the Midwest Forensics Resource Center (MFRC, Ames IA) with support from the FTCoE. This project evaluated the Lean Facility Design Roadmap for Design-Bid-Build Forensic Facilities that was developed by the MFRC, Brazos Group (Flower Mound, TX), Crime Laboratory Design (St. Louis, MO), and the FTCoE two years earlier [2]. The procedures used to conduct the BSO crime laboratory LFD assessment are provided as an example to (1) inform stakeholders about the LFD process and (2) provide insights to improve laboratory workflow in a facility.

What does it mean to use a "lean approach"?

Using a lean approach means eliminating all steps that do not add value to a process. The principles of lean, as adapted for a forensic context from Hicks et al., are as follows [1]:

► Identify and focus on the customer's needs.

► Assess laboratory processes to identify and address wasteful steps.

► Manage the workflow and standardize processes around best practice.

► Manage by fact and reduce variation.

► Continuously strive to achieve optimal process flow.

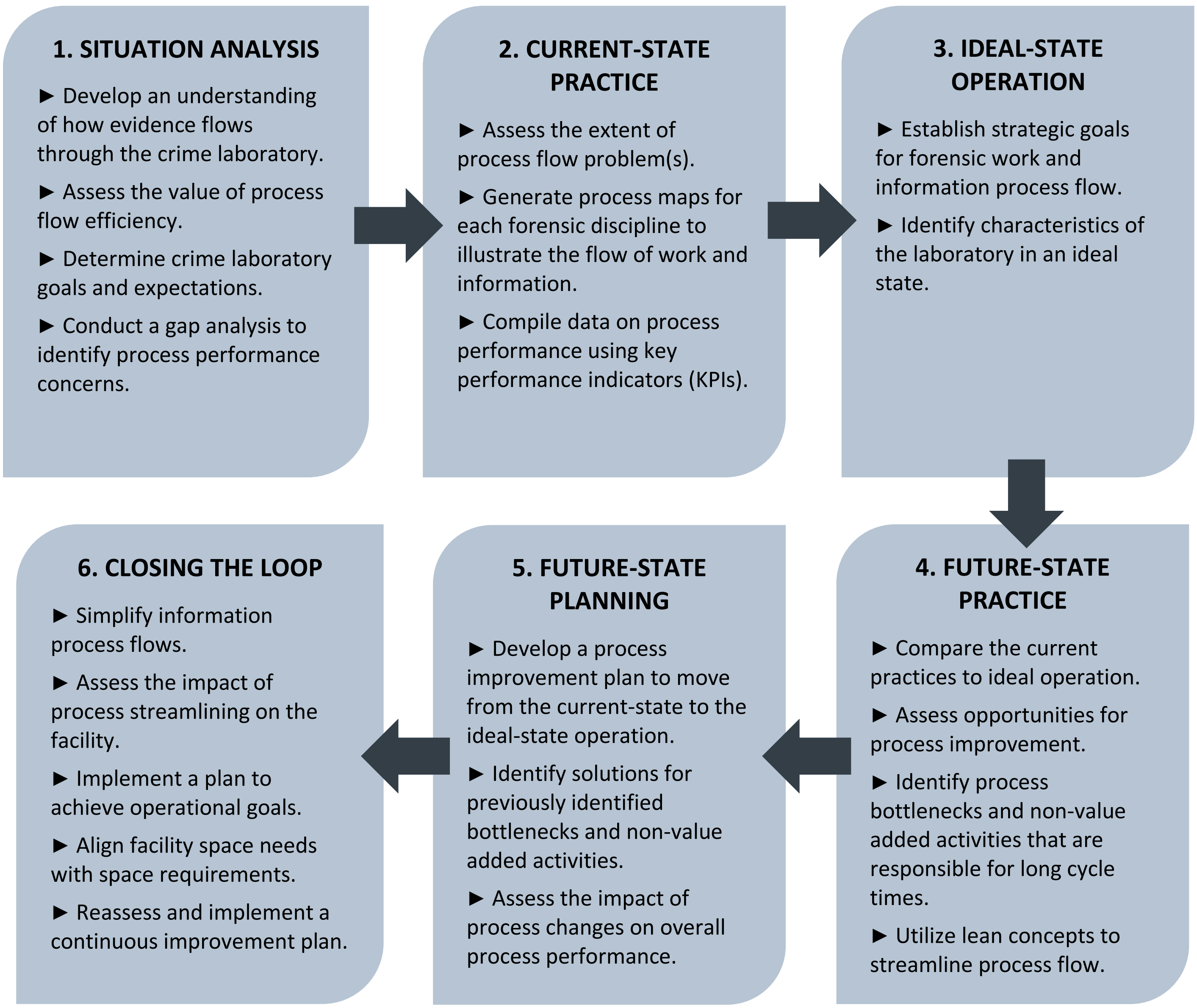

Figure 1. This figure demonstrates the methodology created to assess the operational needs of a forensic facility. Each stage plays an important role in improving operational performance. “State” refers to the way in which a facility operates.

LFD Needs Assessment Methodology

Figure 1 demonstrates six stages that should be followed during an operation needs assessment in a forensic facility. Completing the steps within these six stages allows forensic laboratory personnel to better understand the underlying issues that impact process performance and information flow within the laboratory. It also indicates that an LFD operational needs assessment should be periodically reassessed to achieve continuous improvement goals.

Case Example: BSO Crime Laboratory

This section serves as an exemplary LFD assessment, including the processes that should be followed and factors to keep in mind when conducting a needs assessment. Each stage of the LFD process **(Figure 1)** is further described with examples to help stakeholders understand the goals of each stage. The following examples and reported outcomes of this assessment may differ in other laboratories.

1. Situation Analysis

The goal of a *situation analysis* is to understand the flow of evidence through the laboratory and to identify process performance concerns. This analysis entails identifying the laboratory's structure; in other words, determining the units that evidence flows through before, during, and after analysis. It is not only important to consider all forensic disciplines within the crime laboratory (e.g., chemistry, latent prints), but also the units that support these disciplines, such as the administrative unit. Situation analysis aids LFD assessors in understanding some of the core structural issues that may be causing a delay in the evidence analysis process. For example, a lack of communication between the chemistry unit and the administrative unit hypothetically could increase case turnaround times.

The first step of the BSO assessment was determining the crime laboratory's structure. The forensic units in the BSO laboratory are DNA, chemistry, firearms and tool marks, and latent prints. An administrative unit provides clerical support for case assignment and return, and the evidence intake and handling (EIH) unit is responsible for receiving and storing evidence when it is not in the custody of the analyst.

Next, a questionnaire was developed to familiarize the assessors with BSO operational issues and concerns in order to identify root problems. The questionnaire was tailored to each discipline and distributed to laboratory personnel to gather responses. Example questions to ask during this stage of an LFD assessment can be found in **Appendix A**.

Information gathered from the questionnaire was reinforced by on-site staff interviews to clarify survey findings. The surveys and interviews uncovered four key issues present within the BSO crime laboratory: (1) ineffective external communication and information flow, (2) an understaffed and underfunded laboratory[1], (3) little to no space for work or storage within the current facility, and (4) poor air quality in the laboratory.

The issues identified during the BSO assessment do not necessarily reflect those present in other facilities, and survey questions should be customized for each laboratory.

2. Current-State Practice

After determining the structure and communication network of a forensic facility, the next stage is identifying the intricacies within each unit; simply, what is the step-by-step process that each unit follows during casework? Creating process maps for each forensic discipline proves useful when assessing the *current-state practice* of a unit or facility because these maps can highlight some of the wasteful steps within the overall process.

All workflow steps, no matter how insignificant they may seem to the overall task, should be considered when constructing a process map. An example of a process map is shown in **Figure 2.** The creation of thoroughly detailed process maps assists the facilitation of the lean processes and potentially improves the laboratory's workflow.

A detailed review of the BSO crime laboratory's workflow through process mapping led to the discovery of a few critical issues. For example, in the DNA unit, there is no physical space for additional instrumentation. Although DNA technology is rapidly advancing, the BSO DNA unit is unable to adapt, which could eventually result in an inefficient workflow and an increased backlog. Other units may have similar issues that have the potential to be uncovered during the process mapping phase.

Including forensic laboratory personnel in the process mapping phase will ensure that the most accurate product is created. Members from each unit often serve as process mappers and validators, the laboratory director serves as process validator mainly for compliance and resource support, and members from an external agency with experience in forensic laboratory planning serve as project leaders and meeting facilitators.

Key performance indicators (KPIs) can also be used during this phase to help assess whether a laboratory is functioning efficiently **(Appendix A)**. KPIs monitor the efficiency, quality, and productivity of individuals and the laboratory.

LFD assessors can use the information gathered as a basis for the evaluation. Learning about the laboratory's current state and shortcomings early on is crucial to a successful needs assessment.

[1] Though identified as an issue during the survey, lean never assumes that understaffing is a problem until all waste has been eliminated from the system. Conducting a full LFD assessment will determine whether this is a true issue.

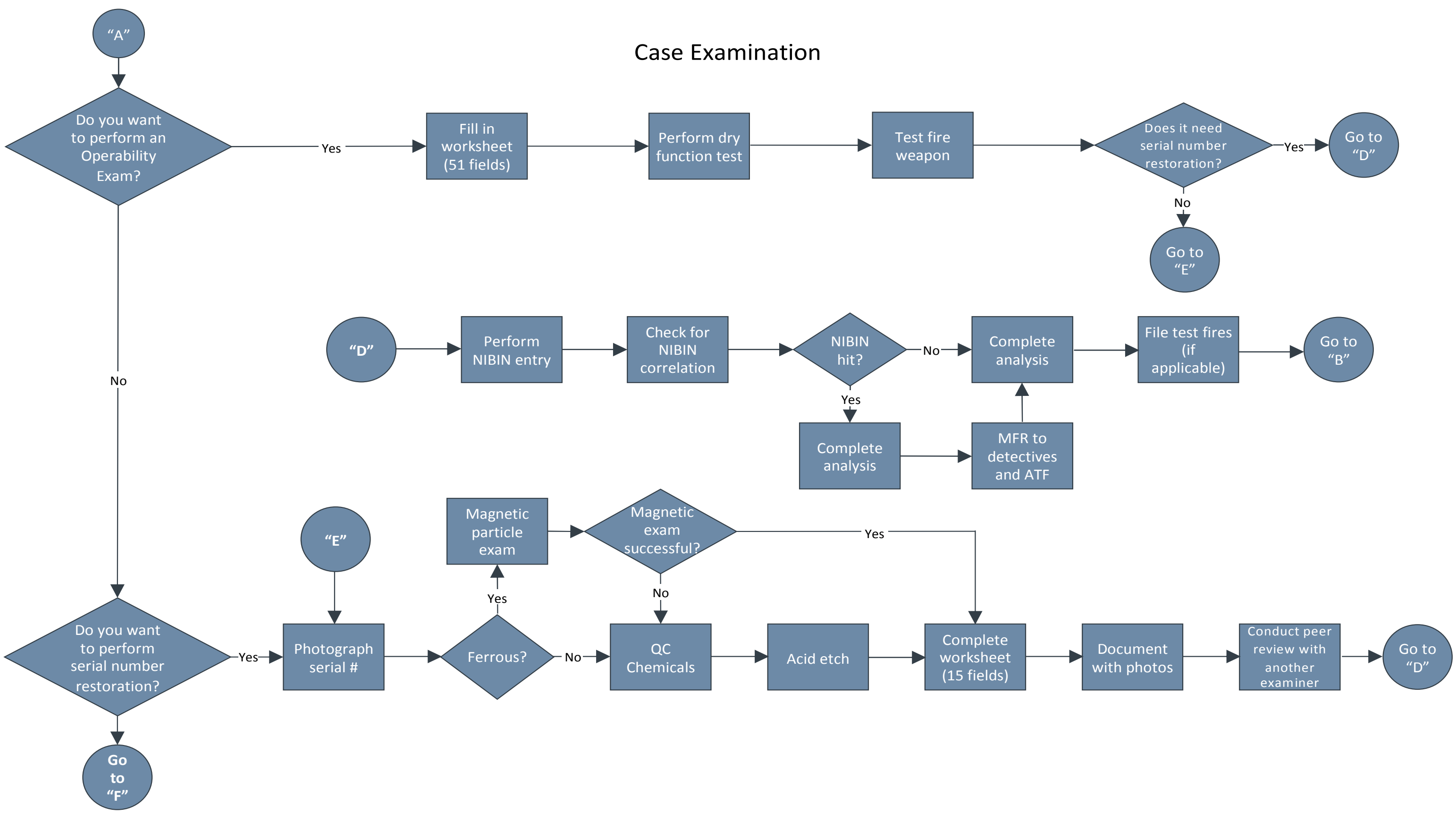

Figure 2. Example of firearms unit process map for case examination. The full process map contains all procedures that unit follows.

3. Ideal-State Operation

Ideal-state operation entails establishing goals to improve workflow and function. It may also be helpful to pose questions to assess the laboratory's future **(Appendix A)**.

The forensic laboratory's vision statement can also assist in determining the organization's expectations and future goals. For example, the BSO crime laboratory's vision statement is "to be recognized as one of the leading forensic laboratories in the nation, consistently exceeding the expectations of our customers through our commitment to excellence." Discussing the vision statement with laboratory personnel can help to spur a forward-thinking, productive attitude for restructuring and improving the laboratory atmosphere as well as the information process flow.

Drafting a comprehensive list of expectations, goals, and characteristics to envision the "ideal state" can assist a laboratory to achieve the goals set forth in its vision statement. The BSO also drafted a list of characteristics that included a wide range of elements, such as operational/process performance, facility layout, and safety/security. For example, some of the drafted characteristics include the following:

- Integrated Laboratory Information Management System (LIMS) with more flexibility
- More automation/technology
- Dedicated Information Technology (IT) personnel
- Large conference/training room
- More evidence storage space
- Externally vented hoods.

Drafting a comprehensive list of expectations, goals, and characteristics to envision the "ideal state" can assist a laboratory to achieve the goals set forth in its vision statement.

4. Future-State Practice

The purpose of *future-state practice* is to compare current-state practices to ideal-state operations and identify process bottlenecks and non-value added activities (NVAs). Bottlenecks and NVAs may, in part, be responsible for long cycle times and inefficient workflow. By identifying these inefficiencies in the system, one can better understand process performance issues and how to fix them.

Reviewing the process maps for all the BSO crime laboratory units showed that there was redundancy in the work and a need to streamline the information flow to increase efficiency and reduce bottlenecks. Assessors compiled data on process execution times and process wait times to assess which process step caused the most significant delays in each unit **(Figure 3)**. *Process execution time* (i.e., touch time) is the time it takes from the beginning of one step to the beginning of the next step without interruptions and delays; *cycle time* is the total time—including delays due to waiting, interruptions, equipment failure, and rework—between the beginning of one step and the next step.

The BSO assessment results found that there were discrepancies between the process execution and cycle times that vary between units. This means that each step of the process is not being carried out in the ideal time (i.e., a certain number of hours or days) due to waiting, instrument failure, or other laboratory processes. To identify possible causes for the observed time delays and potential opportunities for improvement, forensic facility managers and staff were asked to review the discipline process maps created during current-state practice. Areas of concern were identified as a bottlenecks or NVAs, allowing assessors to better target the root of the problem(s). An example of this process is shown in **Table 1.**

Table 1. Example of Identifying Bottlenecks and NVAs During BSO Case Assignment.

Process Step	Area of Concern	Description	Bottleneck or NVA?
Case assignment	Case prioritization	Errors, unit selection, rush	NVA
	Case documentation	Wait on property receipt	Bottleneck
	LIMS	Slow access time	Bottleneck

After gathering information about the causes of bottlenecks and NVAs, it is important to think about possible solutions for the issues and inefficiencies (**Appendix A**).

5. Future-State Planning

Future-state planning entails applying principles of lean thinking to formulate solutions for bottlenecks and NVAs. Lean thinking tries to eliminate waste and increase efficiency within a process and encompasses the principles of automation, elimination, and mitigation to identify potential solutions for process improvement.

For example, two of the issues identified by BSO included case prioritization and manual operation of instrumentation. These two processes could ultimately become automated, which would help to increase workflow efficiency.

Additionally, BSO noticed that the laboratory benches were disconnected and identified this issue as an NVA related to sample transfer. This ineffective laboratory configuration caused analysts to spend time walking back and forth unnecessarily, increasing analysis time. This process could be more efficient by reconfiguring the workspace to make it a more user-friendly environment. **Table 2** shows an abbreviated example of solutions developed using lean thinking principles.

Figure 3. Seven steps of BSO case processing.

Table 2. Example of Suggested Solutions to Minimize BSO Bottlenecks and NVAs.

Bottleneck/NVA	Description	Solution
Case prioritization	Appropriate unit, rush cases	**Automate** evidence intake
Instrumentation	Manual operation, batch setup	**Automate** case analysis process
Sample transfer	Disconnected bench areas	**Reconfigure** the workspace

Simple changes made throughout the facility using lean thinking can increase productivity and work efficiency, ultimately reducing the number of NVAs and bottlenecks. Some changes may include the elimination of duplicate paperwork, excessive work, waiting times, and personnel movement. For example, the BSO crime laboratory could minimize process execution and wait times by automating processes and tasks (e.g., evidence intake, case analysis); updating policies and software; and replacing faulty equipment.

Eliminating NVAs can be beneficial; however, remember that improving or optimizing an infrequent task does not drastically reduce the overall cycle time. The BSO crime laboratory found that tasks that are difficult to control are often the biggest contributors to process delays. For example, external communication—such as communication with law enforcement and the district attorney's office—contributed significantly to time delays. Delays of 16–27 days occurred in the BSO crime laboratory due to poorly communicated or uncommunicated court schedules, court interruptions, expedited cases, and poorly scheduled property receipt clerks. The time delays related to these events could be avoided with improved communication among external entities. Effective policies, such as sample and case submission policies, could also help to reduce time delays.

Some successful facilities have solved the problem by holding monthly meetings with inter-agencies to review backlogged cases. Each agency reviewed the case list and indicated that the case (1) had been solved, (2) had been closed, or (3) no longer needed analysis.

Timothy Kupferschmid, Chief of Laboratories of the Office of the Chief Medical Examiner of the City of New York (NYC OCME), estimated that communication delays could account for approximately 10%–20% of the total time spent on a case [3].

Mr. Kupferschmid further stated in the report that a new form for DNA analysis submittal was created for NYC OCME. This form contains all the information that was previously obtained over emails and phone calls and provides a place for investigators to document notes about the sample for determining whether the sample is eligible to be entered into the Combined DNA Index System (CODIS). To help improve the flow of each case, submitting agencies were also asked to prioritize five samples for analysis [3].

> "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" [3].

This example is specific to the DNA unit of a particular laboratory; however, this same methodology can be applied to any unit within a forensic facility. Developing new procedures that eliminate the need for additional communication will help increase analyst productivity within the unit. Solutions to identified inefficiencies are not always complex—simple changes within a laboratory can have a large impact on the overall forensic facility process flow.

6. Closing the Loop

Closing the loop entails simplifying work and information flows and implementing solutions devised during future-state planning. In this final stage, operational needs should be translated into facility space requirements, and design and construction decisions should be made. For two decades, the NIJ, in cooperation with the National Institute of Standards and Technology (NIST), supported two working groups and published two extensive reports to assist with planning, designing, constructing, and moving or renovating forensic laboratory facilities [4,5]. The NIST "White Book," or *Handbook for Facility Planning, Design, Construction and Relocation* provides detailed guidance on integrating the latest scientific developments, efficiency improvements, and sustainability practices in building forensic facilities. The

2016 FTCOE integrated Lean Design principles into the NIST Handbook to create an LFD Roadmap that this facility assessment at BSO implemented and evaluated continuing NIJ's support in realizing efficient forensic facilities. If it is determined that a new facility is necessary to meet the needs of the forensic laboratory, there are available resources that detail the methodology for the planning, design, construction, and relocation of a forensic facility [4]. As stated in the 2016 FTCoE report this Additionally, solutions to minimize bottlenecks and NVAs are implemented during this step to increase process efficiency and to ensure that any implemented changes do not negatively impact downstream processes.

If it is determined that a new facility is necessary to meet the needs of the forensic laboratory, there are available

BSO Crime Laboratory: 1 Year Later

After completing the space and operational needs assessments, the BSO decided that building a new facility is the best path forward for the crime laboratory. The BSO plans to build the new facility within the next 4 years and is currently in the bidding process for a project manager and architectural firm.

BSO management has noted that many of the issues identified by the facility needs assessment are related to the available space within the current facility; these issues will be fully addressed once the new facility has been built. In the meantime, however, some changes have been made to improve the operational processes and address bottlenecks and NVAs identified during the assessment. For example, although the BSO is unable to obtain a dedicated Information Technology professional (a need identified during ideal-state operation), BSO has explored cloud options for several current programs—a few of which have already been approved and converted. Interagency communications are also being addressed. Additionally, new management staffing within one unit has helped to address some process performance issues and bottlenecks to reduce process wait times during report review.

Conclusions

Conducting a facility needs assessment using LFD can improve workflow and increase efficiency within a forensic facility. An LFD evaluation can be successfully executed within a forensic facility, but it requires the commitment of personnel and an external team specializing in lean thinking. The six stages of the LFD process are critical in assessing a laboratory's process flow. These stages can be easily modified and adapted to new tasks, goals, and objectives.

In the BSO example presented in this report, an LFD assessment helped to identify key process flow issues and develop solutions to improve efficiency. Building a new facility is necessary for the BSO to fully optimize operational processes and address staffing concerns to achieve ideal and future states; however, the agency was able to take a stepwise approach in the meantime to improve efficiencies by implementing lean concepts. The outcome of a needs assessment will vary by agency. For example, an agency that does not have facility space restrictions may be able to easily implement some of the solutions identified through a needs assessment. Although the operational needs of all forensic facilities differ, the same lean thinking strategies can be applied to increase efficiency.

References

1. Hicks, C., et al., *Applying lean principles to the design of healthcare facilities.* International Journal of Production Economics, 2015. **170**: p. 677-686.
2. Forensic Technology Center of Excellence (FTCoE). (2015). Development of a Lean Facility Design Roadmap for Design-Bid-Build Forensic Facilities. U.S. Department of Justice, National Institute of Justice, Office of Investigative and Forensic Sciences; Available from: https://forensiccoe.org/report-development-of-a-lean-facility-design-roadmap/.
3. Richard, M. and T.D. Kupferschmid. *Increasing Efficiency of Forensic DNA Casework Using Lean Six Sigma Tools*. July 2011. US Department of Justice; Available from: https://www.ncjrs.gov/pdffiles1/nij/grants/235190.pdf.
4. National Institute of Standards and Technology. *Forensic Science Laboratories: Handbook for Facility Planning, Design, Construction, and Relocation*. June 2013; Available from: https://ws680.nist.gov/publication/get_pdf.cfm?pub_id=913987.
5. U.S. Department of Justice. Office of Justice Programs. National Institute of Justice. (1998). Forensic Laboratories: Handbook for Facility Planning, Design, Construction, and Moving. Research Report 7941. Retrieved from https://www.ncjrs.gov/pdffiles/168106.pdf

RTI International (RTI) and its academic and community based-consortium of partnerships, including its Forensic Science Education Programs Accreditation Commission partners, work to meet all tasks and objectives put forward under the National Institute of Justice (NIJ) Forensic Technology Center of Excellence (FTCoE) Cooperative Agreement (award numbers 2016-MU-BX-K110 and 2011-DN-BX-K564). These efforts include determining technology needs; developing technology program plans to address those needs; developing solutions; demonstrating, testing, evaluating, and adopting potential solutions into practice; developing and updating technology guidelines; and building capacity and conducting outreach.

The FTCoE is led by RTI International. The FTCoE builds on RTI's expertise in forensic science, innovation, technology application, economics, data analytics, statistics, program evaluation, public health, and information science. RTI International is an independent, nonprofit research institute dedicated to improving the human condition.

Suggested Citation:

Luyendijk R., Brancaccio J., Cochran AR. Forensic Technology Center of Excellence (January 2019). *Conducting a Forensic Facility Needs Assessment Using Lean Facility Design: A Case Example*. U.S. Department of Justice, National Institute of Justice, Office of Investigative and Forensic Sciences.

Acknowledgments
The authors wish to recognize the contributions of the following individuals who made this project and this report possible:

Broward County Sheriff's Office:

- Claudine Carter Pereira, Crime Laboratory Director (Claudine_CarterPereira@sheriff.org)
- Juan Kattah, Evidence Intake Unit
- Diane Edwards, Forensic Administration Unit
- Erica Lawton, Firearms/Tool Marks Unit
- Julissa Inclan, Latent Print Unit
- Chris Rivas, Latent Print Unit
- Yanet Gattoro, Drug Chemistry Unit
- Evelyn Ortiz-Davis, Drug Chemistry Unit
- George Duncan, DNA Unit
- Petros Tsingelis, DNA Unit
- Arlene Petrosky, DNA Unit

Crime Lab Design:

- Ken Mohr, Principal Planner
- Lou Hartman, Principal Engineer

NYC OCME:

- Timothy Kupferschmid, Chief of Laboratories

Appendix A: Questions to Ask During an LFD Assessment

The following are examples of questions that may be useful while gathering information during an LFD assessment. Additional questions may be used during this phase, and all questions should be tailored for individual laboratories.

Situation Analysis

- Do you have a process that keeps you aware of the latest trends in forensic science?
- What are the main challenges driving the need to adopt new approaches in your forensic unit?
- Could you describe the impact that the adoption/implementation of multiple new or emerging technologies would have on process efficiency, worker productivity, employee morale, and customer satisfaction at this facility?
- Are all laboratory personnel aware or the key performance indicators (KPI) within their unit and within the forensic facility?

Current State Practice [2]

- Are we following procedures according to design?
- Are we giving customers what they expect?
- Are we completing requested tasks on time?
- Are we measuring and evaluating our KPIs?

Ideal State Operation

- What characteristics of an ideal laboratory do you feel are lacking in your laboratory?
- What outcomes could be realized if improvements were made?
- What changes would facilitate efficient workflow within the laboratory to achieve ideal-state operation?

Future State Practice [2]

- What can we do as continuous improvement to move towards ideal state and streamline process flow?
- How can changing the process increase productivity (i.e., identify and provide solutions for bottlenecks and NVAs)?
- How can NVAs be removed to improve process efficiency?
- If we are not following procedures according to design, what can we do to achieve compliance?
- What can we do in the next 5 years [put an achievable timeline for mid-term and long-term goals for your forensic facility] to identify growth potential; develop design charrette (Poka-yoke[1]), or organize workspace?
- What else could we do to give customers what they expect?

[1] Japanese term for mistake-proofing method or device developed to prevent an error or defect from happening or being passed on to the next operation. Design charrette is a short, intense collaborative period of design or planning activity [2].