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Forensic Science in Transition: Critical Leadership Challenges

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Abstract *Our nation needs strong forensic leaders. National leaders are needed to champion reforms recommended by the National Research Council and Committee on Identifying the Needs of the Forensic Sciences Community (2009). Leaders are also needed in laboratories to address difficult challenges in the context of resource limitations and constraints that hamper progress toward important goals. Business tools, strategies, and tactics are reviewed from the extant literature to help forensic leaders develop necessary skills. Specifically, leader influence tactics can be used to gain commitment for important projects. We draw from our experience and research to facilitate a discussion of the "best practices" for developing leader effectiveness in forensic science. In this regard, we offer six recommendations for effectiveness measures. Finally, we describe four components of a laboratory that must be in alignment going forward. Leadership is needed at both the national and local levels to provide new direction for the forensic science community.*

Keywords Leader effectiveness, influence tactics, business tools, management, measurement, best practices

Developing Forensic Leaders

> Scores of talented and dedicated people serve the forensic science community, performing vitally important work. However, they are often constrained by lack of adequate resources, sound policies, and national support. It is clear that change and advancements, both systematic and scientific, are needed. [National Research Council and Committee on Identifying the Needs of the Forensic Sciences Community 2009].

Forensic laboratories are state-of-the-art technology enterprises that provide services to the criminal justice community. In both times of fiscal constraint and budget surplus, laboratories must respond to a multitude of issues that require leadership. The interdisciplinary and scientific nature of the field requires strong leadership ability, often in adversarial legal settings (Peterson and Leggett 2007).

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But limited resources are available for developing forensic industry leaders, as noted in the recommendations of the NAS report, *Strengthening Forensic Science in the United States: A Path Forward*, cited above. Yet importantly, the International Organization for Standardization's (ISO) International Standard 17025:2005 Second Edition 2005-05-15, General Requirements for the Competence of Testing and Calibration in Laboratories, contains specific language about the leadership authority and resources that forensic managers need:

> 4.1.5 The laboratory shall have managerial and technical personnel who, irrespective of other responsibilities, have the authority and resources needed to carry out their duties.

> 5.2.2 The management of the laboratory shall formulate the goals with respect to the education, training and skills of the laboratory personnel.

This is a pivotal time in which forensic science leadership is needed, yet there are serious obstacles to surmount.

The purpose of this article is to initiate a discussion on issues of forensic leadership. We focus on two important issues: national leadership at the federal level and the needed reforms recommended by the NAS report, and the basic leadership needs of the forensic science manager. We highlight basic concepts in the extant literature as well as research that we have found useful working with forensic leaders.

We begin with a discussion at the national level, followed by leader issues in the laboratory. Next, we briefly review material from the leadership literature as well as practical techniques that have been positively received in forensic leadership workshops. We conclude with several recommendations for the national leadership challenges that we raise. We hope to initiate a discussion of best practices for developing leaders in the forensic science community.

National Leadership Challenges

There is a vacuum of forensic leadership in our nation. Forensic leaders—not regulators—need to address difficult and entrenched laboratory issues. The NAS report, *Forensic Science: A Path Forward,* has been widely discussed within the profession for its recommendations to strengthen the forensic sciences. The NAS report provides an objective overview of forensic science today, including both positive and negative attributes. However, the NAS report does not articulate a clear vision on where the forensic path leads or how to get there. The NAS report does not provide a vision of the end state—where we need to be—or what a quality forensic laboratory would look like.

Leaders are needed that can clearly articulate a vision and provide a road map for the forensic science community. The NAS report can be seen as a "gap analysis" that describes what is needed, such as sustained funding, graduate and post-graduate training, multidisciplinary and interagency research, as well as ongoing university and agency collaborations. As such, the NAS report provides the background citations and substantiating interviews that clearly define the problem in the state of forensic science today—a snapshot, so to speak, of the industry and its challenges.

The answer lies partly through providing a continuous learning environment using the best practices of forensic and technology management. Functional partnerships between the academic community (such as the sciences, business, law, and medicine), practitioner laboratories, and all of the criminal justice community stakeholders, provide the intangible relationships needed to develop future laboratory managers and forensic leaders.

While the NAS report provides an objective overview of forensic science today, including both positive and negative attributes, it does not provide a path forward. Only the first recommendation—the definition of the problem—is provided. We need leaders to articulate a vision of the end state; i.e., where we want to be. What does a quality forensic lab look like? In the Army the question is: "What does *right* look like?"

Leadership Challenges in the Laboratory

The modern forensic laboratory is a technology enterprise representative of a small company; as such, the leadership challenges are quite similar to any technology-intensive organization. Forensic science leaders need to address these challenges with a heightened sense of awareness. Annual budgets of large forensic laboratory systems can range between $50-$100 million and employ several hundred scientific personnel. To survive, leaders in these laboratories must continuously monitor policy cost and effectiveness using measures of productivity, efficiency, quality, turnover, intellectual capital, customer outreach, and branding.

Typical challenges involve issues both internal and external to the organization, including vertical and horizontal relationships, and relationships with superiors, peers, and subordinates (Bernardin 2010). The challenges faced in crime laboratories share these common challenges. For example, public and private-sector laboratories of all sizes and scopes face financial pressures that limit resource allocation and support. The coordination required of leaders in laboratories to influence successful outcomes is significant.

Table 1 provides a list of specific challenges identified by forty-one participants attending a series of four

Table 1. Common Leadership Challenges in the Forensic Science Laboratory

- Identification of qualified candidates for key positions
- Retention of key personnel
- Competitive salaries for key disciplines
- Motivating employees
- Generational differences
- Sense of entitlement among employees
- Balancing backlog reduction with supervision of new employees
- Providing incentives for top performers
- Lab succession planning
- Sworn versus civilian cultural differences
- Command-and-control management style
- Having time for scientific research
- Cost cutting/staff reduction
- Workload increase
- Workforce freeze or reduction
- Support for sending lab personnel to training programs, especially those off-site or out of state;
- Funding for new technology and systems
- Addressing the problem of less effective employees
- Working with labor representatives
- Using performance appraisals effectively

National Institute of Justice workshops on forensic leadership. These leaders represented thirty-seven U.S. laboratories in a variety of position titles in their respective laboratories, including director, associate director, manager, section chief, QA/QC leader, supervisor, senior scientist, and coordinator. As noted in Table 1, these leaders face a wide range of common organizational challenges involving vertical and horizontal relationships and relationships with superiors, peers, and subordinates, as well as financial pressures. Interestingly, these leaders also face specific challenges such as organizational cultural differences between sworn versus civilian management styles.

More information about challenges unique to the forensic leader emerged from our discussions. Many laboratories operate within a law-enforcement command-and-control organizational culture. Police organizations must follow policies defined by court decisions. In general, police organizations support conservative values and beliefs with an aversion to risk-taking behavior, and changes in policy and procedure advance slowly (Dale and Becker 2007). In contrast, scientists typically hold advanced education degrees and have specialist skills and technical expertise; in general, scientific disciplines encourage a continuous learning environment and the development of new ideas. Forensic scientists face increased pressure for production within a context of zero tolerance for errors (Becker et al. 2005; Becker and Dale 2007). The mixture of law enforcement personnel with civilian scientific personnel forms a unique organizational culture that can be very stressful for both employees and leaders (Dale and Becker 2007).

Leadership in forensic laboratories involves more complexity than managing or supervising. Manager and supervisor are job titles that imply specific tasks or duties related to the job; they describe *what* needs to be done in the job. In contrast, leadership implies *how* tasks and duties are to be carried out, including the social-psychological aspects of the role. Leadership implies that a change in behavior will take place, such as improving quality procedures, increasing efficiency, or building cohesiveness, teamwork, and personal fulfillment in scientific personnel.

Leaders also depend on teams to execute the plans identified by the leader. Even the best leadership efforts are not always successful. Bass (1960) differentiates between attempted, successful, and effective leadership. Attempted leadership is when person A attempts to change person B's behavior. Successful leadership means that person B changes his or her behavior as a function of person A's efforts. Effective leadership results when person B changes behavior as a result of person A's efforts, and person B is more satisfied, better rewarded, and attains a goal of mutual importance to both A and B (Bass 1960). The forensic leaders in our workshop found these distinctions important in trying to understand why their attempts to lead are not always successful.

Most people can become effective leaders given the right circumstances and with guidance and support. Leadership is more than the possession of a specific set of inborn traits. In our workshops we question the idea that "great leaders are born not made." Rather, we stress the idea that leadership can be developed and trained. Leadership is a broad concept that encompasses the collective effort by members of a group to accomplish meaningful tasks:

> Leadership is the process of influencing others to understand and agree about what needs to be done and how to do it, and the process of facilitating individual and collective efforts to accomplish shared objectives (Yukl 2010).

Theories of Leadership

Leadership theories abound and we will not attempt to review this vast literature. Rather, we focus here on material that has been described as most useful in our NIJ and ASCLD-LAB presentations. In this section we review fundamental theories related to leadership. While these fundamental theories can be applied in all settings, they are particularly important in the forensic laboratory setting for three reasons. First, leadership theory provides a basis for understanding operational concepts and is important for all leaders to understand. Second, these fundamental theories are particularly influential in work settings that require a high degree of responsibility, monitoring, measurement, and control mechanisms, including policies, procedures, and systematically derived, professionally accepted practices. Military, public safety, hazardous, and highly regulated environments such as forensic laboratories are included in this domain. Third, many laboratory managers have limited exposure to leadership theory. Technology managers such as forensic scientists are often promoted into management because of specific technical skills and an aptitude for influencing others. Often these managers have not had an opportunity for formal or informal training in leadership theory.

Two broad aspects of leadership have been suggested: initiation of structure and consideration (Stogdill 1963). Initiation of structure concerns production while consideration concerns people. These two strands run through many theories of leadership. The effective leader will evaluate the needs of the situation to achieve the correct proportion of these two aspects of leadership; the proportion changes as people become more experienced, as staff members leave and are replaced, and as policies and technologies change. For example, the scientists analyzing DNA and specialists analyzing tool marks work under

different conditions, their teams have different degrees of cohesion, and they represent distinct technical backgrounds. Leaders must adjust their styles to fit the people working in different specialty areas.

Three additional foundation theories are briefly described here—those of Fayol, Taylor, and Follett. Fayol (1917) stated that leaders must develop five functions to succeed: planning, organizing, commanding, coordinating, and controlling. The leader is responsible for providing an organized system, must set up the organization and provide resources, must direct subordinates, must ensure coordination of efforts, and must track and record results. Forensic laboratories work under the constraints of scientific practice, policies, and procedures; the adversarial legal system; and public scrutiny resulting in tight constraints and controls in laboratory operations. An autocratic or quasi-military approach results in a command-and-control system. One laboratory director noted that there is nothing "quasi" about the militaristic approach that many laboratories take in terms of leadership style!

Frederick Taylor's (1911) scientific approach revolutionized organizations. An engineer who developed time-and-motions studies, Taylor identified the best practices, tools, methods, and people for specific tasks. Applied correctly, organizations can make great progress in productivity and standardization, and many successful organizations today are organized around these basic principles. For example, UPS uses scientific management to balance competing goals of speed and accuracy of delivery. Taylor's principles helped UPS identify the most efficient way to process up to 22 million packages a day with a workforce of 408,000 employees serving more than 200 countries (Dolezalek 2009; Weber 2009). UPS managers know precisely how many minutes it takes for each driver to deliver packages in a route, as well as how much time it takes to walk to a customer's door with a package. The results are measurable productivity along with high levels of precision. The systematic and efficient operation of a forensic laboratory owes a considerable debt to the operational, recording, and tracking system related to the innovations of Fayol and Taylor. But a cautionary note: Taylor's efficiency methods have been misused to exploit employees, producing boredom, fatigue, and decreased commitment. In addition, efficiency methods cannot be implemented to the neglect of quality. The concepts of quality theorists such as Shewhart, Deming, Juran, and Ishikawa are complementary to the systematic approaches of Fayol and Taylor.

Mary Parker Follett (2003) made numerous recommendations to improve organizations by encouraging productive conflict as a way to develop solutions as opposed to polite agreement or avoidance of conflict. Responsibility resides in the situation, not the person. The leader is the person best suited to help solve problems; in this sense, participation is a form of leadership. Follett also formulated the concept of the integrative solution as the best way to resolve conflict, i.e., conflict is best resolved if all parties get what they need. This is the foundation for "win-win" solutions, which can be more effective than compromise. Follett's approach recognized that teamwork is more effective than individual effort and that organizations need different viewpoints. Technical personnel and individual contributors, including scientists, are often motivated by this inclusive, empowering approach because the nature of conflict and negotiation provides a wider view of the leader's role (Follett 2003). In this regard, leaders are encouraged to take different perspectives, to use conflict as a tool instead of an impediment, and to include negotiation in situations in which authoritarian approaches simply do not work.

Relevance of Classic Leadership Theory to the Laboratory Environment

These classic theories are applicable to the forensic laboratory environment today for three reasons: (1) their seminal nature for leaders today, (2) their simplicity, and (3) their broad applicability. While not uniquely applicable to forensic laboratories, they are a logical starting point for the understanding of the human side of laboratory environments.

Importantly, the two broad aspects of leadership discussed above—initiation of structure and consideration—are widely discussed in the modern organization as a concern for production and concern for people; they are the most frequently endorsed leadership factors (Bass 1990). The work of Taylor and Fayol addresses coordination, order, efficiency, continuous improvement, predictability, reliability, and the reduction of variance and uncertainty. These factors are part of the scientific method; indeed, they are critical elements in the work of laboratory scientists. Both Taylor and Fayol had backgrounds as engineers as applied scientists. Follett's work is important to understanding both the beneficial and destructive sides of conflict, and in the practical skill of negotiation with team members and all stakeholders. Scientists promoted from the bench to the amorphous and complex world of politics, negotiation, and interpersonal challenge benefit from understanding Follett's work as the foundation for conflict resolution, listening skills, bases of power, the win-win solution, and other elements of effective leadership.

Integrating Leadership Theory

It is important to integrate these basic ideas to build an understanding of the context for leadership (Pavur 1996). Table 2 identifies the relationships among the two factors

Table 2. Leadership Factors, Functions, and Behaviors

Leadership Factors (Stogdill, 1963)	*Leader Functions (Fayol 1917; Follett 2003; Taylor 1911)*	*Leader Behaviors (Yukl 2010)*
Consideration	Participation, Motivation, Support	Supporting Consulting Delegating Recognizing Rewarding Motivating
	Achievement, Constructive Conflict	Managing Conflict, Building Teams Developing
Initiation of Structure	Management Functions: Plan, Organize, Command, Coordinate, Control	Clarifying Planning and Organizing
	Organize and Monitor	Problem Solving Informing Monitoring
	External Representation	Envisioning Change Taking Risks and Leading By Example Representing Networking, Interfacing

of leadership (initiation of structure and consideration), general leadership functions (such as gaining employee participation, motivating employees), and leader behaviors (such as leading by example or planning and organizing). The simple model of two factors (initiating structure and consideration) makes it easier for leaders to see the forest for the trees. As described above, task-oriented behaviors are primarily concerned with accomplishing a task in an efficient and reliable way, while consideration behaviors are concerned with increasing mutual trust, cooperation, job satisfaction, and identification with the organization. The two-factor dichotomy can be expanded to include a third category of managing external relationships, which is important to laboratory senior leaders who communicate with external stakeholders in the criminal justice community. Behaviors in this domain include encouraging and facilitating change, an important component of effective leadership, especially with regard to the national leadership challenges in forensic science today.

The behaviors listed on the right side of Table 2 were developed from three converging lines of evidence: theories of leadership, independent research in various organizations, and direct observation of manager behavior (Yukl 2010). The three columns are useful for understanding different components and levels of analysis that leaders need to be effective. For example, managers can analyze their own behavior with a view to improvement. Managers can evaluate the performance of those they supervise. Managers can also use the table as a diagnostic framework for discussions about improvement of management performance. Finally, newly promoted leaders can use the table as a guide to the necessary skills they will need to develop as they gain experience in their new leadership role.

In Table 2, the set of supportive leader behaviors—supporting, consulting, delegating, recognizing, rewarding, and motivating—involves developing team members by encouraging participation. Supporting and consulting behaviors require the manager's assistance or advice if needed. In contrast, delegating behaviors recognize that the subordinate has real responsibility. The outcome of responsibility will be recognized or rewarded.

The set of relational behaviors such as managing conflict, building teams, and developing, involve ways of learning to solve problems as a team, not as an individual or through an authority figure. Solving problems as a team is very different from solving problems alone; it is an essential skill in forensic laboratories.

The set of management functions includes clarifying, planning and organizing, problem solving, informing, and monitoring. These are the operational functions that contribute to "getting the work done." Clarifying involves setting expectations, while planning and organizing involves using the right people with the right skills, right equipment, and right material to accomplish the work. Problem solving represents the analysis of unexpected events or slowdowns, as well as corrective action. Informing and monitoring have to do with setting a baseline, a goal, a timeline, and a tracking system. In the laboratory, budgets and backlog statistics fall into this category.

The set of representing, networking, and interfacing functions relate to external liaison activities. Laboratory managers are the figureheads of their work units; they meet with management and customers, and they coordinate laboratory efforts with the efforts of others such as sworn officers, attorneys, and political figures.

Leader Influence Tactics

Leaders need to influence other people to carry out requests, support proposals, and implement decisions, often in situations where the request is unpopular (Yukl 2010). Leaders also need to overcome resistance, facilitate problem solving, and maintain employee commitment during times of unanticipated change. Specific strategies or techniques that can be used to influence the attitudes and behavior of another person are called *influence tactics* (Yukl 2010). The four most effective influence tactics are known as the *core tactics*; they are: rational persuasion, consultation, collaboration, and inspirational appeals. The core tactics are especially useful in influencing others to carry out a request or support a proposal.

Specific examples along with definitions are provided in Table 3. In a series of recent leadership workshops consisting of forensic managers, *rational persuasion* was the most frequently used core tactic. Managers agreed that "using facts and logic" and "explaining in detail why requests were important" were most effective in convincing scientific personnel to carry out necessary tasks in the laboratory, even when the proposed task was difficult or challenging.

Leader influence tactics are more likely to be successful if the leader has sufficient position and personal power, if used in a skillful way, if used for a request that is legitimate and consistent with employee values and needs, if employees perceive it to be a socially acceptable form of influence, and if the tactic can affect employees' attitudes about the desirability of the request (Yukl 2010).

Supplementary tactics are additional influence behaviors that can be used for specific situations; seven supplementary tactics are shown in Table 4. Ingratiation, exchange, and apprising are moderately effective tactics for influencing subordinates, but they are difficult to use when attempting to influence superiors. Personal appeals can be used to influence a person with whom the leader has a friendly relationship; however, this tactic works only for certain types of requests, such as getting assistance, changing a scheduled meeting or deadline, etc. Pressure and legitimating are not likely to result in employee commitment, but may be needed to elicit compliance. Forensic managers in our laboratory agreed that use of pressure (repeatedly checking and asking in a persistent way) and legitimating (explaining that a request was consistent with official policies and rules) were often necessary to obtain compliance in the laboratory. Coalition can be used to support a change effort or innovation when used with new work tasks; coalitions are especially effective in combination with rational persuasion and inspirational appeal. However, a coalition can be negatively perceived as ganging up on an employee when it is used to try to influence someone to work faster or improve performance (Yukl 2010). In this regard, Tables 3 and 4 provide information about the general effectiveness of each tactic, as well as the recommended directional use for each tactic (Yukl and Tracey 1992; Yukl 2010).

In workshops conducted for the NIJ, forensic managers took part in a role-play exercise in which they each identified a leadership challenge they had experienced in the laboratory. After learning the eleven influence tactics, the managers practiced using them in the problem situations they had identified previously. Managers provided additional suggestions for each other for using the tactics to influence others. Much discussion ensued, and in the months following the workshop participants were sharing their leader influence successes via e-mail.

Table 3. Core Influence Tactics

Influence Tactic	*Directional Use of Tactic*	*General Effectiveness*
Rational Persuasion	Widely used in all directions	High
• Explain in detail why a request or proposal is important		
• Use facts and logic to make a clear case in support of a request or proposal		
• Explain why a proposal is better than the alternatives		
Inspirational Appeals	More down than up or lateral	High
• Describe a proposed change as an exciting and worthwhile opportunity		
• Link a proposed activity or change to the person's ideals and values		
• Describe a clear, appealing vision of what can be accomplished by a project or change		
Consultation	More down and lateral than up	High
• State your objective and ask what the person can do to help attain it		
• Ask for suggestions on how to improve a tentative proposal		
• Involve the person in planning action Steps to attain an objective		
Collaboration	More down and lateral than up	High
• Offer to provide assistance or resources the person will need to carry out a request		
• Offer to help solve problems cause for the person by a request		
• Offer to show the person how to do the task involved in a request		

Source: Yukl (2010).

Table 4. Supplementary Influence Tactics

Influence Tactic	*Directional Use of Tactic*	*General Effectiveness*
Apprising • Explain how the person could benefit from carrying out a requested task • Explain how a proposed change would solve some of the person's problems	More down than lateral or up	Moderate
Exchange • Offer something the person wants in exchange for providing help on a task or project • Promise to do something for the person in the future in return for his/her help now	More down and lateral than up	Moderate
Ingratiation • Say that the person has special skills or knowledge needed to carry out a request • Praise the person's past achievements when asking him/her to do another task	More down and lateral than up	Moderate
Legitimating • Explain that your request or proposal is consistent with official rules and policies • Use a document to verify that a request is legitimate	More down and lateral than up	Low
Personal Appeal • Ask the person to do a favor for you as a friend • Say that you are in a difficult situation and would really appreciate the person's help	More lateral than down or up	Moderate
Pressure • Keep asking the person in a persistent way to say yes to a request • Repeatedly check to see if the person has carried out a request	More down than lateral or up	Low
Coalition • Mention others who endorse a proposal when asking the person to support it	More lateral and up than down	Low/moderate

Source: Yukl (2010).

Measures of Effectiveness

To influence key stakeholders, it is important for leaders to measure the effectiveness of their initiatives. *Measurement* is consistent with Fayol's advice to *control* to understand results. How can leaders be assured that implementation of a laboratory policy is effective? Measures are needed to assure, for example, continuous improvement, retention of intellectual capital, productivity, efficiencies, and corrective actions or non-conformances (Becker and Dale 2007; Speaker 2009). The ISO/IEC 17025:2005, Second Edition 2005-05-15 4.15.1 General Requirements for the Competence Testing and Caliberation standard states:

> In accordance with a predetermined schedule and procedure, the laboratory's top management shall periodically conduct a review of the laboratory's management system and testing and/or calibration activities to ensure their continuing suitability and effectiveness, and to introduce necessary changes or improvements. The review shall take account of the suitability of policies and procedures; reports from managerial and supervisory personnel; the outcome of recent internal audits; corrective and preventive actions; assessments by external bodies; the results of inter laboratory comparisons or proficiency tests; changes in the volume and type of the work; customer feedback; complaints; recommendations for improvement; other relevant factors, such as quality control activities, resources and staff training.

The question for forensic leaders is how to determine the impact of these measures or the *so what?* factor. What metrics can be used to measure and monitor quality of laboratory services? Measures that are objective and tangible, such as cost and cycle time are less complex than measures that are more subjective and intangible, such as community safety, quality of life, and reduced recidivism. Yet the subjective factors may be more significant to criminal justice stakeholders than the objective factors. How do forensic leaders decide the most effective policies when resources are fixed? More specifically, how are decisions made to test one submitted item with a particular technology and not test other items? There are limits to resources and they will continue to be further restrained in the future. The consequences of making the wrong decisions can have high consequences for forensic leaders and all of the laboratory's stakeholders.

To address these issues, we recommend the following:

1. *Recommendation 1.* Forensic leaders must identify common laboratory outcomes, both tangible and intangible, in terms that are quantifiable. For example, number of reports, number of testimonies, number of analyses, number of opinions, number of submissions, number of source attributions between unknown items in known controls, and number of exclusions between unknown items in known controls, can all be considered as outcome measures.

2. *Recommendation 2.* Leaders must identify common laboratory outcomes for quality that are both tangible and intangible in terms that are quantifiable. For example, number of task or procedure outcomes that are not acceptable, the total cost of rework, customer surveys that subjectively measure customer satisfaction, and laboratory reputation are examples of quality outcome measures.
3. *Recommendation 3.* Leaders must benchmark metrics for productivity, efficiency, cost, and quality with similar-sized laboratories in scope of services and customer demographics.
4. *Recommendation 4.* Leaders must collaborate with similar-sized laboratories to define best practices,comparing metrics for productivity, efficiency, and quality. For example, two or more similar laboratories in size, scope, and customer demographics that exhibit a wide variety of productivity, efficiency, and quality metrics would collaborate to identify and develop best practices.
5. *Recommendation 5.* Leaders must continually monitor these metrics at least monthly (not annually) using statistical analysis tools (e.g., histograms, control charts, Pareto charts) popularized by Deming (2000). Continuous monitoring will increase productivity, efficiency, quality, and customer satisfaction. Laboratory managers must also deal with fixed resources in a variety of "production" non-conformances that require solutions.
6. *Recommendation 6.* Leaders must use cost-benefit analyses and cost-effectiveness analyses as part of the decision tree to solve problems. For example, solutions to problems usually require internal or contracted human resources, such as salary, benefits, expenses, and lost productivity from solution teams. Smart decisions need to be made concerning where resources should be applied that will have the largest effect overall in the laboratory. For example, systemic reporting errors, contamination, inclusionary and exclusionary false positives, and false negatives are high-risk non-conformances that are categorically unacceptable, requiring resources to continually monitor effectively and efficiently.

The Way Forward

Finally, there are four main components of a forensic laboratory that must be in alignment to provide high-quality, effective, and efficient forensic service. These are: facilities, instrumentation/information technologies, human resources, and organizational culture. The NAS report does not provide specific detail on facility and instrumentation/information technology needs. However, issues regarding scientific human resources and a scientific organizational culture to sustain forensic science education and research are a common thread throughout the NAS report. For example, the NAS report provides a specific recommendation to remove forensic laboratories from the control (and culture) of police departments.

A strategic human resource management model is needed to provide guidance to forensic leaders for operating a state-of-the-art laboratory that delivers high-quality services in a timely manner to a specific geopolitical region (city, county, state, or federal agency). For example, what combination of laboratory facility, instrumentation/information technologies, human resources, and organizational culture is needed to provide high-quality and timely set of services for a city with a population of 1 million? What will it cost to start up the laboratory and what will it cost to sustain the laboratory into the future? How can leaders measure and sustain the scientific intellectual capital responsible for providing high-quality forensic services? What are the key ratios or intellectual capital metrics required to produce high-quality forensic services? For a laboratory serving a city of 1 million, how many PhD degrees, master's degrees, bachelor degrees, professional organization memberships, scientific publications, texts, and college classes are needed to provide the highest quality forensic service? A state-of-the-art laboratory requires scientific leadership working with all stakeholders to provide the best forensic services to the criminal justice community (Dale and Becker 2005).

Forensic science operates in a performance measurement system that tolerates no errors. The application of new identification technologies such as DNA have forced the traditional crime laboratory out of the basement and back rooms of the police departments and into state-of-the-art facilities with instrumentation and information management systems. These new laboratories are a significant step in the right direction and they require leaders with skills and business tools to apply concepts such as economy of scale, high throughput technology, cost-benefit analysis, cost-effectiveness analysis, and efficiency and effectiveness metrics that will routinely measure continuous improvement.

However, as is the case in any enterprise, the *people* factor of scientific intellectual capital is an intangible factor and the ultimate key to success. A small number of universities have tried to customize undergraduate and graduate science degree programs using elective credits specializing in forensic disciplines. These beginning forensic academic programs are showing success in specialized areas but do not possess the capacity needed for our nation.

National forensic science leadership is needed to design, develop, and implement a solution that would

resolve the core competency human resource needs for the forensic community. A strategic forensic science-human resource staffing model designed to provide quality and timely forensic services for small, medium and large forensic service areas would show the way for top management and budget directors in the criminal justice community. Traditional undergraduate and graduate science academic programs do not address the specific leadership and business tools needed by the forensic community. Forensic science needs a new graduate curriculum designed specifically to address the unique needs of the forensic community. New collaboration between science, law, medicine, information technology, and business schools are needed to select individual core curricula and design innovative new curricula specifically for the forensic scientist, supervisors, managers, and top-level executives. National forensic leadership is essential as the only alternative to bring together a fragmented system consisting of thousands of forensic scientists working within a fragmented system of city, state, and federal laboratories. We can do it better, smarter, and cheaper by treating human resources as an investment and not as an expenditure. National leadership is needed to show the way through the development of new innovative forensic science undergraduate and graduate degree programs that will produce forensic science professionals for the future. National leadership is also needed to develop forensic science staffing models for small, large, and very large forensic laboratories that will identify, measure, and monitor forensic science human intellectual capital for continuous improvement. City, state, and federal policy-makers will then know what a quality laboratory looks like, customized for a specific reason and will be able to develop a long-term funding strategy that will sustain quality forensic services in their geopolitical region. A teaching hospital model can help nurture new forensic scientists and leaders for the future.

Summary and Conclusion

Forensic science leaders face challenges in technical, budgetary, productivity, quality, efficiency, and team process areas, but there are strategies and tactics to help with these challenges. In this regard, we identified common leadership challenges faced in the forensic laboratory today. We described leader challenges at the national and local level. We reviewed leadership theory to provide a frame of reference to think about these challenges. We offered specific influence tactics that can be used to influence others and gain success on important projects. The influence tactics can be used as skills for leaders to develop and practice as they think of new techniques for gaining effectiveness when managing internal and external contingencies in forensic science laboratories. We offered six recommendations for effectiveness measures and described how these could be used. Finally, we defined the four components of a laboratory that must be in alignment so forensic leaders can help close the gap between the recommendations from the NAS report and the way forward.

References

Bass, B.M. 1960. Leadership, psychology, and organizational behavior. New York: Harper & Row.

Bass, B.M. 1990. Bass and Stogdill's handbook of leadership: Theory, research, and managerial applications, 3rd ed. New York: The Free Press.

Becker, W.S. 2009. Leadership best practices: Developing the next generation of lab managers. Presentation to the 37th Annual American Academy of Crime Lab Directors (ASCLD) Symposium, Sept 16, 2009, Anaheim, CA.

Becker, W.S., and W.M. Dale. 2007. Critical human resource issues: Scientists under pressure. Forensic Science Communications 9:2.

Becker, W.S., W.M. Dale, A. Lambert, and D. Magnus. 2005. Forensic lab directors' perceptions of staffing issues. Journal of Forensic Science 50:5, 1255–1257.

Bernardin, H.J. 2010. Human resource management: An experiential approach, 5th ed. Boston: McGraw-Hill Irwin.

Dale, W.M., and W.S. Becker. 2007. *The crime scene: How forensic science works*. Kaplan: New York.

Dale, W.M. and W.S. Becker. 2005. Managing intellectual capital. Forensic Science Communications 7:4.

Deming, W.E. 2000. *Out of the crisis*. MIT Press: Cambridge, Mass.

Dolezalek, H. 2009. UPS: Brown's training methods. *Training and Development Journal* 46:4, 30.

Fayol, H. 1917. *Administration industrielle et générale; Prévoyance, organisation, commandement, coordination, controle*. Paris: H. Dunod et e. Pinat.

Follett, M. 2003. Dynamic administration: The collected papers of Mary Parker Follett. In L. Urwick (Ed.), Early sociology of management and organizations, Vol. 3. New York: Taylor & Francis.

International Organization for Standardization (ISO). 2005. International Standard 17025:2005, Second Edition 2005-05-15, General Requirements for the Competence of Testing and Calibration in Laboratories.

National Research Council and Committee on Identifying the Needs of the Forensic Sciences Community. 2009. Strengthening forensic science in the United States: A path forward. Washington, DC: The National Academies Press.

Pavur, E.J., Jr. 1996. Integrating leadership and management: Theories, functions and skills, Presentation to the New Orleans Area Applied Psychologists, October 1996, Tulane University, New Orleans, LA.

Peterson, J.L. and A.S. Leggett. 2007. The evolution of forensic science: Progress amid the pitfalls. Stetson Law Review 36:621-660.

Speaker, P.J. 2009. Key performance indicators and managerial analysis for forensic laboratories. *Forensic Science Policy and Management* 1:32-42.

Stogdill, R.M. 1963. *Manual for the leadership behavior description questionnaire—Form XII.* Columbus, OH: Ohio State University, Bureau of Business Research.

Taylor, F.W. 1911. *The principles of scientific management.* New York: Harper & Row.

Weber, H.R. 2009. UPS expects to deliver roughly 22M packages on its busiest day this year. Business News, November 12.

Yukl, G. 2010. Leadership in organizations. Upper Saddle River, NJ: Pearson Prentice Hall.

Yukl, G., and B. Tracey. 1992. Consequences of influence tactics used with subordinates, peers, and the boss. Journal of Applied Psychology 77:525-535.