GIS

지리정보시스템

Geographic Information System

https://ubm1-pmc.mn

Produced by : Park K. H.

UBM PMC

PART 1

What is GIS?

Geographic **I**nformation **S**ystem

1.1 Definition & Core Components of GIS

1.2 Necessity & Advantages of GIS

1.3 Differences between Maps & GIS

1

What is **GIS ?**

1.1 Definition & Core Components of GIS

GIS is a system designed to **collect, store, manage, analyze, and visualize** geographic data.
It allows users to understand patterns, relationships, and trends through **location-based information**.

🧭 **"GIS helps answer questions like what, where, why, and how by using location data."**

Generated by ChatGPT

UBM PMC

1.1 Definition & Core Components of GIS

1

What is GIS ?

Methods include various procedures by which data can be edited, accessed, managed, stored, and analyzed to achieve the required output for the particular application and analysis, such as change detection analysis.

Hardware enables users to capture, store, process, and visualize the geographic information.

Software enables users to input data, store, transform, analyze, and generate desired outputs in the form of maps and reports.

GIS professionals are the technical personnel who manage data, develop procedures, and process and analyze geospatial data to apply it to real-world problems.

GIS data is stored as spatial (geographic data) and non-spatial(tabular) data. Data must be collected from a reliable source and should be an accurate record of reality..

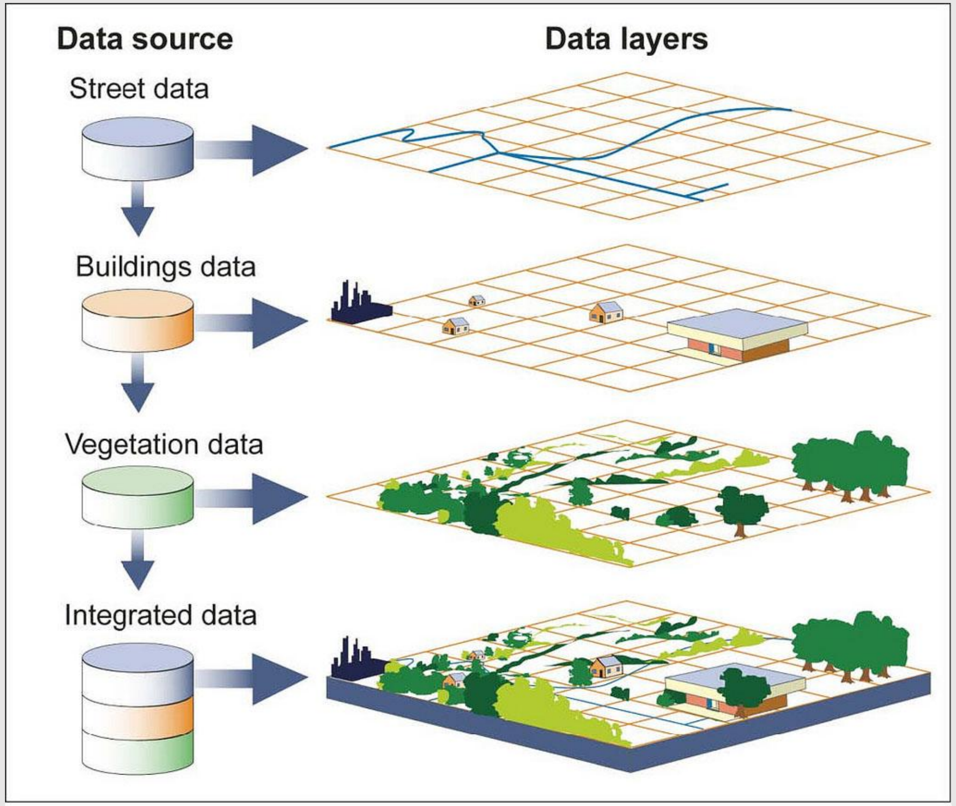
https://gisoutlook.com/2019/05/what-is-gis-geographical-information-system.html

1.1 Definition & Core Components of GIS

1

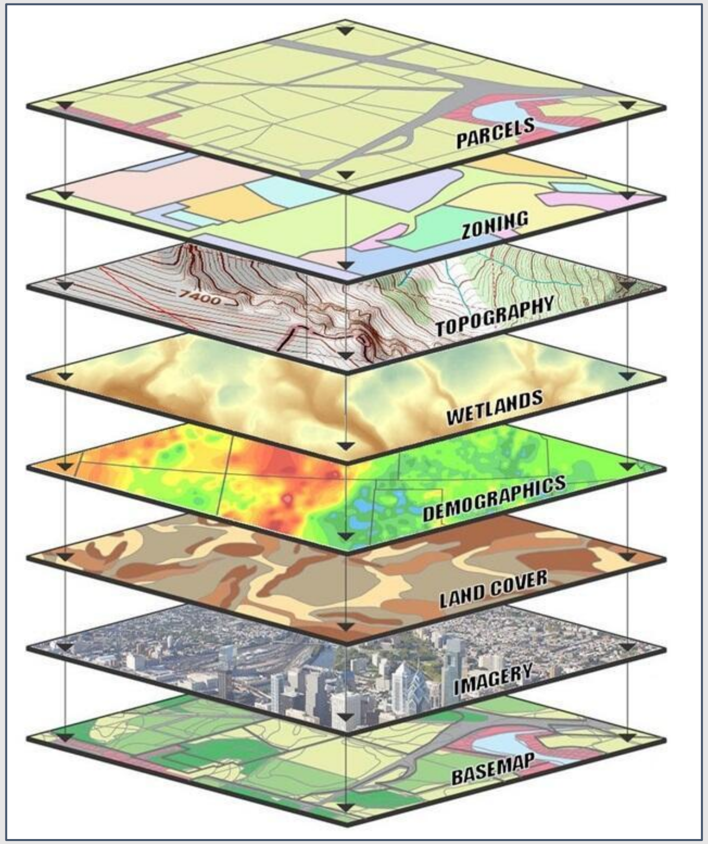
What is GIS ?

What is the Spatial Data of GIS?



Source: GAO.

https://images.nationalgeographic.org/image/upload/v1638886493/EducationHub/photos/gis.jpg



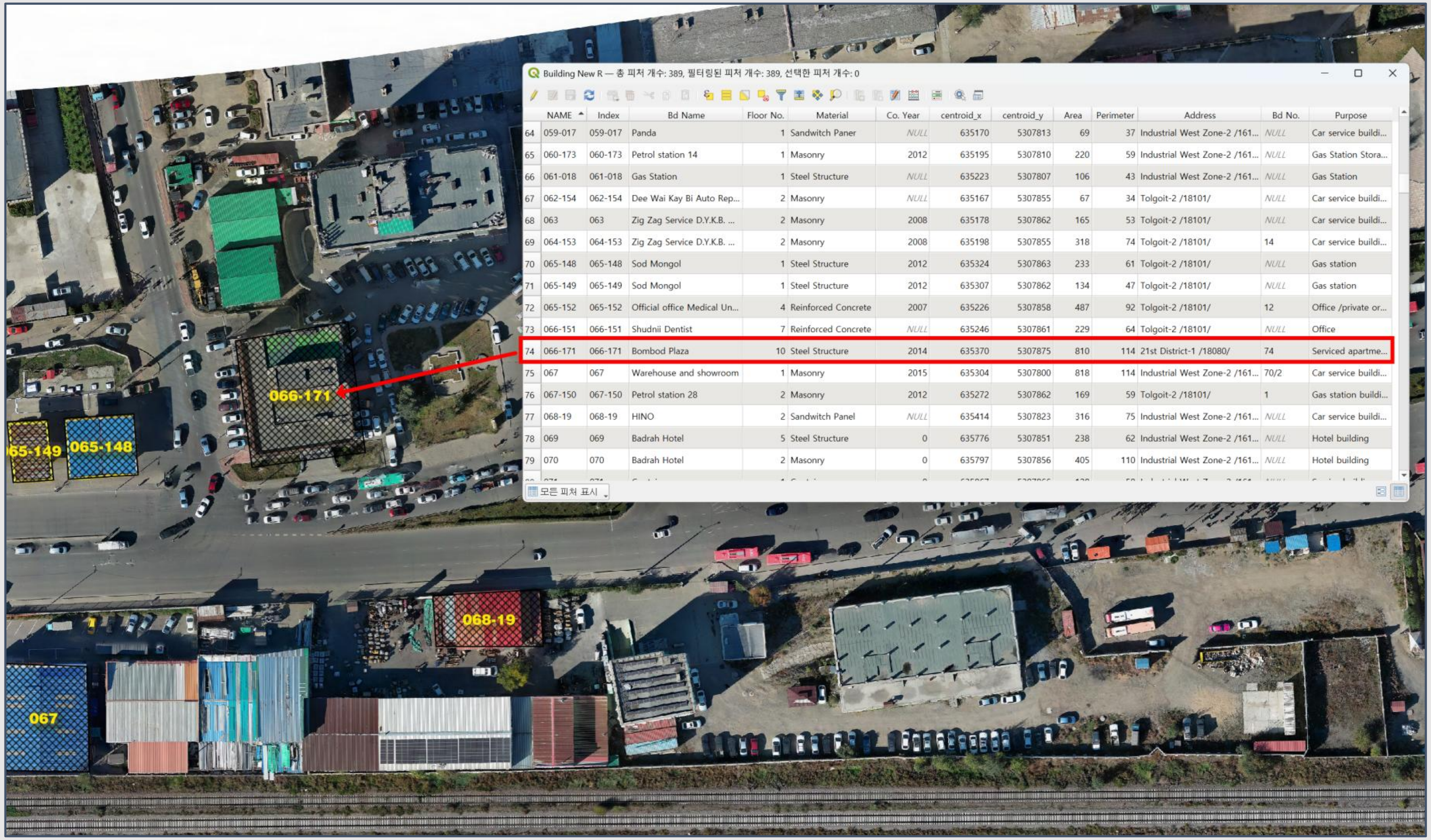
https://www.usgs.gov/media/images/gis-data-layers-visualization

1.1 Definition & Core Components of GIS

1

What is
GIS ?

What is the Attribute Data of GIS?



	NAME	Index	Bd Name	Floor No.	Material	Co. Year	centroid_x	centroid_y	Area	Perimeter	Address	Bd No.	Purpose
64	059-017	059-017	Panda	1	Sandwitch Paner	NULL	635170	5307813	69	37	Industrial West Zone-2 /161...	NULL	Car service buildi...
65	060-173	060-173	Petrol station 14	1	Masonry	2012	635195	5307810	220	59	Industrial West Zone-2 /161...	NULL	Gas Station Stora...
66	061-018	061-018	Gas Station	1	Steel Structure	NULL	635223	5307807	106	43	Industrial West Zone-2 /161...	NULL	Gas Station
67	062-154	062-154	Dee Wai Kay Bi Auto Rep...	2	Masonry	NULL	635167	5307855	67	34	Tolgoit-2 /18101/	NULL	Car service buildi...
68	063	063	Zig Zag Service D.Y.K.B. ...	2	Masonry	2008	635178	5307862	165	53	Tolgoit-2 /18101/	NULL	Car service buildi...
69	064-153	064-153	Zig Zag Service D.Y.K.B. ...	2	Masonry	2008	635198	5307855	318	74	Tolgoit-2 /18101/	14	Car service buildi...
70	065-148	065-148	Sod Mongol	1	Steel Structure	2012	635324	5307863	233	61	Tolgoit-2 /18101/	NULL	Gas station
71	065-149	065-149	Sod Mongol	1	Steel Structure	2012	635307	5307862	134	47	Tolgoit-2 /18101/	NULL	Gas station
72	065-152	065-152	Official office Medical Un...	4	Reinforced Concrete	2007	635226	5307858	487	92	Tolgoit-2 /18101/	12	Office /private or...
73	066-151	066-151	Shudnii Dentist	7	Reinforced Concrete	NULL	635246	5307861	229	64	Tolgoit-2 /18101/	NULL	Office
74	066-171	066-171	Bombod Plaza	10	Steel Structure	2014	635370	5307875	810	114	21st District-1 /18080/	74	Serviced apartme...
75	067	067	Warehouse and showroom	1	Masonry	2015	635304	5307800	818	114	Industrial West Zone-2 /161...	70/2	Car service buildi...
76	067-150	067-150	Petrol station 28	2	Masonry	2012	635272	5307862	169	59	Tolgoit-2 /18101/	1	Gas station buildi...
77	068-19	068-19	HINO	2	Sandwitch Panel	NULL	635414	5307823	316	75	Industrial West Zone-2 /161...	NULL	Car service buildi...
78	069	069	Badrah Hotel	5	Steel Structure	0	635776	5307851	238	62	Industrial West Zone-2 /161...	NULL	Hotel building
79	070	070	Badrah Hotel	2	Masonry	0	635797	5307856	405	110	Industrial West Zone-2 /161...	NULL	Hotel building

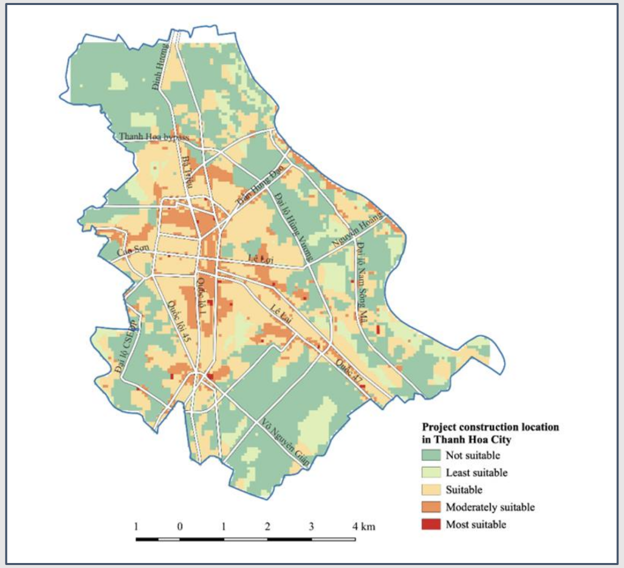
Captured from Dilapidation GIS data of UB Metro 1

1.2 Necessity & Advantages of GIS

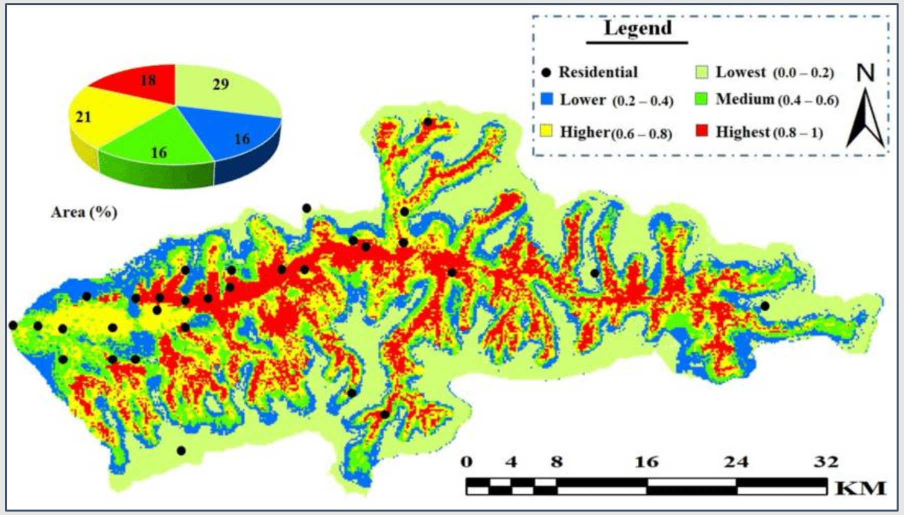
Why Do We Need GIS?

Understanding the world through the Power of location information

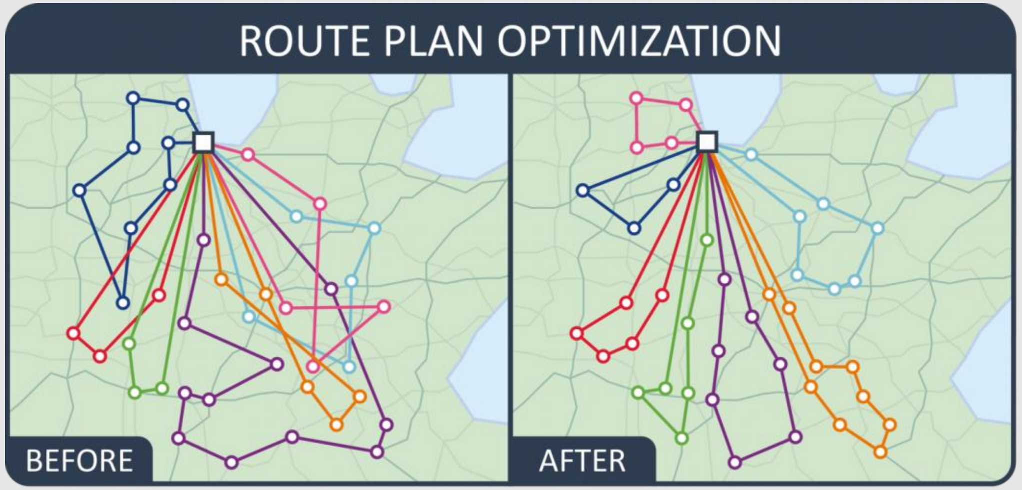
- Real-world Problems Need Spatial Solutions
  . Most decisions are related to "where".
  . GIS helps analyze spatial relationships and patterns.
- Examples:
  . Choosing the best location for a new subway station
  . Analyzing flood risk zones
  . Optimizing delivery routes.



https://evtech.vn/gis-based-multi-criteria-analysis-method-for-conference-center-location/



https://www.researchgate.net/figure/Map-of-flood-risk-assessment-by-the-RF-model_fig4_355912766



https://www.paragonrouting.com/en-gb/ultimate-guides/post/the-ultimate-guide-to-route-optimization/

1

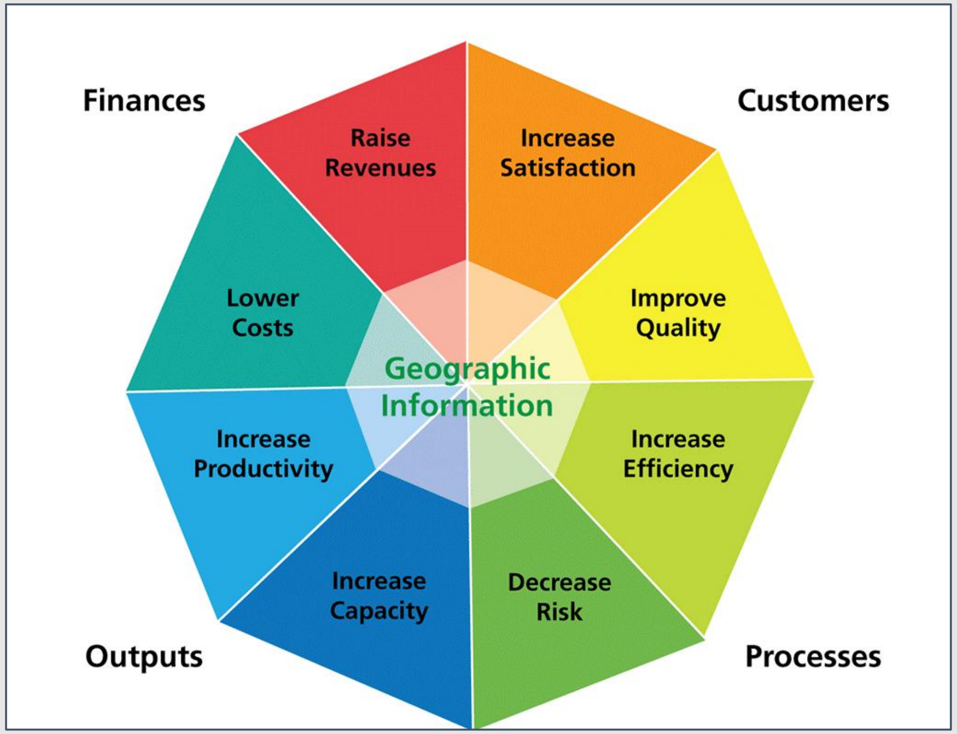
What is GIS ?

1.2 Necessity & Advantages of GIS

What are the Advantages of GIS?

Turning complex data into clear, actionable insight

- **Visualization**
  . Converts data into interactive maps
  . Helps identify trends and patterns easily
- **Data Integration**
  . Combines data from various sources
  . Enables holistic analysis
- **Better Decision-Making**
  . Supports planning with evidence-based insights
  . Reduces risks and improves efficiency
- **Better Decision-Making**
  . Can be applied to local or global problems
  . Adapts to many fields: Environment, Logistics, Health



https://aidco.com.pk/geographic-information-system/

1

What is GIS ?

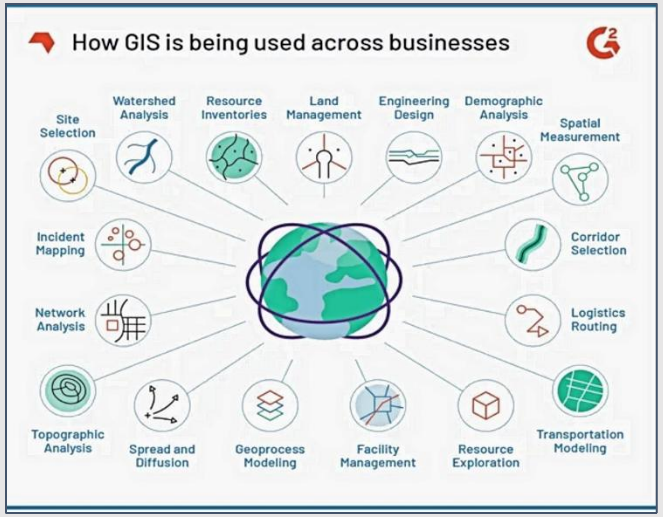
1.3 Differences between Maps & GIS

What are the Differences between Maps & GIS

Aspect	Paper Map	GIS
Format	Physical, printed map	Digital format, displayed on a screen
Interactivity	Static, no user interaction	Interactive, allows zooming, panning, and data manipulation
Data Handling	Limited data, often simplified	Handles large datasets with complex attributes and analysis
Customization	Fixed features, no customization	Highly customizable with layers, styles, and analysis tools
Accuracy	Accuracy can be limited by scale and updates	Can provide real-time, highly accurate, and detailed data
Storage	Physical space required for storage	Can store vast amounts of data digitally
Analysis	Cannot perform complex spatial analysis	Supports complex spatial and statistical analysis

Generated by ChatGPT

https://www.thecollector.com/history-cartography-maps/



https://www.g2.com/articles/what-is-gis

PART 2

Core Components of GIS

Geographic **I**nformation **S**ystem

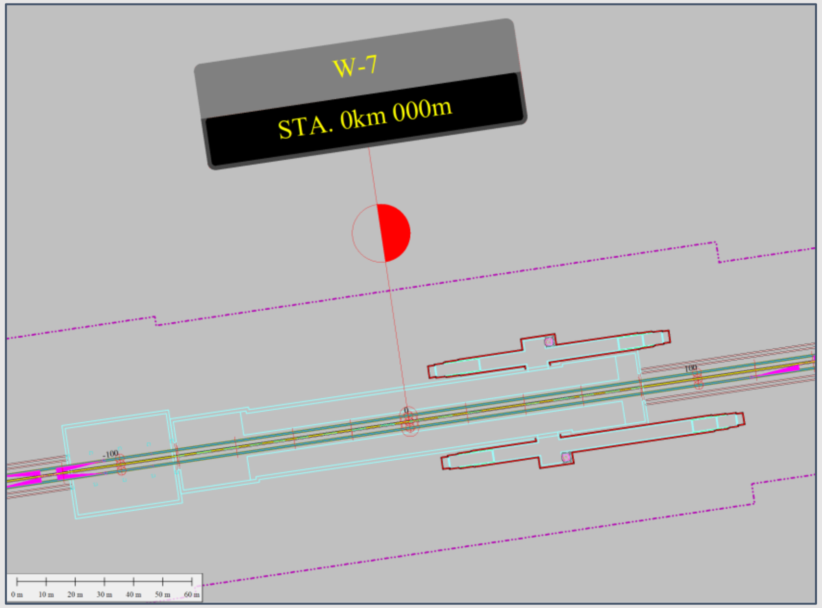
- 2.1 Data
- 2.2 Software
- 2.3 Hardware
- 2.4 People

2

Core Components of GIS

2.1 Data

🌍 In GIS, data is categorized into two primary formats: vector and raster. Each data format stores and processes spatial information in different ways.



Vector Data (UB Metro 1 – Station W7)

Vector + Raster Data (UB Metro 1 – Station W7)

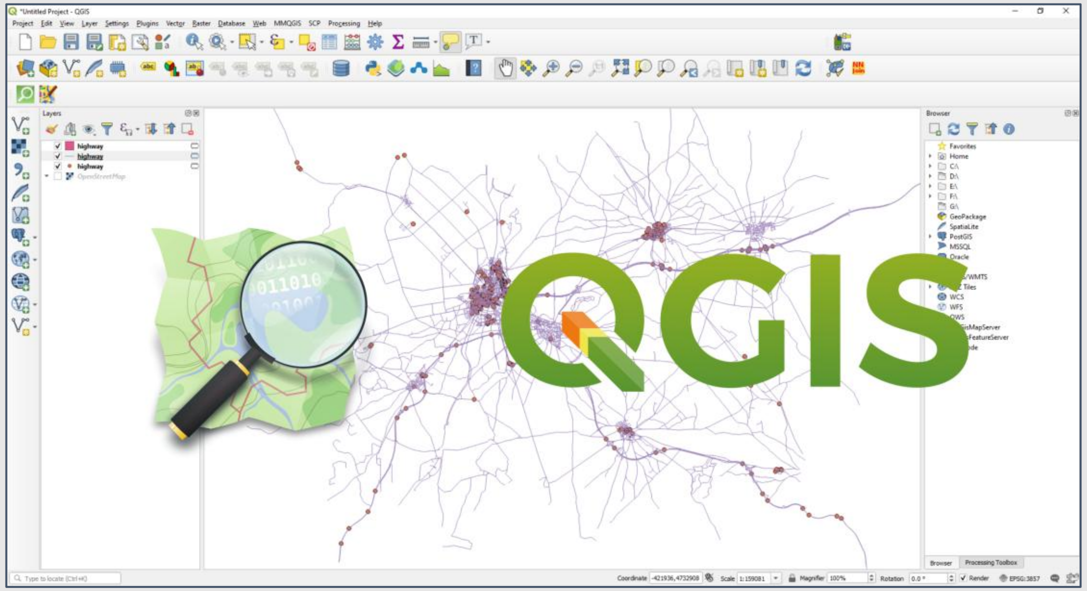
Component	Description	Examples
Vector Data	Represents data in geometric forms like points, lines, and polygons. Each feature is defined by coordinates and includes both spatial and attribute information.	Digital Maps, CAD file, 3D model files, etc.
Raster Data	Represents data in a grid of cells. Each cell contains a color or value that represents a variable of geographic information.	Satellite images, Aerial/Drone Photographs, DEM/DSM/DTM, etc.

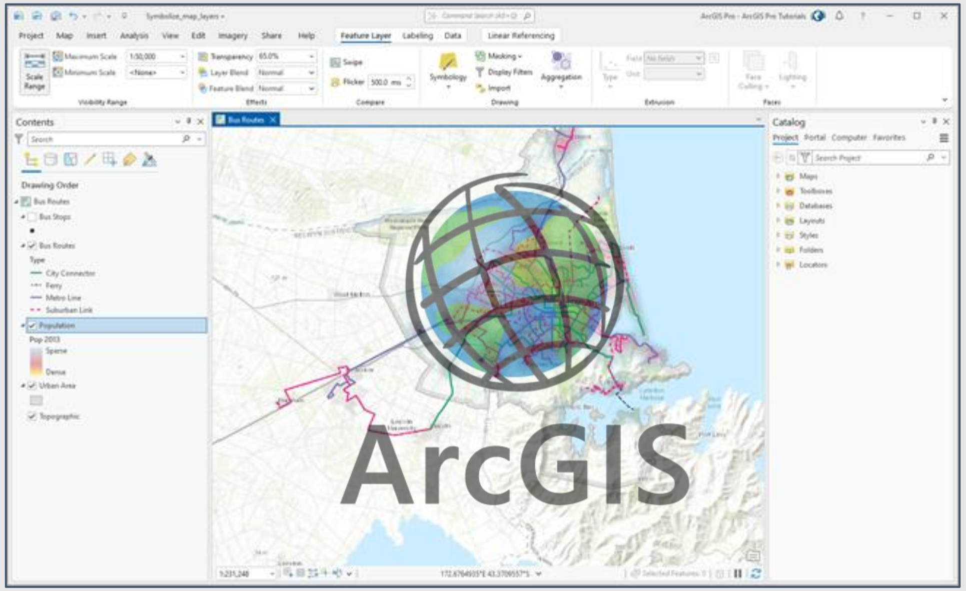
2

Core Components of GIS

2.2 Software

🌍 GIS software is responsible for **storing, analyzing, and visualizing** spatial data. Key GIS software includes QGIS and ArcGIS.





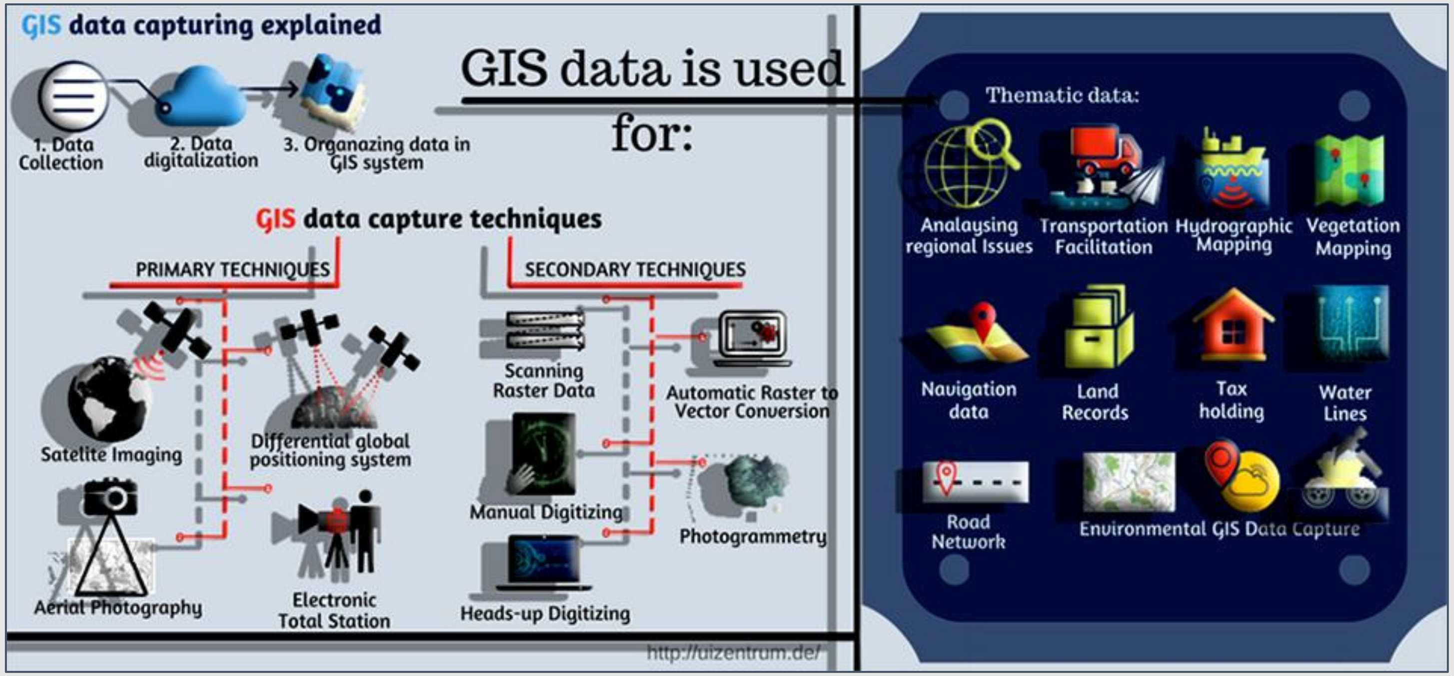
Software	Description	Features
QGIS	An open-source GIS software with a wide range of plugins and customizable features.	Free, customizable, supports various data formats.
ArcGIS	A commercial GIS software with robust analytical tools and technical support.	High accuracy and reliability, widely used in enterprise environments.

2

Core Components of GIS

2.3 Hardware and System

🌍 GIS requires powerful hardware and systems for data storage, processing, and analysis.



https://uizentrum.de/gis-data-capture/?lang=en

Hardware/System	Description	Examples
Computer/Server	High-performance computers or servers are needed to process and analyze GIS data.	Desktop PCs, workstations, cloud servers
GPS/Sencors	Devices used to collect location data, improving the accuracy of spatial information.	GPS devices, drones, laser scanners, etc.
Database	Systems used to efficiently store and manage GIS data.	PostgreSQL/PostGIS, Oracle Spatial, etc.

2

Core Components of GIS

2.4 People: Experts in GIS

🌍 Experts in GIS collaborate across disciplines to collect, analyze, and manage spatial data. They develop tools, produce maps, and provide insights to support informed decision-making.

Disciplines	Roles
GIS Analyst	Analyzes spatial data to generate maps and insights. Supports decision-making with geographic information.
GIS Developer	Builds custom GIS applications and tools. Integrates spatial data with software systems.
GIS Database Administrator (DBA)	Manages and maintains GIS databases for data integrity. Ensures efficient data storage and access.
GIS Project Manager	Leads and coordinates GIS projects and teams. Ensures timely and successful project delivery.
Cartographer	Designs clear and accurate maps from spatial data. Focuses on visual communication of geographic information.
Geospatial Data Scientist	Analyzes satellite and aerial imagery. Extracts valuable information from remote sensing data.
Remote Sensing Specialist	Systems used to efficiently store and manage GIS data.
Surveyor	Collects precise field data using GPS and instruments. Provides foundational data for GIS mapping and analysis.

UBM PMC

PART 3

Core Terms for GIS

Geographic **I**nformation **S**ystem

3.1 Map Projection

3.2 Reference System

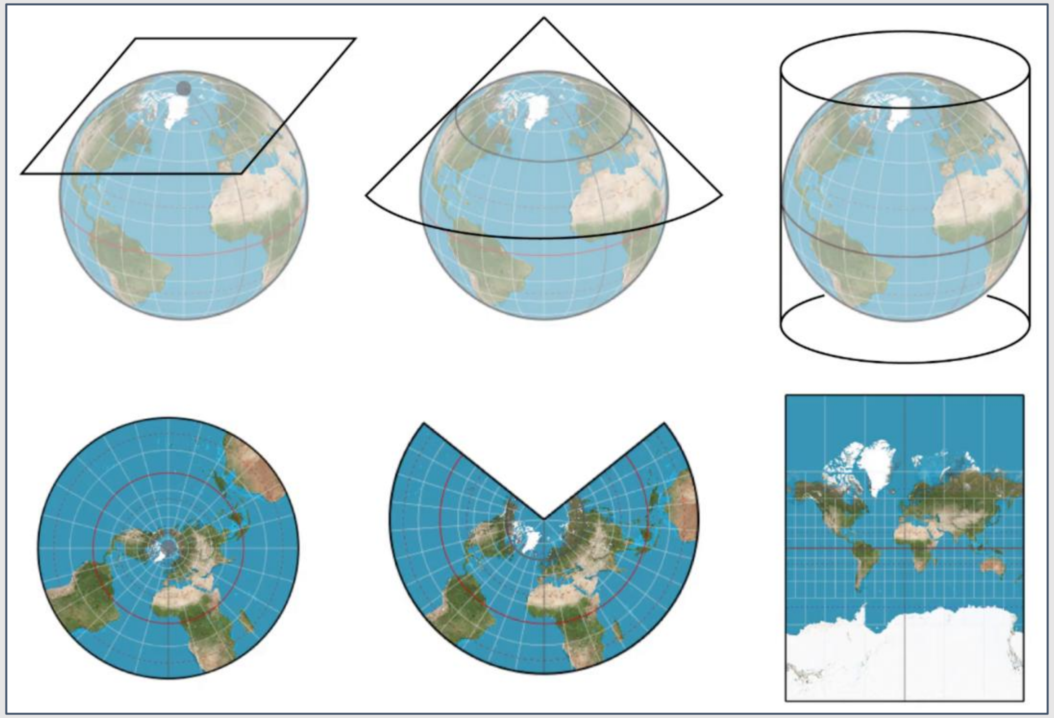
3.3 Resolution & GSD

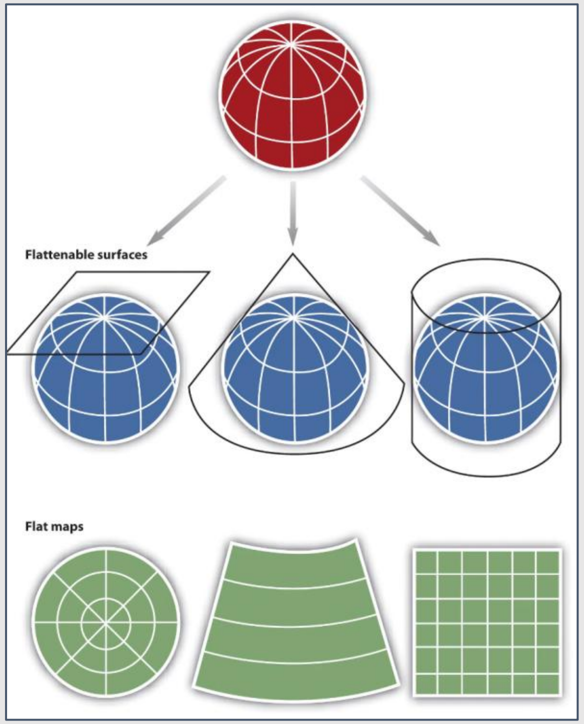
3.4 Digital Elevation Model

3.5 Point Cloud

3.1 Map Projection

🌍 Map projection is the method of representing the 3D curved surface of the Earth on a 2D flat map. Each projection introduces some distortion in shape, area, distance, or direction, depending on its purpose.





https://mapscaping.com/understanding_map_projections/

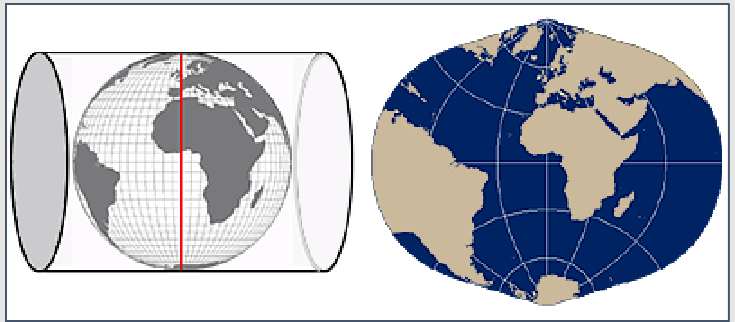
Types	Roles	Examples
Planar(Azimuthal)	Best for polar areas; preserves directions from the center point.	Polar Stereographic Projection
Conic	Ideal for mid-latitude regions; balances area and shape distortion.	Lambert Conformal Conic
Cylindrical	Best for equatorial regions; shape preserved but area distorted near poles.	Mercator Projection

3

Core Terms for GIS

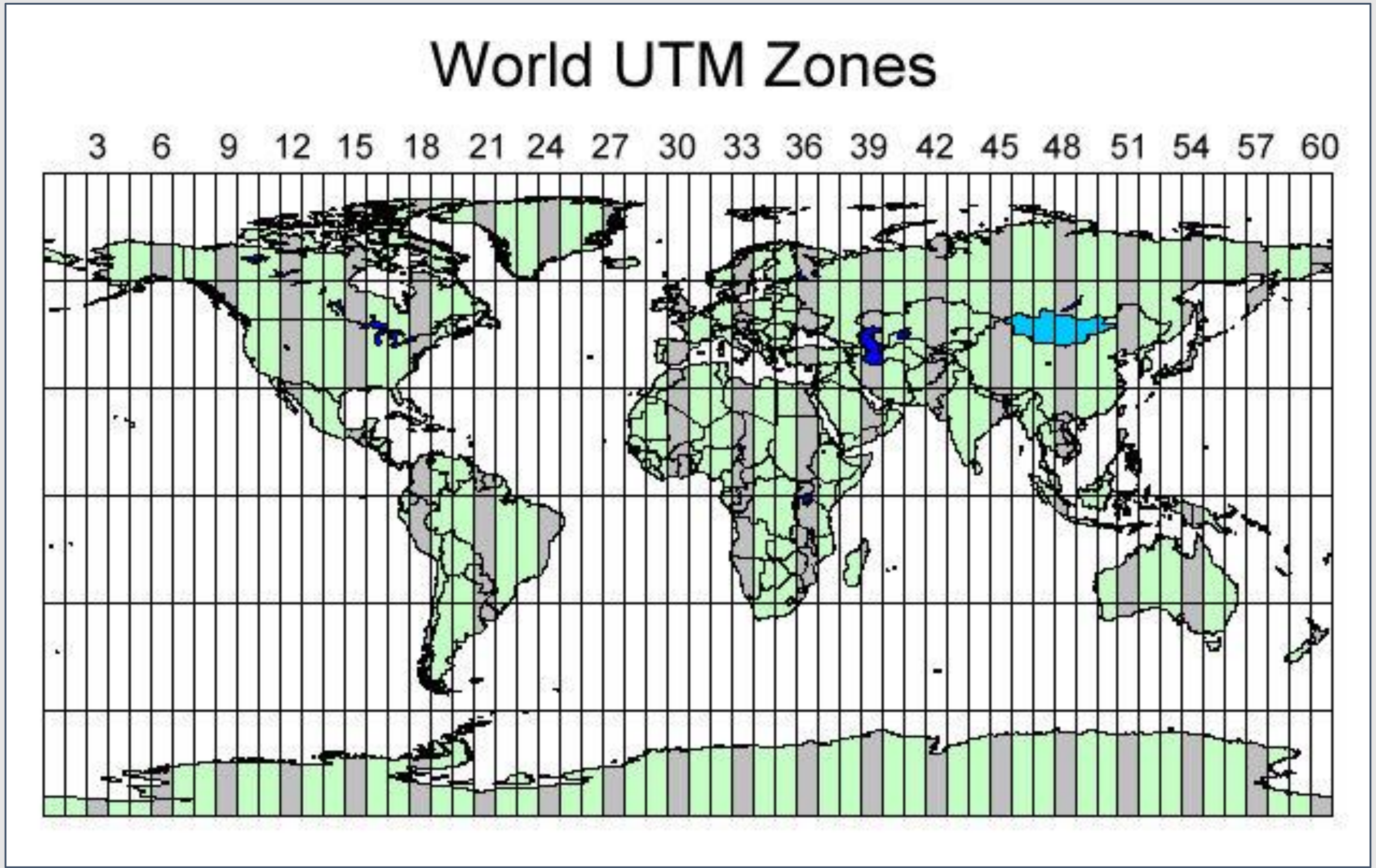
3.1 Map Projection

🌍 UTM (Universal Transverse Mercator) is a projected coordinate system that divides the world into 60 zones, each 6° of longitude wide. It provides accurate distance and area measurements, making it ideal for regional mapping and engineering applications.



http://www.geography.hunter.cuny.edu/~jochen/GTECH361/lectures/lecture04/concepts/Map%20coordinate%20systems/Transverse%20aspect.htm

The Transverse Mercator Projection is a cylindrical map projection in which the cylinder is rotated 90 degrees, making the central meridian the line of true scale. It is commonly used for large-scale mapping, such as the UTM coordinate system.



https://uizentrum.de/gis-data-capture/?lang=en

UBM PMC

3

Core Terms for GIS

3.2 Reference System

https://mapscaping.com/understanding_map_projections/

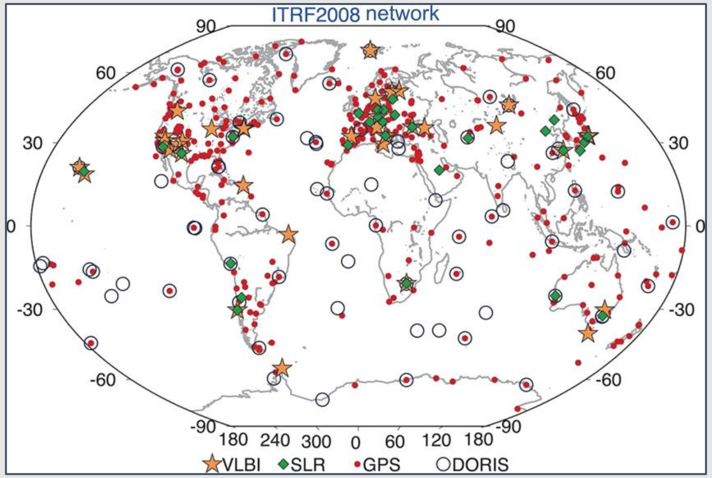
A Reference System is a framework used to define locations, distances, and directions on Earth. It consists of a set of parameters that are used to map positions in the real world onto a coordinate system.

Types	Description	Examples
Geodetic Reference System	Defines the Earth's shape and size	WGS84, NAD83
Projected Coordinate System	A flat, 2D representation of the Earth's surface.	UTM
Geocentric Coordinate System	Based on the Earth's center	ECEF, ITRF
Local Coordinate System	Used for small-scale, localized applications	Local engineering projects

Why is a Reference System Important?

- Provides a consistent framework for geographic data.
- Essential for accurate positioning and mapping.
- Crucial for applications such as GPS, GIS, and remote sensing.

ITRF 2008 is a specific version of the International Terrestrial Reference Frame, a highly accurate geodetic reference frame that provides a consistent framework for positioning on Earth. ITRF 2008 is a realization of the Earth's reference system that incorporates the latest measurements and observations from global satellite systems, such as GPS, and terrestrial networks.



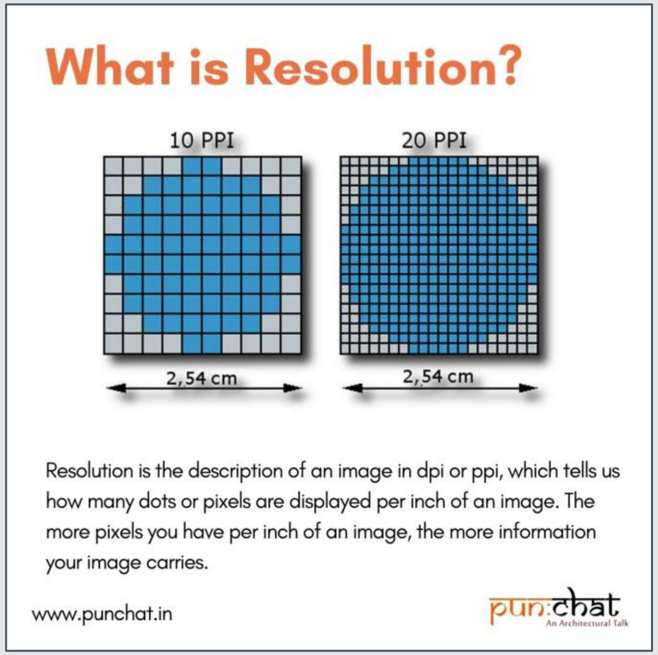
https://www.researchgate.net/figure/Full-ITRF2008-network-comprising-934-stations-located-at-580-sites-highlighting-stations_fig2_311849443

3

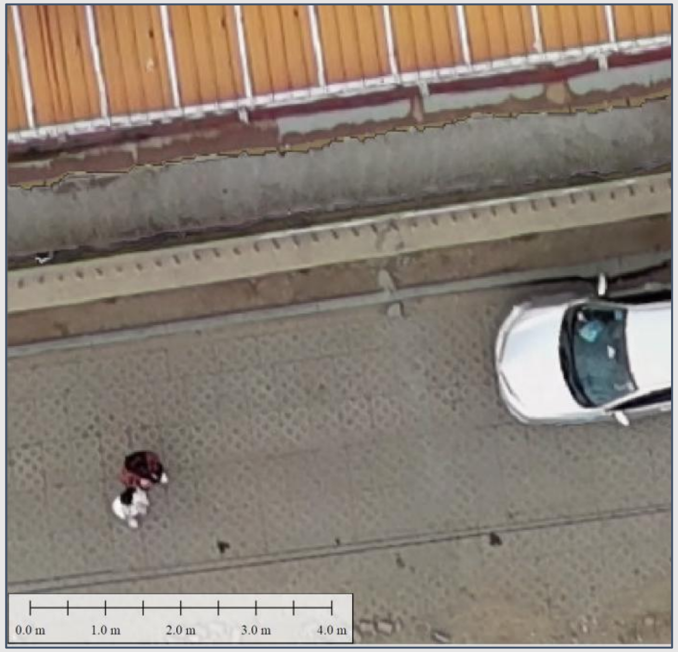
Core Terms for GIS

3.3 Resolution & GSD

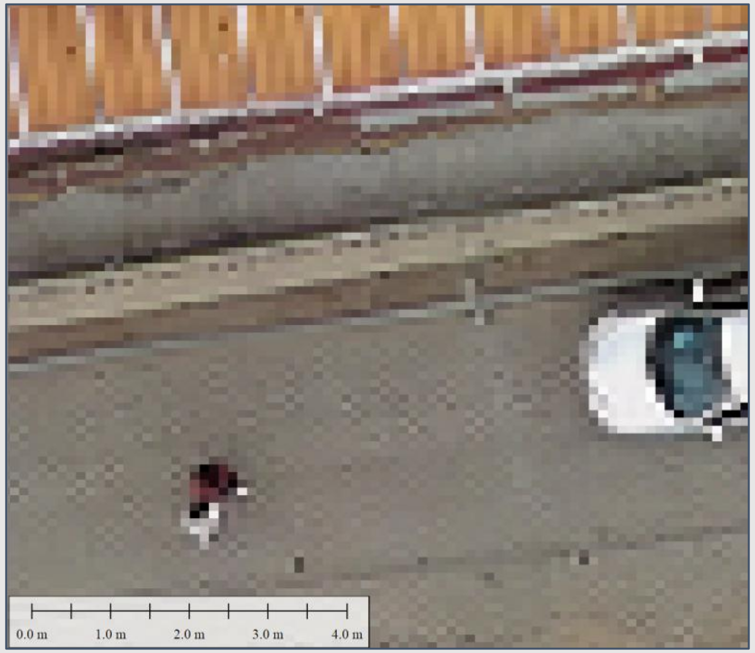
🌍 Raster data resolution refers to the level of detail in a raster dataset, determined by the size of each pixel. A higher resolution means smaller pixels and greater detail, while a lower resolution means larger pixels and less detail.



https://www.punchat.in/funpun-1/quick-guide-to-understanding-image-resolutionnbsp



GSD 22mm

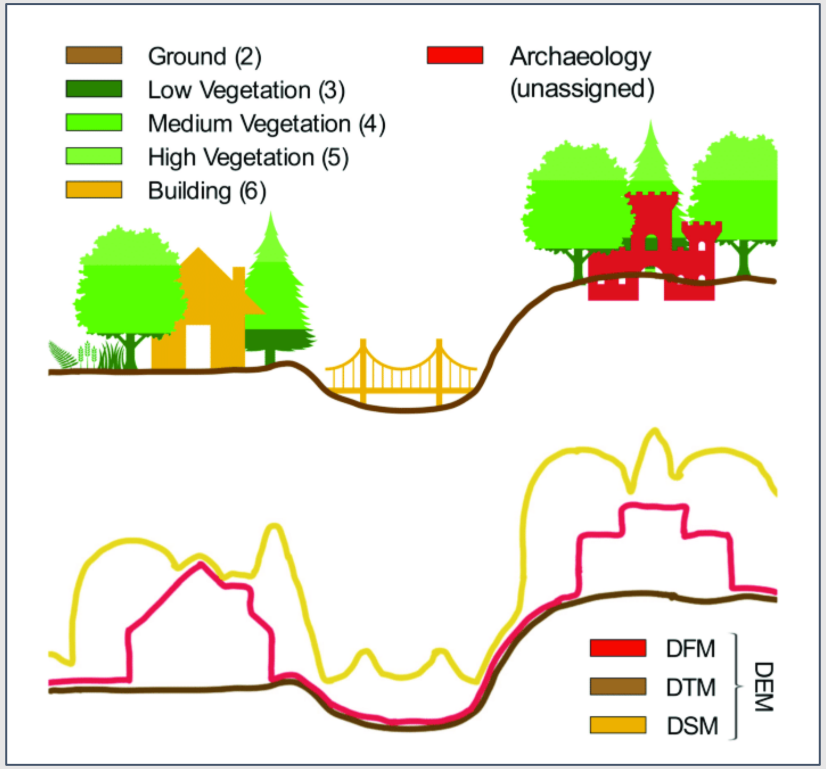


GSD 220mm

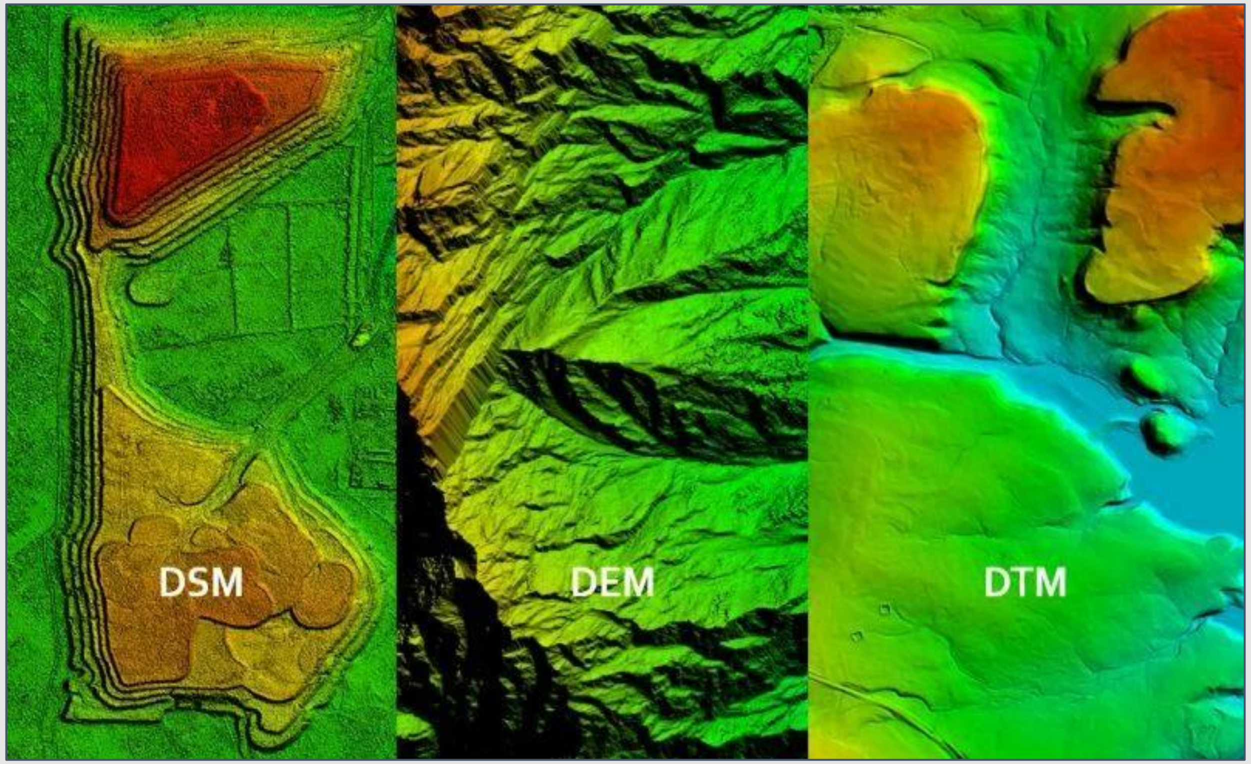
Terms	Description
Resolution	Refers to the level of detail in a digital image or raster data, typically defined by the size or density of pixels in the image.
GSD (Ground Sample Distance)	In remote sensing, it represents the actual ground distance that one pixel covers on the Earth's surface.

3.4 Digital Elevation Model

🌍 A DEM is commonly represented in raster format, where each pixel (or cell) contains an elevation value corresponding to a specific location on the Earth's surface. There are Digital Elevation Models (**DEM**), Digital Terrain Models (**DTM**), Digital Surface Models (**DSM**), and Digital Feature Models (**DFM**) to represent the Earth's surface.



https://www.researchgate.net/figure/An-outline-of-the-differences-between-digital-elevation-model-DEM-digital-feature_fig1_353929383



https://shustrik-maps.com/elevation-modeling-which-to-choose-dtm-dsm-or-dem/

3

Core Terms for GIS

3.4 Point Cloud

🌍 A point cloud is a collection of data points in 3D space, typically captured by LiDAR or photogrammetry. Each point represents a precise location on a surface, used to create detailed 3D models and analyze spatial features.

Point Cloud Data generated by Drone Photographs(UB metro 1)

UBM PMC

PART 4

Technologies for GIS

Geographic **I**nformation **S**ystem

4

Technologies for GIS

4.1 Modern Surveying Technologies

🌍 Today, **land surveys** are conducted using both traditional and modern technology-aided methods. Modern tools improve speed, accuracy, and data richness.

Technology	Description
Auto Level	A precise optical instrument used to determine height differences and ensure level surfaces. Ideal for construction and topographic leveling.
Total Station	Combines angle and distance measurement with electronic data recording for high-precision surveys.
GPS / GNSS	Uses satellite signals for accurate positioning, widely used in geodetic and RTK-based surveys.
UAVs / Drones	Captures aerial imagery for photogrammetry or 3D modeling; efficient over wide areas.
LiDAR	Uses laser pulses to generate detailed 3D point clouds of terrain and surface features.
Mobile Mapping System	Vehicle-mounted system with GPS, LiDAR, and cameras for rapid street-level spatial data collection.

4

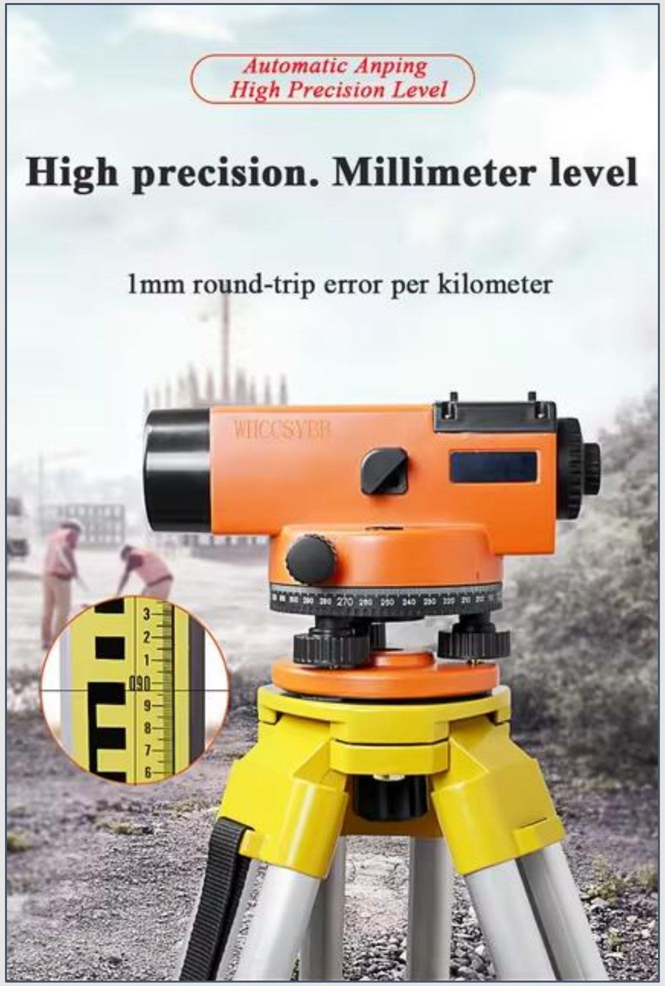
Technologies for **GIS**

4.1 Modern Surveying Technologies

🌍 An **Auto Level** is an optical instrument used for leveling and height measurements in surveying. It automatically maintains a horizontal line of sight using an internal compensator.

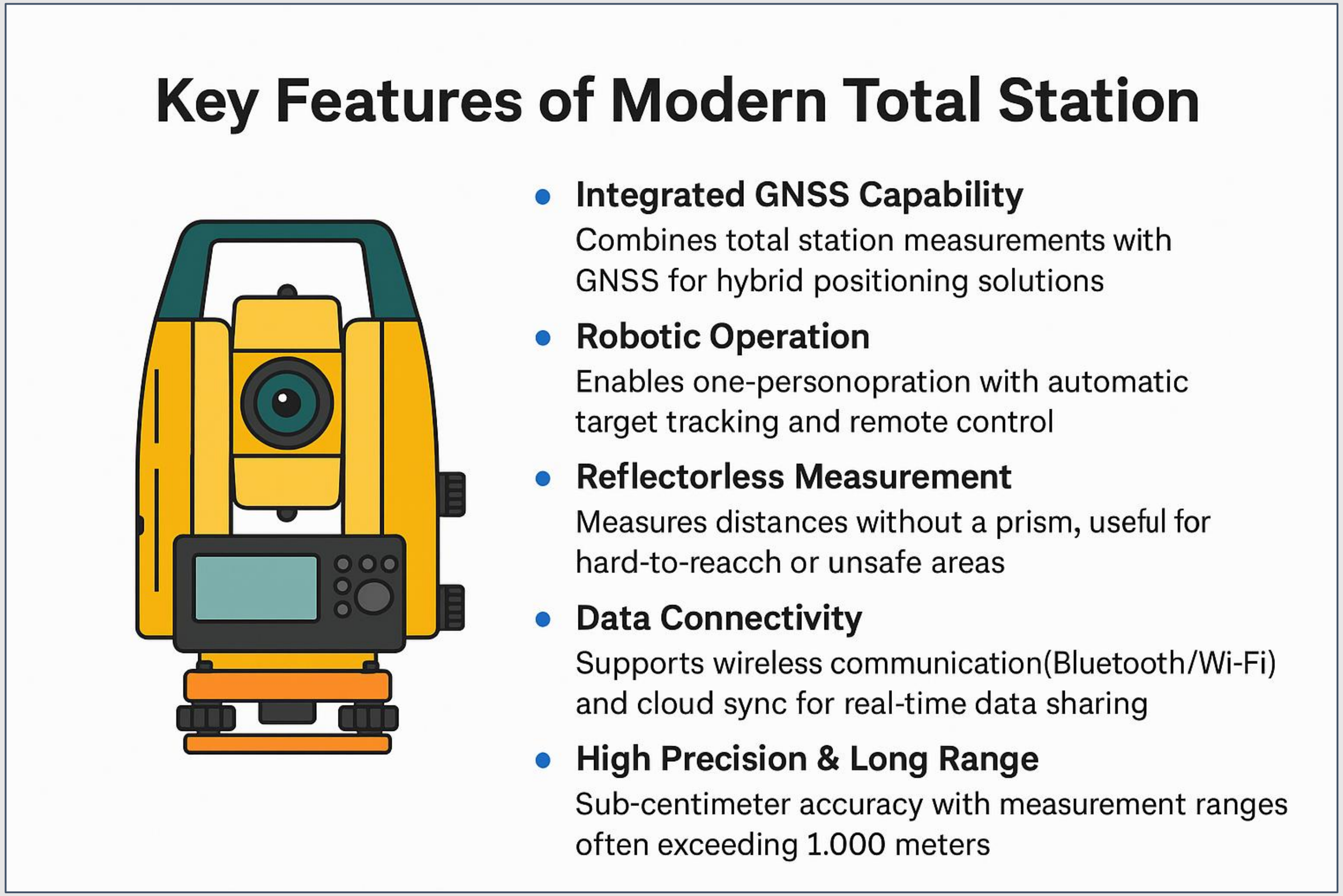
Methodology	Advantages	Disadvantages
Manual	. Detailed distress information can be collected . Simple to conduct . No Capital expenditures required	. Resource intensive . High safe risk . Potential for high variability in the data without strong training programs and control checks
Automated	. Legend itself to capturing large quantities of data . Multiple types of data can be collected at the same time . Data can be collected at traffic speeds . Images are stored and available for other uses	. May require a large capital investment of contracting fees . Data must be viewable from the pavement lanes . Some distress characteristics are difficult to capture (e.g., weathering and raveling of the pavement surface)

https://www.researchgate.net/figure/Advantages-and-disadvantages-of-manual-and-automated-surveys-AASHTO-2006_tbl1_322644620

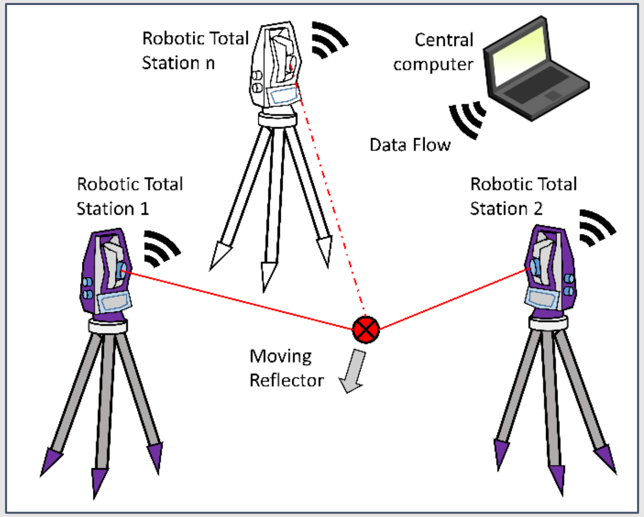


4.1 Modern Surveying Technologies

A **Total Station** is a surveying instrument that combines electronic distance measurement and angle measurement to determine precise 3D coordinates.



Generated by ChatGPT



https://www.researchgate.net/figure/Robotic-Total-Station-Network_fig1_330779154

4

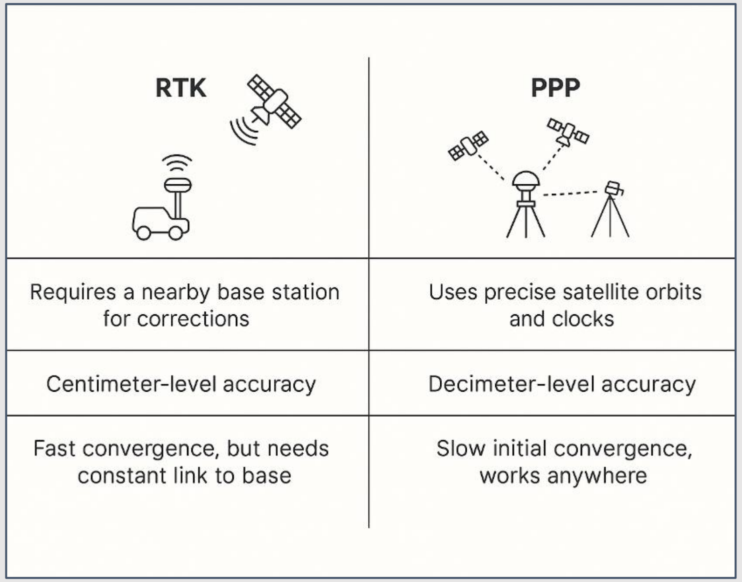
Technologies for GIS

4.1 Modern Surveying Technologies

🌍 **GNSS** (Global Navigation Satellite System) is a satellite-based system that provides **positioning, navigation, and timing data anywhere on Earth**. It includes systems like **GPS (USA), GLONASS (Russia), Galileo (EU), and BeiDou (China).**

Criteria	RTK (Real-Time Kinematic)	PPP (Precise Point Positioning)
Positioning Method	Relies on a base station and a rover for real-time corrections.	Uses precise satellite orbit and clock data to process positioning without the need for a reference station.
Accuracy	High accuracy (centimeter level) in real-time, dependent on distance from base station.	High accuracy (centimeter level) after post-processsing, less sensitive to satellite geometry.
Reliability	Dependent on the communication link between the base station and the rover.	More reliable in remote areas since no communication link is required with a base station.
Latency	Real-time corrections with low latency (seconds).	Higher latency, as PPP requires processing time (minutes to hoursı PT).
Correction Source	Local correction from a reference station.	Geophysical surveys, remote monitoring, and applications where real-time corrections are not required.
Cost	Limited in areas withouta base station coverage or internet access.	Can be more cost-effective as it does not require a base station or reim-time correction service.

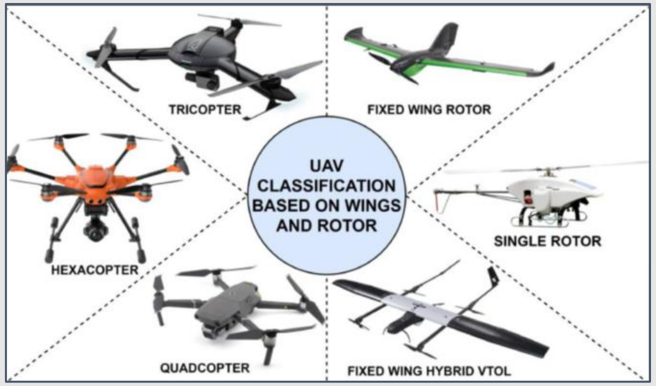
Generated by ChatGPT



Generated by ChatGPT

4.1 Modern Surveying Technologies

🌍 **UAVs** (Unmanned Aerial Vehicles), also known as **drones**, are widely used in GIS for high-resolution aerial imagery and terrain mapping. They enable efficient data collection over large or hard-to-reach areas, supporting applications like land surveying, agriculture, and urban planning.



https://pigeonis.in/blog/detail-guide-about-uav-technology-supporting-aerial-task-operations/

Key Features of UAVs/Drones for GIS

High-Resolution Data
Captures centimeter-level aerial imagery and terrain data.

Access to Hard-to-Reach Areas
Suitable for mountains, forests, and disaster zones.

Rapid Data Collection
Efficient mapping over large areas in short time.

Multiple Sensor Options
Supports RGB, multispectral, thermal, and LiDAR sensors.

3D Modeling & Orthophoto Creation
Enables generation of orthomosaics, DSM/DTM, and 3D maps

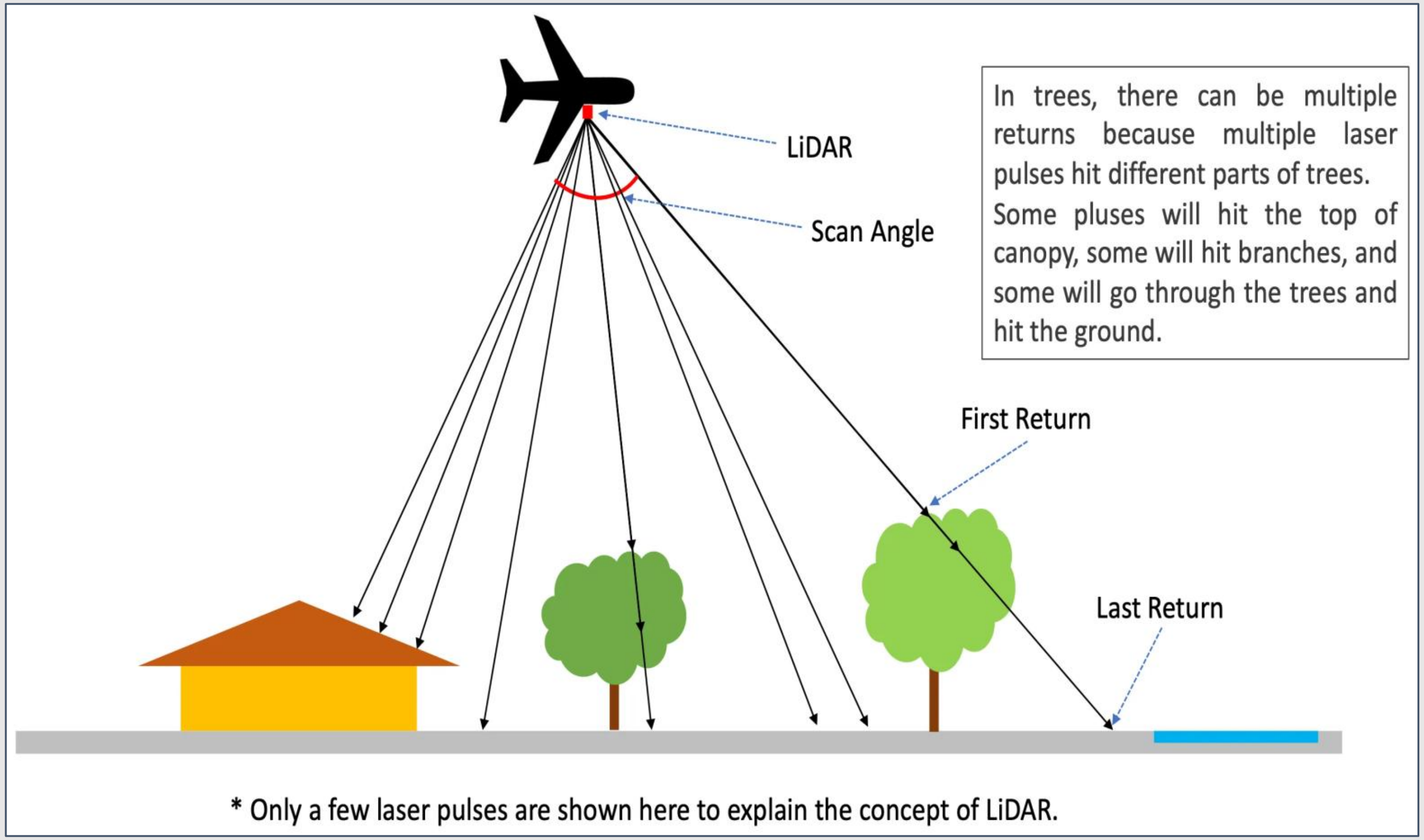
Generated by ChatGPT

4.1 Modern Surveying Technologies

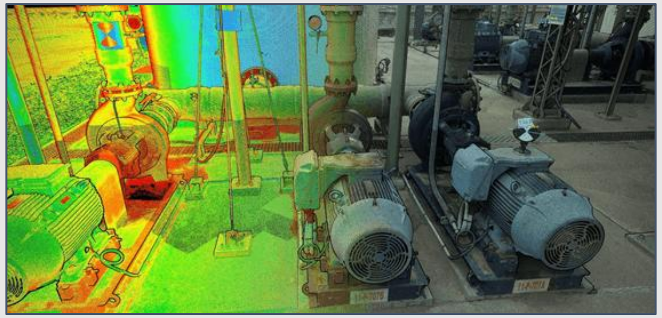
4

Technologies for **GIS**

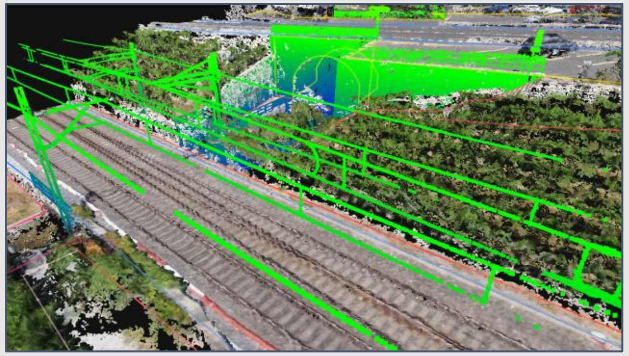
LiDAR (Light Detection and Ranging) is a **remote sensing technology** that uses **laser pulses** to measure **distances** to the Earth's surface. It generates precise **3D models of terrain, structures, and vegetation,** making it ideal for **GIS, mapping, and environmental analysis**.



https://medium.com/@namratadutt2/a-quick-guide-to-lidar-part-1-theory-7c8ff48af0b9



https://grupotec.es/point-cloud-technology-what-are-the-advantages/?lang=en



https://www.pix4d.com/blog/lidar-photogrammetry/

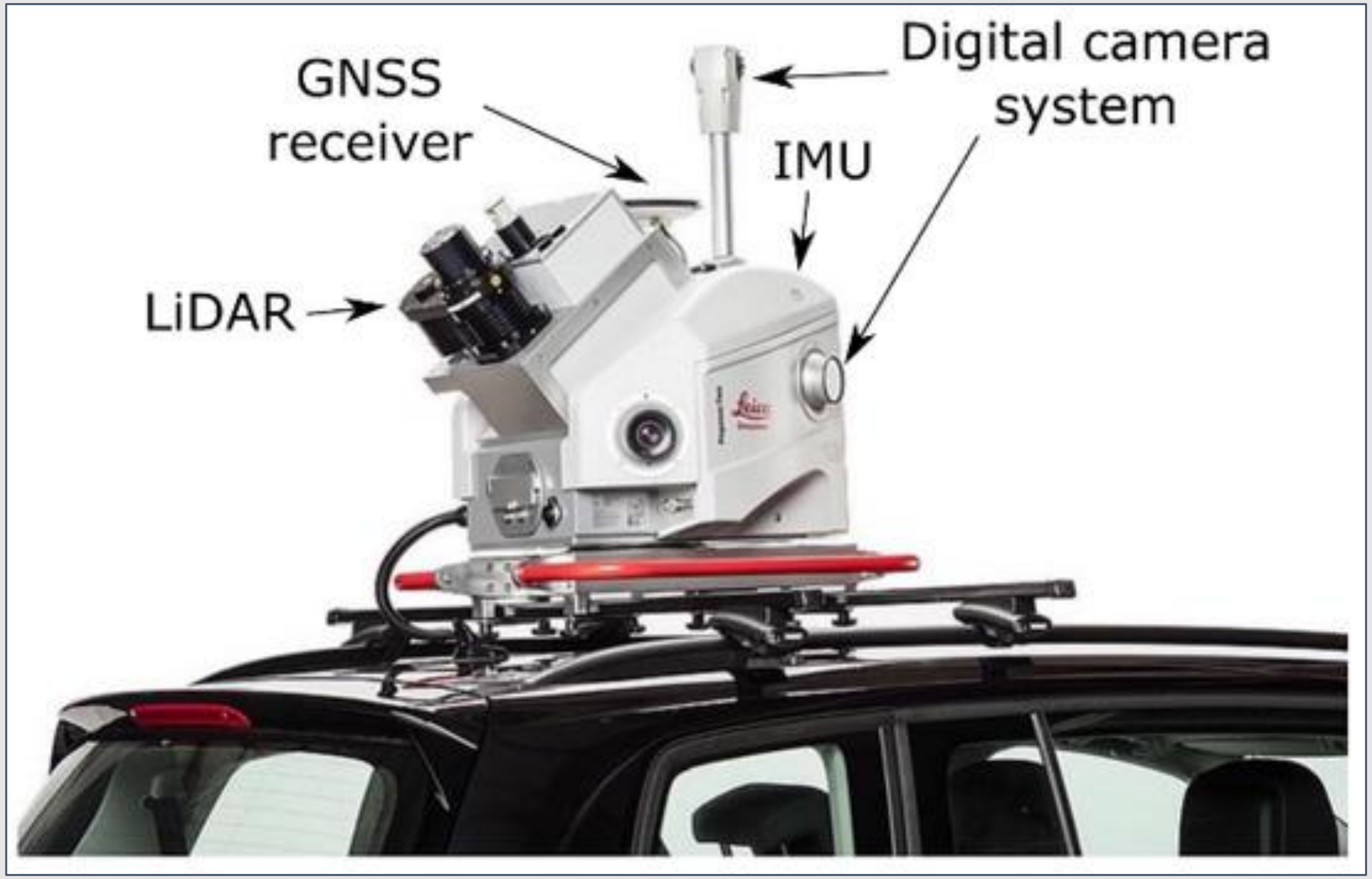
UBM PMC

4

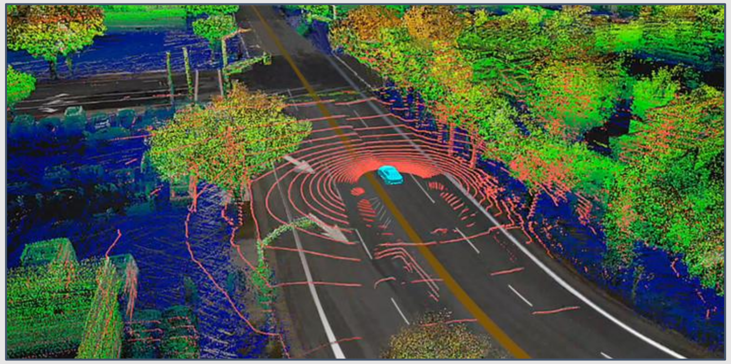
Technologies for **GIS**

4.1 Modern Surveying Technologies

🌍 An **MMS** (Mobile Mapping System) is a vehicle-mounted system equipped with LiDAR, cameras, and GNSS to capture geospatial data while in motion. It enables rapid, accurate 3D mapping of roads, buildings, and urban environments for GIS and infrastructure applications.



https://www.mdpi.com/1424-8220/22/11/4262



https://intellias.com/solving-the-challenges-of-hd-mapping-for-smart-navigation-in-autonomous-cars/

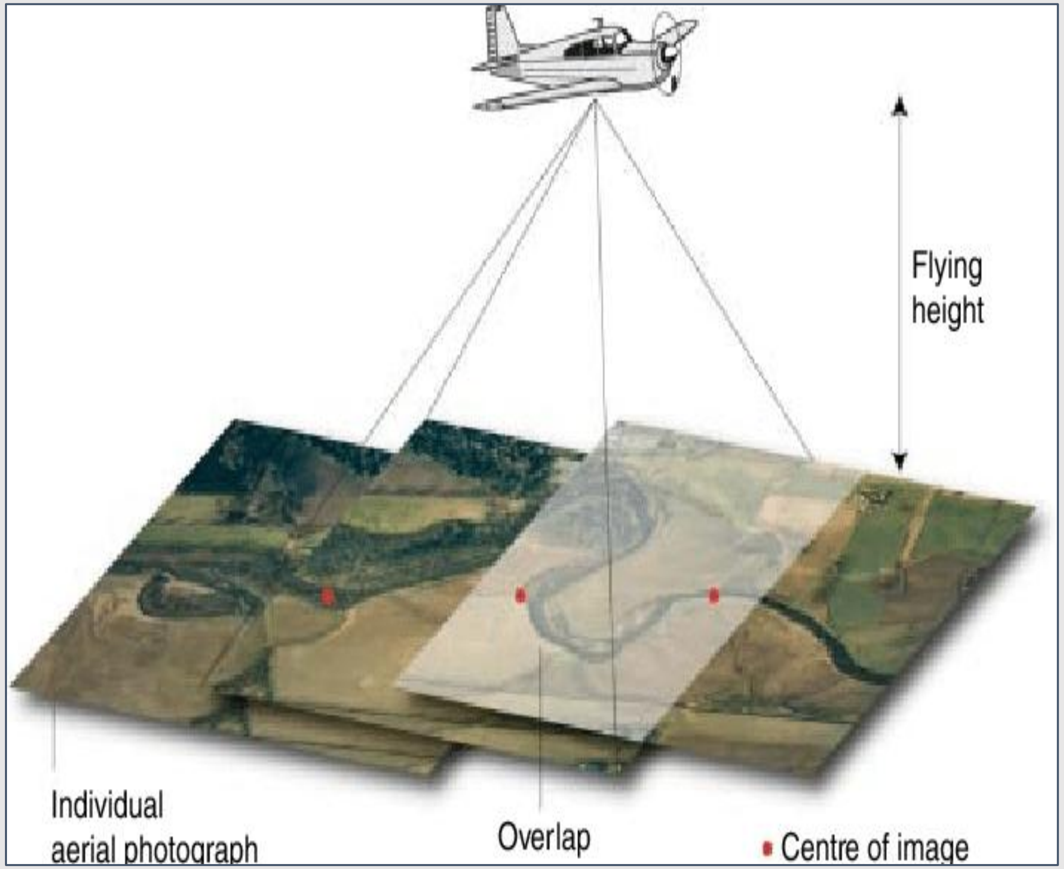
https://www.gim-international.com/content/news/orbit-gt-launches-mobile-mapping-publisher-11-0

4

Technologies for **GIS**

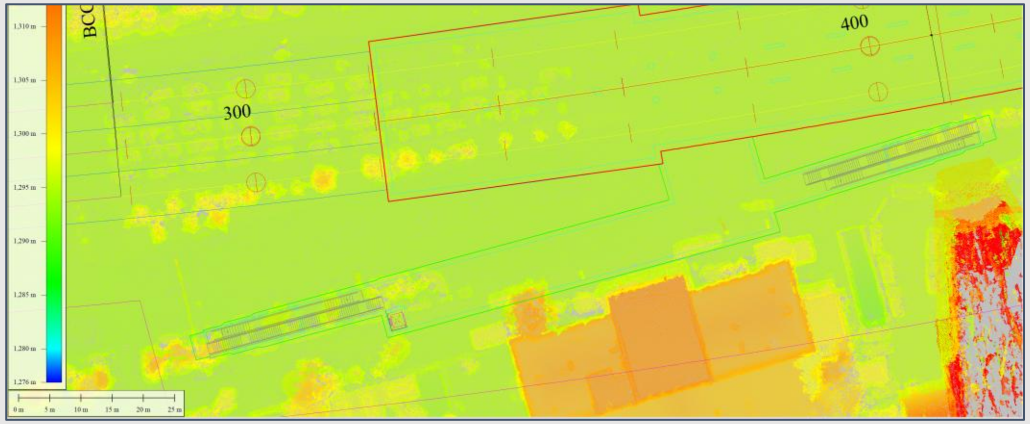
4.2 Aerial Photogrammetry

🌍 **Aerial Photogrammetry** is the science of obtaining reliable measurements and 3D information from photographs. It uses overlapping images from different angles to calculate depth and recreate the geometry of objects or terrain.



https://www.researchgate.net/figure/Figure-12-Illustrate-the-geometry-of-aerial-photogrammetry-13_fig1_334164581

Orthophotograph generated by Drone Photographs (UB Metro 1)



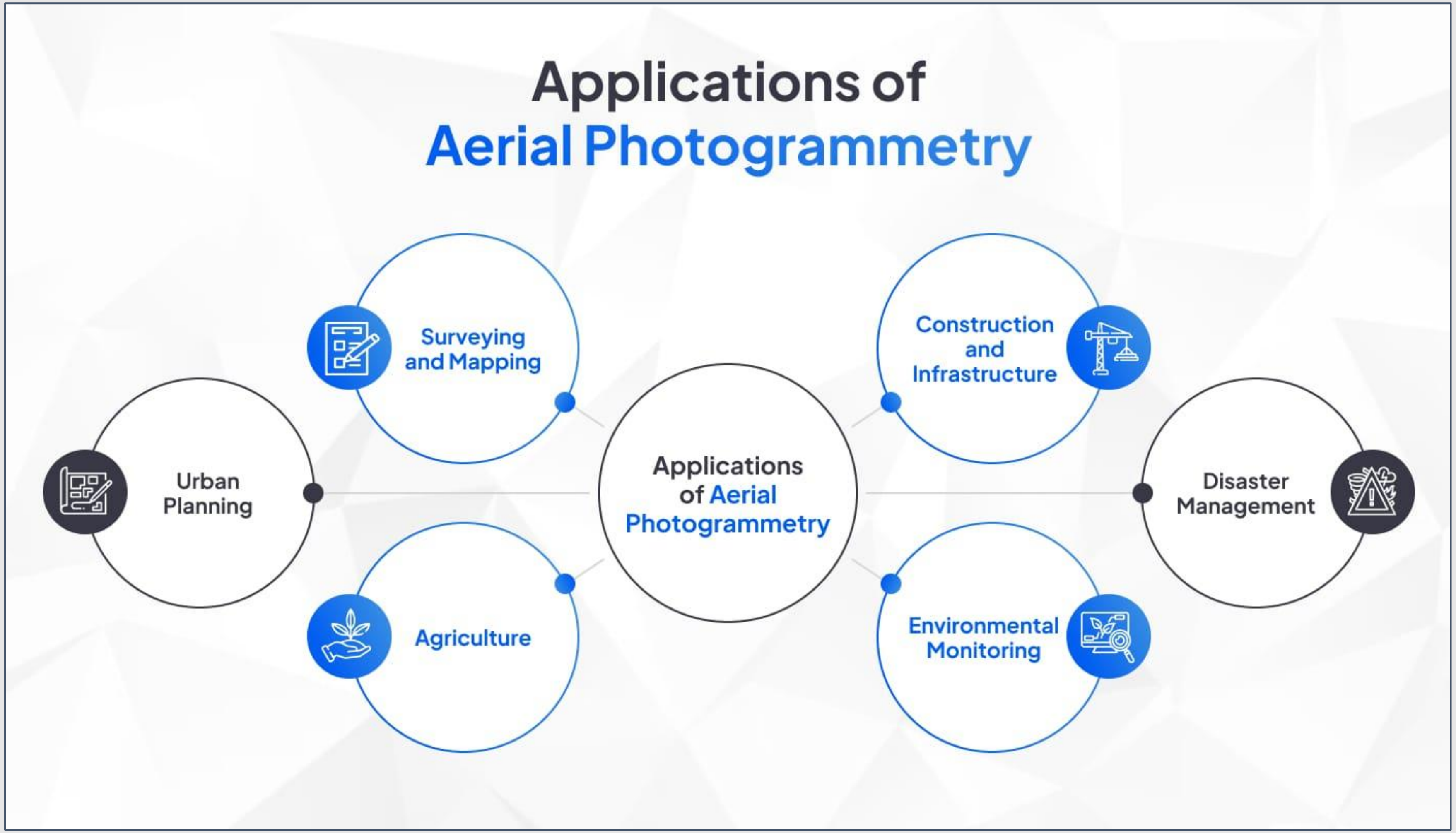
Point Cloud generated by Drone Photographs (UB Metro 1)

4

Technologies for GIS

4.2 Aerial Photogrammetry

🌍 **Aerial photogrammetry** has diverse applications across various industries. Its ability to provide detailed and accurate spatial data makes it an invaluable tool for numerous fields.



https://ikarus3d.com/media/3d-blog/the-comprehensive-guide-to-aerial-photogrammetry/

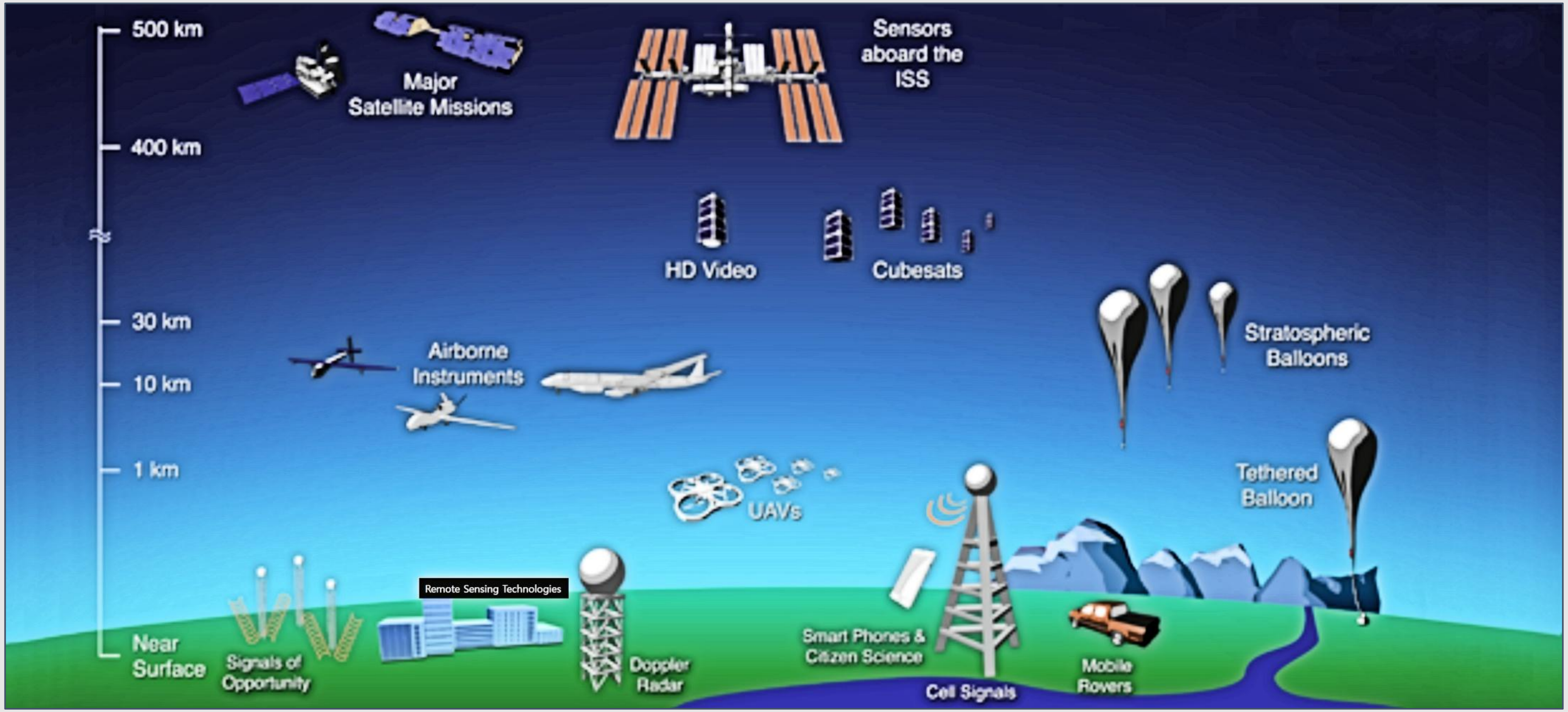
UBM PMC

4

Technologies for GIS

4.3 Remote Sensing

🌍 **Remote sensing** is the process of collecting information about the Earth's surface from a distance, typically using satellites or aircraft. It enables large-scale monitoring of land use, vegetation, climate change, and natural disasters without physical contact.

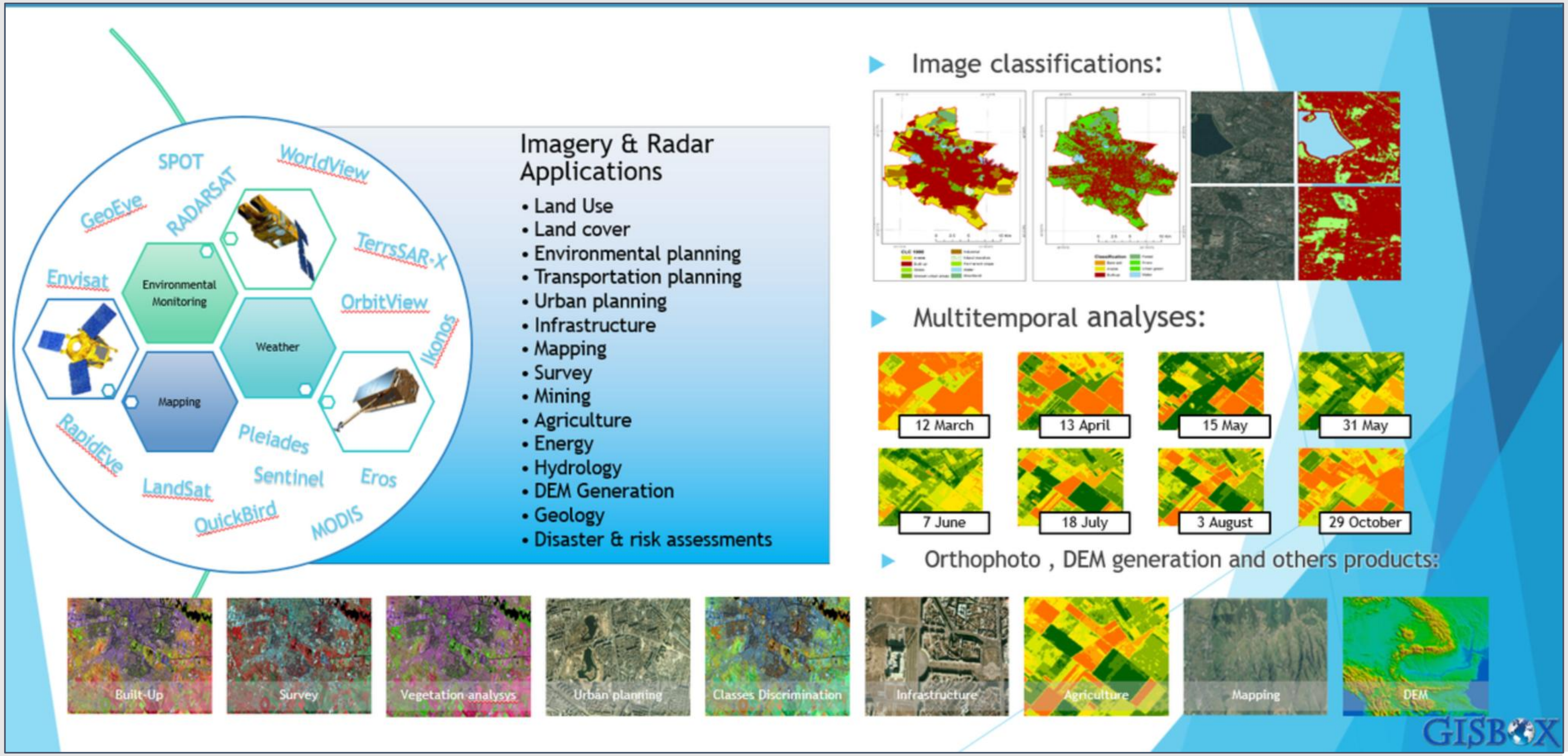


https://worldbank.github.io/OpenNightLights/tutorials/mod1_1_introduction_to_remote_sensing.html

4

4.3 Remote Sensing

🌍 **Remote sensing** is widely used in various fields, such as land use planning, agriculture, disaster management, and environmental monitoring. It provides accurate and timely geospatial data to support decision-making and resource management.

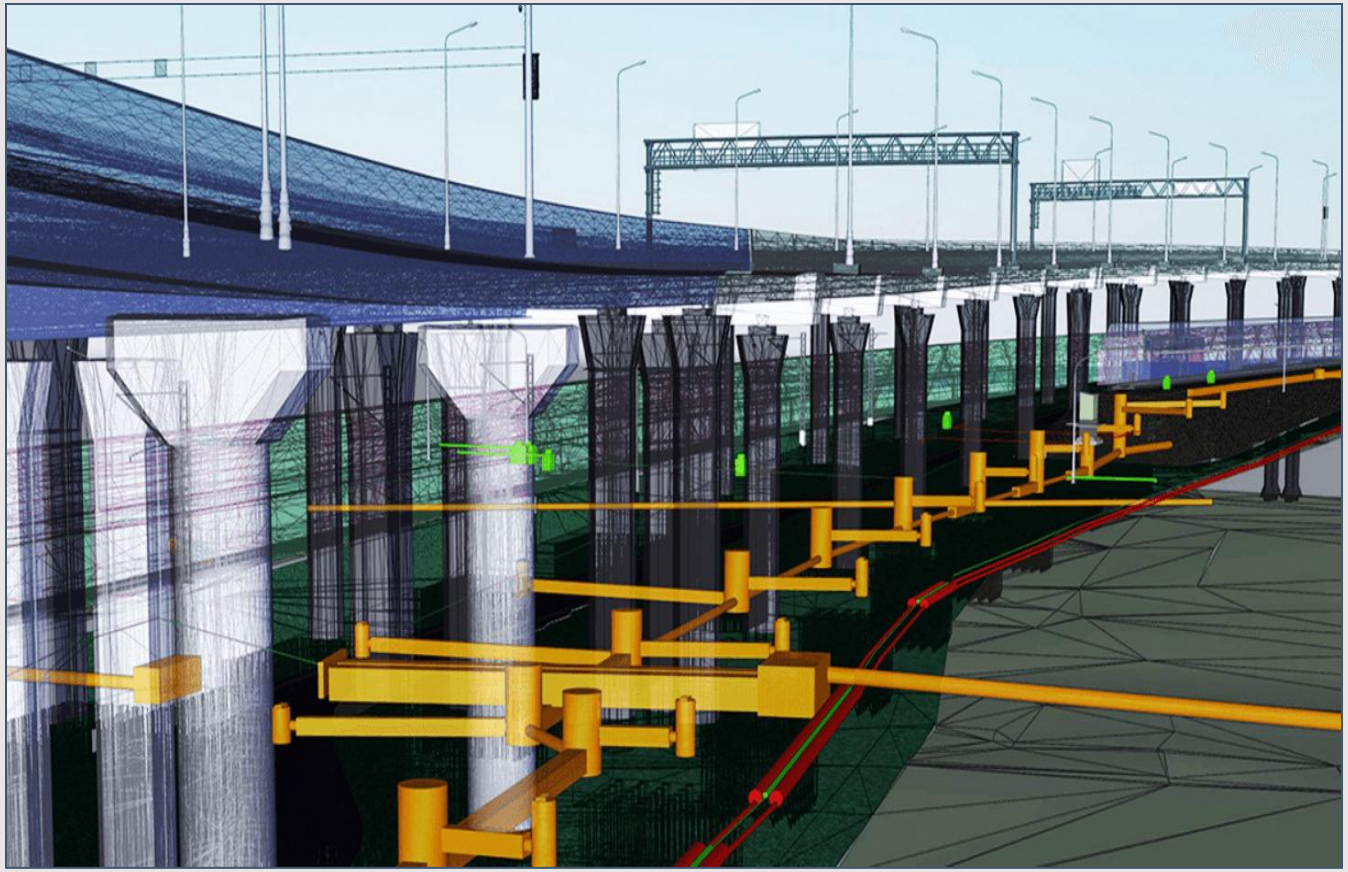


https://www.gisbox.ro/remote-sensing/

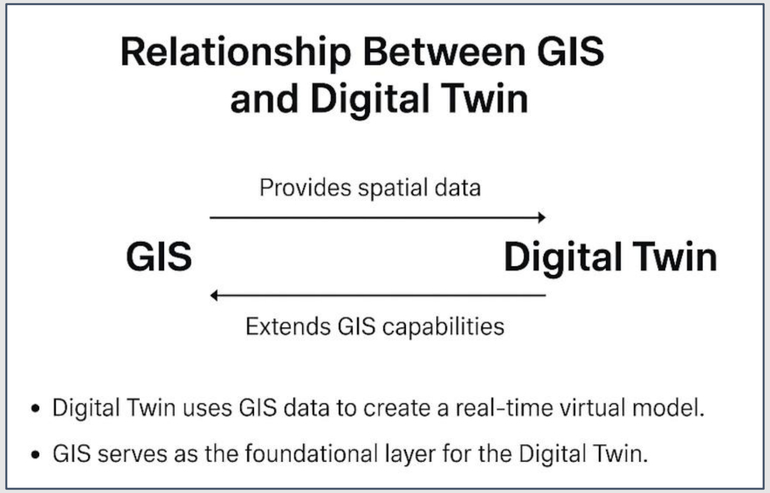
Technologies for **GIS**

4.4 Digital Twin

🌍 A **Digital Twin** is a dynamic virtual representation of a physical object, system, or environment that integrates real-time data from sensors. It enables monitoring, simulation, and predictive analysis for improved decision-making and operational efficiency.



https://www.heliguy.com/blogs/posts/digital-twins-and-augmented-reality/



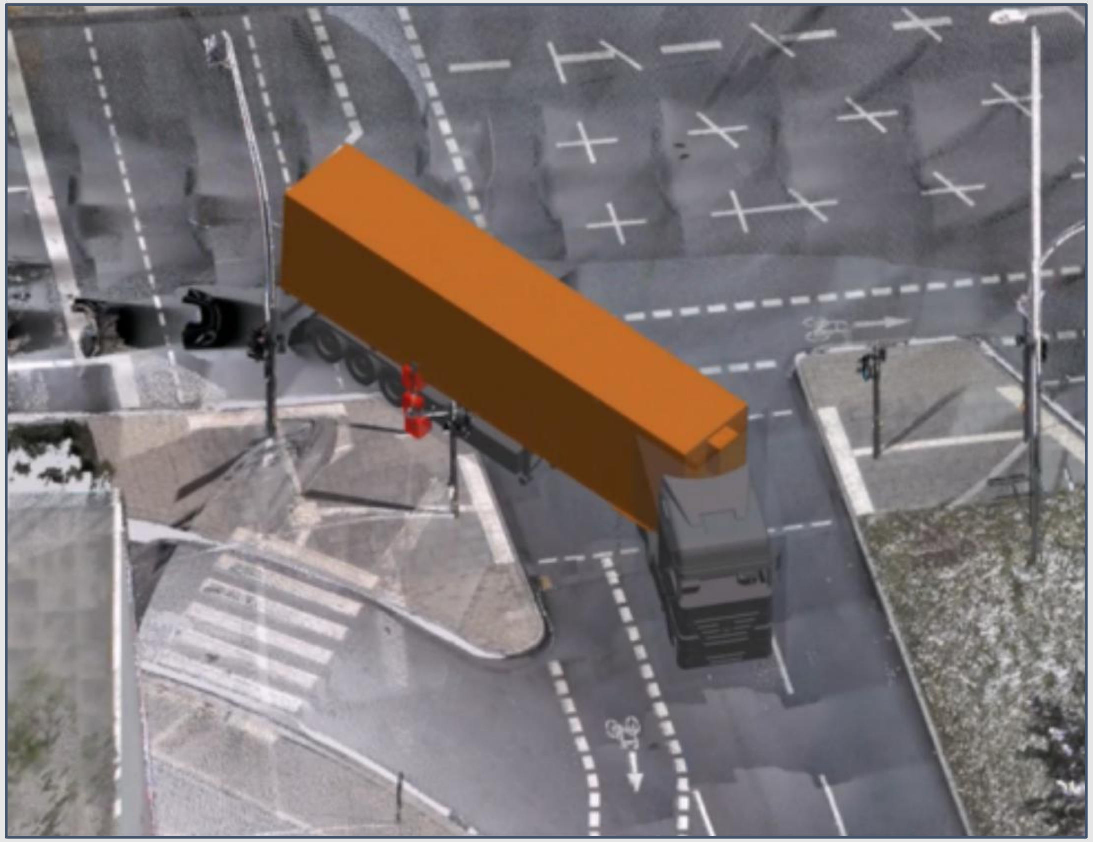
Generated by ChatGPT

4 Technologies for GIS

4.4 Digital Twin

🌍 **Digital Twin applications** create **virtual replicas** of physical systems, enabling **real-time monitoring, simulation, and predictive analysis**. They enhance **decision-making**, optimize **performance**, and reduce **operational risks** across various industries.

https://www.researchgate.net/figure/Different-application-fields-of-digital-twin_fig4_336870688/



Traffic routes are analysed using digital twins to ensure that large vehicles avoid collisions. (Image courtesy: Hexagon)

https://www.gim-international.com/content/article/geospatial-digital-twins-will-make-cities-smarter

UBM PMC

PART 5

Applications of GIS

5

Applications of GIS

5.1 Understanding Geography Categories

🌍 **Geography** is broadly categorized into Astronomical, Physical, and Human Geography, along with Geographic Information Science. These branches help us understand the Earth's systems, human interactions, and spatial data for informed decision-making.

Main Catagory	Subfields	Description
Astronomical Geography	Time zones	Studies the division of the Earth into zones based on longitude and rotation.
	Earth's rotation & revolution	Explores how the Earth's spinning and orbit affect seasons and time.
	Latitude & Longitude	Defines locations on Earth using a coordinate system based on the celestial sphere.
Physical Geography	Geomorphology	Studies landforms and the processes that shape the Earth's surface.
	Climatology	Examines patterns and causes of climate and weather phenomena.
	Biogeography	Analyzes the spatial distribution of plants and animals.
	Hydrology	Focuses on the movement and distribution of water on Earth.
	Pedology	Investigates the formation, classification, and distribution of soils.
Human Geography	Economic Geography	Studies the spatial aspects of economic activities such as trade and industry.
	Urban Geography	Examines the development, structure, and functioning of cities and towns.
	Cultural Geography	Focuses on cultural practices, languages, and beliefs in spatial context.
	Political Geography	Analyzes political boundaries, geopolitics, and territorial issues.
	Population Geography	Studies population distribution, density, and migration patterns.

♠ GIScience (Geographic Information Science)

Generated by ChatGPT

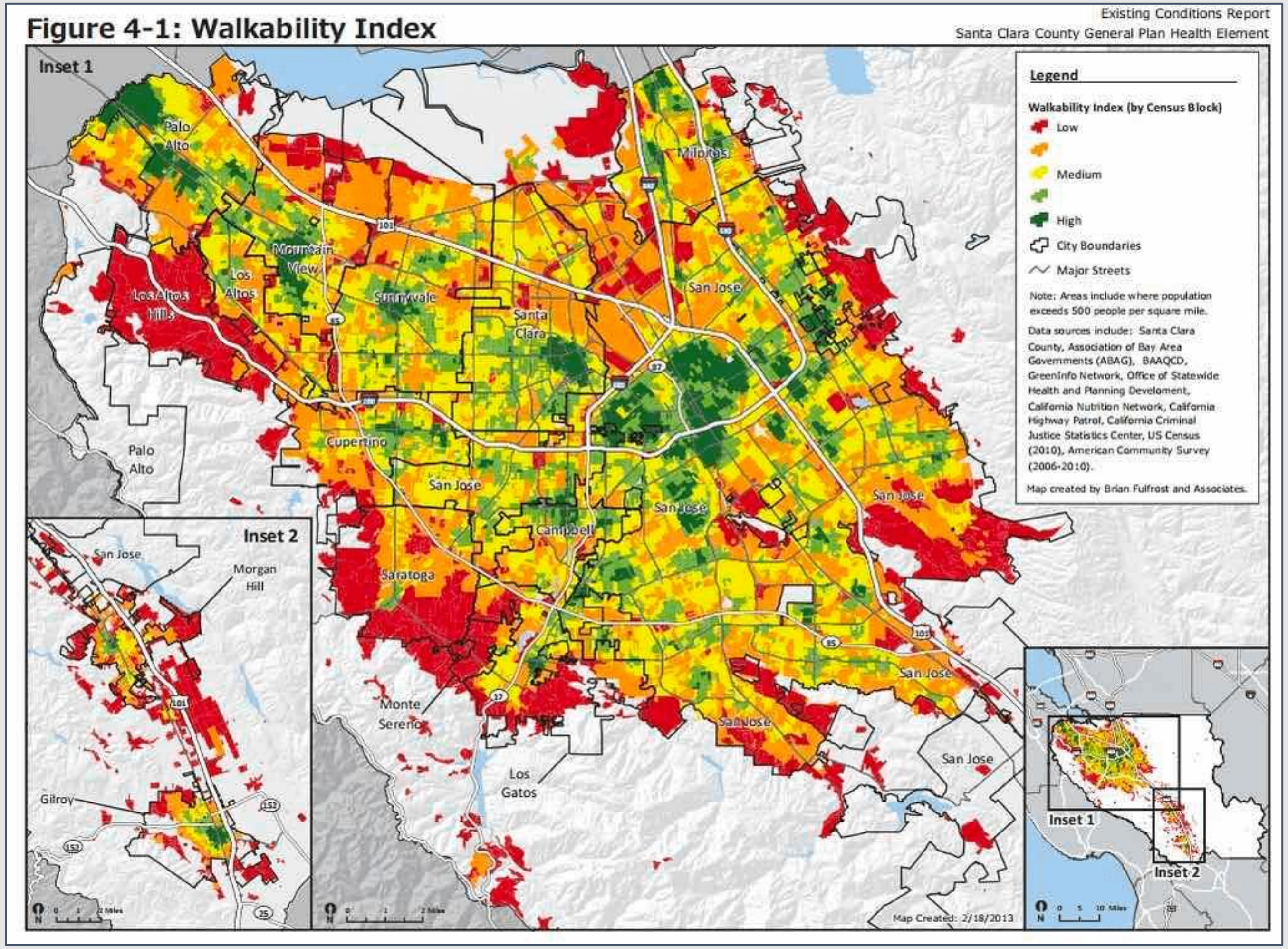
UBM PMC

5

Applica
tions
of
GIS

5.2 Urban Planning & Smart Cities

🌍 The **application of GIS** in smart city planning and urban development has been highly prioritized across a variety of institutions today. Its key advantage – data visualization – helps urban stakeholders of different ranges in the design, realization, and evaluation of urban projects.



https://www.linkedin.com/pulse/application-gis-urban-planning-smart-cities-vladimir-ovramenko

5

Applications of GIS

5.3 Environmental Management

🌍 The application of GIS in environmental management involves mapping and analyzing spatial data to monitor natural resources, track pollution, plan land use, conserve biodiversity, and manage disasters.

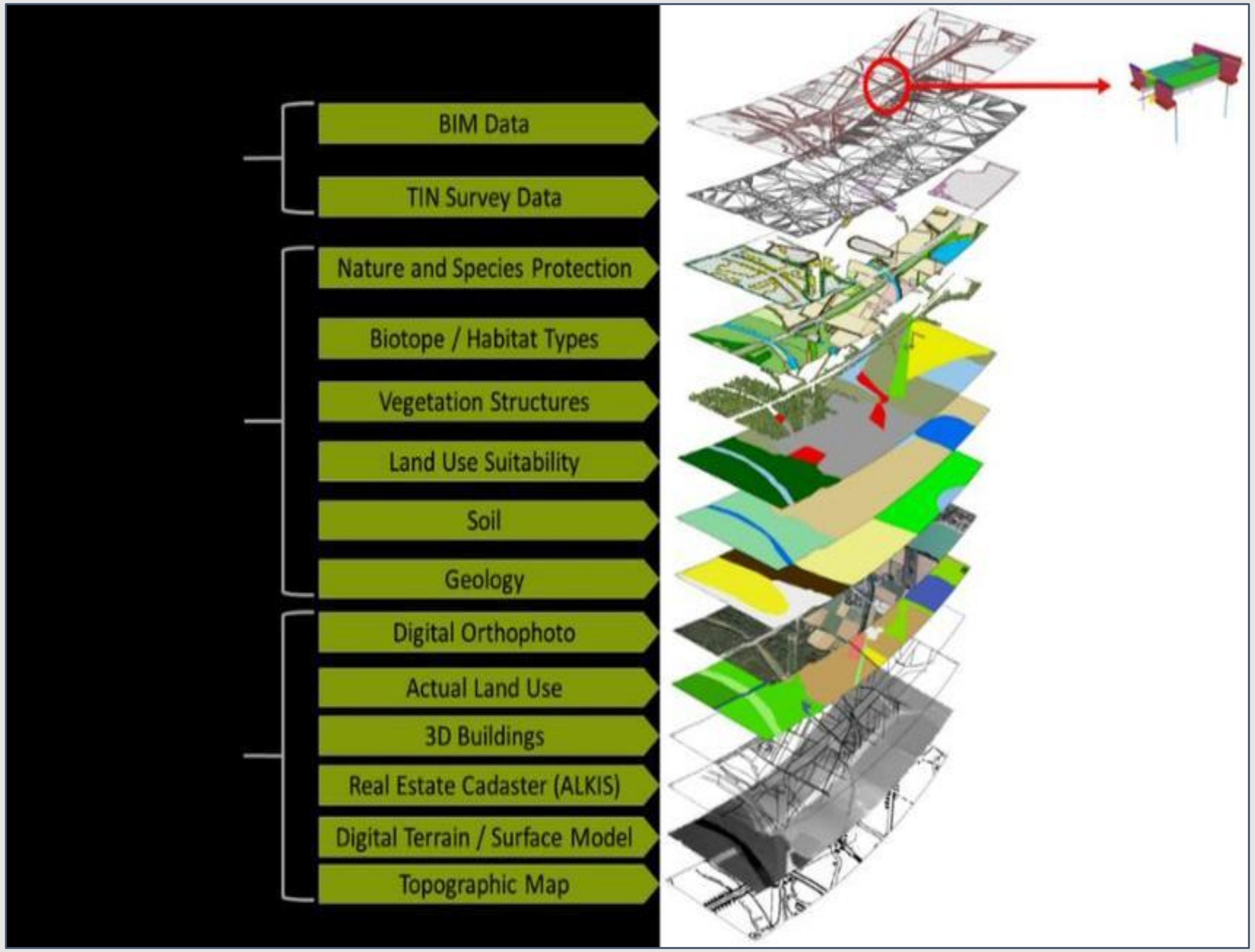
https://www.spatialpost.com/application-of-gis-in-environmental-management/

5

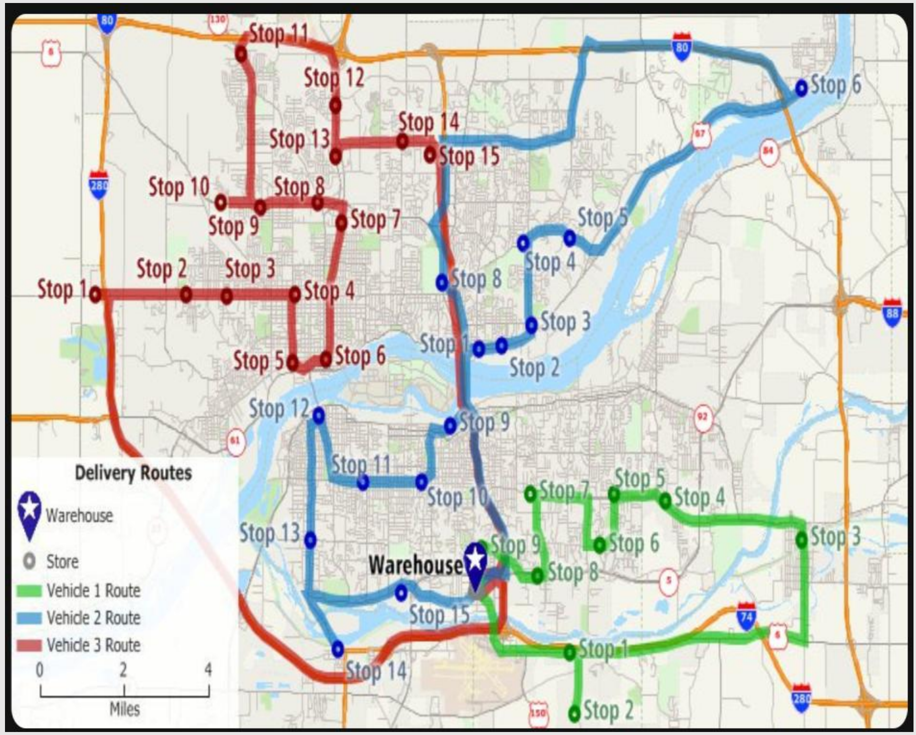
Applications of GIS

5.4 Transportation & Logistics

🌍 **GIS** in transportation and logistics supports route optimization, traffic analysis, and infrastructure planning. It enables efficient movement of goods and people by integrating spatial data with real-time information.



https://www.topbimcompany.com/gis-for-transport-planning/

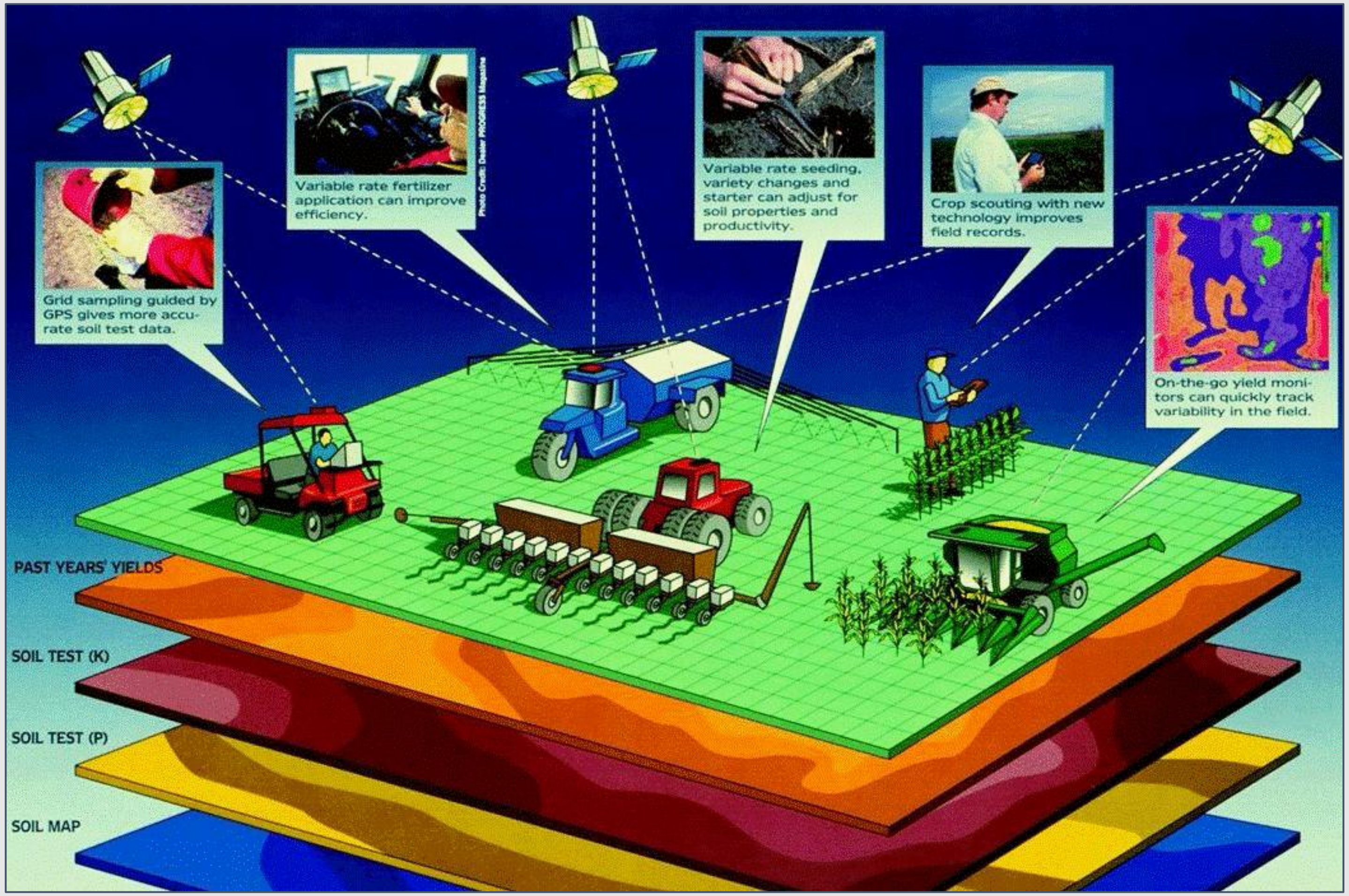


GIS logistics tools are critical to a company's success. Research shows that companies using sophisticated supply chain methods achieve ***profit levels 12 times greater*** *than those with less sophisticated solutions.*

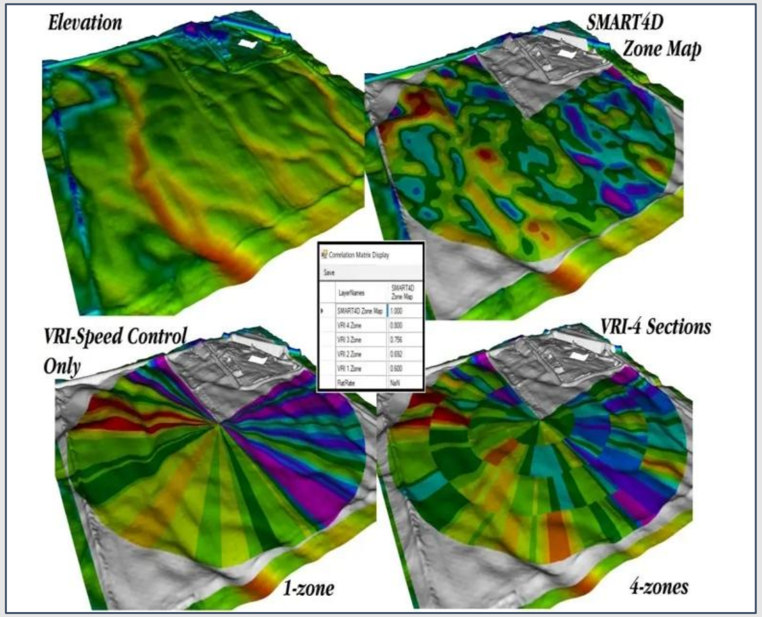
caliper.com/products/gis-logistics-mapping-software.htm

5.5 Agriculture & Precision Farming

🌍 **Good farmers** do lots of **planning and analysis**. Information like soil type, soil characteristics, water sources and climate are important for strategic planning. By using <u>**GIS**</u> in agriculture, farms can be more profitable because informed farmers can achieve higher crop yields and they can reduce waste.



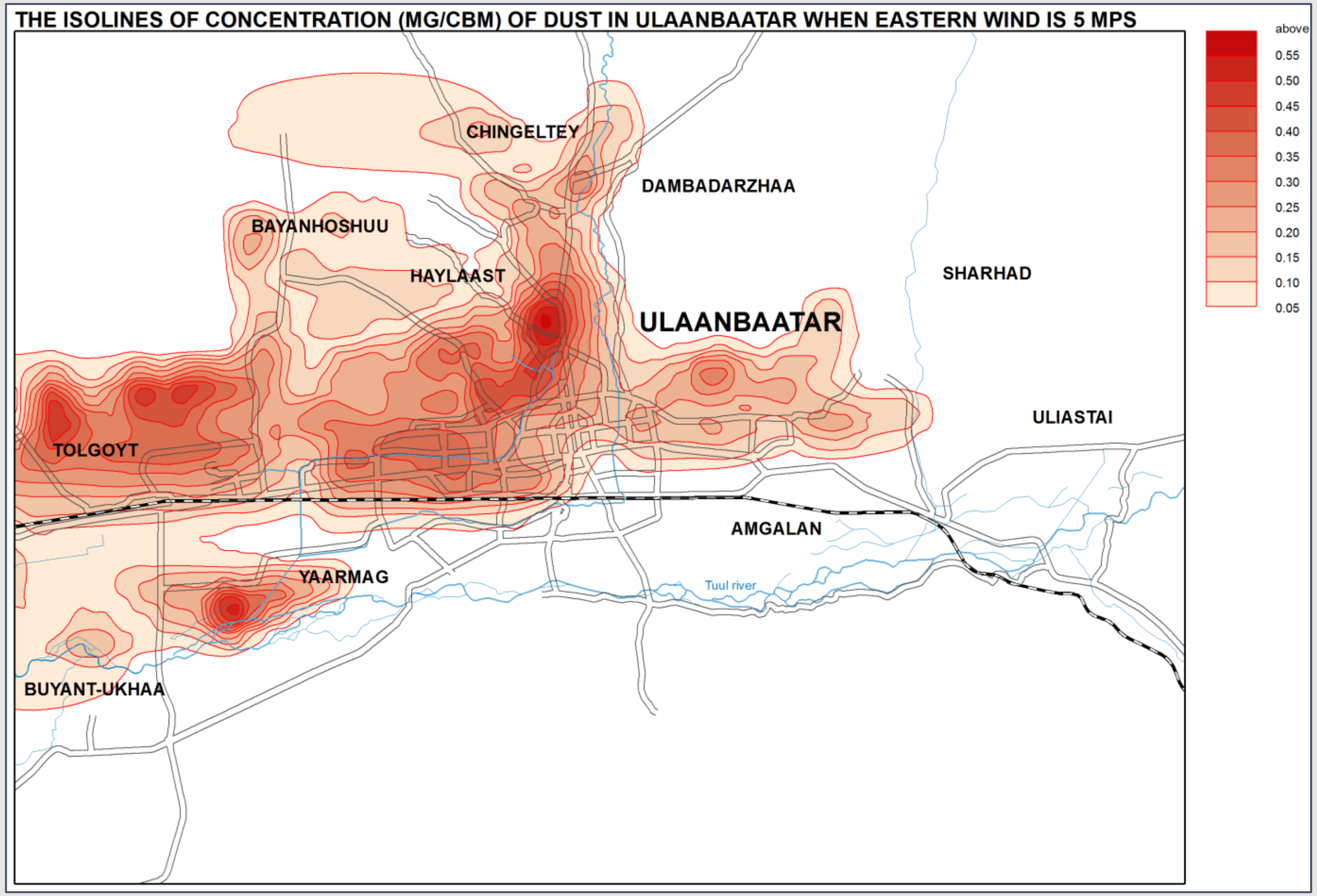
https://gis-university.com/gis-in-agriculture/



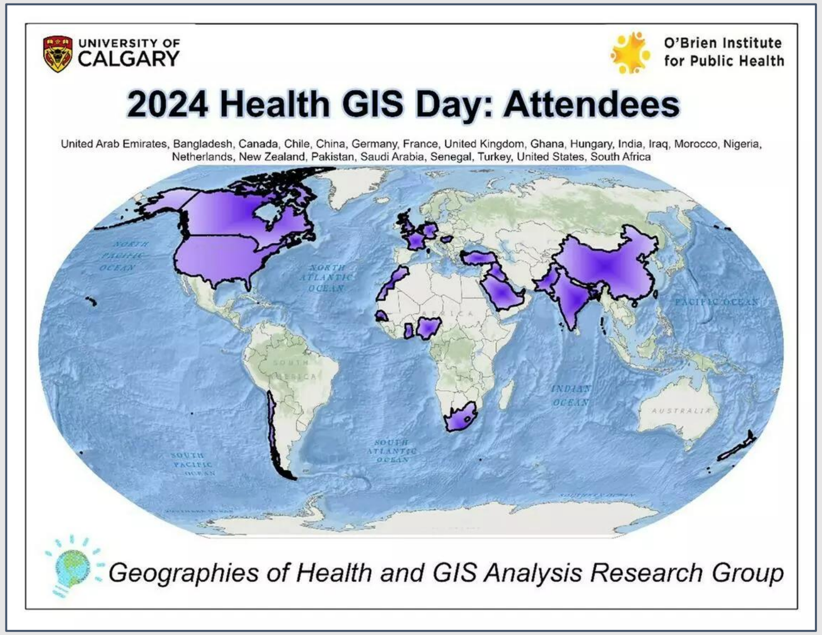
Map layers such as soil chemistry, soil type, and topography (and derived maps such as soil drainage), previous yields, etc, can provide important information for field management.

5.6 Public Health

🌍 Public health is another focus area that has made increasing use of GIS techniques. The efforts fall naturally within the domain of problems requiring the use of spatial analysis as part of the solution, and GIS and other spatial analysis tools are therefore recognized as providing potentially transformational capabilities for public health efforts.



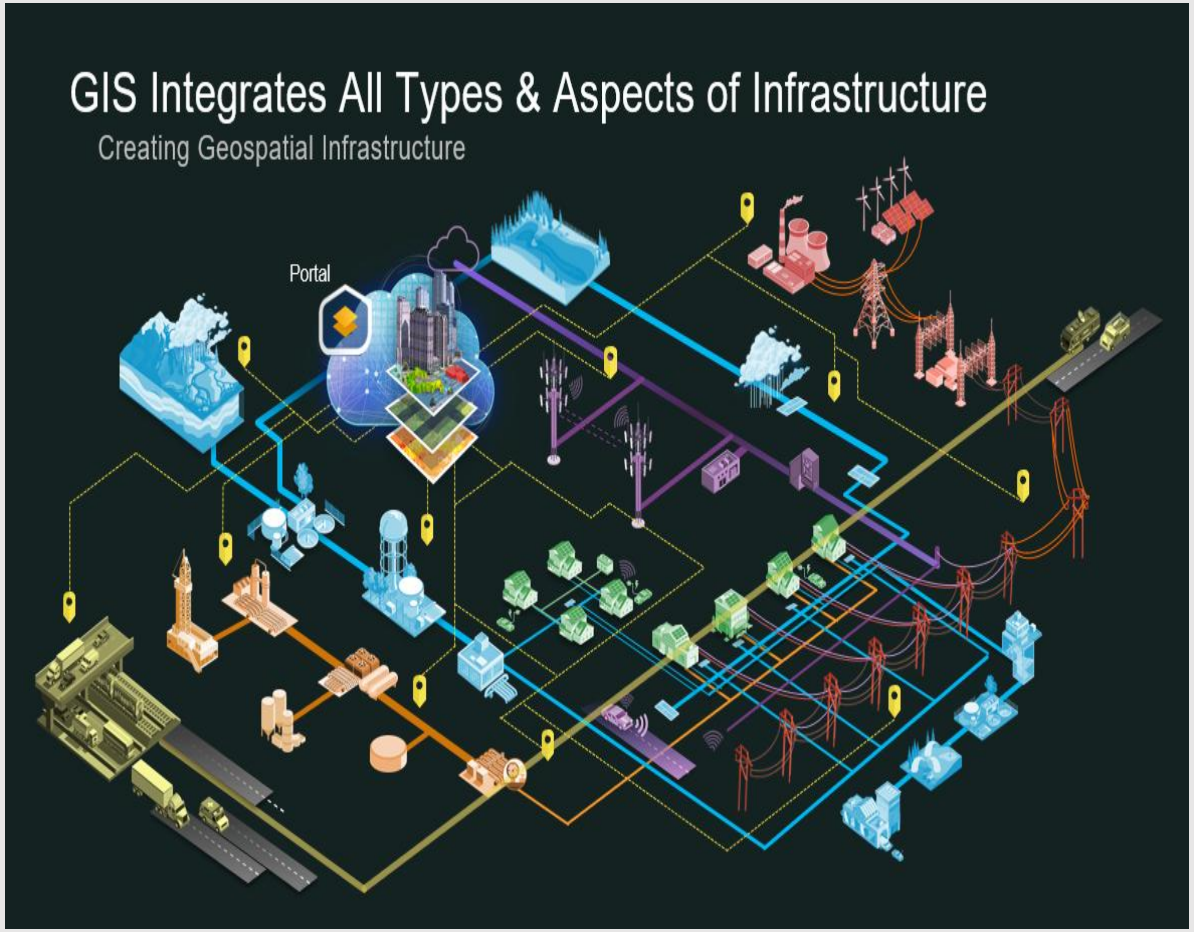
http://bic.iwlearn.org/en/atlas/atlas/88-1-atmospheric-air-condition-ulaanbatar_the-isolines-of-concentration-of-dust-in-ulaanbaatar-when-eastern-wind-is-5-mps-map



https://obrieniph.ucalgary.ca/groups/geography-health-and-gis

5.7 Utility & Infrastructure

GIS is uniquely positioned to not only **manage the location of assets** but also **interconnect and model physical networks** in a digital world while providing **real-time asset updates**.



https://www.esri.com/en-us/industries/blog/articles/communications-data-management-for-arcgis

3D utility mapping is the process of creating a three-dimensional, geospatially located model of an area to comprehensively map its utilities, including data on potable water, stormwater, wastewater, gas, communications, electricity, and any subsurface anomalies.

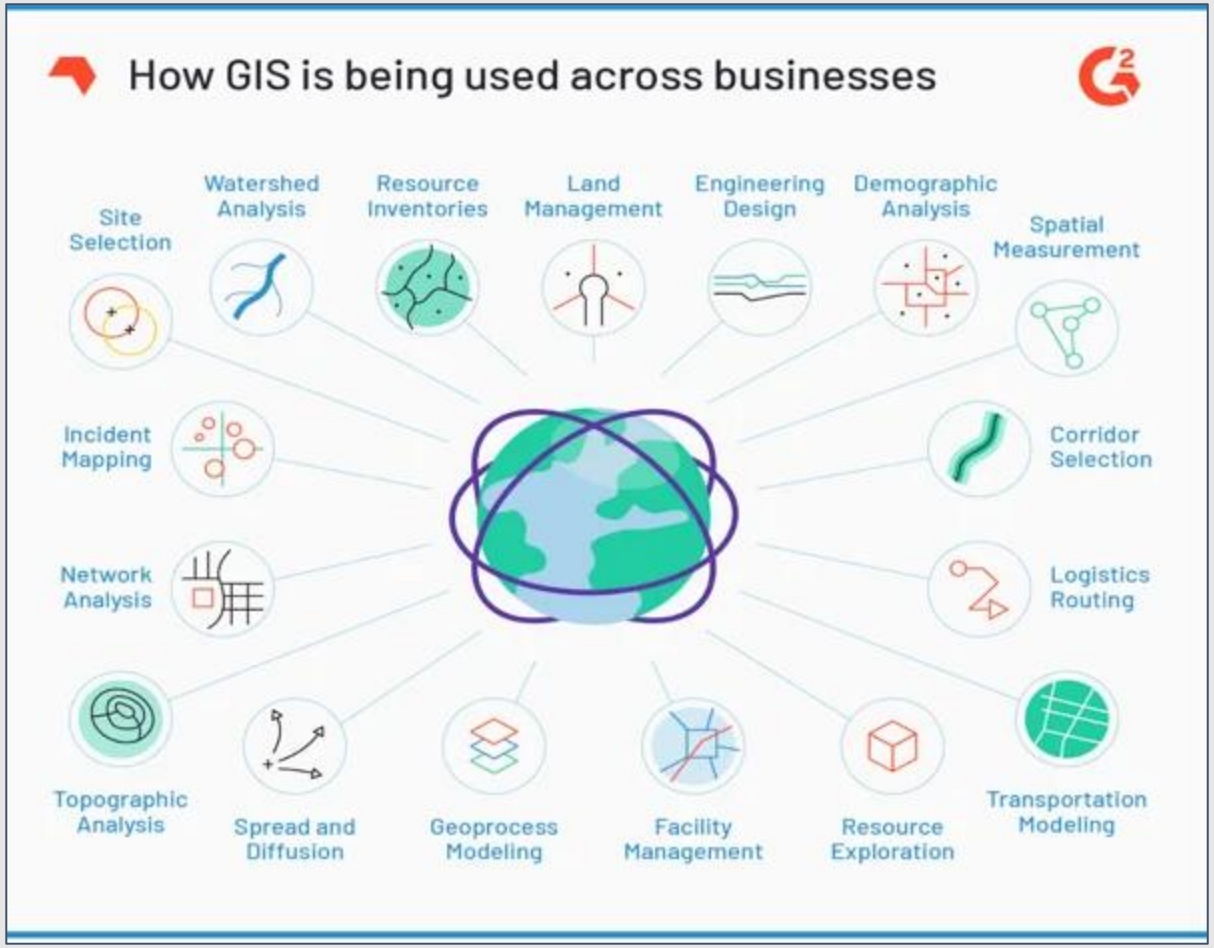
https://www.reveal.nz/articles/the-importance-of-3d-utility-mapping-and-data-sharing-to-mitigate-risk-and-budget-overruns-in-roading-projects

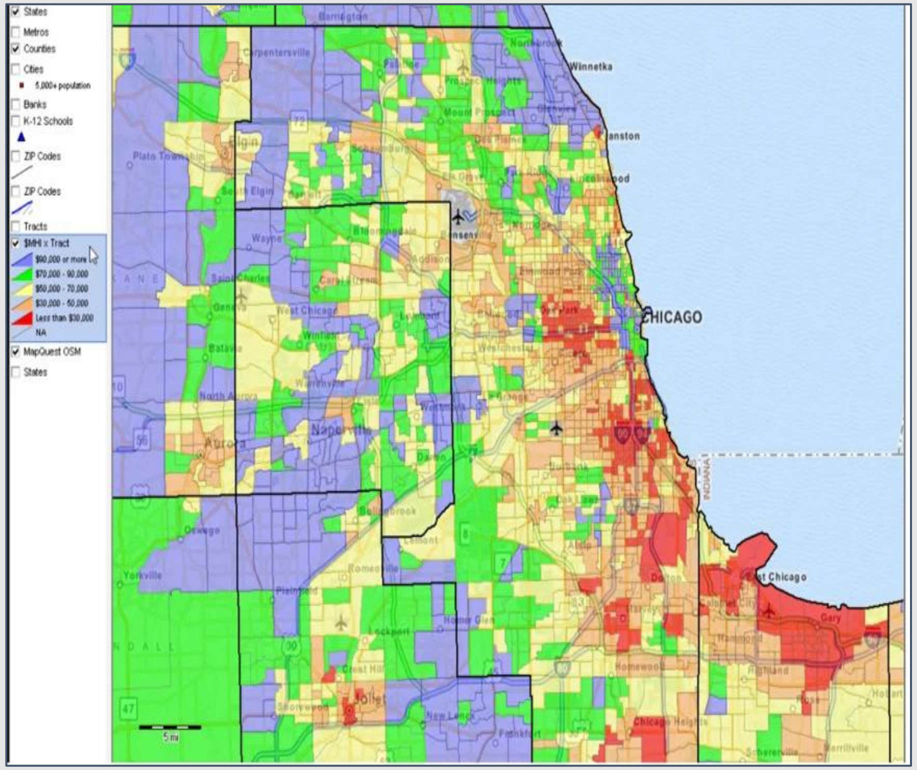
5

Applications of GIS

5.8 Business & Marketing

🌍 The **picture below** illustrates the **variety of ways GIS** can be applied in the business world, and as you can tell, they're more than just a few ways that GIS can help **improve business processes**.





***GIS** shows the **relative income** of different neighborhoods, with **red** being the **lowest**-income neighborhoods and **blue** being the **highest**.*

https://www.g2.com/articles/what-is-gis

5

5.9 GIS for UB Metro 1

🌍 **GIS** was used to analyze terrain and infrastructure for optimizing metro routes in Ulaanbaatar. It supported evidence-based decision-making and efficient metro design. GIS data was also integrated into the BIM process to enhance spatial accuracy and contextual understanding of the metro infrastructure.

Applications of GIS

BIM model with GIS data(Point Cloud)

Utility Line Relocation check with CAD data and Orthophotography

5

5.9 GIS for UB Metro 1

Applica
tions
of
GIS

UBM PMC

2025

THANK YOU!

Park Kyung Hwan _ immosaic@hanmail.net