



DO YOU THINK? OR DO YOU KNOW?

Improving State Government Operations Through Business Analytics

INFORMATION OVERLOAD – THREATS AND OPPORTUNITIES

It is no surprise that the amount and diversity of data that is collected by state government continues to grow. As large enterprises, state government organizations reflect the global trends in data growth. IBM estimates that worldwide data volumes are doubling every two years.¹ State government is already challenged with the nominal growth in data because of new programs, program expansion, citizen demands, regulations and legislative mandates. It is anticipated that traditional structured data volumes will grow. However, the advent of new data streams and types of data can be expected to far surpass early estimates in nominal data growth. Some of the contributing factors include:

- The growth of “born digital” content and reliance on email for conducting the business of government
- Legislation calling for more performance measurement, metrics tracking, and more information sharing
- The drive and demand for greater government transparency including the collection and reporting of new types of data (e.g., *ARRA of 2009, section 1512*)
- The growing ubiquity of digital surveillance within public safety
- The burgeoning number of sensors and automated devices with data feeds
- More mobile devices such as personal digital assistants (PDAs)
- More geospatially enabled devices and the need track and store *movement* data
- Expanding volumes of Large Objects (LOBs) such as videos, images, audio²

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NASCIO
Series on
Analytics

 **ThinkQuake**

"A major driver of the looming *ThinkQuake* is the existence and innovative use of information management tools for business intelligence and advanced analytics, which provide the ability to evaluate data and information in more detail than ever before. With these tools, organizations can not only rethink the ways they think, but they can also take control and rethink the ways they lead."

Thorton May, *The New Know*³

The organizational threats from information overload are real and the challenges considerable. The framing of policy and legislation that results in the creation of more data, more metrics, and more kinds of data will need to include consideration of the cost of data quality, records management and preservation, and the necessary *analytics* to exploit that data. State government must anticipate and plan for this "data explosion" and the necessary capabilities to harvest meaningful value from this data in order to deliver effective services and operate as efficiently as possible. With growing state government capabilities in analytics, *gone will be the days of linear thinking, and straight line budget management*. In future, *analytics* will provide the necessary knowledge to enable government policy makers and operational executives to make the right "cuts" and the right investments depending on the relevant environmental circumstances – both during economic crisis and during times of prosperity.

BUSINESS ANALYTICS AND FACT BASED DECISION MAKING

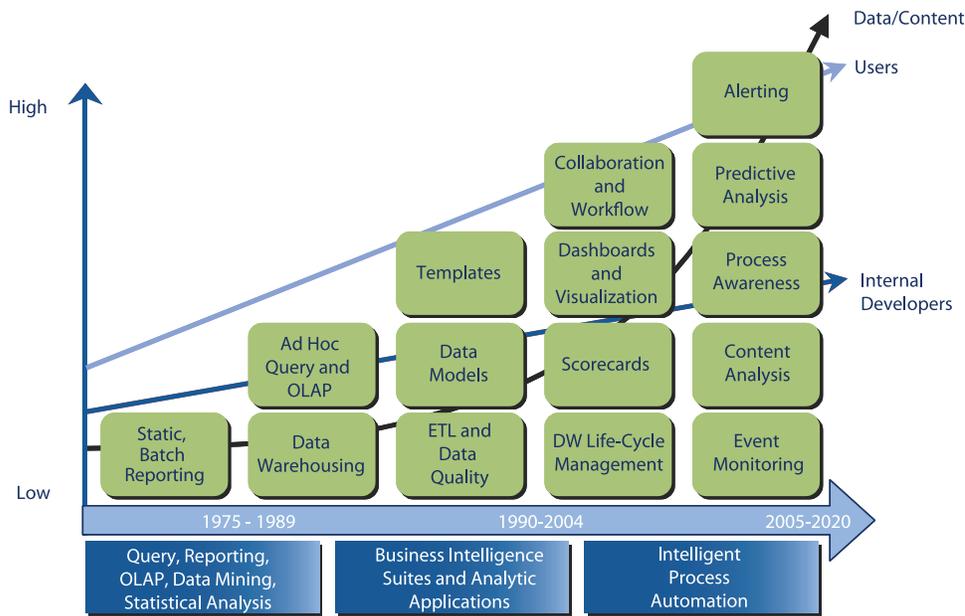
State government runs on information. Information assets are highly valued enterprise assets. As such, this resource must be properly managed through appropriate governance.⁴ One of the major challenges in governance of this resource is dealing with the continued growing volume of data, and how to sort out what data is most valuable in delivering efficient, high quality government services. The amount of data, the various media and types of data, and the sources of data is continually proliferating. From sensory technology within transportation⁵ and environmental to email and social networks, the quantity and content of government information is ballooning. State government needs the means for managing this data in order to derive valuable information for ensuring: government services operate efficiently and effectively; fraud, waste, and abuse are detected and eliminated; government is able to anticipate future demands and opportunities. Typically state government is underinvested in business analytics capabilities.

This issue brief is an introduction to the broad and compelling subject of business intelligence, business analytics and performance management. Another term that can be used and may come into vogue within state government is *government analytics* to describe the application of analytics within government. Other terms that are used frequently include analytics, business analytics, and predictive analytics. Bottom line – government is moving toward more sophistication in the process for creating understanding, reaching conclusions, and making decisions.

The growth in the creation and availability of data and information is unprecedented. Parallel to this trend is a growing appetite for harvesting this data and information in order to improve operations and business processes, develop more integration across the government enterprise, improve decision making and *accurately predict the future*.⁶

There is a strong increasing trend in *fact based decision making* in all sectors of the economy as evidenced by the growing market for enabling methods and technologies.⁷ Business analytics has moved from the risk management specialties to organization wide adoption. One example of this is *predictive policing*. The City of Richmond, Virginia, Police Department (RPD) employs data mining, GIS, and executive dashboards. Analytics are applied to historical and real time data to predict where to assign officers.⁸ *The results?* Richmond experienced significant reductions in crime and it went from number 5 in 2004 to number 38 in 2006 on the national ranking of the most dangerous cities.⁹

FIGURE 1: BUSINESS INTELLIGENCE AND ANALYTICS MARKET TRENDS



Source: IDC, 2009

IDC provides a graphical representation to describe the historical perspective and growing demand for analytics capabilities.¹³

This trending of *business intelligence and business analytics (BI/BA)* capabilities illustrates that the demand is increasing in terms of broad adoption of more sophisticated techniques and tools for analyzing data and predicting the future.

Analytics can be described as follows:

Analytics is the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions. Analytics may be input for human decisions or may drive fully automated decisions. Analytics are a subset of business intelligence – a set of technologies and processes that use data to understand and analyze business performance.

Analytics are the higher value and more proactive aspect of *business intelligence*.¹⁴

Justice – Predictive Policing

The Arizona state legislature employed predictive analytics to evaluate new mandatory sentencing for DUI cases *before* enacting the change into law. The analysis demonstrated that the courts and local jails would not have the capacity to accommodate the increased processing and caseload. This was a case where predictive analytics were applied to evaluate and report the operational impact of proposed new legislation. Subsequently, the legislation was *not* enacted.¹⁰

NYPD proved that data-driven police tactics can produce dramatic reductions in crime rates. With its Crime Information Warehouse, it is proving that integrated crime data, delivered in real time, can improve law enforcement even more. Predictive policing provides the ability to see trends as they form—instead of in the *rearview mirror* reactive operations. It provides the ability to see relationships among multiple observations and helps to break cases faster. It is the ability to make life-saving decisions by seeing the big picture. New York employs the CompStat program which has been widely reported and highlighted as an example of data analytics. These programs use analytics including GIS to predict where to position officers and other resources to *intercept crime before it happens*.^{11,12}



Tax Revenue Collection - The California Franchise Tax Board (FTB)

The FTB processes more than 15 million state and corporate income tax returns and collects \$60 billion annually. The FTB estimates that there is \$6.5 billion in unpaid taxes. FTB initiated its *Business Problem Analysis* in order to improve its services and to help identify and collect these unpaid taxes. The financial benefits from this enterprise solution are significant – estimated to range from \$20 to over \$120 million annually in increased revenue to the state due to a higher level of compliance.¹⁵

WHY INVEST NOW? *TIMING*

Why is business analytics (or *government analytics*) so ripe for harvesting now? One reason is that the necessary data management capabilities have come into use that *enable* analytics. There are new technologies, data management standards, national standards such as the National Information Exchange Model (NIEM)¹⁶ for sharing information across the enterprise, capabilities for storing more data, and modeling and optimization sciences that make it possible to implement enterprise wide analytics initiatives.¹⁷ Use of business analytics has always been necessary. However, proper use of analytics requires access to available high quality data for analysis. There are optional approaches available that include extensive and sophisticated data warehouses, and alternatives such as the use of *data mashups* that don't require a data warehouse.¹⁸ Both approaches have merit under the right circumstances. Careful examination of outcomes sought, business requirements, and the capabilities and limitations of current IT investment will determine what approaches are most appropriate.

Another reason for the new emphasis on business analytics is the current global economic, social, and environmental *connectivity* that exists today. Atmospheric changes in air quality in China affect air quality in California. Economic stresses in any region of the world affect the economies of the rest of the globe. There is *more* competition and *more intense* competition. The *commoditization* of labor and skills is playing havoc with traditional business models. With business failures, manufacturing slow downs, the loss of jobs, and decreasing property values, there is inevitably a loss of the tax revenues that finance government and government services.

State government is facing ongoing fiscal crisis that requires the ability to predict demand for services and an understanding of the effectiveness of government programs. Cost cutting mandates intended to achieve balanced budgets are resulting in across-the-board budget cuts. *But are these the right cuts?* As funding decreases, demand for programs, and program performance must be understood so state government knows where it *should* and *can* cut budgets, and where it *should* invest. Intuition alone is not enough to make the necessary strategic decisions required in today's state government. *Fact based decision making* must be employed. And, fact based decision making requires quality data and careful analysis of that data in order to understand current circumstances and predict future circumstances.

Analytics will provide the process for determining what programs are most effective, cost efficient, and needed most during a crisis. Programs can be evaluated and prioritized to achieve *highly targeted* and *effective cuts* initially.¹⁹ Without this kind of rationale, it will be difficult to understand the impact of budget cuts on service level agreements, contracts, and most important, government services.²⁰ In fact, cost cutting is one of the drivers for acquiring capabilities in analytics *with one change* – that is to uncover the most appropriate cost-cutting opportunities.

BUSINESS ANALYTICS VERSUS BUSINESS INTELLIGENCE – WHAT’S THE DIFFERENCE?

These terms refer to different but related concepts. Yet they are often used interchangeably.

Computerworld conducted a survey in 2008 on the subject of *business analytics*.²¹ The goal of this survey was to gain an understanding of how business and information technology professionals define and think about *business analytics*, and the associated enabling software implementations.

Most respondents to that survey think of business intelligence applications when they hear the term *business analytics*. This report makes the point that business intelligence is a key element of an enterprise strategic BI/BA framework. However, *business analytics* goes beyond *business intelligence* as a next step that includes not only historical analysis, but *predictive analysis*, and *fact-based decision making*. Business analytics seeks to uncover *insights* and provide understanding *quickly*.²²

Business Intelligence

Business intelligence has been described in the literature as the *larger universe*. Davenport and Harris define business intelligence as incorporating the collection, management, and reporting of decision making data as well as the analytical techniques and computing approaches that are performed on data.²³

The following are working definitions for *business intelligence* (BI):

DEFINITION - Business intelligence (BI) is a broad category of applications and technologies for gathering, storing, analyzing, and providing access to data to help enterprise users make better business decisions. BI applications include the activities of decision support systems, query and reporting, online analytical processing (OLAP), statistical analysis, forecasting, and data mining.²⁴

DEFINITION - The process by which an organization manages large amounts of data, extracting pertinent information, and turning that information into knowledge upon which actions can be taken.²⁵

Business Analytics

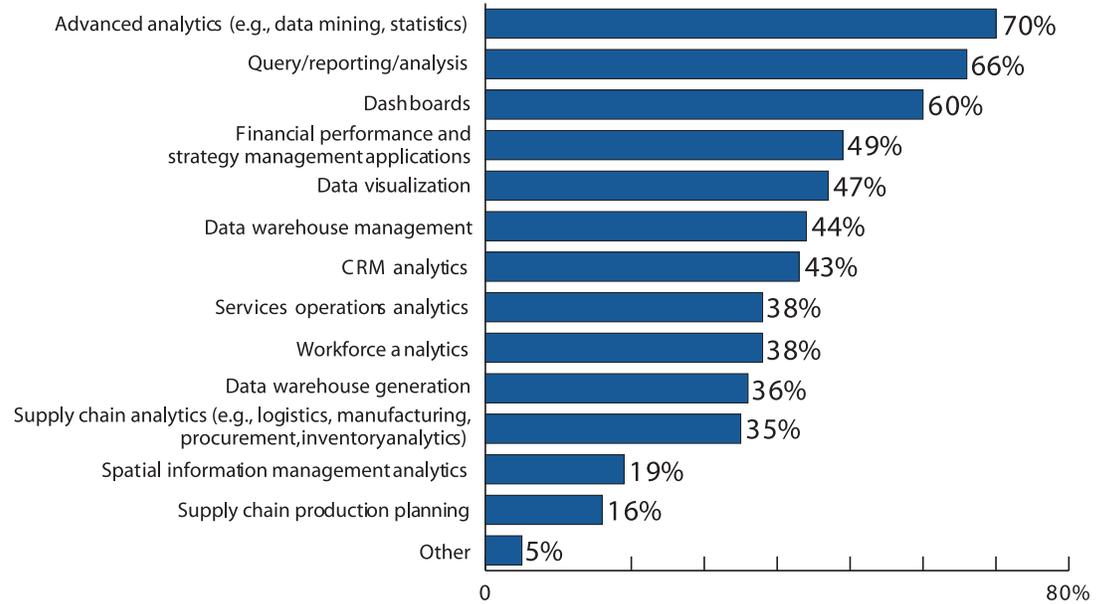
Business analytics is defined by Davenport and Harris as the extensive *use of data*.²⁶

DEFINITION: Analytics is the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions.²⁷

Business analytics can be thought of as the “beyond business intelligence” or a subset of *business intelligence* to describe *what is done with information*. This includes the manipulation, visualization, statistical analysis, trending, and correlation analysis that are applied to data.

According to the *Computerworld* survey cited earlier, respondents listed the following tools as part of *business analytics*. And these are the kinds of tools government will be calling upon the state CIO and their agency business partners to evaluate and implement.²⁸

FIGURE 2: WHICH OF THE FOLLOWING SOFTWARE TOOLS DO YOU CONSIDER PART OF BUSINESS ANALYTICS?



Source: Computerworld, 2009

Note: Multiple responses allowed.

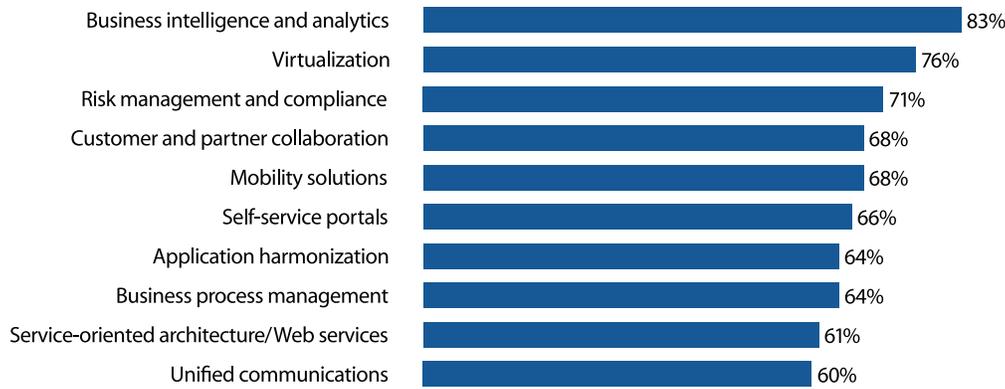
Business analytics and business intelligence are considered by most of the respondents to be a combined responsibility of IT and the business (73%). This emphasizes the need for the business and IT to work together in developing and sustaining *analytics capabilities*.

How important are business analytics and business intelligence? Business Intelligence (BI) and analytics applications are on the *NASCIO Top Ten Priorities* for state CIOs for 2009 and again in 2010.²⁹ Gartner's 2009 survey of CIO priorities places the use of BI technologies as the No. 1 technology priority.³⁰ Business intelligence, analytics and program management initiatives have been the top technology for CIOs in Gartner's CIO survey since 2006.³¹ As reported in IBM's groundbreaking survey of 2,500 CIOs worldwide, business intelligence and analytics are a component of the visionary plans for 83% of the respondents.³²

"We are in a historic moment of horse-versus-locomotive competition, where intuition and experiential expertise is losing out time and time again to *number crunching*."³³ *Ian Ayres, author of Super Crunchers*

Business intelligence and advanced analytics are presented on Gartner's hype cycle as moving up the "Slope of Enlightenment."³⁴ These capabilities are expected to provide a high level of benefit and will reach mainstream adoption in the next 2 to 5 years. Advancing and adopting business intelligence and business analytics should be considered a *multi-year initiative*. It is important to start with highly focused initiatives that have a limited scope, and then to build upon these successes over time. It will take time, a lot of communications, and marketing to move the culture toward *fact-based* thinking across the enterprise. *And that is one of the outcomes sought*. That is, *fact-based* thinking and decision making that is ubiquitous throughout the enterprise and at all levels.³⁵

FIGURE 3: CIOs HAVE VISIONARY PLANS



Source: IBM survey of 2,500 CIO worldwide

Note: CIOs were asked to select all applicable answers to the question, “What kind of visionary plans do you have for enhanced competitiveness?”

THE STRENGTH OF BUSINESS ANALYTICS

One of the simpler reasons business analytics wins over intuition is that analytics are more effective at *applying appropriate weighting* to the individual factors for predicting outcomes. Even very simple correlations have proven to out perform human intuition.³⁷

*In 2003, IDC released the results of a study titled “The Financial Impact of Business Analytics” that evaluated the ROI of business analytics projects at 43 leading organizations in North America and Western Europe. Each of the resulting case studies was accompanied by in-depth ROI calculations, which showed, for the group as a whole, a median ROI of 112%. Notably, the median ROI for projects that IDC classified as incorporating predictive analytics was 145% versus 89% for those projects that did not.*³⁸

The point is made in the above cited IDC article that business process improvement is certainly a benefit to be achieved. 96% of the ROIs achieved were directly attributed to business process improvement and business process enhancement. However, the real gold mine is in *business process enhancement* through the use of *predictive analytics*. That is, the move to a new level of outcomes. Business process improvements entail the use of continual improvement processes or CIPs, and utilize non-predictive analytics, whereas *business process enhancement* is all about doing new kinds of activities and decisions based on *predictive analytics*. Business process improvements have a diminishing rate of returns. However, business process enhancements have no end point. Examples of business process enhancements include new operational decisions related to fraud detection, and customer behavior.

The market for business analytics software has grown to a \$22 billion market in 2007 reflecting the growing adoption.³⁹ In the commercial sector, companies that use advanced analytics effectively experience higher financial performance with profit margins in the range of 19 to 73 percent higher than companies that don’t effectively use advanced analytics.⁴⁰

There is a progressively increasing sophistication in employing analytics. It is at the higher iterations where greater value is harvested. This progression up to advanced analytics is presented here.⁴¹

* Workforce Planning

The state of North Carolina is experiencing incredible growth in its population. In parallel with this growth and anticipated demand for state government services, the state is looking at the demographics of its workforce - *with concern*. The North Carolina Office of State Personnel (NCOSP) anticipates that 10 percent of its workforce will be eligible for retirement by 2010, and 38 percent will be eligible by 2015. The challenge is to ensure the state has access to the necessary talent pools so that it has the human capital it will need in the future. NCOSP implemented NC WORKS - a data warehouse and business intelligence applications that allow the state to conduct predictive analytics regarding talent needs. The analytics employed assist in analyzing employee data, retirement plans, and anticipated attribution within a central data warehouse. NC WORKS helps the state to proactively respond to workforce needs.

“The real power of the NC WORKS system is the predictive modeling and forecasting capability it provides,” states Thomas Write, State Personnel Director.³⁶

FIGURE 4: PROGRESSIVE SOPHISTICATION IN THE USE OF ANALYTICS



Source: Deloitte Consulting LLP

RECOMMENDATIONS

States are examining business intelligence and business analytics on an enterprise level. Enterprise wide initiatives are fairly early, but are increasingly part of the conversations CIOs are having with policy makers and decision makers. As state government begins to shape programs and management initiatives it is important that the strategic intent of these business intelligence / business analytics (BI/BA) programs is clearly articulated. There must be a *specific business purpose* that drives the creation of BI/BA initiatives.

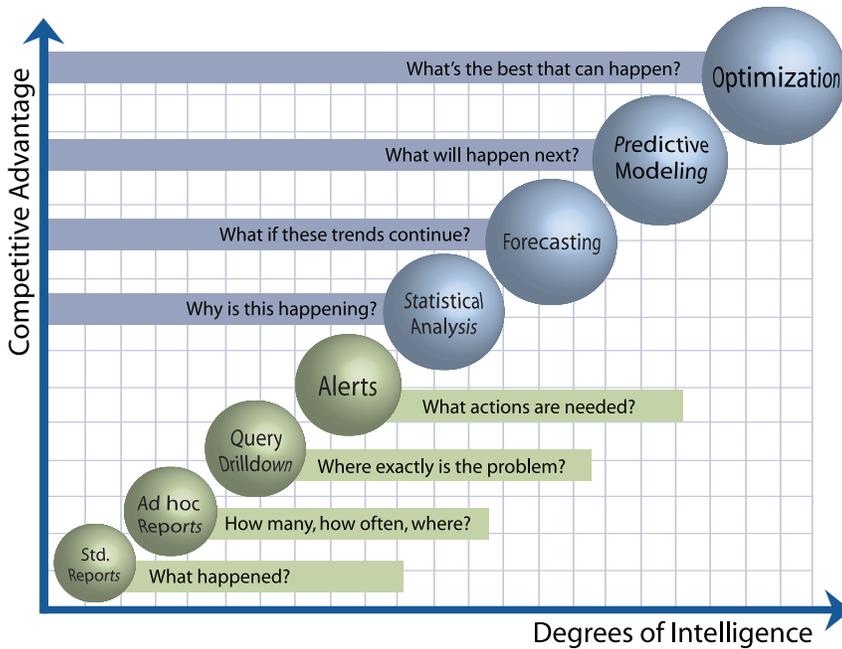
It is also important to understand state government *should not* begin a BI/BA initiative by purchasing tools. BI/BA *tools* are *enablers* of BI/BA. In exploring and eventually establishing the “intent” of a BI/BA capability, identification of the types and level of sophistication of tools will be developed. If tools are purchased first, then the capabilities of the tools will drive what comprises the BI/BA initiative.

The Role of the CIO

The demand on state CIOs is to provide *the data and the information* decision makers need, and *the analytical tools* to manipulate the data, evaluate options, and make the best fact based decision possible. The decision maker may conclude that not all information is currently available to execute on a final decision or strategy, and will have assembled a portfolio of potential actions while awaiting further information, or the outcome of other related events in progress. The CIO plays an important role as advisor in this process.

The services and expertise of the state CIO is in demand to provide the capabilities in business intelligence and business analytics. Government analytics includes statistical analysis, correlation analysis, neural networks, optimization tools, data manipulation and exploration approaches, visualization techniques, and of course geographical information systems (GIS).⁴⁶ The

FIGURE 5: SAS DESCRIPTION OF THE PROGRESSION IN ANALYTICS



Source: SAS

CIO is positioned to pull together the necessary collaborative relationships to research, evaluate and recommend how to assemble the necessary capabilities to create expertise in business intelligence and business analytics. First and foremost, before analytics can be applied, there must exist the foundational data, information and intelligence that will be analyzed. That foundation must be reliable, timely, accurate, and secure.⁴⁷ Thus, the first step in achieving a level of capability in business analytics requires strong and effective data governance. That foundation is often achieved through the development of an enterprise data warehouse. Another approach is through the use of data mashups. The CIO can ensure that the appropriate foundational enablers are in place in the proper sequence.

The employment of government analytics is not a step function. Rather it is a gradual adoption and growth in sophistication. During this growth and maturation, the culture of the enterprise must be brought along gradually but deliberately to ensure effective adoption and employment of analysis, fact based decision making, and predictive analytics. The graphic presented from SAS provides an excellent description of this process of maturation.⁴⁸

As the enterprise migrates toward more and more fact based decision making, decision making can and should be pushed down as far as appropriate. This requires the development of government analytics capabilities in government employees through ongoing professional development.⁴⁹

The CIO is in a unique position to be an evangelist, promoter, and communicator of business analytics. In this role the CIO can help set expectations at each stage of the journey and ensure expectations of decision makers are in line with where the enterprise is on the maturity curve.

*** Healthcare**

As fact based decision making gains momentum, be prepared to answer questions like, "where's your data?"; "what's your intell?"; "your choice is based on what analysis?" This includes the medical clinic. Physicians have been facing highly informed patients for some time now. Patients are asking their care givers to back up what they are prescribing. And that will require evidence, statistics, and clinical epidemiology that drive *evidence based medicine*. The examination room is empowered by the web to provide a virtual library to care givers.⁴² Providers of data who have historically served physicians and epidemiologists are providing consumer health journals and websites. The National Library of Medicine and the National Institutes of Health provide an online consumer website for consumers to research health issues, diagnosis, disease cause and effects, and treatment options.⁴³

The state of New York is leveraging analytics and predictive modeling services to help manage the cost and quality of healthcare to Medicaid members. This initiative will improve health outcomes, identify healthcare services that are duplicative or outside evidenced based practice guidelines, help the state better utilize its healthcare resources, and lessen the burden of Medicaid spending on the state budget.⁴⁴

Disease Surveillance

The New York City Department of Public Health utilizes analytics to create robust surveillance and health-care monitoring in order to identify potential health threats and the impact on city residents. There is an identified need for government capabilities that provide for the detection of disease outbreaks and emerging infectious diseases. The capability sought is early detection and diagnosis, and real time surveillance. Surveillance can be deployed at the city, county, state, national and global levels. Surveillance dash boards are now employed in state and local government to conduct rapid data analysis, predict disease incidence, and prepare to respond and/or prevent. Predictive analysis will uncover anticipated disease outbreaks. Related communication capabilities will be used to alert first responders and hospitals so they can prepare to respond. Similar approaches have been employed by the State of Missouri, and the City of Houston.⁴⁵

Adoption of “fact based” decision making that relies on business analytics and advanced analytics requires an effective message that reaches the entire state government enterprise. A marketing and communication plan must be created that is relevant to state government and the issues and challenges that state government workers are facing. Adoption requires that *leaders are convinced* and are *able to effectively evangelize* across their organizations. Effective leadership does not require leaders to understand all of the applied statistical and analytical methods employed, but it does require that leaders are convinced of the value of analytics and the results that can be obtained through effective application of those analytics.⁵⁰

What the State CIO can do Now

- Assess the current utilization and deployment of BI/BA within state government. Determine the current ASIS relative to investment, including projects, tools, training, and effective usage. Evaluate the strengths and weaknesses of current capabilities, and identify opportunities for effectively leveraging BI/BA. Early targets of opportunity should be carefully scoped to build experience and effective utilization. Early success will help build the business case for future investments. Create a portfolio of BI/BA projects. The portfolio of investments must then be evaluated and prioritized.⁵¹
- Use the current fiscal stress in the states to drive the conversation regarding the need for BI/BA. The fiscal benefits could be enormous.
- Outline and define an enterprise direction and investment strategy for BI/BA. See the *NASCIO Enterprise Architecture Value Chain*.⁵² BI/BA will assist in understanding the environmental context (*the first chevron in the value chain*); in evaluating needs and opportunities (*second chevron*); provide the evidence for establishing strategy (*third chevron*); and help comprise the capabilities for carrying out enterprise strategies (*fourth chevron*). Business intelligence and analytics capabilities must be managed within the umbrella of state government enterprise architecture. For example: Business architecture will drive the intent of BI/BA and will demonstrate the touchpoints of BI/BA within state government business processes; data architecture will drive the intent and implementation of the data strategies that provision BI/BA capabilities.
- Negotiate enterprise relationships and contracts with suppliers of analytics expertise and tools to ensure BI/BA investments are aligned with the state’s enterprise architectural direction. This will enable an enterprise approach to analytics and help avoid point solutions, stovepipes, and multiple redundant solutions. An enterprise approach will also facilitate cross enterprise collaboration and idea sharing in the use of analytics going forward.
- Work with government business executives to identify their greatest challenges in delivering government services. Identify barriers and challenges to understanding and rationalizing the plethora of data they collect in its multiple forms. Explore the subjects of business intelligence and business analytics with business partners to determine the readiness to adopt “fact based decision making.” Anticipate a journey that may begin with basic performance metrics but that will continue to evolve. Many significant advancements and efficiencies can be gained through

simple data matching relationships such as *data offsets* to detect fraud, abuse and simple errors – *e.g., citizens applying for professional licenses matched with defaulters on student loans; recipients of social security benefits with death certificates.*⁵³

- Seek opportunities to share best practices and innovations internally from state agencies that are already using BI/BA techniques and tools.
- Prepare your organization to be able to assist and support the use of analytics under the auspices of the American Recovery and Reinvestment Act (ARRA). Anticipate what performance monitoring established under ARRA will continue to provide value *beyond ARRA*.
- Partner with individual agencies to evaluate how to integrate BI/BA into ongoing, real time decision making, and executive decision support. *e.g., Work with your department of education in evaluating, and employing dynamic analytics. These analytics will not only contribute to P-20 longitudinal studies, but will also provide necessary triggers for making course corrections throughout the educational process. Scrutinize and evaluate the metrics employed and understand the relationships among these metrics.*
- Stay tuned to NASCIO research and forums on this subject. NASCIO forums will present what other states and local government are doing in this area. Leverage the learnings from other state CIOs.

APPENDIX A – ACKNOWLEDGEMENTS

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APPENDIX B – RESOURCES

NASCIO Publications

www.nascio.org/publications

Data Transparency

A Call to Action for State Government: Guidance for Opening the Doors to State Data

Data Governance

Data Governance - Managing Information As An Enterprise Asset: Part I - An Introduction

Data Governance Part II: Maturity Models – A Path to Progress

Data Governance Part III: Frameworks – Structure for Organizing Complexity

Governance of Geospatial Resources: “Where’s the Data? Show Me” - Maximizing the Investment in State Geospatial Resources

Security

At Risk! Securing Government in a Digital World

Resource Guide for State Cyber Security Awareness, Education, and Training Initiatives

Best Practices

2009 Best Practices in the Use of Information Technology in State Government Booklet

State Priorities

State CIO’s Top Ten Policy and Technology Priorities for 2010

DAMA International

<http://www.dama.org/i4a/pages/index.cfm?pageid=1>

- *Data Management Body of Knowledge*
- *Dictionary of Data Management*

Case Studies in the Use of Business Analytics

ESRI

<http://www.esri.com/industries.html>

IBM Cognos

http://www-01.ibm.com/software/success/cssdb.nsf/CategoryL1ViewFM?ReadForm&Site=cognos_industryL1VW&cty=en_us

Information Builders

http://www.informationbuilders.com/applications/industry_specific.php#Government/Public%20Sector

SAS

<http://www.sas.com/success/indexByIndustry.html#0300.0000.0000>

White Papers and Libraries

Oracle Enterprise Performance Management & Business Intelligence Whitepapers

http://www.oracle.com/solutions/business_intelligence/resource-library-whitepapers.html

National Information Exchange Model

www.niem.gov

Global Justice Information Sharing Initiative

<http://it.ojp.gov/global>

Global Justice Reference Architecture for SOA (JRA)

<http://it.ojp.gov/default.aspx?area=globalJustice&page=1148>

The Global Federated Identity and Privilege Management (GFIPM) Initiative

<http://it.ojp.gov/default.aspx?area=globalJustice&page=1149>

Curriculum in Analytics

North Carolina State University Institute for Advanced Analytics

http://analytics.ncsu.edu/?page_id=123

The Data Warehouse Institute Certification in Business Analytics

<http://www.tdwi.org/Certification/CBIP/display.aspx?id=7151>

APPENDIX C - ENDNOTES

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- ⁵ "Highway Traffic Monitoring," Transportation Research Board, retrieved on December 8, 2009, from www.trb.org/publications/millennium/00052.pdf.
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- ⁸ The Computerworld Honors Program, *Honoring those who use Information Technology to benefit society*. City of Richmond Police Department – Predictive Analysis. Retrieved on December 2, 2009, from <http://www.cwhonors.org/viewCaseStudy.asp?NominationID=303>. See further articles on this award winning application at http://www.informationbuilders.com/applications/industry_specific.php#Government/Public%20Sector.
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