

# Forensic Laboratory Productivity and Return on Investment

## **Data-Driven Support for Forensic Laboratories**

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## The Economic Problem

“resources are decreasing. We must keep learning how to be more efficient in using ever-evolving forensics technologies and examining the actual justice outcomes resulting from forensic evidence so that limited resources can be used wisely.”

Browning, K. (2015). Social Science Research on Forensic Science: The Story Behind One of NIJ's Newest Research Portfolios. NIJ Journal 275 <http://nij.gov/journals/275/Pages/social-science-forensics.aspx>, 40 - 47.



# Informing Policymakers

- Assist decision-makers in the allocation of scarce resources
- Provide metrics that permit comparison with other expenditure alternatives
- Return on investment (ROI) at the jurisdictional level
- Optimum use of limited resources
- Marginal social welfare improvement from alternative allocations of these scarce resources in light of objectives of public sector entities.

# ROI Measures for Forensic Laboratories

- Most studies emphasize the social benefits, but only have a cursory analysis of the associated costs
- Cost detail from project FORESIGHT
- Cost detail from the Census of Publicly Funded Crime Laboratories
- Estimated costs for all non-reporting crime laboratories

## ROI from Testing SAKs (Wang & Wein (2018))

- Use relative frequencies from recent studies to estimate the expected social benefits from testing the backlog of SAKs.
- The average cost from a sexual assault is \$435,419, which reflects victim costs and avoidance expenditures by others.
- They use New York City SAK testing and Detroit testing for proxies on probabilities that testing results in particular outcomes.
- The number of SAs per year of time at risk (e.g., not incarcerated) committed by a sexual offender varies widely across offenders, but the mean has been reported as 7.10

Wang, C., & Wein, L. M. (2018). Analyzing Approaches to the Backlog of Untested Sexual Assault Kits in the U.S.A. *Journal of Forensic Sciences*, 1-12.

# The New York experience

	Manhattan
Tested	3,777
No DNA	2,448
Hits	1,329
Already arrested	279
Statute run out	792
Compromised file	138
Open cases	44
DNA not conclusive	29
Convictions	47

Martha Bashford, Chief, Sex Crimes Unit, New York County District Attorney's Office

# ROI Using Project FORESIGHT data

- Costs differ across laboratories
- Size matters
- Economies of Scale
- Productivity increases from low levels to optimal

Speaker, P.J. (2019). The Jurisdictional Return on Investment from Processing the Backlog of Untested Sexual Assault Kits. *Forensic Science International: Synergy*, 1(1), 18 – 23.

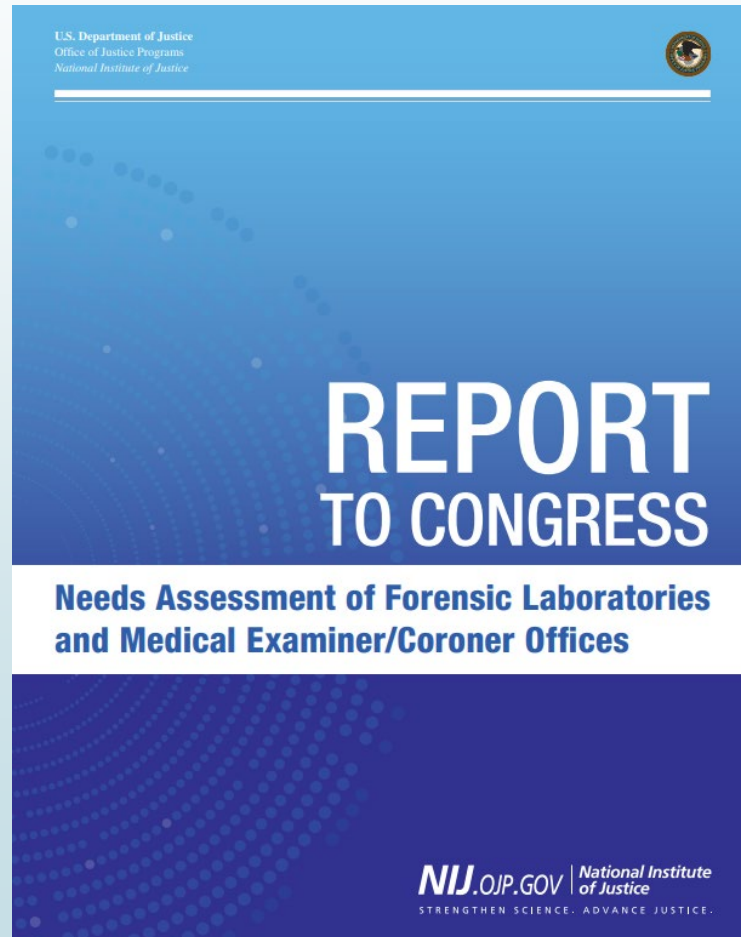
Caseload	ROI <sub>1</sub>	ROI <sub>2</sub>	Caseload	ROI <sub>1</sub>	ROI <sub>2</sub>
100	9,874%	12,962%	5,500	47,951%	62,831%
200	14,215%	18,648%	5,750	48,727%	63,848%
300	17,470%	22,910%	6,000	49,189%	64,452%
400	19,740%	25,884%	6,250	49,247%	64,529%
500	21,015%	27,554%	6,500	49,188%	64,450%
600	22,120%	29,000%	6,750	49,011%	64,219%
700	23,105%	30,291%	7,000	48,720%	63,838%
800	24,003%	31,467%	7,250	48,320%	63,314%
900	24,836%	32,558%	7,500	47,816%	62,654%
1,000	25,617%	33,581%	7,750	47,214%	61,866%
1,100	26,357%	34,550%	8,000	46,524%	60,962%
1,200	27,063%	35,475%	8,250	45,753%	59,952%
1,300	27,742%	36,363%	8,500	44,910%	58,848%
1,400	28,397%	37,222%	8,750	44,005%	57,663%
1,500	29,033%	38,054%	9,000	43,047%	56,409%
1,600	29,652%	38,865%	9,250	42,046%	55,097%
1,700	30,256%	39,656%	9,500	41,010%	53,740%
1,800	30,848%	40,431%	9,750	39,947%	52,348%
1,900	31,428%	41,191%	10,000	38,866%	50,933%
2,000	31,999%	41,939%	10,250	37,774%	49,502%
2,100	32,560%	42,674%	10,500	36,678%	48,067%
2,200	33,114%	43,399%	10,750	35,583%	46,633%
2,300	33,660%	44,114%	11,000	34,495%	45,208%
2,400	34,199%	44,820%	11,250	33,418%	43,797%
2,500	34,732%	45,518%	11,500	32,357%	42,407%
2,600	35,259%	46,208%	11,750	31,314%	41,042%
2,700	35,780%	46,891%	12,000	30,292%	39,704%
2,800	36,296%	47,566%	12,250	29,295%	38,397%
2,900	36,806%	48,235%	12,500	28,322%	37,124%
3,000	37,311%	48,897%	12,750	27,377%	35,886%
3,250	38,552%	50,522%	13,000	26,459%	34,684%
3,500	39,761%	52,105%	13,250	25,570%	33,519%
3,750	40,936%	53,644%	13,500	24,709%	32,391%
4,000	42,076%	55,136%	13,750	23,877%	31,302%
4,250	43,176%	56,578%	14,000	23,074%	30,250%
4,500	44,234%	57,963%	14,250	22,299%	29,236%
4,750	45,245%	59,287%	14,500	21,553%	28,258%
5,000	46,205%	60,544%	14,750	20,834%	27,316%
5,250	47,108%	61,727%	15,000	20,142%	26,410%

# Return on Investment for Other Projects

- DUI: Drugs & Legalization of Marijuana
- Benefits from costs avoided (Aldy & Viscusi (2008) Value of a Statistical Life
- Net Benefit from societal costs avoided
  - Fatality \$8.39 million
  - Injury \$83,214
  - Property Damage \$10,525
- Expense for toxicologist
- Sentinel laboratory emphasis
- COVID-19 and Medical Examiners
- Opioid Crisis and synthetic analogs
- Council of economic advisors report on opioids suggests an annual cost that exceeds 2% of GDP
- Benefits from convictions, but also exoneration, prevention



# Needs Assessment of Forensic Laboratories and Medical Examiner/Coroner Offices



# Forensic Technology Center of Excellence

## WORKFORCE CALCULATOR PROJECT

### OVERVIEW

The workforce calculator project follows a two-year timeline to produce a workforce calculator to be housed on the FTCoE website. The calculator permits a laboratory to identify the personnel required to support a given level of casework within each area of identification and the associated investment in capital equipment to support that level of activity. The intent of the first year is to produce an initial working tool (Beta Calculator), based upon a decade of performance of the most efficient laboratories from Project FORESIGHT. The second year of analysis permits enough time to develop a more sustainable and more detailed econometric analysis as a long-term planning tool.

### THE BETA WORKFORCE CALCULATOR

The beta workforce calculator is a proof of concept, developed from a selection of high performing laboratories from project FORESIGHT. All sample laboratories met a standard of 90% laboratory-wide efficiency using the ASCLD Maximus award criteria<sup>[1]</sup>. Econometric models estimate the relationship between the full-time equivalent (FTE) workforce and achievement of the 90% efficiency standard for laboratory analysis. The econometric analysis examined laboratory performance in light of the type of jurisdiction (state, metro, or regional), size population served, and state crime rates (violent and property).

Laboratories are encouraged to test the calculator and report findings to principal investigator Paul Speaker ([paul.speaker@mail.wvu.edu](mailto:paul.speaker@mail.wvu.edu)). Laboratory insights will be incorporated into the more detailed econometric analysis in the second year of the project.

Download the Beta Workforce Calculator by clicking the button below.

DOWNLOAD FILE

### THE UPDATED WORKFORCE CALCULATOR

The second year of analysis permits enough time to develop a more sustainable and more detailed econometric analysis as a long-term tool. Feedback from the beta calculator will be incorporated into the second year testing with additional output breaking down the expected FTE into analytical, support, and administrative positions for optimal performance. Corresponding annual capital expenditures to maintain the support of the workforce will also be developed.

### REMINDER TO ALL WORKFORCE CALCULATOR USERS

Cases per FTE is not linear, so a linear comparison should not yield the same results. The calculator is a non-linear econometric model that uses population or  $\ln(\text{population})$ , dummy variables for jurisdiction type, crime rates (property and violent), and interaction variables between all of these.

<sup>[1]</sup> Identification of the highest performing laboratories over the past decade reviewed the ASCLD Maximus criteria. At the 2016 ASCLD Symposium, fifteen forensic science laboratories were recognized with the Maximus Award for a weighted performance across areas of investigation that demonstrated casework processed per dollar outperformed above the sixth percentile across all laboratories. A similar analysis was conducted for each past FORESIGHT collection year to identify the annual high performers.

# Data Sources

- Project FORESIGHT
  - Over 200 forensic crime laboratories
  - FY2006-FY2020
  - Casework, expenditures, & personnel allocation
- U.S. Census population data
- FBI ucr data
  - Statewide levels
  - Violent
  - Property

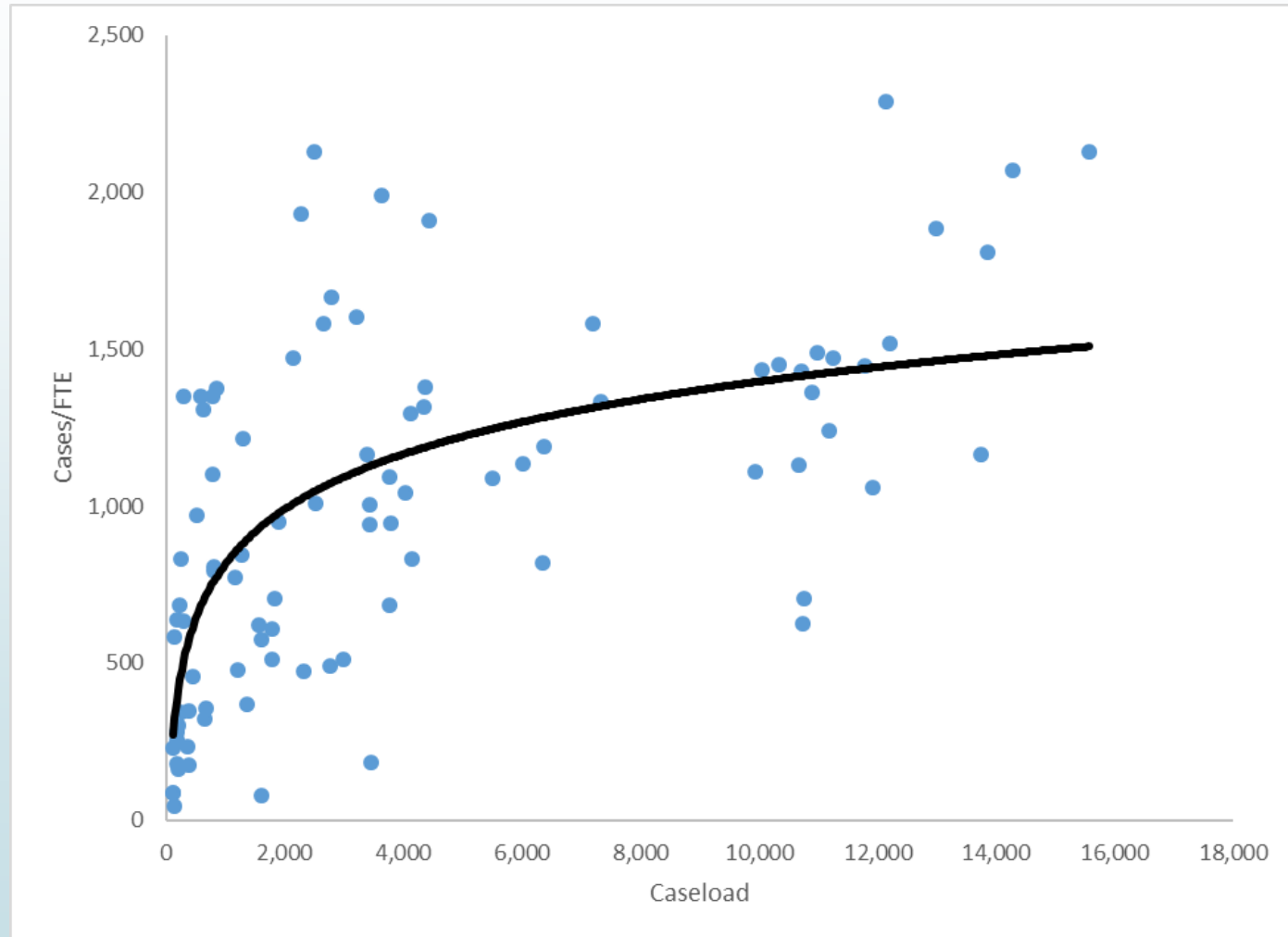
# Project FORESIGHT & LabRAT

<b>Investigation area</b>	<b>Cases</b>	<b>FTE</b>
Blood Alcohol		
Crime Scene Investigation		
Digital evidence		
DNA Casework		
DNA Database (including CODIS)		
Document Examination (including handwriting)		
Drugs - Controlled Substances		
Evidence Screening & Processing		
Explosives		
Fingerprints		
Fingerprints Database (including IAFIS)		
Fire analysis		
Firearms and Ballistics		
Firearms Database (including NIBIN)		
Forensic Pathology		
Gun Shot Residue (GSR)		
Marks and Impressions		
Serology/Biology		
Toxicology ante mortem (excluding BAC)		
Toxicology post mortem (excluding BAC)		
Trace Evidence (includes Hairs & Fibers, Paint & Glass)		
Administration and Support		
Other Specialties (describe below)		
TOTAL		0.00

# Project FORESIGHT & LabRAT

[illegible]

# Project FORESIGHT Output



# The Workforce Calculator

Answer each of the following to estimate your workforce needs. Use the up and down arrows to select jurisdiction type and state crime rates (note that the worksheet "Crime Rates by State" has recent data for your state). Enter the population questions in numeric format only. Additional worksheets contain recent crime rate and population detail for city and counties. For the anticipated caseload in each area of investigation, enter the number of cases for one year (leave blank if you are not supporting a particular area of investigation).

**Jurisdiction:** state, metro, or regional

**State crime rates**

State crime rate violent

State crime rate property

**Populations**

State population

Jurisdiction population

Population Largest City in Jurisdiction

Area of Investigation	Caseload	Current FTE	Optimal Total FTE	Operational Staff FTE	Administration & Support FTE	Additional Staffing Needed
Blood/Breath Alcohol			0.00	0.00	0.00	0.00
Crime Scene Investigation			0.00	0.00	0.00	0.00
Digital Evidence			0.00	0.00	0.00	0.00
DNA Casework			0.00	0.00	0.00	0.00
DNA Database			0.00	0.00	0.00	0.00
Document Examination			0.00	0.00	0.00	0.00
Drugs--Controlled Substances			0.00	0.00	0.00	0.00
Evidence Handling/Processing			0.00	0.00	0.00	0.00
Explosives			0.00	0.00	0.00	0.00
Fingerprint Identification			0.00	0.00	0.00	0.00
Fire Analysis			0.00	0.00	0.00	0.00
Firearms & Ballistics			0.00	0.00	0.00	0.00
Forensic Pathology			0.00	0.00	0.00	0.00
Gun Shot Residue			0.00	0.00	0.00	0.00
Marks & Impressions			0.00	0.00	0.00	0.00
Serology/Biology			0.00	0.00	0.00	0.00
Toxicology ante mortem			0.00	0.00	0.00	0.00
Toxicology post mortem			0.00	0.00	0.00	0.00
Trace Evidence			0.00	0.00	0.00	0.00
Administrative						
<b>TOTAL Laboratory Personnel</b>		<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>

Minimum Annual Capital Budget\* to Sustain Efficiency  (2019 dollars)

# The Workforce Calculator Output

Answer each of the following to estimate your workforce needs. Use the up and down arrows to select jurisdiction type and state crime rates (note that the worksheet "Crime Rates by State" has recent data for your state). Enter the population questions in numeric format only. Additional worksheets contain recent crime rate and population detail for city and counties. For the anticipated caseload in each area of investigation, enter the number of cases for one year (leave blank if you are not supporting a particular area of investigation).

**Jurisdiction: state, metro, or regional** Regional ▼

**State crime rates**

State crime rate violent 350

State crime rate property 2,650

**Populations**

State population 2,000,000

Jurisdiction population 450,000

Population Largest City in Jurisdiction 125,000

Area of Investigation	Caseload	Current FTE	Optimal Total FTE	Operational Staff FTE	Administration & Support FTE	Additional Staffing Needed
Blood/Breath Alcohol	3,500	3.25	3.06	2.40	0.66	-0.19
Crime Scene Investigation			0.00	0.00	0.00	0.00
Digital Evidence			0.00	0.00	0.00	0.00
DNA Casework	5,000	19.50	24.94	20.68	4.25	5.44
DNA Database			0.00	0.00	0.00	0.00
Document Examination			0.00	0.00	0.00	0.00
Drugs--Controlled Substances	4,000	5.50	5.13	4.07	1.06	-0.37
Evidence Handling/Processing			0.00	0.00	0.00	0.00
Explosives			0.00	0.00	0.00	0.00
Fingerprint Identification	2,500	4.75	5.05	4.09	0.96	0.30
Fire Analysis			0.00	0.00	0.00	0.00
Firearms & Ballistics			0.00	0.00	0.00	0.00
Forensic Pathology			0.00	0.00	0.00	0.00
Gun Shot Residue			0.00	0.00	0.00	0.00
Marks & Impressions			0.00	0.00	0.00	0.00
Serology/Biology	1,500	6.00	6.85	5.51	1.34	0.85
Toxicology ante mortem	3,000	7.50	9.66	7.70	1.96	2.16
Toxicology post mortem	2,500	8.49	12.17	9.16	3.02	3.68
Trace Evidence	100	2.25	2.78	2.30	0.48	0.53
Administrative						
<b>TOTAL Laboratory Personnel</b>		<b>57.24</b>	<b>69.63</b>	<b>55.90</b>	<b>13.73</b>	<b>12.39</b>

Minimum Annual Capital Budget\* to Sustain Efficiency \$932,453 (2019 dollars)



# Concluding Comments

- All laboratories are encouraged to visit the Forensic Technology Center of Excellence site and try the Workforce Calculator.
- The calculator is free to use.
- After trying the calculator, laboratories are encouraged to provide feedback to FTCoE or Project FORESIGHT, including comparison of their current staffing to the output of the workforce calculator.
- Additionally, all laboratories are encouraged to participate in Project FORESIGHT.
- As of this writing, participation in Project FORESIGHT continues to be free of charge to participating laboratories.

## For more information:

- Project FORESIGHT <https://business.wvu.edu/research-outreach/forensic-business-studies/foresight>
- FTCoE <https://forensiccoe.org/workforce-calculator-project/>

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