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Strategic Management of Forensic Laboratory Resources: From Project FORESIGHT Metrics to the Development of Action Plans

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Abstract *The project FORESIGHT stated objectives begin with the development of metrics applicable to the activity of forensic science laboratories. These metrics enable a laboratory to assess how they fit within the forensic science industry and offer a glance at the levels of performance that they might be able to achieve. FORESIGHT's mission goes on to state the intent for laboratories to use those measurements to "preserve what works, and change what does not" (Houck et al. 2009, p. 85). This paper addresses the strategic implications of those additional aspects of the FORESIGHT mandate with a view of the strategic planning process for a forensic science laboratory. The keys to the development of an ongoing strategic planning and execution process are outlined, and then the actions of one laboratory, Ontario's Centre of Forensic Sciences, are examined to demonstrate the move from metrics to action. While there cannot yet be made a claim of "best practices," this Canadian example offers some guidance to "better practices" in the quest for continual improvement in the provision of forensic science services.*

Keywords Finance, forensic laboratories, management, strategic planning

Introduction

The first decade of the new millennium was marked by dramatic changes in the state of the world economy from boom to recession. The lingering recession has resulted in reduced revenues to governments at all levels and that, in turn, has been met with a reduction in budget allocations for many publicly funded organizations including forensic science laboratories (Speaker & Fleming 2009). Simultaneously, there have been dramatic changes in the demands on the justice system and the expectations of forensic laboratories to support the needs of the justice system. The combination of these two phenomena opened the second decade with great expectations placed upon the shoulders of the managers of forensic science services. How will these laboratories be able to provide a greater number of services with fewer resources at their disposal?

Fortunately, efforts in the last decade have established the groundwork to address this question. The European QUADRUPOL study (2003) and the North American FORESIGHT[1] study (Houck et al. 2009) offer a means to begin the measurement of forensic science services through the provision of a common nomenclature upon which to have a discussion about performance. Once a common language had been established, participating laboratories could begin to collect data and compare that data across laboratories to establish baseline industry information. The collected data was drawn from a variety of laboratory databases including casework, financial, and human resources records and separated by area of investigation. For each investigative area, the information regarding budgets and budget allocation, human resource data on the provision of personnel, and finally casework were united for each laboratory to evaluate performance.

In the present paper, we address the issue as to what a laboratory can and should do with the data for improved laboratory performance. We turn to specific business lessons regarding forensic laboratories with special attention to the laboratory management issues raised by the project FORESIGHT participants. The review of this literature includes discussions of strategic missions, key performance indicators, budgeting, and specific short-term and long-term problems in the management of forensic laboratories. With approximately 70% of the typical

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laboratory's budget devoted to compensation of laboratory personnel, personnel issues dominate the lessons highlighted in the literature (Speaker 2009b). We follow that discussion with a review of relevant literature in the field of strategic management. While forensic science laboratories represent a unique industry, they share a great number of commonalities with other service industries. The foundation of these shared lessons from strategic management is presented in the next section.

Combining a look at mission, vision, and values, we are able to connect the budget allocation process to a feedback loop through which the laboratory uses the FORESIGHT metrics to evaluate performance and reformulate strategic plans. To highlight the process, we provide an example of how one laboratory, Ontario's Centre of Forensic Sciences, has created a program inclusive of the management team across the laboratory to monitor and manage for continual improvement in laboratory performance. Concluding remarks follow with some suggestions on the implementation of similar processes in other laboratories.

The Business of Forensic Sciences

To date, there are few studies that have taken a strategic management approach to the operations of individual forensic crime laboratories or the role of these laboratories as an industry within the justice system. The forensic laboratory industry has traditionally lacked standard definitions and collection of data to assist in the measurement and improvement of performance. An early study (Dale & Becker 2003) noted that personnel expenditures account for the majority of forensic laboratory expenditures and the pressure for forensic laboratories to process more casework will require advanced planning in the preparation of scentists and analysts for the increased workload. While Dale and Becker (2003) call for better data to assess the market demand, they do provide a rough estimate of the numbers of scientists and analysts needed as a function of population served. The call for better industry data was answered with the European QUADRUPOL study (2003), which set the groundwork for such strategic management processes to be conducted by defining standard measures and quantifying performance across laboratories. The FORESIGHT project (Houck et al. 2009) continued the development of standardized measures and expanded participation to include a larger sample of laboratories with representation at the federal, provincial, county, and metropolitan levels and a broadening geographic profile. Additional cross-industry investigations (e.g., Peterson et al. 2010) place the forensic laboratory within the context of the entire justice system and suggest metrics for a strategic evaluation of the system as a whole.

A few recent studies (Speaker & Fleming 2009; Schade 2009; Becker et al. 2009) have undertaken aspects of strategic management issues within the context of singular issues faced by an individual laboratory. The management issues discussed in the literature (Dale and Becker 2003; 2004; Heames and Heames 2010) have tended to center on personnel matters. One example is an investigation into alternative staffing models as a strategic response to turnover in a metropolitan forensic laboratory (Dale & Becker 2004). This investigation offers some insights into the generality of a strategic planning process via a look at one specific problem. The case illustrates the connection between the identfication of the problem, the metrics to be monitored, and the review of results and feedback into the planning process. Heames and Heames (2010) offer some additional insights into measurement alternatives for the development of action plans to address similar laboratory staffing problems. And Houck (2009) offers yet another strategic perspective of personnel and staffing strategy through a discussion of how forensic sciences may provide the hook to attract women to scientific study and increase the talent pool for laboratories.

The FORESIGHT study has provided the base information to formulate a strategic planning process that may be followed by laboratories. While the project began with a plan to replicate the collection of data outlined by the QUADURPOL study, FORESIGHT expanded this collection to include issues raised by the participating laboratories (Houck et al. 2009). Subsequent review of the FORESIGHT data has been guided by the topics identified by the study's participating laboratories. These issues included the need to maintain high standards of quality while addressing an ever-increasing demand for services. Participants noted the need to correct for differences in facility sizes, geographic areas served, populations served, regional and cultural concerns, and the extent to which the CSI effect (Houck 2006) has been pressed upon them. Following the identification of those areas of concern, the search for potential key performance indicators (KPI) began with an examination of mission, vision, and values and the connection to the guiding objectives of a forensic science laboratory. The initial review of appropriate performance measures (Speaker 2009a) offers a host of potential ratio metrics to collect. These metrics offer insight into each of the areas of concern and include measures of return, quality, efficiency, analytical process, and market conditions. The very use of common size statements and ratios offered the ability to correct for differences in size population, geographical areas served, and for asset allocation by the sponsoring government entity. While the presentation of potential KPI marked a step forward, a subsequent article on the decomposition of ratios (Speaker 2009b) provided greater insight into how a laboratory might detect an explanation for its performance and

identified potential red flags to highlight areas of concern. Armed with viable metrics and the means to analyze them, the foundation for the important planning stages of performance review and coordination with strategic goals is in place.

A review of the performance metrics helps to guide modifications in strategy, and along with the adjustments in strategy will come corresponding changes in budget allocations. Schade (2009) offers one example of a change in budget allocations to accompany a change in the division of duties in the analytical processing for fingerprint identification. Dale and Becker (2004) offer another example, where profound budget changes accompany a shift in duties from more highly paid scientists to lower paid analysts with oversight by scientists. Such reallocations are a natural part of the strategic planning process. A broader approach is taken through a look at the budget allocation process for a forensic laboratory (Speaker & Fleming 2009) in which performance is evaluated by connecting planned budgets to actual expenditures and adjusting to future use.

More recent analysis has begun to set the stage for the second stage of inquiry, namely to "preserve what works, and change what does not" (Houck et al. 2009, p. 85). Following a balanced scorecard approach (Kaplan & Norton 1992; Kaplan & Norton 1996), the metrics decomposing the return on investment can be considered as part of a larger set of metrics that address the broader mission of individual laboratories (Houck et al., forthcoming). Recognition of that broader mission suggests that comparison of the financial metrics to the rest of the forensic laboratory industry is only part of the strategic review that should be regularly undertaken by laboratory leadership, and many of the financial issues have at their heart some other aspect of laboratory management. Becker and Dale (2010) provide laboratory leaders with a set of six specific recommendations to assist in the strategic management process. These include adopting common measures across laboratories, common quality standards, benchmarking standards in all areas of concern, identification and dissemination of best practices, constant monitoring of metrics, and use of a cost-benefit review of practices.

The Strategic Planning Process

Strategic management involves managerial decisions and resultant actions that help determine the performance of an organization. Such decisions and actions are derived from a careful internal and external analysis of the firm—a process referred to as environmental scanning. Once a manager undergoes a thorough environmental scan, s/he formulates strategies deemed to best fit with the organization's environment. Each strategy should be articulated to the extent that it can be implemented. The strategic loop is closed with a final step that evaluates the effectiveness of implemented strategies. Corrections can be made to any aforementioned step thought to be defective. This process is depicted in Figure 1.

Figure 1. The strategic management process (color figure available online).

Environmental Scanning

During an environmental scan, the laboratory manager should look at all relevant internal and external influences that have an impact or a potential impact on the laboratory. Internal influences are dichotomized into strengths and weaknesses. Similarly, external influences are divided into opportunities and treats.

Internal Analysis

In evaluating the laboratory from an internal perspective, the manager should visualize the organization as a set of resources—or capabilities—that act as the laboratory's foundation. Examples might include personnel, equipment, building, productivity, technology, supplies, and comparison ratios. A ratio gaining current interest in the forensic science literature is that of return on investment as a cost minimization metric (Speaker 2009b). Strengths and weaknesses are only determined in a comparative sense. That is, it might not be accurate to stake a claim that a laboratory has a specific strength or weakness without comparing a capability in question to that of an industry benchmark. Benchmarks could be obtained through membership in a consortium of forensic labs, such as FORESIGHT. Only through such a comparison can a manager stake a claim that an activity in his/her laboratory is necessarily strong or weak.

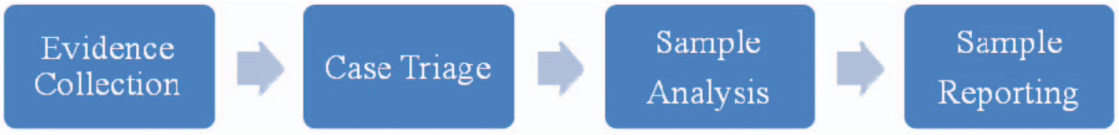

Figure 2. Typical value chain for a forensic crime laboratory (color figure available online).

Resource strengths might be considered to be core competencies of the laboratory. This is not to say that all resource strengths should be left alone. Forward-thinking organizations must consider resource strengths in the context of continuous improvement (Deming 1986). In other words, what can the laboratory do to improve on that which it already does well?

The bigger challenge often comes with the discovery of comparative weaknesses. Weaknesses need to be eliminated or improved upon. One of the most often cited strategy tools for discovering and repairing resource weakness can be observed by using value chain analysis (Porter 1985). The value chain is a sequentially linked set of activities beginning with materials entering a laboratory through test reporting and billing. The focus of the value chain analysis is to examine each activity with the question in mind, is this activity adding value? If the answer is no, the manager must find a way to fix the malfunction. Often, techniques such as brainstorming and process mapping will uncover methods for improving upon a weak link in the value chain.

While the above offers a very generic description of how value chain analysis works, in practice the process should take a fine-grained analysis of all laboratory activities. Blood alcohol, DNA, firearms and ballistics, and toxicology might be among the major value chain activities that a forensic laboratory undergoes. If so, then these four activities should be analyzed individually. For each activity, the strategist needs to address the following questions.

- Which links in that value chain can be called weaknesses? Can they be fixed?
- What are the closest upstream and downstream linkages to the activity under question?
- Are the linkages identified above partially responsible for deficiencies in the focal link? Is there a potential for synergies between the focal link and links with the other value chains? For example, can any links between the value chains of serology be combined into that of DNA analysis?

External Analysis

An environmental scan also includes the environment external to the lab. Major external forces to be scanned include economic, technological, political-legal, and sociocultural variables. Table 1 lists some of the relevant external variables in each of these categories.

While the above variables are used for purposes of illustration, each forensic laboratory faces its own set of external issues. External issues are opportunities or threats to the organization. Once the opportunities and threats have been identified, they need to be subjected to the following questions (Lederman 1984):

- What is the probability of occurrence?
- What is the probability of impact on the laboratory?

If the manager used a simple classification of high, medium, and low in the context of these two questions, then opportunities and threats graded as high in both probabilities should be given the utmost consideration going forward. Similarly, opportunities and threats scoring high/medium or medium/high to the two questions should also be identified as major issues and should be included in the strategic planning process.

Formulate Strategies

A commonly used tool in strategy formulation is the threat, opportunity, weakness, and strength (TOWS) matrix. Once a laboratory has identified the major issues it faces through environmental scanning, it can apply the TOWS matrix. To generate a TOWS matrix, refer to the graphic in Figure 3. From the internal portion of the environmental scan, the strategist lists the major strengths of the laboratory in the strengths (S) cell and lists the identified weaknesses in the weaknesses (W) cell. From the external environmental scan, the major opportunities are recorded in the opportunities (O) cell, with the threats (T) cell listing the major threats facing the laboratory.

The management team would then generate a host of strategies for the laboratory based on four possible strategy combinations from the TOWS matrix. SO strategies are created by brainstorming ways in which the laboratory can take advantage of opportunities using its identified strengths. WO strategies should consider exploiting opportunities while reducing weaknesses. ST strategies are generated in an effort to leverage a strength to minimize a threat. Finally, WT strategies simultaneously attempt to minimize weaknesses while avoiding threats. Once completed, all SO, WO, ST, and WT strate-

Table 1. Environmental Scan External Force Variables

Economic variables	Technological variables	Political-legal variables	Socio-cultural variables
• Unemployment levels • Wage controls • Availability of laboratory scientists, analysts, and technologists	• Industry spending on R&D • New analytical products • Productivity improvements through automation	• Legislative mandates • Government funding • Environmental protection laws • Laws on hiring and promotion	• Population growth • Employee health care • Crime rates

	STRENGTHS – S List strengths (5-10)	WEAKNESSES – W List weaknesses (5-10)
OPPORTUNITIES – O List opportunities (5-10)	SO STRATEGIES Use strengths to take advantage of opportunities	WO STRATEGIES Overcome weaknesses by taking advantage of opportunities
THREATS – T List threats (5-10)	ST STRATEGIES Use strengths to avoid threats	WT STRATEGIES Minimize weaknesses and avoid threats

Figure 3. The TOWS matrix.

gies should be listed as plausible strategies. In practice this list can become very lengthy. Therefore it is advisable to further brainstorm all plausible strategies with the intent of whittling the list down to a manageable few. This short list should contain only the most important—and viable—strategies critical to the lab's success. These selected strategies form the backbone of the lab's strategic plan.

The Centre of Forensic Sciences Case

The Centre of Forensic Sciences (CFS) laboratory in Toronto, Ontario, Canada, was among the initial participants in the FORESIGHT study. As detailed in Houck et al. (2009), the FORESIGHT participants guided the definitions and collection of data through a series of discussions (an environmental scan) of the internal and external influences on their ability to meet their missions. From a discussion of those concerns have come the initial FORESIGHT-spawned studies outlined above, which have been concentrated in the identification and decomposition of appropriate metrics to assess the strategy of the individual laboratories.

The Auditor General of Ontario conducts value-for-money-oriented audits of selected government activities and programs. In December 2007 the Auditor published a report (Auditor General of Ontario 2007) concerning its assessment as to whether CFS had adequate systems and procedures in place to "provide efficient timely and reliable services and measure and report on the effectiveness of its services in supporting the administration of justice in Ontario."

The auditor made a recommendation that CFS improve its strategic management processes, specifically:

> In order to better monitor and report on its financial and operational performance the CFS should:
>
> - Establish measures to monitor the cost-effectiveness of its operations;
> - Benchmark its performance against that of other laboratories

In the next two years CFS implemented a strategic management cycle that integrated annual operational goals and objectives with human resources and financial performance planning cycles.

The framework for the integrated planning cycles was an overarching long-term strategic plan that was aligned with government priorities. The CFS strategic plan articulated mission, vision, and values as a direction statement with three supporting goals and associated objectives underpinned by the stated values of the organization. The strategic goals related to the service delivery, the workforce, and strategic management process. The strategic management goal was: "To ensure the effective employment of resources in support of business objectives through the process of acquiring, allocating, controlling, and reporting on the use of fiscal and human resources." One of the supporting objectives was to establish measures to improve the monitoring and reporting of financial and operational performance.

Participation in the FORESIGHT study presented an opportunity that allowed CFS to respond to the recommendation of the auditor and as a result improve

its strategic management system. In his follow up report published in December 2009 (Auditor General of Ontario 2009), the Ontario Auditor General reported, "The Centre has made a substantial effort to update its systems and procedures to address our recommendations and increase its efficiency. Of particular note is the Centre's participation in a multi-jurisdictional performance-benchmark project."

The need for laboratory leaders to seek continuous improvements in the performance of their organizations has been highlighted in the literature (Speaker 2009a). The determination of metrics to be used as indictors of progress toward this objective presents significant challenges to the managers of forensic science laboratory operations. Speaker (2009a) articulated the value of an examination of the vision, mission, and values, and the goals of an organization to be a good start point in the quest for metrics that will enable the development of objective pointers towards success.

Following the initial FORESIGHT studies, the CFS engaged in a strategic management process in which the metrics from the 2008–2009 fiscal year were used as a baseline from which to assess performance in subsequent periods.[2] Following the decomposition of average cost in Speaker (2009b), the baseline metrics came from the following relationship.

$$\frac{Cost}{Case} = \frac{Average\ Compensation \times Testing\ Intensity}{Labor\ Productivity \times Labor\ Expense\ Ratio}$$

where

- Average compensation includes the wages, salaries, and benefits to the average laboratory employee;
- Testing intensity reflects the ratio of the tests performed to the cases processed;
- Labor productivity reflects the output per laboratory employee; and
- Labor expense ratio measures the percentage of total expenses used for employee compensation.

The CFS performance in the 2008-2009 fiscal year was distributed to the managers accountable for laboratory operations. This performance included detail on casework and expenditures with breakdowns by distribution of personnel in the laboratory. Prominent among the metrics were ratio measures within each investigative area with comparisons to the FORESIGHT study averages.[3] These ratio metrics included the return on investment metric (average cost per case), an efficiency metric (tests performed relative to the employees in the investigative area), a quality metric (tests performed per case), a proxy for analytical process (percentage of expenditures for personnel), and an economic market metric (average compensation).

CFS used the concepts of the value chain and also of the TOWS matrix in their internal analysis. The first step was to identify the value chains being performed by the lab. These chains were interpreted to be the division into investigative units as practiced by the laboratory prior to the strategic audit. Section managers were asked to review the value chain for each investigative area and contribute to the environmental scan and strategy formulation. Table 2 provides an annotated depiction of the TOWS matrix with more detailed description in the text that follows.

Identification of the relevant value chains and provision of performance metrics and benchmarks made the assessment of strengths and weaknesses a convenient process for the managers.

Weaknesses

Managers used a combination of an analysis of internal metrics and comparisons to benchmark averages in order to identify weaknesses in each investigative area. Areas in which to concentrate strategic efforts followed from the results of this analysis. A number of weaknesses came to light including the following examples: Analytical processes in toxicology ante-mortem and toxicology post-mortem were operating below capacity; toxicology post-mortem showed room for improvement in productivity and demonstrated an excessive level of testing intensity; ageing instrumentation (SEM) that was potentially costly to replace was identified in GSR; and DNA casework suffered from a high number of staff absences due to the current staffing profile combined with employment benefits that provide for maternity leave of absence of one year. It was also recognized that performance metrics in low-volume, high-expertise areas such as explosives and trace can be impacted dramatically by slight fluctuations in demand and allocation of staff resources.

Strengths

In a similar fashion to the derivation of weaknesses, the identification of strengths came from individual investigative units' self-analysis of internal metrics and comparisons to benchmark averages. These strengths include: an attractive living and work environment in Toronto; superior benefits; a youthful and highly educated scientific staff; an upward trend in productivity; improvements in the availability and accuracy of laboratory performance metrics; a budget to replace/upgrade technology; and a high standard for quality scientific investigations.

Table 2. CFS Threats, Opportunities, Weaknesses, and Strengths Matrix

	STRENGTHS – S • Quality Assurance • Compensation and Benefits • Scientific staff is young and highly educated • Low employee turnover • Upward trend in productivity • Data collection and monitoring	WEAKNESSES – W • Limited Cross training • Some aging equipment • Capacity utilization • Staff Absences • Several analytical processes with low productivity • Unfilled positions
OPPORTUNITIES – O • Federal Government funding initiatives • Technological advances • Funding for outsourcing Toxicology postmortem testing. • Growth in forensic management literature	SO STRATEGIES **(examples)** • Use Federal government funding for new equipment to meet increased demands on DNA testing due to changes to the CCC • Improve data quality to ensure accurate accounting of expenditures and casework output.	WO STRATEGIES **(examples)** • Use temporary funding for outsourcing testing of a historical backlog of Toxicology postmortem cases. • Improve cost per case and efficiency in Toxicology Ante Mortem through batching of same case type for processing and shifting case related duties.
THREATS – T • Government budget constraints • Privatization of services • Changes to the Criminal Code of Canada (CCC) • Redistribution of the demand for services across investigative areas • Declining demand for some services • Generation Y work expectations	ST STRATEGIES **(examples)** • Develop and implement new methods e.g. new combined drug assays in Toxicology. • Restructuring of operations in Toxicology Ante Mortem and Post Mortem and streamlining of testing processes.	WT STRATEGIES **(examples)** • Refurbish older SEM/EDX instruments to extend life without need for full replacement • Reduce Trace cost per case by using technologists rather than scientists for evidence collection

Opportunities

Turning the attention to factors outside the laboratory, the following opportunities were noted: additional funding from the federal government; technological advances across investigative areas especially toxicology and DNA; short-term outsourcing of toxicology post-mortem analysis to reduce a historical backlog; and the growth in forensic management literature.

Threats

As with opportunities, the threats are similar to the issues faced by other forensic laboratories including: widespread government budget constraints as a response to the global economic downturn; consideration of alternative models to privatize services; the so-called "CSI effect" and the increase in demand for forensic services without corresponding increases in budgets; a redistribution of the demand for services across investigative areas; and the work expectations of Generation Y. Most notably in 2008, new legislation had come into force changing the Criminal Code of Canada. These changes created the potential for law enforcement to increase demands for scientific testing in toxicology ante-mortem (impaired driving by drugs offenses) and DNA casework (offenses investigated through the use of the National DNA Data Bank).

TOWS Matrix Application

The above listed strengths, weaknesses, opportunities, and threats become input for the TOWS matrix as shown in Table 2.

SO Strategies

The SO strategies were created by brainstorming ways in which the laboratory can take advantage of opportunities using its identified strengths. Comparing the strengths to the opportunities, CFS developed SO strategic initiatives in several investigative areas. Examples developed in the investigative area of DNA casework are shown in Table 2. Strategies included the use of federal government funding to acquire new equipment to meet increased demands on DNA testing due to changes in the Criminal Code of Canada. Another strategy was to continue to improve data accuracy and develop a strategy to address unusual productivity and costing numbers in the DNA casework investigative area. This included the need to improve staff performance management and the identification and mitigation of any delayed cases in the system.

ST Strategies

The ST strategies represent opportunities to address the threats by taking advantage of significant strengths. Examples of strategies in both of the toxicology investigative areas are shown in Table 2. One strategy was to leverage staff expertise to develop and implement new methods (e.g., new combined drug assays) that would improve return on investment through increased productivity. Toxicology operations were also restructured to improve performance management and to streamline testing processes. The objective of this strategy was to improve efficiencies by reviewing the value chain quality measure of testing intensity. The elimination of unnecessary testing in the toxicology post-mortem investigative area would mitigate the anticipated increase in testing intensity that would be required in the analysis of new drug-impaired driving cases in toxicology ante-mortem investigative area.

WO Strategies

The WO strategies make use of opportunities in order to address the weaknesses. Examples of strategies in both of the toxicology investigative areas are shown in Table 2. The opportunity for short-term funding to outsource toxicology post-mortem cases to reduce a historical backlog was used as a strategy to allow toxicology management to address weaknesses in analytical processes with low productivity. To improve the cost per case and efficiency in the toxicology ante-mortem investigative area, some case-related duties were shifted from higher to lower paid staff and a new method of batch processing similar cases was implemented.

WT Strategies

The WT strategies address the weaknesses that have been identified in order to position the laboratory to avoid the threats. Examples of strategies identified in the investigative areas of GSR and trace evidence are shown in Table 2. To maintain the return on investment in the investigative area of GSR refurbishment of the aging SEM was preferred over replacement. This controlled capital investment costs in an area where technology is operating below capacity. The weakness of a lack of cross training and underutilized capacity in the trace investigative area was addressed by training technologists rather than scientists for evidence collection in cases such as paint/glass hairs/fibers. This would have the net effect of reducing costs per case by reducing labor costs associated with the use of higher paid scientists.

Table 3. Two-Year Percentage Change in Toxicology Investigative Areas Following CFS Strategic Initiatives

Measure	Metric	Toxicology ante mortem	Toxicology post mortem
ROI	Δ Cost/Case	2.02%	−11.98%
Demand	Δ Cases	−4.6%	4.6%
Demand	Δ Items	5.5%	−33.5%
Productivity	Δ Cases/FTE	6.6%	16%
Productivity	Δ Tests/FTE	87%	−21%
Testing Intensity	Δ Tests/Case	75%	−30.42%
Labor	Δ Staff FTE/area	−9%	−9%
Labor expense ratio	Δ Capital Expense/Total Expense	49.54%	40.13%
Turnaround time	Δ Median TAT	−51%	−52%

CFS began to make its changes as suggested by these and other strategies and experienced some meaningful results by the end of the first year and stability in the changes by the end of the second year. Improvements were realized most quickly in the investigative areas of toxicology ante-mortem and toxicology post-mortem. Table 3 illustrates the rate of change in demand (casework inputs) and productivity outputs and the allocation of resources required such as full-time equivalent (FTE) staff and expenditures.

In the toxicology ante-mortem investigative area, the average cost per case increased (5%). However, the return on this modest increase was a 51% decrease in the median turnaround time required to complete the analysis required and to produce a report. Productivity improved by a 6.6% increase in the number of cases per person and an 87% increase in the number of tests per person. The improvement in the tests per person measure was important for the impaired driving by drugs cases where testing for a wide range of drugs is needed. The increase in cost per case was also due in part to increases in the investment in capital as a contribution to the higher cost. In the toxicology post-mortem investigative area, the average cost per case decreased by almost 12%. Changing processes had a significant impact by reducing testing intensity (tests/case) by over 30% and productivity (cases/FTE) increased by 16%. Most importantly for the customer was the 52% decrease in the median turnaround time required to complete the analysis required and to produce a report.

For many of the successful strategies, the improvement in the return on investment had a positive influence through the strategies that improved the productivity of laboratory personnel (i.e., more tests performed per person or more cases processed).

Concluding Comments

Global recession has forced governments around the world to reassess the provision of all public sector services, and forensic science laboratories are not immune from such scrutiny. Fortunately, the last decade has seen growing attention to the business of forensic science and that attention has begun to offer insight as to how a laboratory may meet its mission without sacrificing quality. Past research has offered the adaptation of base business tools and techniques for use by forensic laboratories, and this paper suggests ways to envelope a wide range of tools into a unified process. The initial adoption of a strategic management process will enable a laboratory to set the stage for continual improvement. The combination of these basic management tools with the data being generated industry wide will enable a laboratory to manage that process from production through quality assurance and budget allocation. And, as seen through the experience of the Centre of Forensic Sciences, the sharing of experiences offers a critical addition to the establishment of best practices.

Endnotes

1. As noted in its mission statement, "FORESIGHT is a business-guided self-evaluation of forensic science laboratories across North America. The participating laboratories represent local, regional, state, and federal agencies … The process involved standardizing definitions for metrics to evaluate work processes, linking financial information to work tasks and functions. Laboratory managers can use these functions to assess resource allocations, efficiencies, and value of services—the mission is to measure, preserve what works, and change what does not."
2. The metrics follow Speaker (2009b), where the objective of the laboratory is assumed to be to process as many cases in each investigative area as the budget permits. That objective translates into a minimization of the cost per case. Cost per case may be decomposed into a series of four ratios that help to explain performance. These ratios provide indications of quality, efficiency, analytical process, and local economic market conditions.
3. CFS has more investigative areas than described in the FORESIGHT study. Data across areas was grouped according to the FORESIGHT study to take advantage of the benchmarking benefits from the study. This enabled a review of investigative areas in common including: blood alcohol, DNA casework, document examination (including handwriting), explosives, fire analysis, firearms and ballistics, gun shot residue (GSR), marks and impressions, toxicology ante-mortem, toxicology post-mortem, and trace evidence (including hairs and fibers,

and paint and glass). Discussion has been limited to a subset of possible areas to highlight the connection to strategic management.

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