Preliminary Investigation (PI-0316)

Caltrans Division of Research, Innovation and System Information

# Use of Data Analytics Teams in the Public and Private Sectors

*Requested by*
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# Executive Summary

## Background

California is undergoing a digital transformation and needs employees in data-related positions to support this transformation. Currently a comprehensive review of data job classifications is underway to support a multiagency workgroup aimed at improving the state's ability to recruit, hire, retain and advance data-related jobs. Results from this effort will help to inform how California continues to evolve its jobs classes to recruit and hire the data talent needed and also to provide existing staff with meaningful opportunities for development.

To supplement this review, California Department of Transportation (Caltrans) is gathering information related to strategies and practices in the public and private sectors that optimize the implementation of data analytics teams. Specifically, Caltrans is interested in:

- Staffing positions that make up these teams.
- Roles and responsibilities of team members.
- Location of these teams within an organization's structure.
- Recruiting and retention practices.
- Strategies to implement a team in an organization.

## Summary of Findings

### Survey of Practice

An online survey was distributed to state department of transportation (DOT) members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Data Management and Analytics. The survey inquired about building a data analytics team, developing knowledge and skills in team members, and implementing the team within the organization. Survey questions are provided in Appendix A. The full text of survey responses is presented in a supplement to this report.

Eleven state transportation agencies responded to the survey:

- Agencies in seven states—Iowa, Minnesota, Mississippi, Nebraska, Vermont, Virginia and West Virginia—use data analytics teams.
- Four states—Kansas, Michigan, Nevada and New Hampshire—do not currently use data analytics teams, however, three states are considering them:
    - *Kansas DOT* recently engaged a data analytics firm to evaluate the agency's contractor bidding data to identify trends and the cost-competitiveness of projects being awarded, evaluate the extent to which the agency is attracting satisfactory levels of competition and pricing, and identify factors that are driving these results. As a result of this activity, the agency issued a request for proposal (RFP) to employ on-call consultant data analytics teams for transportation planning and policy, data governance, data science and analysis, performance management, business intelligence, data visualization and geographic information systems (GIS).
    - *Michigan DOT's* Enterprise Information Management office is hiring a contractor and two full-time-equivalents to assist with data analytics. The agency's

information stewards participated in a data literacy program. Michigan DOT has also conducted five data analytics proofs of concept.

- *Nevada DOT's* strategic plan includes a data and analytics program but it is on hold because of a lack of funding and changes in leadership. Agency staff continues to work on this effort by developing a roadmap and governance.

Summarized below are survey findings from the seven state transportation agencies that use data analytics teams. Information is presented in the following topic areas:

- Data analytics team description.
- Developing a data analytics team.
- Implementing a data analytics team.
- Assessment and recommendations.

Data Analytics Team Description

Agencies in three states (Iowa, Mississippi and Nebraska) reported having one data analytics team. Multiple teams were reported in Vermont (four), Virginia (six) and West Virginia (11). Iowa and Minnesota DOTs reported having teams in various functional units within the agency. The date when agencies implemented data analytics teams also varied, ranging from approximately three years (West Virginia) to 20 years (Iowa). Products and services meet the needs of a range of functional areas. Table ES-1 summarizes survey results.

**Table ES-1. Composition of Data Analytics Teams**

| State | Number/Origin of Team | Location Within Agency | Products and Services |
|---|---|---|---|
| **Iowa** | • One Analytics Bureau team<br>• Coordinated efforts with analysts throughout agency<br>• Established approx. 20 years | Transportation Design and Development Division | • Pavement condition evaluation<br>• Pavement management<br>• Interstate planning<br>• Project prioritization<br>• Corridor analysis<br>• National Performance Measures calculations<br>• Highway Performance Monitoring System submittal<br>• Other functions |
| **Minnesota** | • Various teams within agency (e.g., Traffic, Finance, Crash, Freight, Human Resources (HR), Maintenance and IT)<br>• Established: N/R | IT and various functional groups | • Traffic counts<br>• Crash statistics<br>• Workforce data analytics<br>• Financial reports (project expenditures, salary forecasts)<br>• Snow and ice information<br>• Market research<br>• Infrastructure life cycle analyses |

| State | Number/Origin of Team | Location Within Agency | Products and Services |
|---|---|---|---|
| **Mississippi** | • One semiformal analytics team<br>• Established in 2010 | • One analytics manager (warehouse manager and chief warehouse architect)<br>• Manager leads several employees who perform analytics part time and other development. | • Analytical analysis using SQL Server Analysis Services (SSAS), Power BI and other Microsoft tool sets<br>• Warehouse database development for certain data sets<br>• Internal and external dashboard development |
| **Nebraska** | • One team<br>• Established in 2018 | Business Intelligence Section, Data Warehouse Group | • Reports<br>• Dashboards<br>• R code Shiny apps |
| **Vermont** | • Four teams<br>• Oldest team: 20+ years<br>• Other teams: 5-10 years | • Data Management Section, Asset Management Bureau<br>• Data Management, Operations and Safety Bureau<br>• Mapping Unit<br>• Performance Section | • GIS maps and analysis<br>• Data visualization<br>• Analytics specific to functional areas |
| **Virginia** | • Six teams<br>• Established approx. 10 years | • Construction<br>• Fiscal Maintenance<br>• Performance Transformation<br>• Structures and Bridges<br>• Traffic Engineering | • Reports and decision papers<br>• Dashboards<br>• Analyses and predictions<br>• Recommendations for optimizing processes, programs and systems<br>• Data-centric information for decision-makers |
| **West Virginia** | • 11 teams<br>• Established in March 2019 | • One team in each of 10 districts<br>• One team in Central Office | • Tracking and analyzing data<br>• Reporting to management for data-driven decision-making<br>• Reporting to the public for transparency |

N/R No response

*Staffing*

Staffing positions within these agencies are summarized below. Appendix B provides detailed information about these positions, including duties, expertise, prerequisite education or coursework, and gross monthly compensation (when available).

**Iowa**

- Roadway asset management system administrator
- Systems analyst
- Information technology specialist III (three positions)

**Minnesota**

- Financial and economic forecast analyst
- Traffic research analyst
- Operations, signals and lighting analyst

- HR projects manager
- Traffic safety engineer

**Mississippi**

- Applications manager
- Developers (various levels)

**Nebraska**

- Senior IT application developer (two positions)
- IT application developer

**Vermont**

- GIS professional (levels I through V)

**Virginia**

- Senior data analytics specialist (data scientist)
- Senior program administration specialist (in some areas, data/systems analysis manager or senior program engineer)

**West Virginia**

- District administrator I and II
- Highway systems analyst
- GIS technician

Developing a Data Analytics Team

*Expertise*

Experience with data analysis techniques (Iowa, Minnesota, Nebraska, Virginia and West Virginia) and data analysis software (Iowa, Minnesota, Nebraska and Virginia) are the most important types of expertise cited by respondents for members of a data analytics team. Other essential technical skills include experience with GIS and data visualization (Vermont). Strong communication and interpersonal skills and a willingness to learn were also noted (Iowa and Vermont).

*Staff Recruitment*

Both existing staff and new hires are used in Iowa, Minnesota, Vermont, Virginia and West Virginia transportation agencies to fill staff positions. Mississippi and Nebraska DOTs use existing staff only. None of these states use new hires only.

Special recruitment practices have been established in Iowa DOT and West Virginia Division of Highways to encourage applicants to join their data analytics teams. Iowa DOT has advertised at colleges, on social media and through radio outlets while West Virginia Division of Highways has held various hiring events.

Sample job postings were provided by Iowa DOT (systems analyst) and West Virginia Division of Highways (highway systems analyst trainee, Performance Management Division; highway systems analyst, Programming Division; and senior highway systems analyst, Planning Division) (see Appendix C).

*Staff Retention*

Using a rating scale from 1 (not at all successful) to 5 (extremely successful), five states—Iowa, Mississippi, Nebraska, Vermont and Virginia—rated their agencies' success in retaining data analytics team members as very successful. Minnesota DOT and West Virginia Division of Highways rated their agencies' success as moderately successful.

## Implementing a Data Analytics Team

*Initial Implementation*

Six states described how their agencies implemented the first data analytics team. For many agencies, including Virginia DOT, implementation evolved based on the needs of the organization. In Iowa, the team evolved from one that maintained the largest enterprise database in the agency to one that performed analyses. Nebraska DOT began by training its team in basic dashboards and reports, and then moved to advanced statistics and measurements. The Vermont Agency of Transportation team's initial focus was on cartography; the team's focus has expanded over the years and it now performs more analytics.

Consultants helped Mississippi DOT develop the initial warehouse and business intelligence implementation, which essentially trained one person. As new projects arose, additional staff members were trained. West Virginia Division of Highways started with a district that already had a team in place. Members of this team trained new teams.

*Expanded Implementation*

Three states described how implementing a second team differed from the first team:

- Nebraska DOT has contracted with a consultant team for training in predictive analysis and machine learning.
- Vermont Agency of Transportation started its second team many years after the first, and it was implemented "more organically."
- Once West Virginia Division of Highways' first team was in place and functioning, the agency began assembling and training other teams.

*Effective Implementation Practices*

To ensure that team implementation is effective, respondents encouraged focusing on employees and processes:

- **Have the right staff in place**. The Virginia DOT respondent noted that with decentralized teams, "hiring the right people with the right skill sets" brings immediate value and impacts overall program management, which benefits the entire organization.

  Iowa DOT's team was very skilled at using data analysis to drive decision-making throughout the agency, which was "a significant advantage." In Nebraska, choosing employees who want to learn and providing the right training for them are essential.
- **Maintain consistency across teams**. The West Virginia Division of Highways respondent noted that ensuring consistency in positions and processes among the teams throughout the state is needed.
- **Ensure continuous improvement**. The Vermont Agency of Transportation respondent encouraged identifying an analysis need, developing the data (either directly or in partnership with other teams), and developing and refining the analysis.

*Staff Training Program*

Respondents from three agencies described a data analytics training program for staff. Online training is offered in Mississippi; in Nebraska, a consultant performs team training. West Virginia Division of Highways recently started bringing all of its teams together for monthly training and collaboration.

Assessment and Recommendations

Implementing data analytics teams in their organizations has had the following impacts:

**Successes**

- Enhanced decision-making and transparency (Virginia and West Virginia).
- Heightened awareness of team capabilities (Iowa).
- Increased efficiency (Mississippi).
- Enhanced reporting (Mississippi and Nebraska).
- Improved performance (Vermont).

**Challenges**

- Overcoming employee resistance to change (Mississippi, Nebraska and Vermont).
- Spreading the word (Iowa).
- Data integrity (Mississippi and West Virginia).
- Data governance (Vermont).
- Technology and security issues (Virginia and West Virginia).

*Implementation Recommendations*

Respondents from six agencies provided the following considerations for state transportation agencies contemplating the use of data analytics teams:

**Iowa**

- Ensure the data analytics team understands the data generated throughout the agency.
- Understand the need for and process of data integration.
- Ensure management buy-in to provide for any needed resources.

**Mississippi**

- Establish data experts for each database involved. Knowing analytics is only part of the job. Team members need to know how to extract and use the data from each source.
- Get buy-in from end users. Users sometimes think the responsibility of data analytics falls on IT. They need to understand that they must help develop and test analytics.
- Expose end users to the capabilities of data analytics. IT needs to get end users to think beyond their normal report framework to get maximum business benefit.

**Nebraska**

- Outsource data analytics. Agencies “won't be able to hire a data scientist on a state salary; contract that piece out.”
- Hire an on-site trainer to train in-house staff. This practice takes advantage of employee experience with agency data and business practices.
- Advertise data analytics services, and train DOT employees how to use them.

**Vermont**

- Create a centralized warehouse of established data that is shared with all data users.
- Establish procedures for maintaining and documenting established data.

**Virginia**

- Integrate data analytics staff within the disciplines requiring those skills. This practice will provide the "fastest and biggest" organizational impacts overall in optimization and program management.
- Assess the agency's needs and hire the right people for the right roles.
- Support the teams with a flexible technology stack that meets the various demands and is ready for the teams to leverage in their work.

**West Virginia**

- Implement data analytics teams as soon as possible. They provide a wealth of information to users.
- Prepare in advance. Know what is needed for the agency, and prepare specific job descriptions that fit the agency's needs.
- Include the data analytics team in every aspect of the agency. This team is the "heart of the organization." If managed correctly, it will house all of the agency's most valuable information.

## Consultation With Selected Experts

Six subject matter experts were contacted for their insight and experience establishing and implementing data analytics teams:

- Regina Clewlow, chief executive officer/co-founder, Populus.
- Ted Egan, chief economist, City and County of San Francisco.
- Yoz Grahame, developer advocate/solutions architect, LaunchDarkly.
- Jed Kolko, chief economist, Indeed.
- Jane Macfarlane, director, Smart Cities and Sustainable Mobility, University of California, Berkeley.
- Michael Migurski, engineering manager, Spatial Computing, Facebook.

Inquiries to these subject matter experts sought information about data analytics team composition, strategies used to develop and implement these teams, and the benefits and challenges of implementing teams.

Jane Macfarlane responded to the inquiry, asking for more information about the scope of this investigation. None of these experts provided the information requested.

## Related Research and Resources

A literature search of recent publicly available domestic resources gathered information and identified a representative sampling of publications and web sites that are organized into the following topic areas:

- Building data analytics teams.
- Developing data analytics teams.

- Private sector resources.
- Public sector resources.
- State research and resources.

Building Data Analytics Teams

Several industry publications and resources provide guidance for designing and developing a data analytics team, including a 2018 article that presents portions of four blog posts from several industry sources and a guide from the Institute for Operations Research and the Management Sciences (INFORMS) to help leaders “get started with or enhance analytics implementation in their organizations.” Other resources examine the roles and responsibilities of analytics team members, such as a June 2020 Altexsoft blog post and an INFORMS web page.

Developing Data Analytics Teams

Articles from Harvard Business Review focus on team development. Best practices for developing data analytics teams are presented in a March 2020 article, which presents five scenarios that demonstrate varying levels of success with implementation. A May 2020 article encourages organizations to approach data with a product mindset to improve day-to-day operations. An October 2018 article advises coping with the shortage of data talent by hiring from within the organization, sourcing employees who are “innovative, frugal and creative, who produce maximum results with minimal resources.”

Private Sector Resources

Numerous resources present summary information about private sector organizations that encourage data-driven cultures and develop data analytics expertise in-house, including a January 2022 podcast featuring Iwao Fusillo, chief of data at General Motors (GM). Fusillo discusses his two priorities at GM:

- **Acquiring data talent**. GM has created cross-functional communities of data analytics professionals to share best practices and create career paths to acquire talent from multiple industries.
- **Advocating for data literacy throughout the company**. To ensure that all employees develop a passion and core competency in using data, the company has established the GM Analytics Academy, which makes online training available to all employees.

Among the key takeaways from the podcast: The best talent is both skilled and passionate. If you’re only evaluating candidates based on a bulleted list of current skills and past experience, you’re very likely missing out on great talent. Don’t discount a desire to learn and passion for your product or industry.

Additional resources describe data analytics success stories and lessons learned from private sector corporations, including two articles in CIO magazine (October 2018 and August 2019). A June 2017 article in The CEO Corner offers lessons learned during Partners Federal Credit Union’s four-year effort to “cultivate a thriving data analytics practice.”

Public Sector Resources

Highlighted in this section are public agency practices to encourage a data-driven approach to decision-making in city government. A case study of the New York City Mayor's Office of Data Analytics (MODA) examines its data-driven approach that is being adopted by other cities in the United States and abroad. MODA is encouraging use of this approach through three initiatives: analytics projects, citywide data sharing and open data. In addition, MODA facilitates the

Analytics Exchange, a community of practice for data analysts from city agencies who meet quarterly to discuss their work and share interests and concerns.

A June 2015 report presents lessons learned from the MODA model that could be used to form an office of data analytics in London.

A January 2017 report from International City/County Management Association presents common practices and strategies for building a data analytics team, including findings from Kansas City, Missouri; Cincinnati, Ohio; and San Jose, California, which have programs at different stages of development.

State Research and Resources

Resources in this section examine workforce development and challenges in the digital age. A November 2018 University of California report explores obstacles to hiring data analysts and software engineers, and a May 2018 report presents trends in data scientist compensation and demographics. An October 2017 presentation summarizes the state-of-the-practice and the challenges faced in improving transportation system and operations education and training.

## Gaps in Findings

The number of state DOTs that participated in the survey was limited. Although useful information was provided by those agencies that did respond, information from other state transportation agencies could potentially increase the findings of this effort and provide further guidance for building and developing data analytics teams.

The lack of response from the subject matter experts also limited the information gathered from public and private sector resources. Continued outreach to these and other professionals could produce insights and experiences of value.

## Next Steps

Moving forward, Caltrans could consider:

- Following up with selected respondents and other state transportation agencies to gather more information about practices related to data analytics teams:
    - Kansas DOT's RFP to employ consultant data analytics teams.
    - Michigan DOT's plans to develop data analytics teams.
    - Nevada DOT's progress with rolling out a data analytics program.
- Contacting Jane Macfarlane, director, Smart Cities and Sustainable Mobility, University of California, Berkeley, for her insights and past experience with data analytics in the private sector.
- Reaching out to the remaining subject matter experts to encourage them to share their experience establishing and working with data analytics teams.
- Reviewing the resources provided in the literature search:
    - Case study of MODA and lessons learned from other city governments.
    - Interview with Iwao Fusillo for his perspective on acquiring data talent and advocating data literacy throughout a company.
    - Articles and blog posts that address building and developing data analytics teams.

# Detailed Findings

## Background

California is undergoing a digital transformation and employees occupying data-related positions are needed to support the transformation. Currently a comprehensive review of data job classifications is underway to support a multiagency workgroup aimed at improving the state's ability to recruit, hire, retain and advance data-related jobs. This effort will help inform how California continues to evolve its jobs classes to maximize its ability to recruit and hire the data talent needed and also provide meaningful advancement opportunities for existing staff.

California Department of Transportation (Caltrans) is seeking to supplement information gathered in this wide-ranging review with a more focused examination of public and private sector practices related to implementing data analytics teams. Specifically, Caltrans is interested in the composition of data analytics teams, the roles and responsibilities of team members, where these teams exist in an organization, recruiting and retention practices, and team implementation strategies.

To assist Caltrans in gathering information for this narrower area of focus, CTC & Associates conducted a national survey of state departments of transportation (DOTs) to inquire about agency experience with data analytics teams. In addition, a selected group of subject matter experts were contacted to learn about their experiences with data analytics teams. Results of a literature search of publicly available domestic research and resources focused on best practices for building and developing data analytics teams and on the use of these teams in the public and private sectors. Finding from these efforts are presented in three areas:

- Survey of practice.
- Consultation with selected experts.
- Related research and resources.

## Survey of Practice

An online survey was distributed to state DOT members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Data Management and Analytics. This committee's membership is national in scope and includes representatives from state DOTs in all 50 states and the District of Columbia. Survey questions are provided in Appendix A. The full text of survey responses is presented in a supplement to this report.

Eleven state transportation agencies responded to the survey. Agencies in seven states—Iowa, Minnesota, Mississippi, Nebraska, Vermont, Virginia and West Virginia—use data analytics teams.

Four states—Kansas, Michigan, Nevada and New Hampshire—do not use data analytics teams, however, Kansas, Michigan and Nevada are considering implementing them. Information provided by these agencies begins on page 20.

Below are survey findings from the seven state agencies that use data analytics teams. Results are summarized in the following topic areas:

- Data analytics team description.

- Developing a data analytics team.
- Implementing a data analytics team.
- Assessment and recommendations.

# Data Analytics Team Description

## Composition of a Data Analytics Team

Survey respondents described the following components of their agencies' data analytics teams:

- *Number of data analytics teams within the agency*. The number of teams reported by survey respondents ranged from one (Iowa, Mississippi and Nebraska) to 11 (West Virginia).
- *Date when these teams were formed*. The date when agencies implemented data analytics teams also varied, ranging from approximately three years (West Virginia) to 20 years (Iowa). The Iowa DOT respondent noted that as GIS developed, more and more areas within the agency began to understand the importance of data and analysis in day-to-day operations.
- *Location of these teams within the organizational structure of the agency*.
- *Products and services provided by the teams*. Products and services meet the needs of a range of functional areas. The Mississippi DOT respondent noted that the agency uses analytics wherever an appropriate use arises. Generally, an end user identifies a need and the data analytics team then uses the appropriate tools to meet that need. He added that when the agency began implementing business intelligence practices, IT tended to encourage the use of analytics as a management tool. However, that practice was not adopted by all managers.

Table 1 and Table 2 summarize survey responses.

**Table 1. Data Analytics Teams: Number and Origin**

| State | 1 | 4 | 6 | 11 | Other | Description |
|---|---|---|---|---|---|---|
| **Iowa** | X | | | | X | • 1 Analytics Bureau team<br>• Several coordinated efforts with analysts in various areas of the agency<br>• Established approx. 20 years |
| **Minnesota** | | | | | X | • Various within functional groups (e.g., Traffic, Finance, Crash, Freight, Human Resources (HR), Maintenance and IT)<br>• Established: N/R |
| **Mississippi** | X | | | | | • 1 semiformal analytics group<br>• Established in 2010 |
| **Nebraska** | X | | | | | Established in 2018 |
| **Vermont** | | X | | | | Established:<br>• Oldest team: over 20 years<br>• Others: 5-10 years |

| State | 1 | 4 | 6 | 11 | Other | Description |
|---|---|---|---|---|---|---|
| **Virginia** | | | X | | | Established approx. 10 years |
| **West Virginia** | | | | X | | Established in March 2019 |
| **Total** | **3** | **1** | 1 | **1** | **2** | |

N/R No response

**Table 2. Data Analytics Teams: Location Within Agency and Products and Services**

| State | Location | Products and Services |
|---|---|---|
| **Iowa** | Transportation Design and Development Division | • Pavement condition evaluation<br>• Pavement management<br>• Interstate planning<br>• Project prioritization<br>• Corridor analysis<br>• National Performance Measures calculations<br>• Highway Performance Monitoring System submittal<br>• Other functions |
| **Minnesota** | IT and various functional groups (no centralized data analytics office) | • Traffic counts<br>• Crash statistics<br>• Workforce data analytics<br>• Financial reports (project expenditures, salary forecasts)<br>• Snow and ice information<br>• Market research<br>• Infrastructure life cycle analyses |
| **Mississippi** | • 1 analytics manager, who is the warehouse manager and chief warehouse architect.<br>• Manager leads a team of several employees who perform analytics part time and other development. | • Analytical analysis using SQL Server Analysis Services (SSAS), Power BI and other Microsoft tool sets.<br>• Warehouse database development for certain data sets.<br>• Internal and external dashboard development. |
| **Nebraska** | Business Intelligence section of the Data Warehouse Group | • Reports<br>• Dashboards<br>• R code Shiny apps |
| **Vermont** | • Data Management Section, Asset Management Bureau<br>• Data Management, Operations and Safety Bureau<br>• Mapping Unit<br>• Performance Section | • GIS maps and analysis<br>• Data visualization<br>• Analytics specific to functional areas |
| **Virginia** | • Construction<br>• Fiscal Maintenance<br>• Performance Transformation<br>• Structures and Bridges<br>• Traffic Engineering | • Reports and decision papers<br>• Dashboards<br>• Analyses and predictions<br>• Recommendations for optimizing processes, programs and systems<br>• Data-centric information for decision-makers |

| State | Location | Products and Services |
|---|---|---|
| **West Virginia** | • 1 team in each of 10 districts<br>• 1 team in Central Office | • Tracking and analyzing data<br>• Reporting to management for data-driven decision-making<br>• Reporting to the public for transparency |

## Data Analytics Team Staffing

Respondents provided detailed information about the types of staff positions that make up the data analytics team, including duties, expertise, prerequisite education or coursework, and gross monthly compensation for each position, when available. Table 3 summarizes the staff positions currently in place in these state agencies. More detailed information about each position is provided in Appendix B.

**Table 3. Data Analytics Team Staffing**

| State | Staff Position | Additional Information |
|---|---|---|
| **Iowa** | • Roadway asset management system administrator<br>• Systems analyst<br>• Information technology specialist III (3 positions) | The agency sometimes lacks the staff needed to perform all analytics. |
| **Minnesota** | • Financial and economic forecast analyst<br>• Traffic research analyst<br>• Operations, signals and lighting analyst<br>• HR projects manager<br>• Traffic safety engineer | |
| **Mississippi** | • Applications manager<br>• Developers (various levels) | Because its pay scale prevents hiring experienced staff, the agency uses existing employees as analytical developers and trains them to use the tools and techniques to deliver the end result. |
| **Nebraska** | • Senior IT application developer (2 positions)<br>• IT application developer | |
| **Vermont** | • GIS professional V<br>• GIS professional IV<br>• GIS professional III<br>• GIS professional II<br>• GIS professional I | While data analytics teams are primarily made up of GIS professionals, they also include analysts, managers, technicians and other staff. |
| **Virginia** | • Senior data analytics specialist (data scientist)<br>• Senior program administration specialist (in some areas, data/systems analysis manager or senior program engineer) | |
| **West Virginia** | • District administrator II<br>• District administrator I<br>• Highway systems analyst<br>• GIS technician | |

# Developing a Data Analytics Team

## Expertise

Experience with data analysis techniques (five responses) and data analysis software (four responses) are the most important type of expertise cited by respondents for members of a data analytics team. Other essential technical skills include experience with GIS and data visualization. Strong communication and interpersonal skills and a willingness to learn were also noted (two responses). Table 4 summarizes survey responses.

**Table 4. Expertise Needed for Data Analytics Teams**

| State | Data Analysis Experience | Data Analysis Software | Interpersonal Skills | Other | Description |
|---|---|---|---|---|---|
| **Iowa** | X | X | X | | • Ability to understand complex analysis.<br>• Skilled in a variety of analysis software.<br>• Strong communication skills to serve customers effectively. |
| **Minnesota** | X | X | | | Experience and advanced technical knowledge in data analysis software and techniques |
| **Nebraska** | X | X | | | • Ability to analyze what measurement is needed.<br>• Ability to select the tool for the measurement. |
| **Vermont** | | | X | X | • GIS experience.<br>• Data visualization experience.<br>• Good interpersonal skills. |
| **Virginia** | X | X | | | • Expertise in transportation-related analytics.<br>• Experience with diverse tools/platforms and software. |
| **West Virginia** | X | | | X | • Knowledge of subject matter.<br>• Education.<br>• Willingness to learn. |
| **Total** | **5** | **4** | **2** | **2** | |

## Staff Recruitment

Sources for Staff Recruitment

Five states—Iowa, Minnesota, Vermont, Virginia and West Virginia—use both existing staff and new hires when filling staff positions. Mississippi and Nebraska DOTs use existing staff only. None of these states use new hires only.

*Special Recruitment Practices*

Iowa DOT and West Virginia Division of Highways have established special recruitment practices to encourage applicants to join their data analytics teams:

- *Iowa DOT* has advertised at colleges, on social media and through radio outlets.
- *West Virginia Division of Highways* has held various hiring events to recruit staff.

*Job Postings*

Appendix C includes sample position postings provided by two respondents:

**Iowa DOT**

- Systems analyst

**West Virginia**

- Highway systems analyst trainee, Performance Management Division
- Highway systems analyst, Programming Division
- Senior highway systems analyst, Planning Division

### Staff Retention

Using a rating scale from 1 (not at all successful) to 5 (extremely successful), five states—Iowa, Mississippi, Nebraska, Vermont and Virginia—rated their agencies' success in retaining data analytics team members as very successful. Minnesota DOT and West Virginia Division of Highways rated their agencies' success as moderately successful.

## Implementing a Data Analytics Team

### Initial Implementation

Respondents from six states described how their agencies implemented the first data analytics team:

- Iowa DOT's team evolved from the team maintaining the largest enterprise database in the agency. As the need for analysis grew, the team was able to enhance existing skills through training from vendors, conferences and other sources.
- Mississippi DOT used consultants to help develop the agency's initial warehouse and business intelligence implementation. The effort was a learning project to develop in-house ability that essentially trained one person. As new projects arose, additional staff members were trained.
- Nebraska DOT began by training its team in basic dashboards and reports. From there, it moved to advanced statistics and measurements
- Vermont Agency of Transportation's team has had its mapping unit for more than 20 years. While the focus initially was cartographic, it has expanded over the years to perform more analytics.
- As seen in other agencies, implementation in Virginia DOT was a "natural transformation" based on the organizational need for the specific skill sets in data analytics. These teams have been part of the culture for some time.
- West Virginia Division of Highways started with a district that already had a team in place. Members of this team trained new teams.

## Expanded Implementation

Three states with more than one data analytics team described how the implementation practices of a second team differed from the first team:

- Nebraska DOT has contracted with a consultant team for training in predictive analysis and machine learning.
- Vermont Agency of Transportation started its second team many years after the first, and it was implemented "more organically." The respondent added that the agency has only had a need for data analysis in the last five to 10 years.
- Once West Virginia Division of Highways' first team was in place and functioning, the agency began assembling and training other teams.

## Factors in Effective Implementation

Elements to ensure that team implementation is effective focus on employees and processes:

- **Having the right staff in place**:
    - The Virginia DOT respondent noted that with decentralized teams, "hiring the right people with the right skill sets" brings immediate value and impacts overall program management, which benefits the entire organization.
    - Iowa DOT's team was very skilled with the data and understood how to analyze it for use in decision-making throughout the agency. The respondent added that "the time they spent working with the data previously has been a significant advantage."
    - Also key to effective implementation, according to the Nebraska DOT respondent, is choosing employees who want to learn, and providing the right training for them.
- **Maintaining consistency across teams**. The West Virginia Division of Highways respondent noted that consistency in positions and processes among the teams statewide is needed.
- **Ensuring continuous improvement**. The Vermont Agency of Transportation respondent noted the importance of:
    - Identifying an analysis need.
    - Developing the data, either directly or in partnership with other teams.
    - Developing and refining the analysis.

## Staff Training Program

Three agencies have implemented a staff training program specific to data analytics:

- Mississippi DOT primarily uses online training for individuals as needed.
- Nebraska DOT has hired a consultant to train its team.
- West Virginia Division of Highways recently started bringing all of its teams together for monthly training and collaboration. The respondent noted that this effort "has been a success."

# Assessment and Recommendations

## Successes With Using a Data Analytics Team

Six respondents noted successes that their agencies have experienced as a result of implementing data analytics teams in their organizations:

- **Enhanced decision-making and transparency**:
    - Virginia DOT reports improved decision-making and optimization of programs.
    - West Virginia Division of Highways can now make data-driven decisions and be more transparent as an agency.
- **Heightened awareness of team capabilities**. Although Iowa DOT's data analytics teams are still developing, they have been involved in a variety of enterprise activities, which has helped to spread understanding of the teams' capabilities throughout the agency.
- **Increased efficiency**. Using financial data, Mississippi DOT has implemented an analytical cube to allow for ad hoc reporting. Projects that used to require days to collect and compile data from multiple sources can now be completed in minutes. This resource has become the budget division's main reporting source.
- **Enhanced reporting**:
    - Mississippi DOT has developed Microsoft Power BI dashboards to display on its external web site. It has also implemented analyses of maintenance tasks, right of way acquisition, crash analysis and various smaller data sets.
    - Nebraska DOT has also developed Power BI dashboards, reports and R code Shiny app portals. As a result, the number of employees using dashboards has increased, and customers are requesting assistance from data analytics teams instead of being told to use team services.
- **Improved performance**. Vermont Agency of Transportation reports having "a strong GIS backbone." Early adoption of data visualization tools such as Power BI has also improved performance. The respondent noted that keeping efforts "small and concise" contributed to this success.

## Challenges With Using a Data Analytics Team

Respondents reported the following obstacles to implementing data analytics teams:

- **Overcoming the resistance to change**:
    - The Mississippi DOT respondent noted that initially, employees were "a bit apprehensive" of creating reports or conducting analyses from a business intelligence environment instead of the source system, and "[i]t took time for them to come to trust the warehouse data."
    - The Nebraska DOT respondent also cited changing how employees think as a challenge. The team needed to educate employees about the benefits of changing business practices and get them to understand that measurements are "meant to help them find areas for improvement, not to measure what they are personally doing wrong."
    - The Vermont Agency of Transportation respondent noted the "abundance of tribal knowledge."

- **Spreading the word**. Although awareness of Iowa DOT's data analytics teams has grown, the respondent noted that "[t]here is still work to do to help others understand what is available."
- **Data integrity**:
    - When Mississippi DOT began analyzing data, team members would find data problems that either caused technical issues or caused calculations to be skewed, such as begin dates after end dates, end dates in year 30xx and fields with mostly empty data.
    - Obtaining accurate data while the analytic team members were being trained was a challenge for West Virginia Division of Highways.
- **Data governance**. The Vermont Agency of Transportation respondent cited the need for formal data governance.
- **Technology and security issues**:
    - Virginia DOT has experienced technology- and security-related challenges, such as implementation of a government tenant platform for cloud computing.
    - In West Virginia, multiple software databases were incompatible and required the user to calculate manually.

## Recommendations for Implementation

Six respondents provided the following considerations for state transportation agencies contemplating the use of data analytics teams:

### Iowa

- Ensure the data analytics team understands the data generated throughout the agency.
- Understand the need for and process of data integration.
- Ensure management buy-in to provide for any needed resources.

### Mississippi

- Establish data experts for each database involved. Knowing analytics is only part of the job. Team members need to know how to extract and use the data from each source. Usually the more knowledgeable a team member is with the database, "the quicker something can be developed."
- Get good buy-in from the end users. Users sometimes think the responsibility of data analytics falls on IT. They need to understand that they must help develop and test analytics.
- Expose end users to the capabilities of data analytics. IT needs to get end users to think beyond their normal report framework to get maximum business benefit.

### Nebraska

- Outsource data analytics. Agencies "won't be able to hire a data scientist on a state salary; contract that piece out."

- Hire an on-site trainer to train in-house staff. This practice takes advantage of employee experience with agency data and business practices.
- Advertise data analytics services, and train DOT employees how to use them. They won't use a tool that they don't comprehend.

**Vermont**

- Create a centralized warehouse of established data that is shared with all data users.
- Establish procedures for maintaining and documenting established data.

**Virginia**

- Integrate data analytics staff within the disciplines requiring those skills. This practice will provide the "fastest and biggest" organizational impacts overall in optimization and program management.
- Assess the agency's needs and hire the right people for the right roles. It may take several rounds of interviews to hire the right staff, but do not compromise.
- Support the teams with a flexible technology stack that meets the various demands and is ready for the teams to leverage in their work.

**West Virginia**

- Implement data analytics teams as soon as possible. They provide a wealth of information to users.
- Prepare in advance. Know what is needed for the agency, and prepare specific job descriptions that fit the agency's needs.
- Include the data analytics team in every aspect of the agency. This team is the "heart of the organization." If managed correctly, it will house all of the agency's most valuable information.

## Absence of Data Analytics Teams

Respondents from Kansas, Michigan, Nevada and New Hampshire DOTs reported that their agencies do not use data analytics teams. New Hampshire DOT has no plans to employ data analytics teams, however, Kansas, Michigan and Nevada DOTs are considering implementing them. Current practices and future plans from these three agencies are described below:

- **Kansas DOT** recently engaged a data analytics firm to evaluate the agency's contractor bidding data to identify trends and the cost-competitiveness of projects being awarded, evaluate the extent to which the agency is attracting satisfactory levels of competition and pricing, and identify factors that are driving these results. This engagement was very successful, leading the agency to issue a request for proposal (RFP) to employ consultant data analytics teams. Through the RFP, the agency will solicit up to five consulting firms with experience in transportation planning and policy, data governance, data science and analysis, performance management, business intelligence, data visualization and GIS. The firms will perform on-call services through task orders in these subject areas. The outcomes of these task orders will inform and improve data-driven decision-making and business processes; support the agency's strategies in

evaluating, monitoring and reporting agencywide performance of business activities; and support the agency's priorities of transparency and accountability.

- **Michigan DOT**:

  *Current practices:*

  - **Staffing**. The agency's Enterprise Information Management (EIM) office is in the process of hiring a contractor and two full-time-equivalents (FTEs) to assist with data analytics. The office plans to build out self-service data analytics with EIM review. The agency is developing position descriptions for the two FTE positions that will be used when the positions are approved. (*Note*: The respondent planned to share the position description for the contract position. However, we had not received the description at the time of publication of this report.)
  - **Proofs of concept**. The agency has conducted about five data analytics proofs of concept (POCs). "An excellent resource" was assigned to the first two, however, she had to transition off before the second POC was complete. The respondent reported that completing the other POCs "has been arduous" because the resources have a traditional IT perspective instead of a data-driven perspective. She added that these POCs have raised more interest in the "art of the possible" than the agency can currently support.

    Lessons learned from the POCs:

    - Make sure you have qualified staff in place who want to understand the data and like identifying visuals that are meaningful for the data.
    - Don't oversell the speed or easiness. Good data analytics with visuals that appropriately convey the context take time and a special skill set.
    - Consider documenting standards that support transparency of the context of the data analytics and ensure the standards are followed.
  - **Data literacy program**. In the past year, information stewards participated in a data literacy program, which has helped with the general understanding of the importance of good data analytics and how bad data analytics can happen accidentally when people are not versed in good practices.

- **Nevada DOT** has included a data and analytics program in its strategic plan, and the agency is currently developing a roadmap and governance. The respondent noted that the program rollout is on hold because of a lack of funding and changes in leadership.

# Consultation With Selected Experts

The following subject matter experts were contacted to learn about their experience establishing and working with data analytics teams, including information about team composition, strategies used to develop and implement a data analytics team, and the benefits and challenges of implementing a team:

- Regina Clewlow, chief executive officer/co-founder, Populus.
- Ted Egan, chief economist, City and County of San Francisco.
- Yoz Grahame, developer advocate/solutions architect, LaunchDarkly.
- Jed Kolko, chief economist, Indeed.
- Jane Macfarlane, director, Smart Cities and Sustainable Mobility, University of California, Berkeley.
- Michael Migurski, engineering manager, Spatial Computing, Facebook.

Jane Macfarlane responded to our request for information, asking for more information about this investigation. However, none of the experts provided information about data analytics team implementation.

# Related Research and Resources

A literature search of recent publicly available domestic resources gathered information and identified a representative sampling of publications and web sites that are organized into the following topic areas:

- Building data analytics teams.
- Developing data analytics teams.
- Private sector resources.
- Public sector resources.
- State research and resources.
- Related resources.

## Building Data Analytics Teams

**"How to Build a Data Analytics Team,"** Brianne Schaer, Iteration Insights, August 16, 2021.
https://iterationinsights.com/article/how-to-build-a-data-analytics-team/
Guidance is provided for structuring a winning data analytics team. Topics include:

- Building an analytics foundation of data literacy and data culture.
- Ensuring analytics remains an iterative process and that teams are able to adapt.
- Creating an environment where data analytics teams interface with business and IT.
- Dedicating resources to establish a strong data culture.

**"How to Structure Your Data Analytics Team,"** Tim Stobierski, *Business Insights Blog*, Harvard Business School Online, March 9, 2021.
https://online.hbs.edu/blog/post/analytics-team-structure
This blog post describes the key players on a data analytics team and identifies factors to consider when building a team.

**Advanced Analytics—How to Build a Team in 6 Steps**, Matt Cowell, QuantHub, November 13, 2019.
https://quanthub.com/advanced-analytics/
The following topics are addressed in this team-building guide:

- Define your data vision and strategy.
- Structure your advanced analytics organization.
- Define the roles and skills.
- Recruit and assess skills.
- Develop and democratize analytics skills.
- Retain your analytics talent.

**"Designing Analytics Teams, Some Options and Advice to Consider,"** Paul Laughlin, CustomerInsightLeader.com, February 5, 2018.
https://www.customerinsightleader.com/others/designing-analytics-teams/
This article includes portions of four blog posts from several industry sources about designing and developing data analytics teams, including AltexSoft, a travel and hospitality technology consulting company (see *Related Resource* below for an updated blog post from AltexSoft).

*Related Resource:*

**How to Structure a Data Science Team: Key Models and Roles to Consider**, Blog Post, Altexsoft, June 30, 2020.
https://www.altexsoft.com/blog/datascience/how-to-structure-data-science-team-key-models-and-roles/
Topics include data-driven team structure; data science team roles (with a chart listing necessary and preferred skills); team assembly and scaling; various models for integrating a data science team (decentralized, functional, consulting, centralized, center of excellence, federated and democratic); and other recommendations for creating a high-performance data science team.

**Answering the Digital and Analytics Talent Gap: The New 'Trilinguals': The 2015 Leadership Excellence in Analytic Practices (LEAP) Study**, Kearney, 2015.
https://www.kearney.com/analytics/article?/a/answering-the-digital-and-analytics-talent-gap-the-new-trilinguals
This study examines the "opportunities and challenges that companies face in acquiring digital and analytics talent." Strategies and practices are presented to recruit, develop and retain staff.

**Building Successful O.R. and Analytics Teams**, Institute for Operations Research and the Management Sciences (INFORMS), undated.
https://www.informs.org/Explore/Building-Successful-O.R.-and-Analytics-Teams
This web page provides access to How Organizations Can Get Started With Analytics, a guide "for leaders who want to get started with or enhance analytics implementation in their organizations." The guide includes tools and strategies to help leaders

- Assess the current state of analytics within the organization.
- Establish goals for an analytics team, including funding, hiring and managing teams.
- Launch an analytics program.
- Sustain and grow analytics.

**Roles and Responsibilities for the Analytics Team**, Institute for Operations Research and the Management Sciences (INFORMS), undated.
https://www.informs.org/Explore/Building-Successful-O.R.-and-Analytics-Teams/Roles-and-Responsibilities-for-the-Analytics-Team
Initial steps to building an analytics strategy are summarized, including the following:

- Identify the customer (who the team will serve).
- Define how the analytics team will enable the client or business initiative. Most analytics teams will:
    - Build big data collection and analytics capabilities to uncover customer, product and operational insights.
    - Analyze data sources and propose solutions to strategic planning problems on a one-time or periodic basis.
    - Provide data-driven decision support.
    - Develop analytics models and insights for customer- or employee-facing applications to drive efficiency or revenue.
- Determine the types of analytics that the team will provide.

Partnering with other professionals such as IT staff, vendors and universities is also discussed.

## Developing Data Analytics Teams

**"Approach Your Data With a Product Mindset,"** Jedd Davis, Dave Nussbaum and Kevin Troyanos, *Harvard Business Review*, May 12, 2020.
https://hbr.org/2020/05/approach-your-data-with-a-product-mindset?utm_source=facebook&utm_campaign=hbr&utm_medium=social&fbclid=IwAR0XalJOra6iM9DqzPimqzUznEsOxzlYVMChHOTLf5MyGctC2XCxPqgm8_s
*From the introduction*: When it comes to leveraging data to improve their day-to-day operations, organizations need to look beyond building a team of skilled data professionals and arming it with the latest analytics tools and technologies. A well-equipped analytics team is a necessary condition of using data to drive business value, but it's not a sufficient one. To more actively contribute to the achievement of critical business outcomes, analytics teams should start viewing their random forests and neural networks through a product development lens. By bringing a product development approach to the planning and execution of analytics, organizations can scale isolated successes into the kind of sustained, organizationwide, data-driven decision-making that serves as the foundation of genuine digital transformation.

**"What's the Best Approach to Data Analytics?,"** Tom O'Toole, *Harvard Business Review*, March 2, 2020.
https://hbr.org/2020/03/whats-the-best-approach-to-data-analytics
Five scenarios are presented illustrating varying levels of success with data analytics implementation followed by best practices for an effective implementation approach. *From the article*:

**Best Practices for Data Analytics**

- **Data science can't happen in a silo.** It must be tightly integrated into the business organization, operations and processes.

- **There needs to be joint prioritization.** Business leaders and data scientists should jointly decide which business problems to focus on. If there is any question about priority, the final call should go [to] the business heads.
- **Leaders need to be conversant in data science.** Business leaders don't need in-depth expertise in data science, but they require a basic, working understanding. Being conversant enables business leaders to work effectively with their data science teams.
- **You may need to accept "inconvenient outcomes."** Data inevitably creates transparency and reveals business insights that can be unexpected, uncomfortable and unwelcome. Data analytics will unearth inefficiencies and misconceptions that complicate leadership and disrupt conventional thinking. Business leaders who crush or ignore answers they don't like will rapidly undercut the value of data analytics.

**"Your Team Doesn't Need a Data Scientist for Simple Analytics,"** by Kon Leong, *Harvard Business Review*, October 30, 2018.
https://hbr.org/2018/10/your-team-doesnt-need-a-data-scientist-for-simple-analytics
*From the summary*:

> Data analytics is a powerful and promising source of competitive advantage. But organizations are often hobbled by the lack of the requisite skills in the marketplace. To cope with the shortfall in market supply, companies need to better leverage their existing talent. One strategy is to take the team approach to cross-pollinate and commingle the required skillsets, bringing together a diversity of skills and backgrounds from within your organization. Seek individuals who are innovative, frugal and creative, who produce maximum results with minimal resources. This combination of creativity and curiosity is difficult to teach, but essential to effective analytics.

The following approaches to team development are recommended:

- **Build a team.** Bring together a diversity of skills and backgrounds from within your organization.
- **Find the supporting players**—data analytics experts, data experts, data architects, IT technology and process experts, and records managers—outside your department in order to lay the foundation for functional analytics initiatives.
- **Seek creativity and curiosity**. Employees "who are innovative, frugal and creative, who produce maximum results with minimal resources … can make a huge difference in producing actionable results, while reducing time, effort and costs."
- **Make the data usable**. Data teams should use "methodologies and technologies that present data in an accessible, visual and intuitive fashion."
- **Consult legal and compliance stakeholders** to ensure that analytics initiatives are in compliance with legal requirements and new privacy regulations.

**"Help Your Team Understand What Data Is and Isn't Good For,"** Joel Shapiro, *Harvard Business Review*, October 12, 2018.
https://hbr.org/2018/10/help-your-team-understand-what-data-is-and-isnt-good-for
*From the summary:*

> [W]hen it comes to uncovering the motivations and rationale behind individual behaviors within a social system, data can only do so much. It can guide the discovery of a problem, but it won't determine the solution. In other words, data analytics can tell you what is

happening, but it will rarely tell you why. To effectively bring together the what and the why, leaders need to combine the advanced capabilities of big data and analytics with tried-and-true qualitative approaches such as interviewing groups of individuals, conducting focus groups and in-depth observation. Solving social behaviors still requires small-scale qualitative exploration to engage people and learn more about what's truly motivating the behaviors that show up in the data.

The author presents five considerations:

- Data can determine the "what" of a problem.
- Data rarely reveal the "why."
- The "why" needs a qualitative approach.
- You need to consider temporal and other factors.
- You need rigorous testing to find the right solution.

## Private Sector Resources

**"GM's Iwao Fusillo on Recruiting Top Talent and Building a Successful Data Literacy Strategy,"** Podcast, The Data Chief, January 5, 2022.
https://www.thoughtspot.com/data-chief/ep41/gm-iwao-fusillo-on-recruiting-top-talent-and-building-a-successful-data-literacy-strategy
*From the summary:*

> Iwao Fusillo, Chief Data and Analytics Officer at General Motors, explains why domain expertise is not a precursor to a successful career in data and analytics, how to scale remote and hybrid teams, and how to implement a data literacy strategy within a legacy company.

In this interview, Fusillo describes his priorities as GM's "data evangelist":

- **Acquiring data talent.** GM has created cross-functional communities of data analytics professionals to share best practices and create career paths to acquire talent from multiple industries.
- **Advocating for data literacy throughout the company.** To ensure that all employees develop a passion and core competency in using data, the company has established the GM Analytics Academy—online training available to all employees.

Among the key takeaways from the podcast:

- The best talent is both skilled and passionate: If you're only evaluating candidates based on a bulleted list of current skills and past experience, you're very likely missing out on great talent. Don't discount a desire to learn and passion for your product or industry.

**"Developing Data Science Skills In-House: Real-World Lessons,"** Bob Violino, *CIO*, October 2, 2018.
https://www.cio.com/article/222337/developing-data-science-skills-in-house-real-world-lessons.html
Brief summaries of several organizations highlight how they are encouraging data-driven cultures and developing data analytics expertise in-house:

- **Carnival Cruise Line's** Risk Advisory and Assurance Service Department supports professional growth and education for employees through various resources, including

Udacity Predictive Analytics Nanodegree online program and analytics tools from vendors such as Alteryx and Tableau, and training in analytics tools from Alteryx, Tableau and other vendors.

- **Ibotta**, which develops mobile shopping apps, uses formal and informal training to build a data analytics team with employees from within the company. Internal course offerings include SQL, Python, Spark, effectively communicating analytical results and using TensorFlow to build neural networks. Biweekly brainstorming sessions address analytics and data science topics. Ibotta encourages analysts to share "skills, capabilities and constraints." The company also hosts and attends data science meetings near its headquarters, and annually sponsors each data scientist to attend a conference of choice, who then shares findings with the organization.
- **McAfee** has established the Analytic Center of Excellence (ACE) "with a framework of value proposition, evangelism (including training and mentoring), models/algorithms and data management." Among the strategies used to ensure professional growth are regularly scheduled "tech talks" about algorithms; community of practice workgroups in education, human resources and industry/academia partnerships; technical workgroups; a mentoring program; and a short course on data monetization. In-depth training includes an introductory course in analytics, cleaning and preprocessing data, and an introduction to models and machine learning. Employees are also encouraged to pursue degree or certificate programs externally.
- **Micron**, which provides computer memory technology, prioritizes ongoing learning and education, specifically to pursue advanced degrees but also through participating in massive online open courses and attending and presenting at conferences (internally and externally). Approximately half of the data scientists come from within the company, typically engineering. Successful employees "have strong data fundamentals, inquisitive and exploratory mindsets, and most critically [the] aptitude to master statistics and machine learning methods."
- **Ogury**, which provides mobile data technology, believes that creating an inviting workplace is key to maintaining a talented data analytics team. Data teams own and manage their projects, working closely with data engineers and development and product teams. Ogury strives to keep team members well-trained, encouraging employees to join new departments every 12 or 18 months to provide opportunities for growth. Other practices used to retain data scientists:
    - *Eliminate technical limitations* by providing access to a cloud-based testing environment where they can evaluate data and the ideas they are testing.
    - *Encourage collaboration* among data scientists and data engineers.
    - *Fit algorithms to the data* and not "twist the data to fit it into well-known or predetermined algorithm."
- **SessionM**, which provides a customer data and engagement platform, is creating a team of dedicated data science engineers to design and write artificial intelligence (AI) software. The company has also launched several initiatives to help develop data science literacy throughout the company. Meetings with other departments allow the data science engineers to educate employees about the company's data science strategy, methods and best practices, and train employees to gather data from customers that will enhance outcomes and insights. SessionM also hosts meetings and social events focused on AI.

**Establishing a Thriving Data Analytics Practice Is a Journey**, John Janclaes and Juan Gorricho, The CEO Corner, June 10, 2017.
http://theceocorner.com/establishing-a-thriving-data-analytics-practice-is-a-journey/
*From the introduction*: Deploying data analytics across a business organization is not a project but a journey, best navigated in partnership between the Chief Executive Officer and Chief Data & Analytics Officer (CDO). In this Q&A, John Janclaes and Juan Gorricho share insights from their work together at Partners Federal Credit Union and offer lessons learned, positive and negative, during the credit union's four-year (and counting) trek to cultivate a thriving data analytics practice. [Partners Federal Credit Union, a not-for-profit financial cooperative headquartered in Burbank, California, serves employees and cast members of The Walt Disney Company and their family members.]
….

**Key Learnings From This Journey**

- Start with [a] strategy clearly stating business objectives and priorities to help drive the data analytics roadmap.
- Understand that organizational design for data analytics teams is evolving across industries. It's supposed to be that way, so relax!
- Work to ensure role clarity, which can be challenging in getting specialists from across domains (e.g., business owners, information technology, risk management and data analytics) to collaborate. Accelerate this process with role charters and other tactics.
- Experiment with available data before attempting to formalize the organization's data analytics capabilities. Think progress vs. perfection. Think agile vs. waterfall. Think fail-forward to gain momentum.
- Establish data as an asset through working with board members, the CEO [chief executive officer], the CIO [chief information officer], and other C-level executives to develop a shared vision of data as an enterprisewide asset.
- Employ myth busting as a great way for an organization to make the shift to being data-driven. Intuition and data-driven processes yield the best outcomes.
- Learn and grow through an intentional and ongoing effort to evolve the organization's understanding of data analytics and its contribution to the overarching mission.
- Commit to communication processes focused on clarity, shared vision and tempo.

## Related Resources

**"6 Data Analytics Success Stories: An Inside Look,"** *CIO*, August 30, 2019.
https://blog.grandviewcorp.com/blog/6-data-analytics-success-stories-an-inside-look
Six private sector corporations share lessons learned for using analytics to improve business growth:

- **Accenture** uses analytics to evaluate potential business opportunities and to track technology device and real estate use, enhancing the company's decision-making capabilities. Another tool enables the company to leverage diversity and inclusions metrics. The tool showcases predictive analytics to model and forecast the impacts of gender-mix hiring and "is critical for helping Accenture reach its 50/50 gender parity goal by 2025, as well as to have 25% of the female workforce in leadership positions."

  **Lesson learned**: Constantly reevaluate the data collected and the process used to collect data.

- **Belkin**, which produces charging cables, adapters and cases for smartphones, laptops and other devices, "is combing through a variety of Excel spreadsheets for data that will eventually be aggregated into a data lake." The company also manages financial and business reporting data to identify issues; software from Delphix will allow the company to "virtualize, compress and protect data."

  **Lesson learned**: Prepare now for 5G.

- **Shell** uses predictive modeling to anticipate machine failure and manage inventory, determining when to purchase machine parts, how long to keep them and where to store them. Its data platform includes software from Databricks, Alteryx, C3, SAP and other vendors.

  **Lesson learned:** Evaluate the right tools and determine what is effective before making big-ticket purchases.

- **Cargill** developed iQuatic, a mobile data-tracking app that helps shrimp farmers reduce the mortality rate of shrimp. To develop the app, engineers and business executives worked alongside farmers, who had been collecting data manually.

  **Lesson learned:** Collaborate. Involving farmers in the app's development allowed Cargill to conduct the pilot in five months and enable the product launch.

- **Merck** wanted to reduce the time spent moving and reporting data and increase the time spent using the data to obtain business insights. To make this transition, the company created MANTIS (Manufacturing and Analytics Intelligence), a data warehousing system for data scientists and nontechnical business analysts, that has resulted in a "30% reduction in average lead time and a 50% reduction in average inventory carrying costs."

  **Lesson learned**: Scale back a project to a size that will demonstrate the biggest payback. When it succeeds, implement it in other locations.

- **Airlines Reporting Corp. (ARC)** provides ticket transaction settlement services between airlines and travel agencies and management companies. Airlines pay for access to data collected by ARC about travelers. ARC is moving from a Teradata data warehouse to Snowflake cloud software, which will produce data products faster and offer greater scalability and performance. This technology shift was daunting, but change management among employees was a bigger issue.

  **Lesson learned**: Keep staff trained. Encourage certifications and hire consultants to help with change management.

## Public Sector Resources

### New York City Mayor's Office of Data Analytics

Since 2018, the Mayor's Office of Data Analytics (MODA) has worked with "other city agencies and their data to help serve New Yorkers more equitably and effectively." MODA has three objectives:

- Analyze data to improve city agency operations.
- Make open data more accessible to all New Yorkers.
- Advance citywide data infrastructure, integration and sharing.

**Initiatives**
To encourage a data-driven approach to decision-making in the city government, MODA supports three initiatives:

**Analytics projects**. MODA works with city agencies on a wide range of analytics projects that improve the equity and efficiency of city services. Project activities typically include collaborating with the agency to understand the issue and associated data, designing a model to analyze the issue and then delivering insights into solutions. The process and results of many of these projects are available through the online MODA Project Library. Among the published findings was a project focused on predicting which traffic crashes result in severe injuries to help prioritize locations for street redesign. Using crash and hospital data, MODA evaluated New York City DOT's formula for assigning severity to pedestrian crashes.

**Citywide data sharing**. In addition to a portal that provides public access to more than 2,000 data sets, MODA facilitates data sharing among city agencies to provide access to private or sensitive data. Among the data resources available to city employees are a capital projects database, lidar data and traffic incident data through a Waze data feed.

**Open data**. MODA partners with the Department of Information Technology and Telecommunications to support the city's vision of Open Data for All, advocating "for the use of open data in citywide data analytics and in the community." The 2019 Open Data for All Strategic Plan outlines the city's plan through 2029.

**Analytics Exchange**. The Analytics Exchange is a community of practice for data analysts from city agencies. Analytics professionals meet quarterly to discuss their work and share interests and concerns. Discussion topics have included geospatial analysis and how agency data teams are organized. In October 2021, Analytics Exchange hosted a two-day education summit for city employees "to improve their skills in data analytics, data engineering and data governance."

*Related Resources:*

**5 Q's for Kelly Jin, Chief Analytics Officer of New York City**, Michael McLaughlin, Center for Data Innovation, February 26, 2020
https://datainnovation.org/2020/02/5-qs-for-kelly-jin-chief-analytics-officer-of-new-york-city/
*From the introduction*: The Center for Data Innovation interviewed Kelly Jin, chief analytics officer of New York City and director of the Mayor's Office of Data Analytics. Jin discussed the most popular data sets on New York City's open data portal, how the city has used open data to identify bad landlords, and the lessons she has learned working in data roles for multiple cities and the federal government.

**The New York City Business Atlas: Leveling the Playing Field**, Andrew Young, David Sangokoya and Stefaan Verhulst, GovLab, January 2016.
https://odimpact.org/files/case-studies-nyc-business-atlas.pdf
*From the summary:*

> The NYC Business Atlas is designed to alleviate that information gap by providing a public tool that gives small businesses access to high-quality data to help them decide where to establish a new business or expand an existing one. The tool brings together a diversity of data, including business-filing data from the Department of Consumer Affairs, sales tax data from the Department of Finance, demographic data from the census and

traffic data from Placemeter, a New York City startup focusing on real-time traffic information.

The report features the work of MODA as "an example of how governments can go beyond providing data in raw formats to the public by also performing the analytical work needed for those within and outside government to gain new insights from the data."

## Related Resources

**Lessons From Three Cities**, Heain Lee and Sam Lieberman, International City/County Management Association (ICMA), January 2017.
https://www.managementpartners.com/wp-content/uploads/2017/01/DoingDataRight.pdf
In this report, ICMA, an association of professional city and county managers and other employees who serve local governments, presents common practices and strategies for building a data analytics team. *From the introduction*:

> Local governments with effective professional management still want to improve continuously, and using data to reach that goal is an essential practice. But it's daunting to start a data analytics program, and mistakes can doom it to irrelevance. We visited three cities with programs at different stages of development—Kansas City, Missouri; Cincinnati, Ohio; and San Jose, California—to unlock their secrets for data-based decision making.

Below are findings shared by these city governments:

- Setting up shop:
  - Support the data analytics initiative from the top.
  - Position the data analytics team as a unit to support operating staff.
  - Make the initiative sustainable.
  - Find some early wins.
  - Embed a data analyst within departments.
- Creating alliances:
  - Tell stories.
  - Engage willing departments first.
  - Create platforms for highlighting achievements.
  - Build interdisciplinary teams.
- Public outreach:
  - Make data open and push data sets to the public.
  - Use public input in prioritizing projects.
  - Drill down to find the real problem.
  - Develop a vision and communicate it to residents.
- Identifying partners:
  - Foundations.
  - Universities.
  - Networking and peer-to-peer exchanges.
- Challenges:
  - Own the data.
  - Make sure data are easy to collect and use.

**How You Can Use Data Analytics to Change Government**, Nicole Blake Johnson, GovLoop, June 2016.
https://www.govloop.com/wp-content/uploads/2016/01/DataAnalyticsGuide.pdf
GovLoop "serves a community of more than 300,000 government leaders by helping them to foster collaboration, learn from each other, solve problems and advance in their government careers." This report promotes the use of data analytics in the public sector. The resource:

- Defines data analytics and its importance in government (page 2 of the report, page 4 of the PDF).
- Presents case studies from federal, state and local governments, including:
    - State of Indiana: Fighting the Opiod Epidemic (page 4 of the report, page 6 of the PDF).
    - Oracle: How to Make Data Analytics User-Friendly (page 7 of the report, page 9 of the PDF).
    - Teradata Government Systems: The Future of Data Analytics in Government IT (page 19 of the report, page 21 of the PDF).
    - NetApp: [Four] Keys to a Successful Data Analytics Program (page 27 of the report, page 29 of the PDF).
- Offers tips for building a culture for data analytics within an agency (page 35 of the report, page 37 of the PDF).

**Big Data in the Big Apple: The Lessons London Can Learn From New York's Data-Driven Approach to Smart Cities**, Eddie Copeland, Capital City Foundation, June 2015.
http://www.spatialcomplexity.info/files/2015/06/Big-Data-in-the-Big-Apple.pdf
*From the introduction*:

> [T]his report aims to distil the core elements of New York's data success and outline a means for them to be adapted for the specific context of London. It describes the measures that would need to be taken by central government, the Mayor of London, London Borough Councils and the wider London public sector to make this possible. The report also highlights how many of the lessons New York offers London run counter to common wisdom about how to reform public services or create a "smart city."

Chapter 4 (beginning on page 26 of the report, page 28 of the PDF) presents 10 lessons learned from the New York MODA model that could form the foundation of a London Mayor's Office of Data Analytics:

- Strong executive support is essential.
- Data models must be shaped by front-line experience and expertise.
- Focus on outcomes that provide a proven return on investment.
- Start small and with measures everyone can support.
- Do not try to change the work of front-line staff.
- Using data does not require vast numbers of specialized personnel or new layers of bureaucracy.
- Using data does not require procuring high-end technology.
- Any organization that wants to access MODA's data must first share its own.
- All data must be geo-tagged (geo-coded).
- No part of the data extraction or analytics process should require human action.

Chapter 6 (beginning on page 41 of the report, page 43 of the PDF) presents steps to take to create this office in London. Discussion topics include data leadership, technology and data, skills and training, organization and budget, and funding.

*Related Resource:*

**State of Offices of Data Analytics (ODA) in the UK**, Michelle Eaton and Camilla Bertoncin, Nesta, December 2018.
https://media.nesta.org.uk/documents/State_of_Offices_of_Data_Analytics_ODA_in_the_UK_WEB_v5.pdf
This report explores how cities and regions in the United Kingdom (UK) can establish an office of data analytics to get to more intelligent uses of data and collaborative approaches in the public sector. Section 1 (beginning on page 5 of the report) examines how to set up an office, including the benefits and barriers. Lessons learned are also presented (beginning on page 27 of the report) along with case studies of existing programs in the UK (beginning on page 53 of the report).

**Tools to Innovate: Data Analytics, Risk Management and Shared Services**, IBM Center for the Business of Government, 2015.
https://www.businessofgovernment.org/sites/default/files/Tools%20to%20Innovate.pdf
This report features five articles related to data analytics in the public sector:

- From Data to Decisions to Action—The Evolving Use of Data and Analytics in Government.
- The DATA [Digital Accountability and Transparency Act] Act Moves Forward.
- Improving Government Decision Making Through Enterprise Risk Management.
- Risk Management for Grants Administration: A Case Study of the Department of Education.
- A County Manager's Guide to Shared Services in Local Government.

## State Research and Resources

### California

**Workforce Challenges in Implementing Transportation System Management and Operations Within Caltrans**, Joe Butler and Michelle Harrington, University of California Institute of Transportation Studies, November 2018.
https://escholarship.org/content/qt4j3023xk/qt4j3023xk_noSplash_8edca7e7511435655fc60f71cb2e3503.pdf?t=pi6ujq
*From the abstract*: This report explores major impediments to hiring data analysts and software engineers, including lack of understanding among current management personnel in regard to the need for data analysts and software engineers, barriers for Caltrans Operations to directly hire IT/software personnel, lack of interest among Caltrans engineering unions to include software engineers as members, a general belief that software engineers are not "real" engineers, and concern that the state will not be able to hire software engineers due to high salary demands. Opportunities for addressing barriers include developing appropriate recruitment strategies for software related positions, educating agency personnel on the need for data analysis and software skills, changing the requirements for positions in Caltrans traffic operations, and establishing a management team to coordinate and support these efforts.

**"Workforce Development for the Digital Age,"** Joe Butler, Educational Forum, AASHTO Workforce Development Initiative for Transportation System and Operations, American Association of State Highway and Transportation Officials, October 2017.
https://connected-corridors.berkeley.edu/sites/default/files/aashto_workforce_final-1.pdf
This presentation summarizes the state-of-the-practice and the challenges faced in improving transportation system and operations education and training.

### Nebraska

**"Dipping the DOT's Toe Into Data Analysis,"** Korey Donahoo, Nebraska Department of Transportation, *AASHTO Committee on Data Management and Analytics Virtual Annual Meeting*, October 2021.
https://data.transportation.org/wp-content/uploads/sites/44/2021/10/2021_Oct6_2_DataScienceConsortium.pdf
Nebraska DOT's early steps to fulfill its data analytics needs are shared in this presentation. Slide 4 presents the salary range for data scientists from a Burtch Works study of data scientist salaries.

*Related Resource:*

> **The Burtch Works Study: Salaries of Data Scientists**, Linda Burtch, Burtch Works LLC, May 2018.
> https://www.burtchworks.com/wp-content/uploads/2018/05/Burtch-Works-Study_DS-2018.pdf
> This annual study presents trends in data scientist compensation and demographics.

## Related Resources

**"Raising a Digital Twin, Avoiding the 'Terrible Twos,'"** John Meyers and Michael Merritt, *2020 IEEE/AIAA Transportation Electrification Conference (ITEC)*, January 2020.
https://www.itec.co.uk/__media/libraries/draft-abstracts--slides/56---Mike-Merritt.pdf
*From the abstract*: Data analytics and [d]igital [t]wins are becoming popular tools in many organizations[;] this includes government organizations. However, the realities and processes to bring these new tools into an organization [are] not always well understood and shared. This paper captures lessons learned specific to the use of data analytics and creating a digital twin to better understand a very complex and high priority [f]leet issue (in this case, aircraft physiological episodes). These lessons learned begin with understanding the "problem at hand," standing up a functional team, enablers (e.g., software tools, computing power), barriers (e.g., data availability, data quality, business and regulatory issues), successes and best practices. Current capabilities will be presented as well as consideration of the potential benefit of creating human digital twins (both physical and cognitive). Data analytics and digital twin technology is invaluable to better understanding complex problems with the potential to greatly improve human performance in complex systems.

## Risk Management

**Booting Out Bias: How to Derisk Advanced Analytics Models in the Public Sector**, Rahul Agarwal, Mark Levonian, Eric Schweikert and Catharina Wrede Braden, McKinsey & Company, July 16, 2021.
https://www.mckinsey.com/industries/public-and-social-sector/our-insights/booting-out-bias-how-to-derisk-advanced-analytics-models-in-the-public-sector
*From the article*:

> Advanced analytics can transform public-sector services, but U.S. agencies are wary of the risk of biased outcomes. Sound risk management is the key to a wider adoption that will benefit all citizens. … While any model can be poorly designed or misused, AI and ML [machine learning] models carry additional potential risks from the complexity of their algorithms. These risks include the degradation of performance over time and lack of transparency as to how outcomes are produced. But perhaps the most pernicious risks associated with advanced analytics in the public sector are those of bias and discrimination, particularly against vulnerable sections of the community. Examples are not hard to find: advanced analytics models have been shown to sentence people of color more harshly, erroneously accuse low-income and immigrant families of fraud, and award lower grades to students from less privileged neighborhoods. This could help explain why many public agencies may be hesitant to deploy advanced analytics at scale. In fact, a recent report showed that 45[%] of U.S. agencies were still only experimenting with advanced analytics and that just 12[%] were using highly sophisticated techniques. … The solution may partially be found in better model risk management. Here, we outline a best-practice approach to developing and monitoring algorithms that can help public-sector agencies harness the power of advanced analytics to deliver better public services, while mitigating bias and other forms of unfair treatment.
>
> …
>
> Six key actions will help mitigate the risk of bias, along with other risks associated with advanced analytics models:
>
> 1. Make [a senior leader] responsible for model risk management.
> 2. Develop and communicate a clear set of analytical practices and standards.
> 3. Build a model-risk-management infrastructure.
> 4. Consider creating algorithm review panels.
> 5. Consider appointing an ombudsman.
> 6. Strategize at the enterprise level.

# Contacts

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# Appendix A: Survey Questions

The following survey was distributed to members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Data Management and Analytics.

**Survey on the Use of Data Analytics Teams**

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*Note*: The response to the question below determined how a respondent was directed through the survey.

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(Required) Does your agency currently employ data analytics teams?

Response Options:

- Yes. (Directed the respondent to **Composition of Data Analytics Team**.)
- No, but we're considering implementing them. (Directed the respondent to **Considering the Use of Data Analytics Teams**.)
- No, and we have no plans to do so. (Directed the respondent to **Wrap-Up**.)

**Considering the Use of Data Analytics Teams**

(Required) Please briefly describe your agency's discussions or plans to use data analytics teams.

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*Note*: After responding to the question above, the respondent was directed to the **Wrap-Up** section of the survey.

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**Composition of Data Analytics Teams**

1. How many data analytics teams have been established in your agency?
2. When were these teams formed?
3. Where do data analytics teams reside in the organizational structure of your agency?
4. In general terms, what are the products and services the teams provide?
5. Please provide information about the types of staff members participating on the team:

**Staff Type 1**

- Title
- Civil service classification
- Duties (Please Note supervision over others, if applicable.)
- Gross monthly compensation
- Prerequisite education or coursework
- Required experience
- Expertise

**Staff Type 2**

- Title
- Civil service classification
- Duties (Please note supervision over others, if applicable.)
- Gross monthly compensation
- Prerequisite education or coursework
- Required experience
- Expertise

**Staff Type 3**

- Title
- Civil service classification

- Duties (Please note supervision over others, if applicable.)
- Expertise
- Gross monthly compensation
- Prerequisite education or coursework
- Required experience

**Staff Type 4**

- Title
- Civil service classification
- Duties (Please note supervision over others, if applicable.)
- Expertise
- Gross monthly compensation
- Prerequisite education or coursework
- Required experience

**Staff Type 5**

- Title
- Civil service classification
- Duties (Please note supervision over others, if applicable.)
- Expertise
- Gross monthly compensation
- Prerequisite education or coursework
- Required experience

6. Please provide any comments or additional information about the composition of your agency's data analytics teams

**Developing a Data Analytics Team**

1. What type of expertise do you or your agency consider to be most important when seeking to fill positions on a data analytics team?
2. Did you utilize existing staff, new hires or both sources when filling positions?
    - Existing staff
    - New hires
    - Both sources
3. Can you share an example of a position posting for a data analytics team member? Please include a description of the benefits associated with this position.
    - • No
    - • Yes (Please provide a link to the position posting or send any files not available online to carol.rolland@ctcandassociates.comailto:).
4. Has your agency established special recruitment practices to encourage applicants to join an agency data analytics team?
    - • No
    - • Yes (Please describe these practices.)
5. Please characterize your agency's success in retaining data analytics team members using the rating scale of 1 = not at all successful to 5 = extremely successful.
6. If your rating to the previous question was a 1 or 2, why do you feel your agency has not been successful in retaining data analytics team members?

**Implementing a Data Analytics Team**

1. Please describe how your agency implemented its first data analytics team.
2. If your agency has more than one data analytics team, did implementation of your second team differ from the first?
    - No
    - Yes (Please describe how the process differed.)
3. What has been the most effective element of your team implementation process?
4. Did you implement a staff training program specific to data analytics?

- No
- Yes (Please briefly describe the training program.)

**Assessment and Recommendations**

1. What successes has your agency experienced in connection with your use of a data analytics team?
2. What challenges has your agency experienced in connection with your use of a data analytics team?
3. What are your top three recommendations for another state DOT contemplating the use of data analytics teams?
    - Recommendation 1
    - Recommendation 2
    - Recommendation 3

**Wrap-Up**

Please use this space to provide any comments or additional information about your previous responses.

# Appendix B: Data Analytics Team Staffing

Below are descriptions of staff positions that are part of the data analytics teams in Iowa, Minnesota, Mississippi, Nebraska, Vermont, Virginia and West Virginia transportation agencies. When available, information is provided about staff member duties, expertise, prerequisite education or coursework, and gross monthly compensation. Links to online position descriptions are also provided when available.

## Iowa

- Roadway asset management system administrator
- Systems analyst
- Information technology specialist III

### Roadway Asset Management System Administrator

| Topic | Description |
|---|---|
| **Civil service classification** | Information Technology Specialist V |
| **Duties** | • No supervision over others<br>• Serves as system administrator for Roadway Asset Management System (RAMS) and Integrated System Development<br>• Coordinates projects with network management and database administration<br>• Performs federal reporting and National Performance Measure analysis |
| **Expertise** | Computer engineer, system architecture, enterprise data analysis, enterprise data integration |
| **Gross monthly compensation** | $5,598.40-$8,609.60 |
| **Prerequisite education or coursework** | Four-year degree in related field |
| **Required experience** | Certification in either business query writing, GIS, business information technology or data modeling |

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### Systems Analyst

| Topic | Description |
|---|---|
| **Civil service classification** | Information Technology Specialist III |
| **Duties** | Oversees the Linear Referencing System and enterprise analytics |
| **Expertise** | GIS, SQL, FME, ArcGIS products, Oracle Scripts, Webtools, enterprise data knowledge |
| **Gross monthly compensation** | $4,830.40-$7,472 |
| **Prerequisite education or coursework** | Four-year degree in related field |
| **Required experience** | Certified in GIS and analytical tools |

### Information Technology Specialist III

Iowa DOT has three other Information Technology Specialist III staffing positions with similar responsibilities.

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## Minnesota

- Financial and economic forecast analyst
- Traffic research analyst
- Operations, signals and lighting analyst
- HR projects manager
- Traffic safety engineer

### Financial and Economic Forecast Analyst

| Topic | Description |
|---|---|
| **Civil service classification** | Research Analysis Specialist |
| **Duties** | N/R |
| **Expertise** | N/R |
| **Gross monthly compensation** | N/R |
| **Prerequisite education or coursework** | N/R |
| **Required experience** | N/R |

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### Traffic Research Analyst

| Topic | Description |
|---|---|
| **Civil service classification** | Research Analyst Supervisor Senior |
| **Duties** | N/R |
| **Expertise** | N/R |
| **Gross monthly compensation** | N/R |
| **Prerequisite education or coursework** | N/R |
| **Required experience** | N/R |

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### Operations, Signals and Lighting Analyst

| Topic | Description |
|---|---|
| **Civil service classification** | State Program Admin Principal |
| **Duties** | N/R |

| | |
|---|---|
| **Expertise** | N/R |
| **Gross monthly compensation** | N/R |
| **Prerequisite education or coursework** | N/R |
| **Required experience** | N/R |

## HR Projects Manager

| Topic | Description |
|---|---|
| **Civil service classification** | Senior State Program Administrative Manager |
| **Duties** | Workforce data and reports |
| **Expertise** | N/R |
| **Gross monthly compensation** | N/R |
| **Prerequisite education or coursework** | N/R |
| **Required experience** | N/R |

## Traffic Safety Engineer

| Topic | Description |
|---|---|
| **Civil service classification** | Engineer Administrative |
| **Duties** | N/R |
| **Expertise** | N/R |
| **Gross monthly compensation** | N/R |
| **Prerequisite education or coursework** | N/R |
| **Required experience** | N/R |

N/R No response

## Mississippi

- Applications manager
- Developers

### Applications Manager

| Topic | Description |
|---|---|
| **Civil service classification** | Systems Manager III |
| **Duties** | • Oversees a development team that performs most of the analytical development<br>• Oversees the warehouse<br>• Serves as the main lead for business intelligence tools |
| **Expertise** | 32 years development experience |
| **Gross monthly compensation** | $8,000 |
| **Prerequisite education or coursework** | N/R |
| **Required experience** | N/R |

### Developers

| Topic | Description |
|---|---|
| **Civil service classification** | Various levels |
| **Duties** | Develops databases, dashboards, reports or applications to present data |
| **Expertise** | 5- to 30-year development experience |
| **Gross monthly compensation** | N/R |
| **Prerequisite education or coursework** | N/R |
| **Required experience** | N/R |

N/R No response

## Nebraska

- Senior IT application developer
- IT application developer

### Senior IT Application Developer

| Topic | Description |
|---|---|
| **Civil service classification** | N/R |
| **Duties** | Creates reports, dashboards and R Shiny apps |
| **Expertise** | MS PowerBI, Enterprise data warehouse, SSAS, SSIS, SSRS and R code |
| **Gross monthly compensation** | $5,500 |
| **Prerequisite education or coursework** | Bachelor of science in computer or business-related area |
| **Required experience** | 2+ years in MS PowerBI, SQL Server, SSAS, SSIS, SSRS and R coding |

### IT Application Developer

| Topic | Description |
|---|---|
| **Civil service classification** | N/R |
| **Duties** | Creates reports and R Shiny apps |
| **Expertise** | Enterprise data warehouse, SSAS, SSIS, SSRS, R code |
| **Gross monthly compensation** | $4,650 |
| **Prerequisite education or coursework** | Bachelor of science in computer or business-related area |
| **Required experience** | 2+ years in SQL Server, SSAS, SSIS, SSRS, R coding |

N/R No response

# Vermont

- GIS professional V
- GIS professional IV
- GIS professional III
- GIS professional II
- GIS professional I

## GIS Professional V

| Topic | Description |
|---|---|
| **Civil service classification** | PG 28 |
| **Duties** | • Coordinates research, design, procurement, deployment and management of GIS technology (desktop and server) for the organization.<br>• Plans for, manages and participates in the procurement, configuration, and administration of GIS infrastructure and software.<br>• Coordinates GIS activities across state government.<br>• Develops, implements, coordinates and maintains standards and guidelines associated with spatial data and GIS technology within the organization.<br>• Coordinates the procurement, development and management of spatial data within the organization.<br>• Coordinates research, design, procurement, deployment and management of GIS technology (desktop and server) for the organization.<br>• Plans for, manages and participates in the procurement, configuration, and administration of GIS infrastructure and software.<br>• Coordinates GIS activities across state government.<br>• Develops, implements, coordinates and maintains standards and guidelines associated with spatial data and GIS technology within the organization.<br>• Coordinates the procurement, development and management of spatial data within the organization.<br>• Facilitates GIS strategic planning efforts within the organization.<br>• Coordinates budget development, expenditure planning and return on investment analyses for spatial data and GIS technology.<br>• Provides technical oversight of large GIS projects.<br>• Participates in/supports the design, configuration, deployment, administration and maintenance of enterprise GIS databases.<br>• Participates in/supports the development of desktop, web and mobile applications leveraging spatial data and GIS technology.<br>• Defines needs, requirements and specifications for projects that leverage spatial data or GIS technology.<br>• Participates in/supports the development of solutions to automate or semi-automate workflows that provide improved efficiencies.<br>• Identifies and/or resolves problems with GIS applications. |

| | |
|---|---|
| **Duties, continued** | • Develops spatial data sharing and exchange agreements and mechanisms.<br>• Implements and adheres to applicable change management processes.<br>• Reviews vendor proposals, contracts and manages vendor engagements.<br>• Conducts outreach to internal and external users of spatial data and GIS technology.<br>• Trains and/or coordinates staff training in the use of GIS and GPS technologies.<br>• Participates in/supports grant-writing activities relating to the use of GIS technology.<br>• Supports and supervises assigned staff, including hiring or recommendation to hire. |
| **Expertise** | • Considerable knowledge of the principles of geographic information science and GIS technology.<br>• Expert skill in the use of desktop and server GIS software.<br>• Knowledge of GIS other database management software and programming techniques used for GIS.<br>• Solid understanding of web and mobile technologies.<br>• Skilled in the use of data transformation tools.<br>• Knowledge of project management and ability to apply that knowledge to projects with considerable technical complexity.<br>• Experience managing vendor engagements.<br>• Skilled in determining and meeting project and program budgets.<br>• Considerable skill in applying GIS technology to solve difficult analytical problems.<br>• Considerable knowledge of principles associated with project management, change management and business process analysis.<br>• Previous experience delivering complex technical solutions or large scale projects.<br>• Very strong analysis, analytical and problem solving skills.<br>• Self-starter with initiative and ability to work independently with minimal supervision.<br>• Experience managing broad diversity of project types with phased implementations that include multiple programs, vendors, and consultants.<br>• Considerable knowledge of meeting facilitation techniques.<br>• Considerable technical and IT knowledge or experience.<br>• Considerable knowledge of GIS concepts and database design.<br>• Knowledge of advanced spatial analysis and data query tools and techniques.<br>• Knowledge of cartography and porting data to other GIS environments.<br>• Ability to train technical and professional staff in GIS concepts, data collection and applications. |

| | |
|---|---|
| **Expertise, continued** | • Ability to establish and maintain effective and collaborative relationships.<br>• Excellent written and oral communication.<br>• Understanding of effective grant-writing techniques.<br>• Strong leadership, collaboration, influencing and facilitation skills.<br>• Ability to work with people at all levels within an organization, from senior executives, program staff to developers/analysts.<br>• Ability to monitor and control work of mapping contractors and other service providers.<br>• Ability to deal courteously, effectively and promptly with staff and the public.<br>• Knowledge of supervisory principles and practices. |
| **Gross monthly compensation** | $5,220 (starting salary) |
| **Prerequisite education or coursework** | Bachelor's degree in GIS, geography, computer science or other closely related field AND three or more years of experience in GIS, geography, computer science or other closely related field<br>OR<br>Associate's degree or two years of college coursework in GIS, geography, computer science or other closely related field AND five or more years of experience in GIS, geography, computer science or other closely related field<br>OR<br>Eight or more years of experience in GIS, geography, computer science or other closely related field |
| **Required experience** | See **Prerequisite education or coursework**. |

**Complete position description**: https://humanresources.vermont.gov/classification-position-management/classification/job-specifications?code=110500

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## GIS Professional IV

| Topic | Description |
|---|---|
| **Civil service classification** | PG 26 |
| **Duties** | • Pursue advanced-level use of GIS technology (desktop and server) for the organization.<br>• Implement and assist in the development of standards and guidelines associated with spatial data and GIS technology within the organization.<br>• Develop, manage and administer spatial data within the organization.<br>• Conduct outreach to internal and external users of spatial data and GIS technology.<br>• Support GIS strategic planning efforts within the organization. |

| Topic | Description |
|---|---|
| **Duties, continued** | • Assist with budget development, expenditure planning and return on investment analyses for spatial data and GIS technology.<br>• Perform advanced spatial data queries and analyses.<br>• Manage large GIS projects.<br>• Develop, deploy and maintain desktop, web and mobile applications leveraging spatial data and GIS technology.<br>• Help to define needs, requirements and specifications for projects that leverage spatial data or GIS technology.<br>• Identify and/or resolve problems with GIS applications.<br>• Develop spatial data sharing and exchange mechanisms.<br>• Develop and use custom scripts and macros to automate workflows.<br>• May enforce and must adhere to applicable change management processes.<br>• Provide data to or review data products from vendors.<br>• Review vendor proposals and monitor vendor engagements.<br>• Outreach to internal and external users of spatial data and GIS technology.<br>• Support and train other GIS staff.<br>• Assist with representing the agency or department when coordinating GIS activities across state government.<br>• Assist with the planning, procuring, configuring, managing, and administering GIS infrastructure and software. |
| **Expertise** | • Considerable knowledge of the principles of geographic information science and GIS technology.<br>• Expert skill in the use of desktop and server GIS software.<br>• Knowledge of GIS other database management software and programming techniques used for GIS.<br>• Solid understanding of web and mobile technologies.<br>• Skilled in the use of data transformation tools.<br>• Knowledge of project management and ability to apply that knowledge to projects with considerable technical complexity.<br>• Experience monitoring vendor engagements and reviewing vendor products.<br>• Skilled in determining and meeting project budgets.<br>• Considerable skill in applying GIS technology to solve difficult analytical problems.<br>• Expert knowledge of spatial analysis and data query tools and techniques.<br>• Previous experience delivering complex technical solutions or large scale projects.<br>• Very strong analysis, analytical and problem solving skills.<br>• Self-starter with initiative and ability to work independently with minimal supervision.<br>• Experience managing broad diversity of project types with phased implementations that include multiple programs, vendors and consultants. |

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| **Expertise, continued** | • Technical and IT knowledge or experience, including the porting of data to other GIS environments.<br>• Considerable knowledge of GIS concepts and database design.<br>• Knowledge of cartography.<br>• Ability to train technical and professional staff in GIS concepts, data collection and applications.<br>• Ability to establish and maintain effective and collaborative relationships.<br>• Excellent written and oral communication.<br>• Strong leadership, collaboration, influencing and facilitation skills.<br>• Ability to work with people at all levels within an organization, from senior executives, program staff to developers/analysts.<br>• Ability to monitor and control work of mapping contractors and other service providers.<br>• Ability to deal courteously, effectively and promptly with staff and the public.<br>• Knowledge of supervisory principles and practices. |
| **Gross monthly compensation** | $4,630 (starting) |
| **Prerequisite education or coursework** | Bachelor's degree in GIS, geography, computer science or other closely related field AND two or more years of experience in GIS, geography, computer science or other closely related field.<br>OR<br>Associate's degree or two years of college coursework in GIS, geography, computer science or other closely related field AND four or more years of experience in GIS, geography, computer science or other closely related field.<br>OR<br>Six or more years of experience in GIS, geography, computer science or other closely related field. |
| **Required experience** | See **Prerequisite education or coursework** |

**Complete position description**: https://humanresources.vermont.gov/classification-position-management/classification/job-specifications?code=110400

## GIS Professional III

| Topic | Description |
|---|---|
| **Civil service classification** | PG 24 |
| **Duties** | • Provides intermediate GIS services to one or multiple programs or business units.<br>• Creates, edits, manipulates, maintains, performs quality control and documentation of geospatial data in GIS databases.<br>• Administers GIS databases within the context of managing a multi-user editing environment.<br>• Optimizes geospatial features, topology and spatial relationship rules.<br>• Supports and trains other staff who edits GIS data.<br>• Uses GPS technology to collect data.<br>• Produces digital and hardcopy maps.<br>• Uses intermediate spatial analysis techniques.<br>• Ensures and reviews GIS data integrity, data documentation and data quality.<br>• Helps to define needs, requirements and specifications for projects that leverage spatial data or GIS technology.<br>• Provides outreach to internal and external creators and users of spatial data. |
| **Expertise** | • Considerable knowledge of the principles of GIS, GIS technology and database design.<br>• Extensive skill in the use of desktop GIS software.<br>• Experience using server GIS software.<br>• Knowledge of other database management software and programming techniques used for GIS.<br>• Demonstrated knowledge in geospatial editing tools, methods and procedures.<br>• Knowledge of GIS data transformation methods.<br>• Knowledge of the operation and maintenance of computer peripherals and graphic output and input devices associated with GIS functions including GPS units.<br>• Technical and IT knowledge or experience.<br>• Considerable knowledge of GPS data integration into GIS databases.<br>• Ability to edit geospatial data and maps with accuracy and precision.<br>• Ability to document data editing procedures, data quality and metadata.<br>• Knowledge of mobile and web GIS technologies notably with how these technologies enable GIS data management.<br>• Knowledge of advanced spatial analysis and data query tools and techniques.<br>• Knowledge of cartography.<br>• Knowledge of aerial photo interpretation.<br>• Knowledge of programming techniques used for GIS.<br>• Skills in handling people with tact and recommending practical solutions to problems. |

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| **Expertise, continued** | • Ability to establish and maintain effective working relationships.<br>• Ability to read and interpret maps, survey notes, engineering plans.<br>• Ability to evaluate proposed new geospatial techniques, data models and equipment, and prepare recommendations on their use.<br>• Ability to review work of mapping contractors and other service providers.<br>• Ability to effectively communicate verbally and in writing.<br>• Ability to analyze problems and make logical and timely decisions both in office and in the field. |
| **Gross monthly compensation** | $4,100 (starting) |
| **Prerequisite education or coursework** | Bachelor's degree in GIS, geography, computer science, engineering, GIS, a natural resources field or other field closely related to mapping and GIS.<br>OR<br>Associate's degree or two years of college coursework in GIS, geography, computer science, engineering, GIS, a natural resources field or other field closely related field to mapping and GIS AND two or more years of experience in GIS, geography, computer science, engineering, GIS, a natural resources field or other field closely related to mapping and GIS.<br>OR<br>Four or more years of experience in in GIS, geography, computer science, engineering, GIS, a natural resources field or other field closely related field to mapping and GIS. |
| **Required experience** | See **Prerequisite education or coursework** |

**Complete position description**: https://humanresources.vermont.gov/classification-position-management/classification/job-specifications?code=110300

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## GIS Professional II

| Topic | Description |
|---|---|
| **Civil service classification** | PG 22 |
| **Duties** | • Provides basic GIS services to a specific program or business unit.<br>• Creates/maintains GIS data, produces map products and executes basic spatial analyses, including geospatial data editing using GIS software to maintain geospatial data in GIS databases and using GPS technology to collect data.<br>• Ensures and reviews GIS data integrity and data documentation. |

| | |
|---|---|
| **Expertise** | • Knowledge of GIS concepts, database design and cartography.<br>• Intermediate skill in the use of GIS software.<br>• Knowledge of geospatial data editing tools, methods, procedures and transformation methods.<br>• Knowledge of the operation and maintenance of computer peripherals and graphic output and input devices associated with GIS functions including GPS units.<br>• Knowledge of GPS data integration into GIS databases.<br>• Ability to edit geospatial data and maps with accuracy and precision.<br>• Ability to document data editing procedures, data quality and metadata.<br>• Knowledge of mobile and web GIS technologies.<br>• Knowledge of cartography.<br>• Ability to read and interpret maps, survey notes, engineering plans.<br>• Knowledge of intermediate spatial analysis and data query tools and techniques.<br>• Ability to evaluate proposed new geospatial techniques, data models and equipment, and prepare recommendations on their use.<br>• Knowledge of aerial photo interpretation.<br>• Ability to monitor work of mapping contractors and other service providers.<br>• Skills in handling people with tact and recommending practical solutions to problems.<br>• Ability to establish and maintain effective working relationships.<br>• Ability to effectively communicate verbally and in writing.<br>• Ability to analyze problems and make logical and timely decisions both in office and in the field. |
| **Gross monthly compensation** | $3,660 (starting) |
| **Prerequisite education or coursework** | Associate's degree or two years college coursework in GIS, geography, computer science or other closely related field.<br>OR<br>Two or more years of experience in GIS, geography, computer science or other closely related field. |
| **Required experience** | See **Prerequisite education or coursework** |

**Complete position description**: https://humanresources.vermont.gov/classification-position-management/classification/job-specifications?code=110200

## GIS Professional I

| Topic | Description |
|---|---|
| **Civil service classification** | PG 20 |
| **Duties** | Create/maintain GIS data and the production of map products following established guidelines, including geospatial data editing using GIS software to maintain geospatial data in GIS databases and using GPS technology to collect data. |
| **Expertise** | • Working knowledge of GIS concepts, database design and cartography.<br>• Knowledge of GIS software and of geospatial editing tools, methods and procedures.<br>• Knowledge of the operation and maintenance of computer peripherals and graphic output and input devices associated with GIS functions including GPS units.<br>• Knowledge of GPS technology.<br>• Ability to edit geospatial data and maps with accuracy and precision.<br>• Ability to document data editing procedures, data quality and metadata.<br>• Ability to read and interpret maps, survey notes, engineering plans.<br>• Ability to establish and maintain effective working relationships.<br>• Ability to effectively communicate verbally and in writing.<br>• Ability to analyze problems and make logical and timely decisions both in office and in the field. |
| **Gross monthly compensation** | $3,280 (starting) |
| **Prerequisite education or coursework** | High school diploma or equivalent |
| **Required experience** | GIS technology experience |

**Complete position description**: https://humanresources.vermont.gov/classification-position-management/classification/job-specifications?code=110100

## Virginia

- Senior data analytics specialist (data scientist)
- Senior program administration specialist (data/systems analysis manager or senior program engineer)

### Senior Data Analytics Specialist (Data Scientist)

| Topic | Description |
|---|---|
| **Civil service classification** | Program Administration Specialist III |
| **Duties** | All data analytics/data science related work in the specific business line. (Some may supervise other data analytics specialists.) |
| **Expertise** | Data analytics, data science, data modeling, data analytics/data science tools, transportation programs, statistics and predictive models |
| **Gross monthly compensation** | $6,250-$9,166+ |
| **Prerequisite education or coursework** | Master's degree in data analytics, data science, statistics, modeling, systems engineering (not IT), operations research. Certifications in data analytics or data science. |
| **Required experience** | 5-10 years |

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### Senior Program Administration Specialist (Data/Systems Analysis Manager or Senior Program Engineer)

| Topic | Description |
|---|---|
| **Civil service classification** | Program Administration Specialist III (or Architect Engineering II or Architect Engineering Manager II) |
| **Duties** | Program management and all data analytics related work in the specific business line. (Some may supervise other program administrative specialists or engineers.) |
| **Expertise** | Subject matter expert in specific discipline, analytics, related software and tools |
| **Gross monthly compensation** | $6,250-$9,166+ |
| **Prerequisite education or coursework** | Master's degree in engineering. Certification in data analytics/data science. Coursework in statistics, modeling, systems engineering (not IT). |
| **Required experience** | 10 years |

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## West Virginia

- District administrator II
- District administrator I
- Highway systems analyst
- GIS technician

### District Administrator II

| Topic | Description |
|---|---|
| **Civil service classification** | N/R |
| **Duties** | • Supervisor of the team.<br>• Plans, directs and implements a districtwide program. |
| **Expertise** | Expertise in budgeting, utilization of equipment and materials |
| **Gross monthly compensation** | $1,800-$2,769 |
| **Prerequisite education or coursework** | Bachelor's degree |
| **Required experience** | Six years of project experience/administrative |

### District Administrator I

| Topic | Description |
|---|---|
| **Civil service classification** | N/R |
| **Duties** | • Lead person on the team.<br>• Plans, directs and implements a districtwide program. |
| **Expertise** | Expertise in budgeting and the use of equipment and materials |
| **Gross monthly compensation** | $1,600-$2,461 |
| **Prerequisite education or coursework** | Bachelor's degree |
| **Required experience** | Five years of project experience/administrative |

## Highway Systems Analyst

| Topic | Description |
|---|---|
| **Civil service classification** | N/R |
| **Duties** | • Collects and analyzes data.<br>• Evaluates economic, social and environmental impact of projects. |
| **Expertise** | Researching, planning and analyzing the impact of highway construction or maintenance projects |
| **Gross monthly compensation** | $1,275-$1,961 |
| **Prerequisite education or coursework** | Bachelor's degree |
| **Required experience** | Two years of research, analysis and planning |

## GIS Technician

| Topic | Description |
|---|---|
| **Civil service classification** | N/R |
| **Duties** | • Performs digital data entry and maintenance.<br>• Executes applications.<br>• Produces maps and related graphic output and reports.<br>• Complexity involves duties that are varied and involve different and often unrelated processes and methods. Analysis of subject matter is conducted, and decisions are made using the results of this analysis. |
| **Expertise** | Plot and map production, low-level GIS analysis, generating reports and answering information requests |
| **Gross monthly compensation** | $1,350-$2,076 |
| **Prerequisite education or coursework** | Associate's degree |
| **Required experience** | Two years in computer mapping or GIS |

N/R No response

# Appendix C: Data Analytics Job Postings

Below are examples of data analytics position postings from Iowa DOT and West Virginia Division of Highways.

## Iowa

### Systems Analyst

This position administers the Linear Referencing System (LRS) in the Roadway Asset Management System (RAMS). These systems comprise the enterprise data warehouse foundational system for the agency. Administration of the LRS will include identification of business requirements, definition of technical program components, development of prototype outputs, system testing and training of end-users; and must be capable of creating and translating business process maps. The LRS serves as the geospatial foundation system for the agency as well as public and private entities.

In addition, this position must maintain a high level of expertise with the Roadway Asset Management System (RAMS). This requires a significant understanding of the RAMS architecture to provide testing and suggest enhancements throughout the development and maintenance of this system. This position serves as back up to the RAMS administrator in performing functions to ensure system integrity, usability, reliability and supportability. This will require extensive knowledge of the LRS foundational system, the interoperability with other systems and its key integration with RAMS. Integrated system development, data warehouse administration, coordination with network and database administration, and enterprise data facilitation are part of the responsibilities that are involved in this administration. Participates in resolving any application issues related to LRS/RAMS database including data warehouse design and optimizations tasks. Conducts research and makes recommendations on database products, services, protocol and standards. Provides recommendations regarding data warehouse strategy and decisions. Helps define vision, identify timeliness and goals.

In addition, this position must develop business knowledge to effectively anticipate and define opportunities to apply business intelligence and advanced analytical solutions to the management of assets in the department. This is accomplished through the participation in analysis, design modeling and development while participating in the implementation and maintenance of database solutions across a variety of technology platforms. Performs complex work assignments and problem resolution across systems and processes. Assisting others, enterprisewide, in developing their skills and in performing these types of analysis within their area of expertise will be necessary to serve the agencies analytical needs. Skills are necessary to work with multiple integrated databases to design systems which are used in the maintenance, analysis and reporting of critical asset data. This requires the ability to capture user requirements for projects and translating those needs into technical documentation and a data warehouse design. This position is required to have a strong understanding of user needs to enhance the usefulness of the product.

To perform the functions of this position requires advanced level computer programming skills and expertise in knowledge of the business data and data warehouse architecture. In addition, this position requires the ability to decipher user needs and system capabilities in meeting those needs. This position is responsible for collecting available and relevant data from internal and external customers; to take that data and form visual and graphical presentations, query databases and informational systems; and share the data collected and maintained by Analytics and other appropriate integrated data.

This position will provide first level support for software applications such as the operating systems, ESRI Roads and Highways, ARC GIS products, other geospatial software, Oracle SQL/PSQL, JSON, Javascript, Acrobat, Microsoft Office suite, etc. This includes solving application problems, loading new software and updates to existing software and identification of issues requiring network or diagnostic/application support.

Selectives: 121-T-SQL Business Query Writing “AND” 230-Geographic Information Systems (DNR) “AND” 984-Business Information Technology “AND” 233-Data Modeling

## West Virginia

West Virginia Department of Transportation Careers
https://www.governmentjobs.com/careers/wvdot

### Highway Systems Analyst Trainee

Performance Management Division

The Highway Systems Analyst Trainee in this position will work in the Statewide Data Analytical Unit. Responsibilities include collecting data and budget information from Districts and Divisions, monitoring activities, acting as a liaison between districts and the central office, and providing training and assistance to all Data Analytic Units in the districts. Will also assist with distributing the collected information to management in a simplified format. Proficiency in the use of Word and Excel is preferred. Position has little latitude for independent judgment. Complexity of duties are varied, may involve different and unrelated methods and processes, however work is reviewed upon completion and specific instructions are provided when work is assigned. Distinguishing factor is beginning level of work, primarily in the capacity of assisting higher level analysts in this series. Travel may be required to collect data and conduct field studies. Performs other related duties as required.

**Pay Grade**: 11
**Salary:** $1,200-$1,846.15 biweekly

**Typical Duties and Responsibilities**

- Assists in editing, proofreading, and writing transportation reports.
- Assists in the collection and analysis of data and evaluates economic, environmental, and social impact of projects.
- Assists in the compilation of technical and analytical findings into a required document such as assessments, categorical exclusions, impact statements, state management plans, project guides, state transportation improvement programs, or application packets.
- Assists in designing and conducting field surveys, questionnaire surveys, and field reviews to collect data for transportation studies.
- Assists in writing correspondence and reports to be sent to the Federal Highway Administration and/or the Federal Transit Administration regarding necessary amount of funds, scope of work, and revision of project plans.
- Reviews plans, typical sections, cross sections, profiles, cost estimates, and other data required for the preparation of contract bids.

- Reviews projects in the Project Tracking System and Bid Analysis Management System to ensure accuracy and consistency.
- Coordinates review of project plans, specifications, and estimates between agency and federal officials.
- Assists in collecting and researching data such as air, soil, and water quality from reports of federal or state agencies, permits, or through field reviews of proposed, existing or abandoned sites.
- Assists in developing charts, graphs, tables, maps, schedules, and other illustrations for use in transportation reports.
- Assists in applying for, reporting, monitoring, and closing out of federal transit grant programs.
- Assists in the procurement process regarding capital equipment and third-party contracts.
- The work product or service affects the design or operation of systems, programs, or equipment.
- Personal contacts are with employees of the same agency, but outside the immediate organization.
- Travel may be required; therefore, a valid driver's license may be required.

**Required Skills and Knowledge**

- Knowledge that is practical in nature. This knowledge will be used to interpret test results or solve problems identified by previous testing or observations.
- Knowledge of methods and techniques used in the collection, evaluation, and organization of data.
- Knowledge of the objectives, methodologies, and principles of planning.
- Knowledge of principles and practices of environmental analysis.
- Knowledge of the effects of environmental projects on human and natural resources and ecological relationships.
- Ability to orally communicate the purpose of obtaining, imparting, or exchanging information.
- Ability to collect, evaluate and organize data for use in transportation programs, to draw valid conclusions from data.
- Ability to establish and maintain effective working relationships with other Department of Transportation employees, grantees, and federal officials.

**Required Education and Experience**

- Graduation with a bachelor's degree from a regionally accredited four-year college or university.
- Substitution: Full-time or part-time equivalent paid experience in the research, analysis, planning, bidding, or administration of highway construction and maintenance projects or managing transit grant programs may substitute for the required training/education on a year-for-year basis.

OR

One (1) year as a Trainee, Transportation Realty Trainee, Associate Engineering Technician, Engineering Technician, Senior Engineering Technician, or NICET Enrollee 2, 3 or 4 with the Department of Transportation.

## Highway Systems Analyst

Programming Division

The Highway Systems Analyst performs full-performance level work researching, analyzing, and planning the impact of, or bidding highway construction and maintenance projects. This position will work within the Federal Aid Unit of the Programming Division, working with the West Virginia Division of Highways (WVDOH) HUB project management database system. Will also work with the Federal State Transportation Improvement (STIP) Coordinator. May manage grant programs. Position has latitude to independently choose procedures and guidelines to apply to the tasks. Complexity of duties are varied, may involve different and unrelated methods and processes, however work is reviewed upon completion. Distinguishing factor is full-performance level of work, as well as training lower level analysts in this series. Travel may be required to collect data and conduct field studies. Performs other related duties as required.

**Pay Grade** 12
**Salary:** $1,275-$1,961.54 biweekly

**Typical Duties and Responsibilities**

- Edits, proofreads, and writes transportation reports.
- Collects and analyzes data and evaluates economic, environmental, and social impact of projects.
- Compiles technical and analytical findings into a required document such as assessments, categorical exclusions, impact statements, state management plans, project guides, state transportation improvement programs, or application packets.
- Designs and conducts field surveys, questionnaire surveys, and field reviews to collect data for transportation studies.
- Writes correspondence and reports to be sent to the Federal Highway Administration and/or the Federal Transit Administration regarding necessary amount of funds, scope of work, and revision of project plans and/or grant requirements.
- Review plans, typical sections, cross sections, profiles, cost estimates, and other data required for the preparation of contract bids.
- Review projects in the Project Tracking System and Bid Analysis Management System to ensure accuracy and consistency.
- Coordinate review of project plans, specifications, and estimates between agency and federal officials.
- Collects and researches data such as air, soil and water quality from reports of federal or state agencies, permits, or through field reviews of proposed, existing, or abandoned sites.
- Develops charts, graphs, tables, maps, schedules, and other illustrations for use in transportation reports.
- Applies for, reports, monitors, and closes out federal transit grant programs.
- Develops specifications for the procurement process regarding capital equipment and third-party contracts Procures capital equipment and programs and/or materials under third party contracts.
- The work product or service affects the design or operation of systems, programs, or equipment.
- Personal contacts are with employees of the same agency, but outside the immediate organization.

- Travel may be required; therefore, a valid driver's license may be required.

**Required Skills and Knowledge**

- Knowledge that is practical in nature. This knowledge will be used to interpret test results or solve problems identified by previous testing or observations.
- Oversees grant compliance by providing all grantees the requirements of federal regulations and monitoring their compliance.
- Knowledge of methods and techniques used in the collection, evaluation, and organization of data.
- Knowledge of the objectives, methodologies, and principles of planning.
- Knowledge of principles and practices of environmental analysis.
- Knowledge of the effects of environmental projects on human and natural resources and ecological relationships.
- Knowledge of transit grant programs and applicable federal requirements.
- Ability to orally communicate the purpose of obtaining, imparting, or exchanging information.
- Ability to collect, evaluate, and organize data for use in transportation programs, to draw valid conclusions from data.
- Ability to establish and maintain effective working relationships with other Department of Transportation employees, grantees, and federal officials.
- Ability to provide direction and guidance to lower level Transportation Systems Analysts.

**Required Education and Experience**

- Graduation with a bachelor's degree from a regionally accredited four-year college or university.
- Substitution: Experience as described below may be substituted for the required training on a year-for-year basis.

**Required Experience**

- Two years of full-time or part-time equivalent paid experience in the research, analysis, planning, bidding, or administration of highway construction and maintenance projects or managing transit grant programs.
- Substitution: Successfully completed graduate coursework from a regionally accredited college or university in transportation, urban or regional planning, engineering, economics, statistics, mathematics, geography, business administration, public administration, environmental studies, history, archeology, or the physical or natural sciences may substitute for the required experience on a year-for-year basis.

## Senior Highway Systems Analyst

Planning Division

The Highway Systems Analyst Senior performs advanced level work researching, analyzing, and planning the impact of, or bidding highway construction and maintenance projects. Primary duties for this position include utilizing various technical and creative software programs for (A) photographic, video graphic, and graphic design support of agency missions including public-facing engagements and environmental (historic) mitigation actions, (B) visualization support of transportation project concepts in context-based environments. May manage grant programs.

Position has latitude to independently choose procedures and guidelines to apply to the tasks. Complexity of duties are varied, may involve different and unrelated methods and processes. Distinguishing factor is advanced level and complexity of work, as well as serving as a lead worker over lower-level analysts in this series. Travel may be required to collect data and conduct field studies. Performs other related duties as required.

**Pay Grade:** 14
**Salary**: $1,425-$2,192.31 biweekly

**Typical Duties and Responsibilities**

- Edits, proofreads, and writes transportation reports.
- Collects and analyzes data and evaluates economic, environmental, and social impact of projects.
- Compiles technical and analytical findings into a required document such as assessments, categorical exclusions, impact statements, state management plans, project guides, state transportation improvement programs, or application packets.
- Designs and conducts field surveys, questionnaire surveys, and field reviews to collect data for transportation studies.
- Writes correspondence and reports to be sent to the Federal Highway Administration and/or the Federal Transit Administration regarding necessary amount of funds, scope of work, and revision of project plans and/or grant requirements.
- Collects and researches data such as air, soil and water quality from reports of federal or state agencies, permits, or through field reviews of proposed, existing, or abandoned sites.
- Develops charts, graphs, tables, maps, schedules, and other illustrations for use in transportation reports.
- Assigns, schedules, and directs work of other Transportation Systems Analysts.
- Applies for, reports, monitors, and closes out federal transit grant programs.
- Develops specifications for the procurement process regarding capital equipment and third-party contracts.
- Procures capital equipment and programs and/or materials under third party contracts.
- Oversees grant compliance by providing all grantees the requirements of federal regulations and monitoring their compliance.
- Oversees grant compliance in areas such as Disadvantaged Business Enterprises, Equal Employment Opportunities, the Americans With Disabilities Act and Civil Rights.
- Financial oversight over a complex transit grant program.
- Recommends corrective action if needed.
- Travel may be required; therefore, a valid driver’s license may be required.

**Required Skills and Knowledge**

- Knowledge of methods and techniques used in the collection, evaluation, and organization of data.
- Knowledge of the objectives, methodologies, and principles of planning.
- Knowledge of principles and practices of environmental analysis.
- Knowledge of the effects of environmental projects on human and natural resources and ecological relationships.
- Knowledge of transportation grants and federal requirements.

- Ability to orally communicate the purpose of obtaining, imparting, or exchanging information.
- Ability to collect, evaluate, and organize data for use in transportation programs, to draw valid conclusions from data.
- Ability to establish and maintain effective working relationships with other Department of Transportation employees, grantees, and federal officials.
- Ability to assign, schedule, and direct work of other Transportation Systems Analysts.

**Required Education and Experience**

- Graduation from a regionally accredited four-year college or university.
- Substitution: Experience as described below may be substituted for the required training/education on a year-for-year basis.
- Four years of full-time or equivalent part-time paid experience in the research, analysis, planning, bidding, or administration of highway construction and maintenance projects or managing transit grant programs.
- Substitution: Successfully completed graduate training from a regionally accredited college or university in transportation, urban or regional planning, engineering, economics, statistics, mathematics, geography, business administration, public administration, environmental studies, history, archeology, or in the physical or natural sciences may be substitute for two years of the required experience on a year-for-year basis.