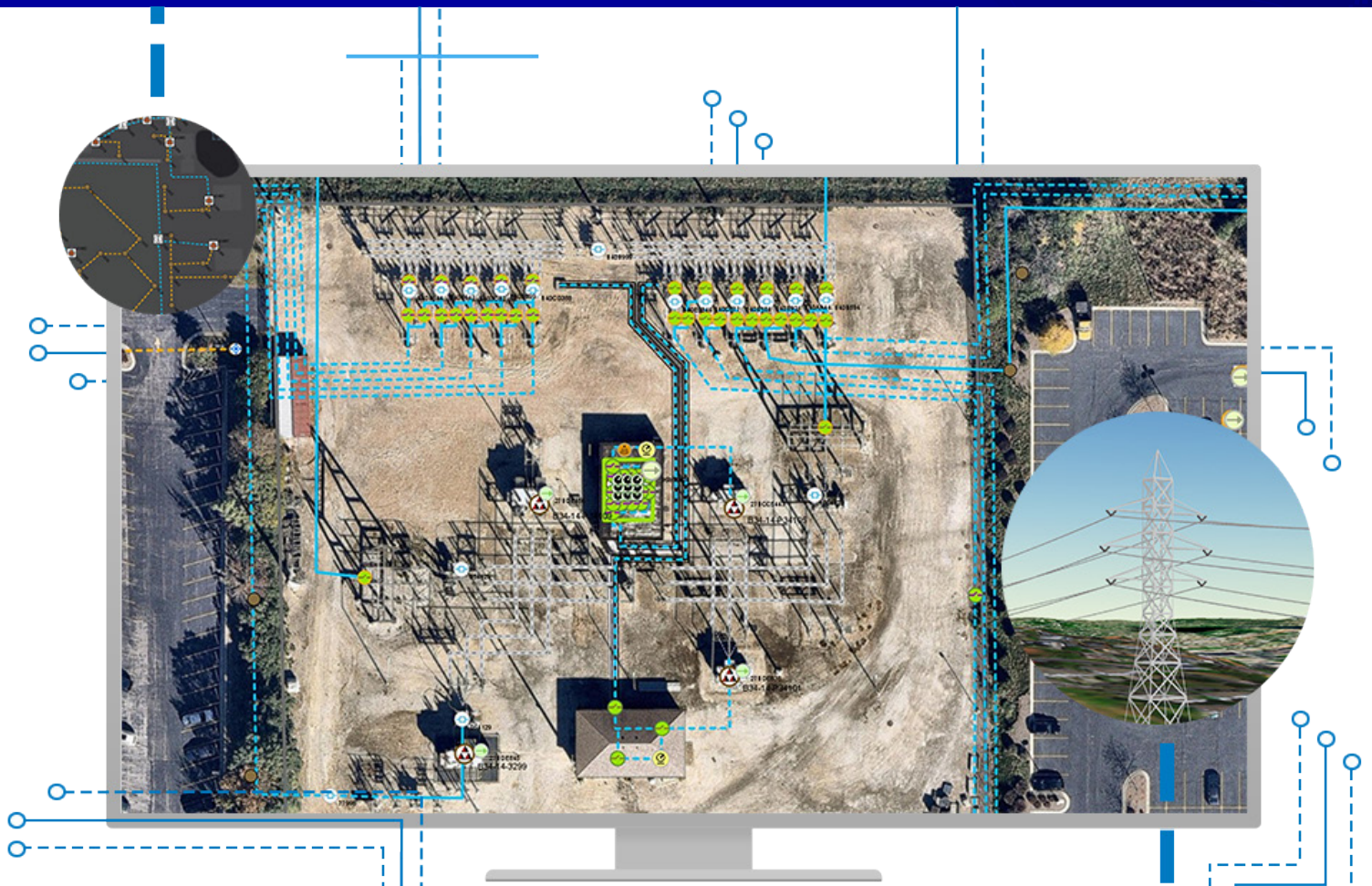


DESIGN & ENGINEERING FOR MODERN UTILITY NETWORKS



A COMPLETE GIS
Electric and Gas Utilities

Introduction

Utility engineers are facing major challenges due to aging infrastructure and the need for network modernization. The infrastructure built today will likewise be around for a long time. Utility engineers need innovative tools and methods to achieve their modernization goals. These goals must be realized while serving customers demanding efficiency, resiliency, and sustainability. Organizations have to deliver more—with fewer resources.

To produce efficient work products, design teams require diverse data, ranging from network configurations to environmental impacts. However, this data often rests in silos, resulting in cumbersome planning, design, and construction workflows.

Crucial engineering systems often start with translated file extracts rather than a steady, authoritative source. These fragmented processes are prone to data degradation, causing mistakes that lead to costly rework.

Reliable information sharpens all phases of every project. Designs not resting on a single source of truth create project risks that affect safety, schedule, and cost. A *single source of true* design information comes from a modern geographic information system (GIS).

A modern GIS extends far beyond simple mapping. It provides a solid foundation of information and communication. This enables utilities to succeed using repeatable solutions to engineering problems.

ArcGIS® software is a modern GIS that models networks holistically. Its rich analytics delivers greater understanding and improves decision-making. Versatile role-based apps accelerate communication and collaboration between all participants.

Using GIS in this way, engineers and designers focus not only on the *what* of infrastructure but also the *why*—in the context of *where*.

The modern capabilities of ArcGIS reinforce excellence for utility design and engineering.



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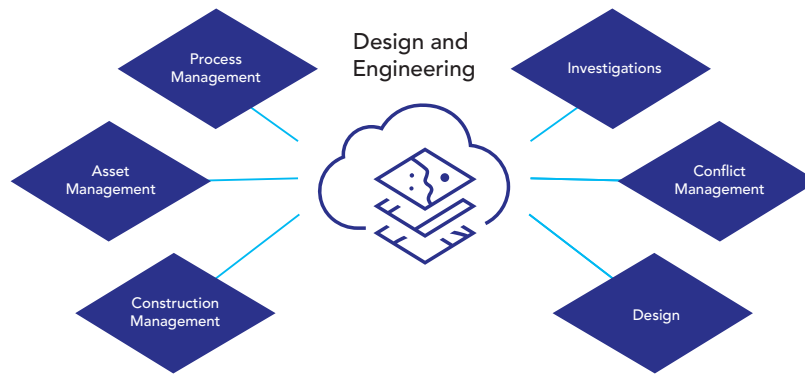
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The Project Life Cycle

The project process begins with planning and extends through engineering, design, and into construction. Teamwork between the office and field forces is critical to a smooth and cost-effective process. Correct as-built information feeds the utility's essential operational and asset management practices. All these functions can capitalize on the same data and technology platform: ArcGIS.

Information plays a key role throughout the entire project life cycle. ArcGIS goes beyond powerful mapping to unify the necessary data. A modern network is complex. Reliable engineering builds on detailed models of the network that reflect the real world. It relies on state-of-the-art visualization and analytics. These communicate engineering trade-offs and decisions. Innovative projects demand flowing coordination and clear collaboration between agencies and departments.

Utilities seek ways to create repeatable design solutions—solutions that scale. They begin with a comprehensive view of the information flows during the entire project life cycle.

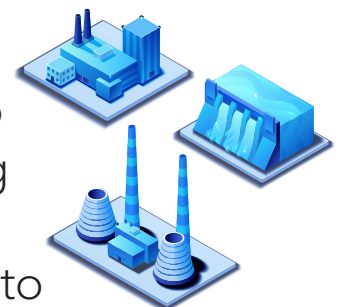
Initial steps rely on general data that places the project within the context of the network and its environment.

Computer-aided design (CAD) software, engineering analysis programs, and graphic GIS tools build on the same GIS network model. In doing so, they increase design efficiency by solving infrastructure optimization challenges and reducing backlog. Capturing mobile data at its source speeds work order closeout and makes as-built information immediately available.

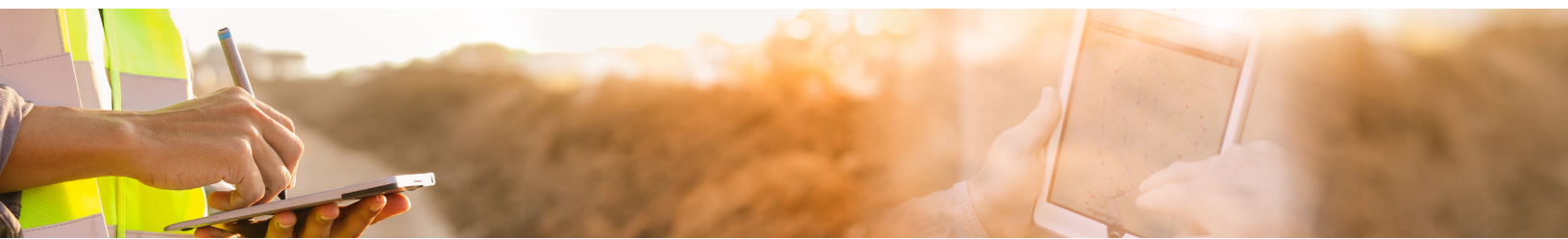
A full work packet includes calculations, drawings, compatible units, estimates, and material lists. ArcGIS integrates seamlessly with common enterprise resource planning (ERP) and enterprise asset management (EAM) systems. It utilizes and updates the appropriate systems without duplicate entry.

With ArcGIS, design and engineering information is assembled, referenced, and shared across the utility enterprise for use by every stakeholder in the process.

"We can bring information into our engineering analysis tools, and it allows us to **accurately start** our planning."



—Charles Robinson, Manager of System Planning Engineering, CoServ Electric



Why Location Technology Matters

Designing utility infrastructure is a location-centric pursuit, and awareness of place precedes valid work products. Lack of awareness can lead to project delays and added costs, as in the example of accidentally digging up a communications cable. Understanding existing conditions early helps avoid such problems during construction.

Nearly everything in the design process has to do with where things are now or need to be in the future:

- **Where** are the existing facilities?
- **Where** are the conflicts?
- **Where** are other plans for the area?
- **Where** are the customers who will be affected?
- **Where** are the environmental impacts?
- **Where** has the community voiced objections?

Design information fits together in the context of location. ArcGIS grasps how projects fit with system planning objectives and site conditions such as the following:

- Capacity needs and constraints
- Land records and rights-of-way
- Clearances from obstructions
- Environmental hazards
- Customer construction plans

Engineers and designers need to use and understand accurate, location-based information every day. They also need to share it widely with consultants, contractors, and construction forces. ArcGIS connects project tasks using role-based web maps and apps. It goes further by integrating tightly with common design tools using the latest services-based architecture.

ArcGIS advances utility design and engineering tasks with location technology.

“Austin Utilities’ transitioning from CAD to GIS is moving us to a more efficient and far more capable future. GIS is becoming a cornerstone—a hub—of business information at Austin Utilities.”

—Keven Maxa, Engineering Supervisor, Austin Utilities

Customer Example

A phased implementation plan allowed Austin Utilities to progress from CAD to GIS in an orderly manner. The plan also allowed the utility to realize benefits from the completion of each project phase.

[View Story](#)



A Holistic Approach to the Network

ArcGIS uses location technology to hone engineering work and provides an all-inclusive view of the network and its surroundings.

Utility engineers can see the many factors impacting their work. Using a modern GIS, they discover how these considerations connect with one another, and this understanding improves their work products.

Using location technology, utilities unlock new sources of value in the project life cycle, thus benefiting engineering analysis, planning, design, construction, and documentation. ArcGIS does this by addressing three needs:

Real-World Modeling

ArcGIS Utility Network captures the real-world characteristics of entire systems—from production to customer delivery. It includes data integrity tools while accounting for 3D and temporal states.

Visualization and Analytics

Compelling analytics and robust tracing actions highlight valuable insights. Schematic views validate design decisions. Integrated tools help determine accurate material and labor demands.

Coordination and Collaboration

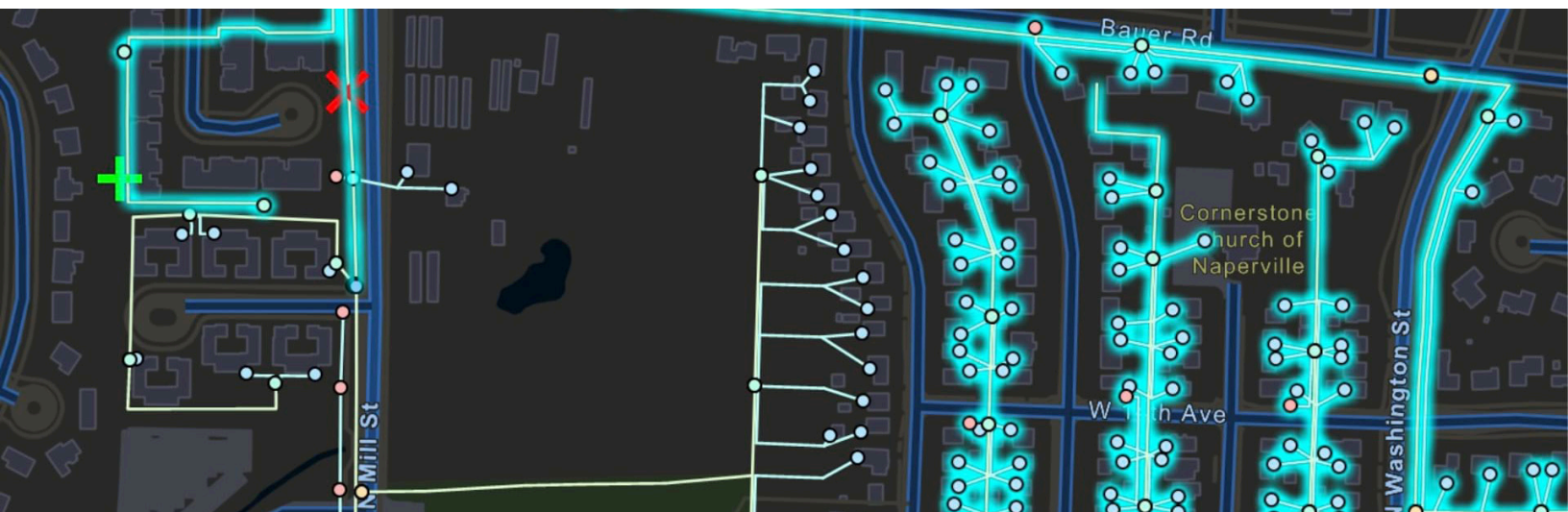
ArcGIS provides a seamless environment to leverage digital collaboration. Stakeholders consider impacts, examine alternatives, and make superior, coordinated decisions.

With a holistic approach, infrastructure designers reduce the time spent collecting data, allowing them to accelerate the project stages. This streamlines review cycles, saving time and money.



"ArcGIS Utility Network is **next generation technology** enabling utilities to achieve their digital transformation targets."

—Matt Piper, Director of Industry Solutions,
Utilities, Infrastructure, and AEC, Esri



Real-World Modeling

ArcGIS models the real-world characteristics of entire utility systems, adding value to each project phase. Contemporary users expect high-end 3D visuals. Today, true modeling accounts for greater detail, 3D, and the fourth dimension of time. It also secures high-quality data as part of its inherent functions. Real-world modeling improves outcomes in several ways:

Designs 3D Networks from Production to Customer Delivery

From distributed production to customer delivery, ArcGIS Utility Network embraces the best possible representations of reality for entire systems. With a complete model, engineers readily assess the customer impacts of design alternatives. ArcGIS Utility Network also accounts for structures and attachments and represents dense clusters without clutter. By capturing x, y, and z, it supports full 3D visualizations and analysis.

The Utility Network models the connection of every element in detail. Operating at scale, it even models multiple commodities together. For example, the effects of a

66 percent of utilities believe better modeling capability will help them achieve their **modernization goals**.

—2019 Esri Poll

communication equipment outage on electric and gas infrastructure become self-evident.

Manages Projects through Their Life Cycle

ArcGIS functions support data enrichment and streamline project delivery from planning to construction.

Esri's extensive partner network provides wide interoperability and access to extended toolsets.

Designers deliver data to the right user, at the right time, with the right tool. Project information flows seamlessly between applications. This advanced capability supports the entire project life cycle with simplicity, efficiency, and intelligence.



Real-World Modeling (continued)

Enforces Rules-Based Standards and Connectivity

ArcGIS Utility Network inherently enforces rules to determine logical and graphic connectivity, which ensures high-quality data. These connections are necessary for accurate modeling. Attribute validation applies quality assurance across all edit sources, on all device platforms—even integrations. Editing templates enable the placement of very complex features with a single, automated action. Enforcing data integrity and reducing entry errors in this way boosts effectiveness for all applications.

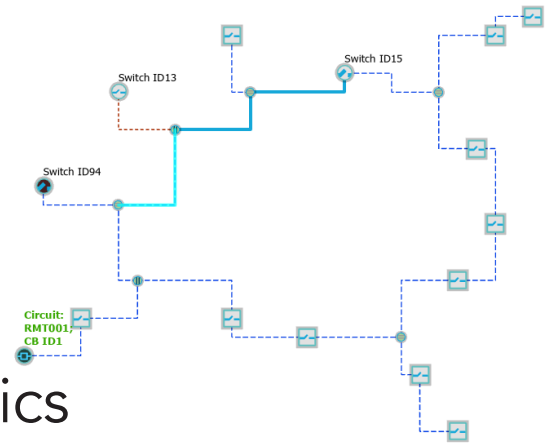
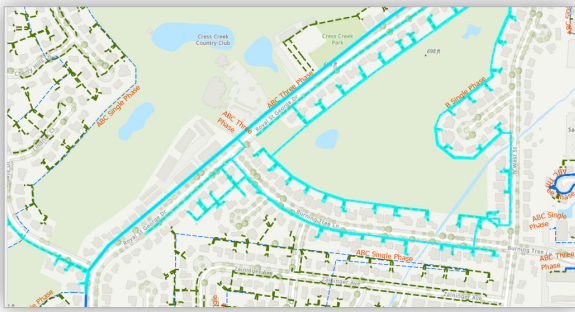
With this high level of quality control, edits can be safely made directly at data sources, including in the field. Subject only to an organization's preferences, edits to the master network can be made via mobile apps. Such a step forward can save time, and there is no loss in data quality. It also markedly reduces data latency in organizations accustomed to work order posting delays.

Represents Past, Present, and Future States

Utility engineering work requires analysis of past conditions and understanding of current parameters. It includes plans and estimations for the future. Compliance activities rely on accurate knowledge of the past. ArcGIS Utility Network accurately captures time—past, present, and future.

Additionally, the model maintains life cycle attributes. These life cycle states consist of proposed, in-service, abandoned, and under construction. Additional states can be added.

Esri poured years of extensive research and development into its network model. It developed this ArcGIS Utility Network capability to support industry needs and customer requests. These networks are an enabling technology supporting optimal engineering and operation of utility systems.



Visualization and Analytics

Industry trends and constraints are placing utility infrastructure under great pressure. Organizations cannot afford to overbuild equipment, so engineering decisions must be based on precise data. Building on a solid data foundation, leading utilities use data science and analytics to discover new insights and optimize designs. In ArcGIS, state-of-the-art visualization brings these design ideas to life through the following capabilities:

Network Analysis and Tracing

Network analysis in ArcGIS brings sophisticated tracing functions to every user. Tracing enables real-time guidance for common engineering matters like voltage drop, reliability, load balancing, and customer impacts.

“We’re adding so many customers and so much load annually. If we didn’t have the **GIS system**, I don’t know how we would keep up.”

—Curtis Trivitt, Sr. Vice President of Energy Services, CoServ Electric

Validation of 3D Designs in the Context of Location

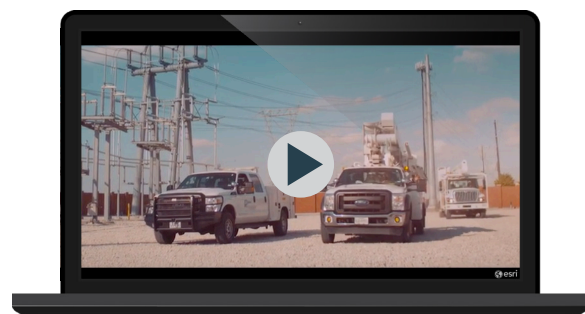
Site location and surroundings affect every design decision. Location technology allows engineers to readily assess environmental impacts and incorporate field data. Using location for context, ArcGIS users engage 3D capabilities to detect conflicts, make safety provisions, plan jobs, and conduct training.

Network Insight by Schematic Portrayal

Schematic views are built into ArcGIS Utility Network. Engineers need to evaluate high-level system considerations. To do so, they use schematics derived from the same solid data foundation.

Optimized Use of Material and Labor

Specific equipment details exist in the context of broad, location-based information. They form a complete picture. Reliable data reinforces tools to determine accurate material and labor estimates based on actual field conditions.



CoServ, one of the nation’s largest co-op utilities, is using Esri® technology and location intelligence to keep pace with customer demands.



Coordination and Collaboration

Design information must be easily accessible to those that use it. Coordination and collaboration begin with a mobile-friendly technology platform. ArcGIS uses web services to reach out across the web and put the right information into the right hands, at the right time.

All users get the information they need to understand impacts and consider alternatives. With it, they can provide input, make superior decisions, and achieve better outcomes. ArcGIS accomplishes these important communication objectives:

Convey Projects Widely on Any Device

ArcGIS changes the way field staff connect with engineering. It distributes information, map displays, and even 3D representations on any device. It does this for the office and the field—whether connected or disconnected.

Customer Example

The Turkish utility Enerjisa Electricity Distribution Companies used GIS analysis to plan its investment decisions for the growing needs of an expanding and changing population.

[View Story](#)

Collaborate with Internal and External Participants

Crews, contractors, and planners alike all need design information like drawings and schematics. Internal and external stakeholders also need to share project updates. ArcGIS provides all members of project teams with the flexible, role-based information products they need to work together.

Distribute Design Information Instantaneously

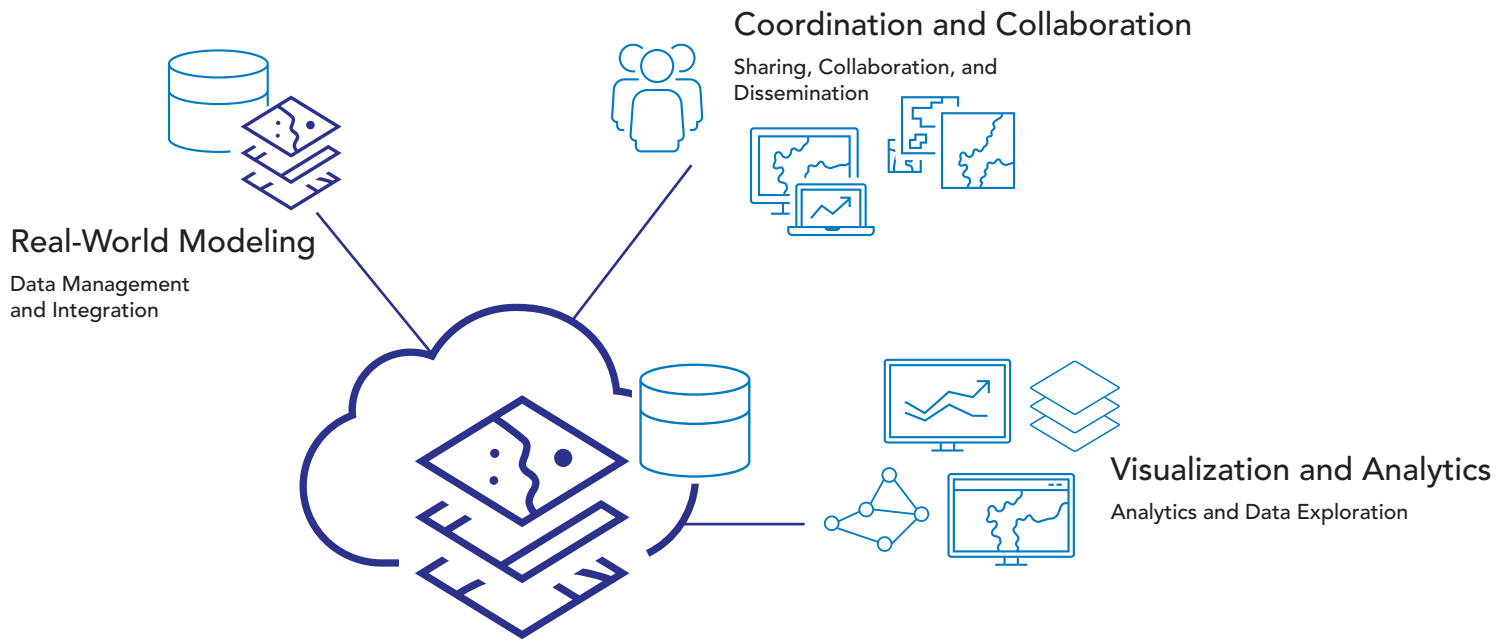
ArcGIS promotes common understanding by communicating project information immediately. It works at the speed of a services-based architecture. It leverages cloud computing where needed and improves situational awareness at every point along design, construction, and operations workflows.

Solicit Community Project Interaction

Using web-based dashboards and apps, customers easily understand project scope and impacts. They visualize design alternatives and provide feedback. They see schedules and understand the benefits.

71 percent of utilities reported that modern field operations solutions will help achieve their modernization goals.

– 2019 Esri Poll



The Complete GIS— Supporting Design and Engineering

Most utilities already use GIS in some capacity. Yet how they use it is changing. ArcGIS is a *complete* GIS, meaning that it contains all the elements needed to meet design and engineering challenges, not just to make conventional maps.

ArcGIS supports real-world modeling. It delivers rich visualization and analytics with artificial intelligence (AI). It enables immediate coordination and collaboration with mobile apps and web browsers. It maintains key information needed for efficient design work. It discovers hidden meaning in data and distributes insights to everyone who needs business intelligence.

These capabilities unite all the phases of design and engineering. They combine asset details with network performance

and future plans. With location as the centerpiece, a complete design picture helps improve key performance indicators and business results.

Utilities face considerable challenges today and will continue to do so in the future.

ArcGIS brings exceptional value to every utility's engineering design and construction practice.

ArcGIS is an extensive information platform that enables new asset management results. Learn more about digitally transforming utilities with a complete GIS in our e-book.

[View E-book](#)

About Esri

Esri, the global market leader in geographic information system (GIS) software, offers the most powerful mapping and spatial analytics technology available. Since 1969, Esri has helped customers unlock the full potential of data to improve operational and business results. Today, Esri software is deployed in more than 350,000 organizations including the world's largest cities, most national governments, 75 percent of Fortune 500 companies, and more than 7,000 colleges and universities. Esri engineers the most advanced solutions for digital transformation, the Internet of Things (IoT), and location analytics to inform the most authoritative maps in the world.

Esri supports utilities in achieving their performance and visibility goals with skills, knowledge, and resources in the following:

- Mapping
- Spatial analytics
- Data-driven insights
- Real-time situational awareness and alerts
- Visualization

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