GIS Solutions for Railroads
Railroads use GIS throughout their organizations.

Railway organizations invest heavily in their track network and related support infrastructure. These networks support critical movement of goods and services and can often make a key difference in keeping regional and even national economies competitive. In many cases, railway networks are highly utilized, and any downtime may create serious bottlenecks, delays, and even safety issues.

Many railroads have brought geographic information system (GIS) software into their information system suites to more efficiently manage their assets, maximize throughput and safety, and minimize disruptions and delays. GIS has been effectively deployed in support of a broad array of railway functions including:

- Infrastructure management and maintenance planning
  - Bridges, tunnels, and track networks
  - Communications and signaling networks
  - Electric power distribution networks
  - Rail yards and other campus facilities
- Real estate management
  - Valuation maps
  - Lease and tenant management
- Rolling stock management
  - Locomotive health and well-being
  - Shipment and asset tracking
- Safety and security
  - Incident tracking
  - Response management
  - Safety planning
  - Access management
  - Risk assessment
- Design and construction
  - Environmental compliance
  - Capacity modeling
  - ROW acquisition
- Supply chain analysis
  - Commodity flow history
  - Marketing analysis
- Passenger information systems
- Intermodal management

Meteorlogix (an authorized ESRI business partner) has created a systemwide network surveillance tool for the Union Pacific Railroad. The tool provides immediate notification to all stakeholders when weather conditions exceed defined tolerance levels. The entire network can be viewed using an ArcIMS® service.

When tolerances are exceeded, the ESRI® ArcGIS® software-based service generates a message and image that are delivered to the appropriate stakeholders. Courtesy of the Union Pacific Railroad Corporation.
Safety and security have taken an even higher priority in recent years, especially in crowded urban areas. Railroad managers have developed GIS systems with the capability to identify in great detail nonrailroad assets in the communities through which they travel. When called on to deal with crime, crashes, spills, or other unusual events, railroad officials use the GIS for immediate access to local data such as streets and at-grade crossings; police, fire, and rescue contact information; schools; hospitals; and rivers and streams and other geographic features needed to better manage incidents and emergencies.

Railroad GIS can also utilize external information such as real-time weather data to adapt speed or other rail traffic activities. This type of weather data can also be critical information to assist in evacuations (e.g., when a derailment increases the likelihood of a chemical spill). Flood levels can also be integrated and alternate routing organized safely and efficiently, minimizing reversed or uncompleted trips.
GIS provides a framework for enterprise-wide information sharing.

GIS can be integrated with business intelligence software tools to identify trends and key status changes on the rail network and to other assets.

Index of georeferenced valuation maps along rail lines in the western United States
Courtesy of the Union Pacific Railroad Corporation

Valuation map along rail line in Colorado
Courtesy of the Union Pacific Railroad Corporation

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A complete inventory and history of hazardous materials can be tied directly to the location where they are stored and shipped. Spills and other safety incidents can be tracked and reported in GIS.

GIS-based plume modeling can be used in both contingency planning and emergency response situations.

Infrastructure investments and plans can be tracked and managed in concert with land parcels, owned or leased, in a GIS.

These screenshots are from IRRIS, the Intelligent Road/Rail Information Server, which provides updates on transportation infrastructure in a context supporting homeland security.

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Railway analysts link various modal networks for integrated analysis.

Intermodal and Ports

Intermodal transfers of cargo, whether from ship to rail or rail to road, can create huge cargo traffic bottlenecks and reduce efficiency. This leads to increased costs and, in some cases, late deliveries, destruction of perishables, or even cancellations due to contractual requirements.

Rail managers have found that GIS helps them manage shipments and transfers more effectively by giving them more accurate and timely information, an essential feature in any decision support system.

GIS also supports the development of “executive dashboards,” bringing the benefits of spatial information and intuitive map graphics directly to facility and operations managers.

ArcGIS Network Analyst offers the ability to combine modal networks, such as for multimodal passenger routing, using both train and bus trips.

Learn more about GIS for railroads at www.esri.com/railroads.
Passenger Railroads

Many of the GIS applications used in passenger railroads are essentially identical to those used in freight rail organizations. However, passenger rail operators face some unique challenges, and GIS provides an excellent tool to help them communicate with their passengers as well as manage complex, intermodal trips. Many commuter rail, subway, and intermodal transit authorities use GIS to analyze trip patterns, both spatially and temporally, to better coordinate rail services with local bus services. In addition, many passenger rail facilities are built in much closer proximity to where people work and live. Passenger rail managers also use GIS for analysis of noise impact on human habitats.

Several rail authorities have also invested in real-time tracking systems and provided kiosk or Web interfaces to their customers. Passengers truly appreciate knowing when a train will arrive and being able to inform associates and loved ones when travel will be delayed.

With data provided with GPS, ArcPad® shows track centerlines approximately 13 feet apart. Also shown are areas that are safe for trains but may give commuters a feeling of horizontal movement within the comfort zone.

Before embracing GPS, the Engineering Department used landmarks to locate defects. Here are shown a platform and a milepost.

GIS can also automatically generate various schematic representations of the rail or communication and signaling networks.
For more than 35 years ESRI has been helping people manage and analyze geographic information. ESRI offers a framework for implementing GIS technology in any organization with a seamless link from personal GIS on the desktop to enterprise-wide GIS client/server and data management systems. ESRI GIS solutions are flexible and can be customized to meet the needs of our users. ESRI is a full-service GIS company, ready to help you begin, grow, and build success with GIS.

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