Recommendations on Advancing the Economic Competitiveness of
Data Analytics and Computing
in Arkansas

Prepared by

Blue Ribbon Commission, Co-Chaired by:

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Report to the Governor from the Blue-Ribbon Commission on the Economic Competitiveness of Data Analytics and Computing in Arkansas

On behalf of the Co-Chairs and the Commission members, the following report communicates the conclusions and recommendations of the Commission, which was charged by Governor Hutchinson to provide guidance to the State on the needs of the business community regarding data analytics and computing. The Commission's report establishes that Arkansas cannot afford to sit idly by as data analytics and computing transforms the way businesses and government will compete in the 21st century.

This report is a result of an unprecedented collaboration between the private and the public sector. The opportunity to succeed is enhanced as great Arkansas companies, working in conjunction with the State, joined together in propelling Arkansas to the lead in this important business transformational effort. The following recommendations do not reflect incremental steps toward a long-term goal; instead this report outlines a very aggressive plan to establish a leadership role for Arkansas in a public and private partnership.

Listing of Commission Members

Charles Morgan, Co-Chair
CEO, First Orion Corporation

Mike Preston, Co-Chair
Executive Director, Arkansas Economic Development Commission

Jerry Adams
President & CEO, Arkansas Research Alliance

Don Bobbitt
President, University of Arkansas System

Andrew Clyde
President & CEO, Murphy USA

Ed Drilling
Arkansas State President, AT&T Services, Inc.

John Haley
Co-Chief Investment Officer, The Circumference Group

Todd Hillman
Vice President, MISO Energy South Region

Rich Howe
CEO, Inuvo, Inc.

Sonja Hubbard
CEO, E-Z Mart, Inc.

Clay Johnson
EVP, Enterprise Chief Information Officer, Walmart Stores, Inc.

Jerry Jones
EVP, Acxiom Corporation

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Director, Arkansas Department of Higher Education

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Chief Growth Officer, Tyson Foods

Walter Smiley
Founder & Former CEO, Systematics

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President, Arkansas State University System

Staff Director
Tom Chilton, Director of Division of Science and Technology, Arkansas Economic Development Commission

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Mitch Horowitz and Joe Simkins, TEConomy Partners LLC., a global leader in research, analysis and strategy for innovation-based economic development. For further information, please visit www.teconomypartners.com

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Executive Summary

In late March of 2017, Governor Asa Hutchinson kicked off the deliberations of his Blue Ribbon Commission to report on the Economic Competitiveness of Arkansas in Data Analytics and Computing (the "Commission"). The Commission is co-chaired by Charles Morgan, CEO of First Orion Corporation and Founder of Acxiom Corporation, and Mike Preston, Executive Director of Arkansas Economic Development Commission (AEDC). The membership of the Commission draws upon industry executives from many of Arkansas' leading companies using data analytics and computing to compete across retail, transportation, food processing, agricultural, energy, information technology, and telecommunications sectors with representation of educational leaders of Arkansas' higher education systems.

The Commission has set out a "breakout" strategy for Arkansas considering the stakes in the economic competition around data analytics and computing. The unprecedented amount of digital information or Big Data being generated from digitizing of records, on-line transactions, social networking, Internet searches and extensive use of sensors and other monitoring technologies is now generating value and competitive business advantage using the tools of data analytics and computing, such as predictive modeling and machine learning algorithms, massive data storage and mining, and data visualization and decision support tools. On its own, the emerging industries providing advanced tools and services in data analytics and related computing will be a nearly $100 billion market in the years to come.

But the economic consequences of data analytics and computing are far greater. Data analytics and computing are at the forefront of a significant new business transformation in the way companies make decisions, design new products and interact with their supply chains and customers in real time.

Arkansas cannot afford to sit idly by as data analytics and computing transform the way businesses compete in the 21st century. As Mike Preston, Executive Director of the Arkansas Economic Development Commission and Co-chair of the Blue-

Ribbon Commission, explained at the kick-off meeting, "The future of Arkansas' economic development is tied to our ability to succeed in data analytics and computing. It is a technology that cuts across our leading industries. If we are to succeed in retaining and growing existing jobs and recruiting industry we have to have the talent and technical capabilities to meet this opportunity." Charles Morgan, founder and past Chairman and CEO of Acxiom and now Chairman and CEO of First Orion Corporation, who serves as the other Co-chair of the Commission, echoed the concern around measuring up to the talent demands in data analytics and computing. "Software development is totally different now than what it used to be. The best job candidate needs to bring a background in computer science and data analysis, with an understanding of business requirements. A public-private partnership is needed to collaborate in developing the talent we all need in industry to compete in data analytics and computing. Higher education is a strategic partner, but not necessarily the total solution."

For Arkansas, the breakout opportunity is to partner with its major existing companies in their efforts to transform their businesses to win in a data-driven, real-time, hyper-consumer-focused marketplace. Data analytics and computing is not merely about an emerging new industry of the future, but goes to the basic question of whether Arkansas' existing industries will stay competitive and be able to generate the high-quality jobs needed to advance the state's per capita income and standard of living for Arkansans. This is at the heart of the Vision Statement set out by the Commission – data analytics and computing is about existing industries and companies in Arkansas winning in the global marketplace.

The success of Arkansas in advancing its vision of transforming existing industries through data analytics and computing depends upon having a balanced approach of near-term actions that meet industry needs, along with an organizational plan for a sustained public-private partnership effort.

Vision Statement

Arkansas is a global leader in the transformation of existing industries through the application of data analytics and related computing capabilities [such as machine learning, predictive modeling, and applied data management and visualization] involving the integration of technical and business skills, advancement of talent pipelines and ongoing upgrades to relevant workforce skills.

Mission Statement of Broad Objectives

Critical for the success of Arkansas in having its leading industries and companies competing in data analytics and computing is **sustaining a public-private partnership** able to accomplish strategic and focused near-term actions that address industry needs, while having a longer-term focus on emerging needs and opportunities for Arkansas to succeed in transforming its existing industries through data analytics and computing.

Over the next five years, the public-private partnership's strategic priorities to advance its vision and address the most pressing needs of industry in Arkansas to strengthen their competitiveness and capabilities in computing and data analytics involves:

- **Addressing the challenge of recruiting top talent actively involved in data analytics and computing**

- **Raising industry awareness and understanding**

- **Developing, engaging and retaining homegrown top talent in data analytics and computing**

The longer-term mission of the sustainable public-private partnership in data analytics and computing would be to advance the following broad objectives:

- **Advance a thriving ecosystem and high-value business environment in data analytics and computing in Arkansas focused around existing industries and business functions, such as supply chain management, consumer and retail services, energy, telecommunications, and health care**

- **Create a critical mass of technology capabilities and workforce skills in data analytics and computing in Arkansas to serve as a competitive advantage to drive economic growth in the state and to improve the quality and efficiency in delivering public services to Arkansans**

- **Foster high-skilled, high-paying career pathways for Arkansans in data analytics and computing**

Recommendations for Near-Term Plan of Action

The near-term strategic priorities and actions recommended by the Commission involve four broad initiatives:

- Advancing increased networking and executive education for Arkansas companies to better integrate data analytics into their businesses

- Reinforcing data analytics skills development across Arkansas' universities and connecting students with businesses

- Target data analytics and computing talent retention, attraction and retraining to ensure Arkansas can meet existing and new company demand for data analytics talent

- Raising Arkansas technical capabilities through a Data Analytics Strategic Implementation Fund

Recommendations to Organize a Sustainable Public-Private Partnership for Advancing Data Analytics and Computing in Arkansas

Governance

The Arkansas Partnership for Data Analytics and Computing will be governed as an independent non-profit organization, comprised of an industry-led Board with representation from state government and higher education.

The governing board will be limited to nine to eleven members to be an effective working board that can best guide and oversee the action plan of the initiative.

Broader planning committees may be organized around specific objectives to ensure stakeholder engagement to be inclusive of all parts of the state and to engage with sectors of state economy and public sector that would not ordinarily think about data analytics as being key to solving industry-wide problems, including agriculture/timber, K-12 education, etc.

An external advisory board also may be considered to engage experts from outside of Arkansas to help provide insights on future directions and help assess ongoing efforts to the governing board.

Operating Model

The Arkansas Partnership for Data Analytics and Computing will require dedicated resources for developing a "lean" staff able to facilitate engagement and keep actions moving forward. The key value is in having dedicated staffing in sustaining and building relationships, supporting board of directors and advisory groups and learning from experiences.

The staff of the initiative also will support the ongoing committees that may be formed by the governing board in areas such as educational support, industry support, economic development and outreach/awareness.

Resource Plan

A base level of funding of up to $25 million over a five-year period from public and private sources will be required to staff the initiative and launch its near-term program efforts as a key technology-based economic development initiative of the state.

A mix of public and private resources will be required to support each specific action, tailored to that action. Overall, public funding is expected to leverage significantly greater private investment through program activities and incentivized actions.

Charge from Governor

In forming this Governor's Blue-Ribbon Commission to Report on the Economic Competitiveness of Computing and Data Analytics, my expectation is to set a guide for the State to respond to the needs of our business community and, in doing so, create career opportunities for our best and brightest young workers to remain in Arkansas and raise our overall state capabilities across industry, higher education and government to advance and apply the tools of data analytics and computing.

Arkansas is not new to the world of data analytics and computing. We have a history of both successful innovative companies and established industry leaders breaking new ground in the use of advanced computing and data analytics. But we know that the competition around the transformation of Big Data and its applications is stiff and the stakes are high for our state's leading industries and future economic prosperity.

Arkansas can be a national leader in data analytics and computing. Our coding initiative is now nationally recognized for its accomplishments, with more than 5,500 high school students participating and a growing cadre of trained teachers certified to sustain the effort far into the future. This success now needs to be carried across industry, government and higher education.

For Arkansas to succeed we must work together to raise our capabilities and have a common game-plan with a clear vision, mission and strategic actions to be a national leader. It is this important task that the Blue-Ribbon Commission is being asked to address.

Opening Remarks from Governor Asa Hutchinson to the First Blue-Ribbon Commission Meeting on March 27, 2017

Setting the Context:
The Importance of Computing and Data Analytics and Arkansas' Competitive Position

Data analytics and computing is at the forefront of a significant new business transformation in the way companies make decisions, design new products and interact with their supply chains and customers in real time. The unprecedented amount of digital information or Big Data being generated from digitizing of records, on-line transactions, social networking, Internet searches and extensive use of sensors and other monitoring technologies is now generating value and competitive business advantage using the tools of data analytics and computing, such as predictive modeling and machine learning algorithms, massive data storage and mining, and data visualization and decision support tools. One indication of the sea change underway is that the market for data analytics and computing applications in Big Data reached $18.3 billion in 2014 and is expected to reach $92.2 billion by 2026 – a strong compounded annual growth of 14.4%.[1]

The economic implications for Arkansas are significant. Arkansas' large and mid-sized growth companies that drive the state's high wage, existing industries need to be global leaders in the use of data analytics or risk being eclipsed by their competition.
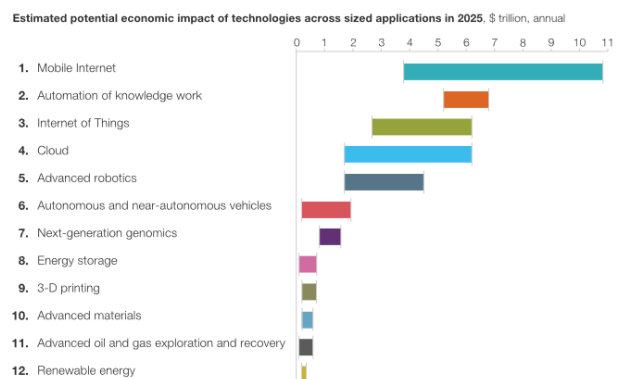
As the McKinsey Global Institute explains:

"The use of big data is becoming a key way for leading companies to outperform their peers. For example, we estimate that a retailer embracing big data has the potential to increase its operating margin by more than 60 percent … Across [industry] sectors, we expect to see value accruing to leading users of big data at the expense of laggards, a trend for which the emerging evidence is growing stronger. Forward-thinking leaders can begin to aggressively build their organizations' big data capabilities. This effort will take time, but the impact of developing a superior capacity to take advantage of big data will confer enhanced

competitive advantage over the long term and is therefore well worth the investment to create this capability. But the converse is also true. In a big data world, a competitor that fails to sufficiently develop its capabilities will be left behind."[2]

Figure 1

A gallery of **disruptive technologies**

Estimated potential economic impact of technologies across sized applications in 2025, $ trillion, annual

SOURCE: McKinsey Global Institute

Notes on sizing: These economic impact estimates are not comprehensive and include potential direct impact of sized applications only. They do not represent GDP or market size (revenue), but rather economic potential, including consumer surplus. The relative sizes of technology categories shown do not constitute a "ranking," since our sizing is not comprehensive. We do not quantify the split or transfer of surplus among or across companies or consumers, since this would depend on emerging competitive dynamics and business models. Moreover, the estimates are not directly additive, since some applications and/or value drivers are overlapping across technologies. Finally, they are not fully risk- or probability-adjusted.

Arkansas companies and higher education institutions are making strong gains, but cannot succeed as a "follow-me" state and needs a break-out strategy to leap frog competitors and become a leading nexus in the business transformations taking place. Businesses in Arkansas are adding jobs in data analytics and computing at a faster pace than the nation over the economic recovery, but Arkansas businesses are generally starting from a smaller pool of such workers in both critical mass and average skill levels. Currently Arkansas is importing talent to meet its demand for data analytics and computing workers, even as higher education institutions in Arkansas are generating more graduates in the fields of data analytics and computing, because the overall levels of graduates and their retention are too low.

1 Ralph Finos, 2016-2026 Worldwide Big Data Market Forecast, Wikibon, March 30, 2016
2 McKinsey Global Institute, Big Data: The Next Frontier for Innovation, Competition and Productivity, June 2011, page 6

Setting the Context

Arkansas Outpacing U.S. Growth in Most Data Analytics and Computing-related Occupations, 2010-2015

- Arkansas Grew 32% compared to 23% for the Nation

- Gain of 12,590 jobs in data analytics and computing over past six years

Source: Arkansas Department of Workforce and U.S. Bureau of Labor Statistics, calculations by TEConomy Partners, LLC. Data Science occupations includes occupations in computer science, statistics and math, economics, business and financial analysts, logistics and operations, engineering and scientists.

Job Growth
in Data Analytics & Computing
2010-2015

23% US
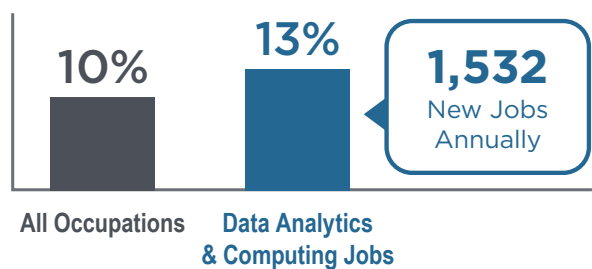32% Arkansas

12,590 Jobs Gained
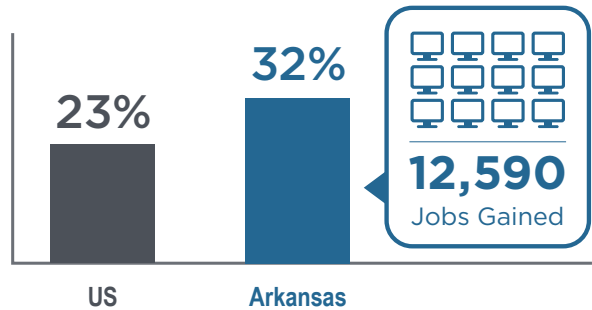
Strong job growth projected for Arkansas Data Analytics and Computing-Related Occupations through 2014

- 13% growth in data analytics and computing jobs compared to 10% for all occupations in Arkansas from 2014 to 2024

- 1,531 new job annual openings expected from 2014-2024 in data analytics and computing in Arkansas

Source: Long Term Occupational Employment Projections, Arkansas Department of Workforce, calculations by TEConomy Partners, LLC.

Projected Job Growth
in Arkansas
2014-2024

10% All Occupations
13% Data Analytics & Computing Jobs

1,532 New Jobs Annually

Big Gap in Share of Arkansas College Graduates Pursuing Degrees in Data Analytics and Computing Fields Compared to National Average

- Less than 10% of Arkansas college graduates getting degrees in fields related to data analytics and computing

- More than 20% of U.S. college graduates getting degrees in fields related to data analytics and computing

Source: National Center for Educational Statistics, 2015, calculations by TEConomy Partners, LLC.

Share of College Degrees
in Data Analytics & Computing
2015

>20% US
<10% Arkansas
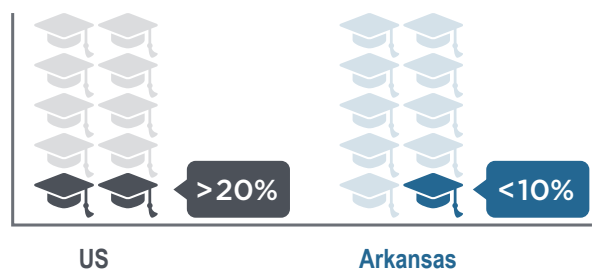
Arkansas Importing Talent to Meet Industry Demand for Workers in Data Analytics and Computing

- Arkansas had a net in-migration of 6,532 workers with degrees in fields related to data analytics and computing from 2011 to 2015

- 11,892 migrated to Arkansas

- 5,360 migrated out of Arkansas

Source: American Community Survey Microfile Data, calculations by TEConomy Partners, LLC.

Migration of Workers
in Data Analytics & Computing
2011-2015

+ **11,892** Workers Migrated In

6,532 Net Gain

− **5,360** Workers Migrated Out

The Governor's Blue-Ribbon Commission on the Economic Competitiveness of Data Analytics and Computing in Arkansas have identified how Arkansas can succeed in becoming a world leader in transforming existing industries through accelerating the usage of data analytics and computing capabilities. The conditions necessary for this success include:

- Breaking down the **silos across its individual companies and industry sectors to advance the overall data analytics and computing capabilities in Arkansas by creating meaningful connections among companies and data analytics/ computing professionals and recent graduates**

- Supporting and stimulating industry demand for data analytics and computing capabilities as a leading existing business retention and growth strategy in Arkansas as well as having a robust business development strategy for data analytics and computing to attract outside investment to Arkansas

- Leveraging the large data sets found across leading companies and organizations in Arkansas involving consumer behavior, supply chain and transportation, retail management, energy transmission, and drug development and health care to advance recognized excellence in specific domain areas of data analytics and computing and establish compelling career opportunities for retaining and attracting top talent to Arkansas

- Having Arkansas state government continue to be a national leader in pursuing and re-aligning public policies, economic development tools, higher education investments and government service delivery to prioritize raising data analytics and computing capabilities in the state

These efforts cannot be advanced as stand-alone initiatives. Instead, a sustained public-private partnership is needed able to implement near-term actions in an integrated manner that offer measurable and meaningful gains for industry,

while having a longer-term focus on emerging needs and opportunities for Arkansas to succeed in transforming its existing industries through data analytics and computing.

Vision and Mission for Arkansas in Computing and Data Analytics

Arkansas cannot afford to sit idly by as data analytics and computing transforms the way businesses compete in the 21st century. As Mike Preston, Executive Director of the Arkansas Economic Development Commission and Co-chair of the Blue-Ribbon Commission, explained at the kick-off meeting, "The future of Arkansas' economic development is tied to our ability to succeed in data analytics and computing. It is a technology that cuts across our leading industries. If we are to succeed in retaining and growing existing jobs and recruiting industry we have to have the talent and technical capabilities to meet this opportunity." Charles Morgan, founder and past Chairman and CEO of Acxiom and now Chairman and CEO of First Orion Corporation, who serves as the other Co-chair of the Commission, echoed the concern around measuring up to the talent demands in data analytics and computing. "Software development is totally different now than what it used to be. The best job candidate needs to bring a background in computer science and data analysis, with an understanding of business requirements. A public-private partnership is needed to collaborate in developing the talent we all need in industry to compete in data analytics and computing. Higher education is a strategic partner, but not necessarily the total solution."

Data analytics and computing is not merely about an emerging new industry of the future, but goes to the basic question of whether Arkansas' existing industries will stay competitive and be able to generate the high-quality jobs needed to advance the state's per capita income and standard of living for Arkansans. In recent years, Arkansas has made steady gains in closing the gap in per capita income with the rest of the nation due to the growth of high wage industries and leading companies in the state, such as transportation and logistics, headquarter operations, financial services, information technology, energy transmission, health products and services and advanced manufacturing. Arkansas' growth in per capita income of 21.2% from 2007 to 2014 outpaced U.S. growth of 15.6% in large

part because high wage industry jobs in the state rose by 4.3% from 2009 to 2014, more than 50% higher than total private industry job growth of 2.8%.

To continue to sustain this pace of economic advancement, Arkansas' leading industries and leading companies must master the skills required in data analytics and computing. This is at the heart of the Vision Statement set out by the Commission – data analytics and computing is about existing industries and companies in Arkansas winning in the global marketplace.

Vision Statement

Arkansas is a global leader in the transformation of existing industries through the application of data analytics and related computing capabilities [such as machine learning, predictive modeling, and applied data management and visualization] involving the integration of technical and business skills, advancement of talent pipelines and ongoing upgrades to relevant workforce skills.

Mission Statement of Broad Objectives

Critical for the success of Arkansas in having its leading industries and companies competing in data analytics and computing is **sustaining a public-private partnership** able to accomplish strategic and focused near-term actions that address industry needs, while having a longer-term focus on emerging needs and opportunities for Arkansas to succeed in transforming its existing industries through data analytics and computing.

Over the next five years, the public-private partnership's strategic priorities to advance its vision and address the most pressing needs of industry in Arkansas to strengthen their competitiveness and capabilities in computing and data analytics involves:

- **Recruiting top talent actively involved in data analytics and computing.** Survey results and follow-on discussions with Commission members involved in the day-to-day operations of data analytics and computing for their organizations make clear that this is the most pressing challenge for Arkansas today and in fact one that all companies across the nation are facing. For many it is not just an issue of helping companies with incentives and other assistance in their attraction and retention of skilled workers, but raising Arkansas' national profile and creating the critical mass in industry activities around data analytics and computing talent, which is missing today. Commission members expressed a variety of views on recruitment needs, revealing that there needs to be a focus both on talent and on companies that can raise the technology capabilities and activities found in Arkansas involving data analytics and computing.

- **Raising industry awareness and understanding.** This priority is akin to having a strong existing business growth and retention agenda to complement ongoing priority of recruitment set out in the first strategic priority. A key theme emerging around this priority is creating a more collaborative and networked business environment around data analytics and computing that enables data analytics and computing professionals to grow their skills and facilitates existing companies effectively integrating data analytics into their business operations. Commission members expressed concerns that Arkansas is missing the level of collaboration and networking found in competitive locations, and that there are potential opportunities to advance data science applications across different industries being missed as a result. Concern also was voiced that many leading Arkansas-based companies have an older mindset on the use of data and IT that is not aligned with leaders in the current national environment and cutting-edge applications and would benefit from peer-based discussions and engagements.

- **Developing, engaging and retaining homegrown top talent in data analytics and computing.** One priority for homegrown talent is the often overlooked need to retrain incumbent workers with the new skills of data analytics and computing that can offer existing industries and companies substantial and near-term returns from a proven and experienced workforce who understands the business context. Still, Arkansas needs to be advancing a robust talent pipeline able to generate new graduates in data analytics and computing. The Governor's Coding Initiative is an important step in this direction, but needs to be complemented with a stronger post-secondary education strategy to develop a high-quality talent base in data analytics and computing. A key concern among several of the Commission members is if top graduates with data analytics and computing skills leave Arkansas with no connections to local industry, it is hard to bring them back in the future. Exploring collaboration activities with higher education is embedded in this near-term objective, including ensuring that data analytics and computing skill development is strongly rooted in the curriculum for business, engineering and scientific degrees. For retention, the generation of new talent in data analytics and computing needs to be engaged in ways that show their skills can make a difference. In particular, opportunities that connect recent graduates advancing their careers in data analytics and computing with solving "big" problems facing government, communities and businesses in Arkansas is an important approach to engage and attract younger workers who might otherwise explore opportunities out of state.

The longer-term mission of the sustainable public-private partnership in data analytics and computing would be to advance the following broad objectives:

- **Advance a thriving ecosystem and high-value business environment in data analytics and computing in Arkansas focused around existing industries and business functions, such as supply chain management,**

consumer and retail services, energy, telecommunications, and health care

- **Create a critical mass of technology capabilities and workforce skills in data analytics and computing in Arkansas to serve as a competitive advantage to drive economic growth in the state and to improve the quality and efficiency of delivering public services to Arkansans**

- **Foster high-skilled, high-paying career pathways for Arkansans in data analytics and computing**

In considering this vision and mission statement, there is a focus on achieving scale across specific measures of success. These may include:

- Direct jobs created in data analytics and related computing activities

- Increased in-migration and decreased out-migration of professionals in data analytics and related computing activities

- Placement of Arkansas post-secondary students in experiential learning activities (internships, senior design projects, etc) and hiring of recent graduates

- Growth of the technology "infrastructure" capabilities for data analytics in the state involving increased industry collaborations, utilization of shared-use facilities for industry-university engagements, and growing presence of suppliers of data analytic and related computing services

Recommended Strategic Action Plan

The deliberations of the Commission suggest that Arkansas can and needs to be among the global winners in the economic competition around data analytics and computing. A breakout strategy for the state requires the strong alignment with our major companies in their efforts to leap frog the competition using data analytics and computing. In doing so, Arkansas can create the critical mass of technological capabilities and talent in data analytics and computing Arkansas needs to be highly competitive across its leading industries.

By co-investing with its existing and emerging industry leaders over a sustained period to create statewide competitive advantage, Arkansas will be following a proven means towards success in advanced technology development. Other examples where states have co-invested with their industry leaders to win in a significant technology-led market opportunity include the Indiana Bioscience Research Institute that Vice President Mike Pence launched as one of his first acts as Governor of Indiana or New York's Nanotechnology Initiative launched by then-Governor George Pataki. For Indiana, it was co-investing with Eli Lilly & Company, Roche and Cook Biomedical, among other life science companies. For New York, it was co-investing with IBM and its significant supply chain and collaborators in microelectronics. The objective of "going big" by co-investing with a state's industry leaders is to have an impact at a scale that can raise the state's competitiveness in data analytics and computing.

The success of Arkansas in advancing its vision of transforming existing industries through data analytics and computing depends upon having a strategic and sustained public-private partnership able to accomplish near-term strategic priorities and actions that results in measurable and meaningful gains in meeting industry needs, while setting a course for continued success of Arkansas to become a global leader in the transformation of existing industries through data analytics and computing.

The recommendations by the Commission seek to create this balanced approach of having near-term actions that meet industry needs, along with an organizational plan for a sustained public-private partnership effort.

Recommendations for Near-Term Plan of Action

The near-term strategic priorities and actions recommended by the Commission involve four broad initiatives:

▶ Advancing increased networking and executive education for Arkansas companies to better integrate data analytics into their businesses

▶ Reinforcing data analytics skills development across Arkansas' universities and connecting students with businesses

▶ Target data analytics and computing talent retention, attraction and retraining to ensure Arkansas can meet existing and new company demand for data analytics talent

▶ Raising Arkansas technical capabilities through a Data Analytics Infrastructure Investment Fund

▶ Advancing increased networking and executive education for Arkansas companies to better integrate data analytics into their businesses

Rationale

- Most widely raised action to be taken in survey and discussions with Commission members

- Viewed as creating the collaborative environment and engagement of CIOs and CTOs from across industry, state and local government, non-profit organizations and state authorities to drive a sustainable public-private partnership in data analytics and computing

- Seen as an important tactic to be able to recruit top talent – potential recruits need to see a rich and growing business environment with ample career opportunities for applying skills in data analytics and computing

- Need for raising C-level executive awareness and understanding of how data analytics and computing can transform their businesses

Potential Activities

Establish a statewide professional network for CIOs/CTOs to:

- Support technical and continuing education workshops and professional development

- Provide job placement tools

- Sponsor an annual event to put global spotlight on Arkansas in data analytics

- Encourage private sector engagement on data analytics solutions for pressing public policy challenges

  Arkansas can initiate this professional network by establishing a statewide chapter of the Society for Information Management and growing its programs and outreach efforts.

Advance customized executive management education services targeting CEOs and other C-level executives, as another key lever for enabling Arkansas businesses to succeed in data analytics and

High-Value Approach of Local Chapters of the Society for Information Management

- Local separately incorporated groups of IT professionals, sharing knowledge and supporting each other in the pursuit of business and professional excellence

- Creating and disseminating valuable intellectual capital to help members
  - Further their careers
  - Develop their professional networks
  - Maximize their value to their organizations

- Tailoring programs based on the needs of the members:
  - General meetings
  - CIO only roundtables
  - Community services

- Giving back to the communities we serve

computing. The focus of these executive management education services is to build the capacity of business leaders to ask the right questions, guide investments and focus on the insights from data analytics and computing for their company. These executive management education services will require hands-on learning, use of simulations to model decision-making, and an integrated focus around the technology, business operations and strategic insights from data analytics and computing from across a variety of industries.

Example of Major Fortune 500 Companies effort on Top Executive Digital Immersion Program

- One full day immersion program for top executives on topics of digital marketing, eCommerce, and use of data analytics

- Pre-meeting work exercises to simulate use of tools and pre-survey diagnostic to assess current skills and readiness

- Use of case studies and live discussions with industry leaders, such as Google

- Ended with action planning to prioritize opportunities and deploy what had been learned in the one day immersion program

Based on experience of Commission member at Fortune 500 companies

Rationale

- The demands for talent in data analytics and computing requires an integration of skills across coding, statistics and business and subject matter expertise that need to be brought together for students in a meaningful way as they pursue their degrees

- It is critical to expose students early in their academic careers to data analytics and coding in a way that is engaging and enables them to be work-ready upon graduation

- Arkansas universities need to keep pace in fast moving fields of data analytics and computing by having close collaboration with industry

- Develop industry-student relationships to enhance the ability to retain graduates in Arkansas

Figure 2
What A Good Data Scientist Actually Looks Like
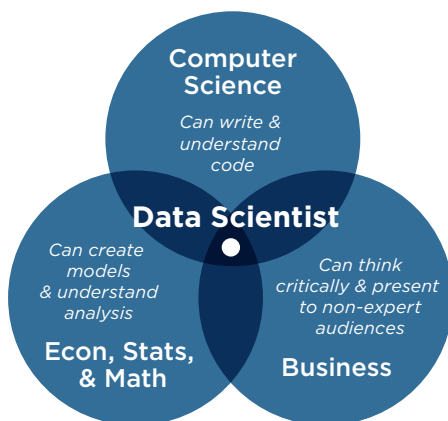
Potential Activities

Advance senior design capstone project courses involving student teams working on real-world industry projects set out by Arkansas companies with faculty serving as advisors and having industry mentors.

The various degree options in data analytics and computing should offer this experience to all seniors in concert with companies from a wide range of industries.

Create a Summer Institute for Advanced Data Analytics for rising college juniors. This effort should be a highly competitive program with industry sponsors, where students learn-by-doing through a project-oriented curriculum in which university faculty and company professionals team teach to bring together advanced data analytics and computing skills and the real-world context of business.

Establish an Arkansas Data Analytics and Computing Internship Program. Commission members identified their successful approaches with internships, including the importance of identifying top students, starting early in a student's academic career and engaging them in multiple internships to help ensure they are work-ready. For each selected student, the state should co-invest with companies by contributing a tax credit for 50% of the cost of an eight to twelve-week internship over the course of a year, up to $2,500.

Example of Michigan State's Capstone Project

- Semester course for all students majoring in computer science

- Students develop real-world software solutions working in a team environment, emphasizing written and oral communication skills, along with proficiency with software development tools.

- Multiple companies propose projects, including large and small local companies and national leaders, such as Amazon, IBM and Microsoft

- Projects are vetted and refined in consultation with faculty

- Companies and students get valuable exposure to each other

- Companies help offset cost by contributing $5,000 per project

▶ Target data analytics and computing talent retention, attraction and retraining to ensure Arkansas can meet existing and new company demand for data analytics talent

Rationale

- Having an incentive to retain new graduates in Arkansas is needed to ensure local businesses benefit from the public-private investments in growing the data analytics and computing pipeline

- The fast pace of technological advances in data analytics and computing pose a challenge for existing workers to keep advancing their skills, yet these incumbent workers offer a proven and experienced workforce with in-depth business knowledge that would be hard to replace

- One of the most pressing challenges for Arkansas companies is recruiting top talent in data analytics and computing

Potential Activities

Create an Arkansas data analytics retraining initiative for incumbent workers. Arkansas offers some highly valuable tools that can be adapted to targeting the retraining of incumbent workers, such as the University of Arkansas System's on-line learning platform, eVersity.uasys. Working together with industry, a specialized series of rigorous on-line courses emphasizing both skill development and experiential, project-based learning should be developed in fields associated with data analytics and computing.

Offer financial incentives for Arkansas students graduating with degrees in fields associated with data analytics and computing (including residents attending out of state universities) to make their careers in Arkansas. These financial incentives would help pay off student loans and/or enable a young worker to get settled in Arkansas and make a down payment on a home. This incentive could be structured to be revenue neutral by considering the average tax revenues generated by a worker in data analytics and computing over a period of time after graduation.

Create a brand for Arkansas in being a place for advancing careers in data analytics built around major Arkansas companies. For top talent recruitment, several Commission members raised the concern that the biggest challenge for companies is "selling Arkansas" as they recruit data analytics professionals to come work for them. The concern of these highly skilled and experienced professionals in data analytics and computing is that Arkansas may not offer the long-term career opportunities of larger metropolitan areas. The branding of Arkansas needs to feature the multiple opportunities across leading companies in the state and the exciting opportunities to work with the largest data sets in the world across many industries, including consumer and retail purchasing, logistics, farming/logging, energy and drug development.

Tax Credit for Aerospace Engineers in Oklahoma

A critical skill need identified in Oklahoma for a targeted area of that state's economic development is aerospace engineering. A complex financial incentive has been developed that includes:

- A personal tax credit to the aerospace engineer of up to $5,000 per year for a maximum of 5 years.

- A tax credit to the employer for tuition reimbursements they make to their newly graduated engineers. The credit would apply to up to 50 percent of the average annual amount the engineer paid to earn his or her degree.

A review by the Oklahoma Incentive Evaluation Commission at the end of 2016 showed they had generated $1.4 billion in economic output, $287 million in employee wages, 4,200 new jobs paying about $80,000 annually, and a 16.7 percent growth in aerospace engineer employment in Oklahoma.

▶ Raising Arkansas technical capabilities through a Data Analytics Strategic Implementation Fund

Rationale

- Arkansas needs to have "demonstrated" excellence in specific areas/applications of data analytics to compete for top talent and address the challenges of working in large data sets that can be applied in a variety of "use cases".

- Importance of leveraging the existing and substantial capabilities and infrastructure of Arkansas' higher education institutions and enhancing them in targeted areas identified by and in collaboration with industry

- A range of specialized interest groups were identified in discussions with Commission members and broader stakeholders in specific applications of data analytics and computing, such as distribution and logistics, energy grid management, consumer marketing, health-related informatics and precision agriculture. This offers an opportunity to create industry-university-government collaborations that lead to new funding opportunities and project ideas and keep momentum around specific applications areas that reinforce Arkansas as a competitive place for data analytics and computing.

- Strong interest by Arkansas government be a national leader in use of data analytics and computing to improve the quality and efficiency of public services, which will require new tools and applications in big policy areas, such as health care, transportation, and education, where higher education and industry collaborations can help advance innovative policies and solutions to address public needs

Potential Activities

Establish a Data Sciences Infrastructure Investment Fund. This fund would be designed as a public-private partnership effort involving competitively selected projects with both private sector and state government investments focusing

on a range of activities to raise Arkansas' capacity to further data analytics capabilities, including support for 1) university shared-use facilities with identified industry and government partners; 2) equipment fund for new educational programs involving industry and government partners; 3) data analytics and computing accelerators, co-working space, incubators; and 4) matching new federal centers addressing pressing technology and policy issues and opportunities with the involvement of industry and government partners.

North Carolina's Renaissance Computing Institute (RENCI)

Since 2004, RENCI has worked to stimulate long-term investments that will help position North Carolina as a major force in advancing data science research and education, and the use of data for the public good. RENCI develops and deploys data science cyberinfrastructure that helps researchers in academia, government, and business use data to drive discoveries, innovate, make informed decisions, and spur economic development. It is actively involved in building communities of domain scientists, data scientists, technology practitioners, and end users who apply data to catalyze innovation and knowledge discovery.

Among its many leading data science efforts, RENCI helped found and administers a membership organization involving IBM, Dell EMC, Intel, and Seagate, among other leading organizations in the development of Integrated Rule-Oriented Data System (iRODS), free open source software for data discovery, workflow automation, secure collaboration, and data virtualization.

Recommendations to Organize a Sustainable Public-Private Partnership for Advancing Data Analytics and Computing in Arkansas

The public-private partnership for advancing data analytics and computing in Arkansas needs to be able to accomplish near-term strategic priorities and actions, while setting a course for continued success of Arkansas to become a global leader in the transformation of existing industries through data analytics and computing.

The organizational structure to carry out this effort includes:

Governance

The Arkansas Partnership for Data Analytics and Computing will be governed as an independent non-profit organization, comprised of an industry-led Board with representation from state government and higher education.

The governing board will be limited to nine to eleven members to be an effective working board that can best guide and oversee the action plan of the initiative.

Broader planning committees may be organized around specific objectives to ensure stakeholder engagement to be inclusive of all parts of the state and to engage with sectors of state economy and public sector that would not ordinarily think about data analytics as being key to solving industry-wide problems, including agriculture/timber, K-12 education, etc.

An external advisory board may also be considered to engage experts from outside of Arkansas to help provide insights on future directions and help assess ongoing efforts to the governing board.

Operating Model

The Arkansas Partnership for Data Analytics and Computing will require dedicated resources for developing a "lean" staff able to facilitate engagement and keep actions moving forward. The key value is in having dedicated staffing in sustaining and building relationships, supporting board of directors and advisory groups and learning from experiences.

The staff of the initiative will also support the ongoing committees that may be formed by the governing board in areas such as educational support, industry support, economic development and outreach/awareness.

Recommended Resource Plan

A base level of funding of up to $25.5 million over a five-year period from state, private industry and other sources will be required to staff the initiative and launch its near-term program efforts as a key technology-based economic development initiative of the state.

A mix of public and private resources will be required to support each specific action, tailored to that action. Overall, public funding is expected to leverage significantly greater private investment through program activities and incentivized actions.

Table 1: Proposed Funding to Launch and Staff the Initiative

Broad Initiative	Potential Funding Requirements
Advancing increased networking and executive education for Arkansas companies to better integrate data analytics into their businesses	Average $100,000 annually to focus on start-up and program development costs 5-year commitment: $500,000
Reinforcing data analytics skills development across Arkansas' universities and connecting students with businesses	Average $1 million a year annually in state funding for summer institute and internship program 5-year commitment: $5 m
Target workforce retraining, retention, and attraction to ensure Arkansas can meet existing and new company demand for data analytics talent	Average $1 million annually to provide incentives for incumbent workers successfully completing on-line retraining and recent graduates taking and holding jobs in Arkansas Devote portion of state advertising to branding data analytics talent/careers 5-year commitment: $5 m
Create a Data Analytics Investment Fund	Average $1.5 million annually in capital expenditures through public universities involving industry partners 5-year commitment: $7.5 m
Ramping up an Arkansas Data Analytics Partnership	Average $1.5 million annually for supporting lean staff 5-year commitment: $7.5 m
	Total 5-year commitment: Up to $25.5 million

Recommended Resource Plan

The suggested annual funding plan would involve a mix of operating and capital funds over the next five years. The first year will be focused on kicking off the networking and executive education activities and planning the detailed design and operation of other strategic actions. The second year will begin to ramp-up the services and years 3-5 will be ongoing service delivery.

The high-level breakout of proposed annual costs is as follows:

Table 2: Proposed Funding by Year

Broad Initiatives	Year One	Year Two	Year Three	Year Four	Year Five	Total 5-Year
Advancing increased networking and executive education for Arkansas companies to better integrate data analytics into their businesses	$100,000	$100,000	$100,000	$100,000	$100,000	$500,000
Reinforcing data analytics skills development across Arkansas' universities and connecting students with businesses	$250,000	$750,000	$1.33 m	$1.33 m	$1.33 m	$5 m
Target workforce retraining, retention, and attraction to ensure Arkansas can meet existing and new company demand for data analytics talent	$250,000	$750,000	$1.33 m	$1.33 m	$1.33 m	$5 m
Create a Data Analytics Infrastructure Investment Fund	$0	$500,000	$2 m	$2.5 m	$2.5 m	$7.5 m
Ramping up an Arkansas Data Analytics Partnership	$1 m	$1.625 m	$1.625 m	$1.625 m	$1.625 m	$7.5 m
Annual Projected Funding from State, Private Industry and Other Sources	**$1.6 m**	**$3.725 m**	**$6.385 m**	**$6.885 m**	**$6.885 m**	**$25.5 m**

Glossary of Terms for the Governor's Blue-Ribbon Commission on the Economic Competitiveness of Computing and Data Analytics

The Governor's Blue-Ribbon Commission requested that a glossary of terms be developed so each member is clear on the meaning of specific technical and business terminology being used.

Below is a compilation of terms associated with computing and data analytics from a variety of sources. These terms were organized into three major categories of:

- Technical terms associated with methods, technologies and applications of computing and data analytics

- Skills required in computing and data analytics

- Types of jobs associated with computing and data analytics

Technical Terms

Term	Definition
Algorithms*	A step-by-step procedure for performing calculations, generally associated with data processing and automated reasoning.
Analytics*	Everyday tools for exploring data sets, such as queries and text search through discovery of meaningful patterns in data using advanced techniques such as machine learning, data visualization and statistical analysis.* Synthesis of knowledge from information as one of the steps in the data life cycle: collection of raw data,
Big Data*	Data sets that are both massive and complex.*
Cloud Computing*	Computing resources that are delivered as a service via a network, typically the Internet
Data Life Cycle**	Set of processes in an application that transforms raw data into actionable knowledge. It involves collection of raw data, preparation of information, analytics, visualization and access.
Data Mining*	Use of computational methods to find desired information in data sets.
Data Science**	The extraction of actionable knowledge directly from data through a process of discovery, or hypothesis formation and hypothesis testing. It is the fourth paradigm of science, following experiment, theory and computational sciences. It refers to the conduct of data analysis as an empirical science, learning directly from data itself.
Machine Learning*	The use of automated algorithms to find and evaluate patterns in data, enabling predictions that are increasingly accurate. Often referred to as advanced analytics,

Structured Data*	Familiar database technology in which data elements are characterized in a specific format.
Unstructured Data*	Data that consists of a vast number of data points that often have multiple form and may or may not be inter-related
Visual Analytics*	Data analysis using visualization techniques, which enable researchers to look for novel patterns in data.

Skill Requirements

Term	Definition
Coding****	Code is a set of instructions (or rules) that computers can understand; it might be helpful to think of code as a recipe. People write code, code powers computers and computers power many everyday objects like phones, watches, microwaves and cars. Just as people can understand different languages computers can understand different languages (like Python, C, C++, Perl, Visual Basic, Java, Javascript, Ruby and PHP, among others) which translate our instructions into binary. There are "low-level" and "high-level" coding languages. Lower-level languages more closely resemble binary code while higher-level languages are easier to code in. So learning to code is literally like learning a new language (learning to construct sentences, etc.).
Computing	The process of utilizing computer technology to complete a task. Computing may involve computer hardware and/or software, but must involve some form of a computer system.
Computational Science****	Computational science is a rapidly growing multidisciplinary field that uses advanced computing capabilities to understand and solve complex problems. Computational science fuses three distinct elements: Algorithms (numerical and non-numerical) and modeling and simulation software developed to solve science (e.g., biological, physical, and social), engineering, and humanities problems; Computer and information science that develops and optimizes the advanced system hardware, software, networking, and data management components needed to solve computationally demanding problems; The computing infrastructure that supports both the science and engineering problem solving and the developmental computer and information science
Data Analysis***	Manipulate and analyze data for use in functional or business units. Identify and develop methodologically sound and reproducible approaches for analyzing data sets that are often large and/or messy.
Decision-Making***	Drawing from various information sources, analyze, visualize and communicate insights regarding what has happened. Create models and software that predict what is going to happen or prescribe what should happen.
Problem-Framing***	Frame industry problems as analytical problems and use statistical analysis to solve them. Create the data sets and analytical tools necessary to solve industry problems and/or innovate.
Statistics	A number of approaches, largely based on advanced mathematics, that are used to collect, analyze and extract information from data sets.

Types of Jobs

Term	Definition
Data Analyst***	Leverage data analysis and modeling techniques to solve problems and glean insight across functional domains
Data-driven Decision Maker***	Leverage data to inform strategic and operational decisions. Common titles include: CEO, Chief Data Officer, CIO, Director of IT, Financial Manager, Human Resources Manager, Marketing Manager
Data Engineers***	Design, build and maintain an organization's data and analytical infrastructure
Data Scientist**	A practitioner who has sufficient knowledge in the overlapping regimes of business needs, domain knowledge, analytical skills and software and systems engineering to manage the end-to-end data processes in the data life cycle
Functional Analysts***	Utilizes data and analytical models to inform domain-specific functions and business decisions. Common titles include: Actuary, Business/Mgt Analyst, Compensation/Benefits Analyst, Financial Analyst, GIS Specialist, HRIS Analyst, Operations Analyst, Researcher.

Sources:
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