**Section 1:**

**What is GIS?**

A geographic information system (GIS) is a system that creates, manages, analyses, and maps all types of data. GIS connects data to a map, integrating location data (where things are) with all types of descriptive information (what things are like there). This provides a foundation for mapping and analysis that is used in science and almost every industry. GIS helps users understand patterns, relationships, and geographic context. The benefits include improved communication and efficiency as well as better management and decision-making.

Source:

<https://www.esri.com/en-us/what-is-gis/overview>

**What is GPS?**

**Abstract**: GPS is a system of 30+ navigation satellites circling Earth. We know where they are because they constantly send out signals. A GPS receiver in your phone listens for these signals. Once the receiver calculates its distance from four or more GPS satellites, it can figure out where you are.

Source:<https://spaceplace.nasa.gov/gps/en/>

**Section 2:**

**How does GPS work?**

Satellite Navigation is based on a global satellite network that transmits radio signals from medium earth orbit. Users of Satellite Navigation are most familiar with the 31 Global Positioning System (GPS) satellites developed and operated by the United States. Three other constellations also provide similar services. Collectively, these constellations and their augmentations are called Global Navigation Satellite Systems (GNSS). The other constellations are GLONASS developed and operated by the Russian Federation, Galileo developed and operated by the European Union, and BeiDou developed and operated by China. All providers have offered free use of their respective systems to the international community. All providers have developed International Civil Aviation Organization (ICAO) Standards and Recommended Practices to support the use of these constellations for aviation.

The basic GPS service provides users with approximately 7.0-meter accuracy, 95% of the time, anywhere on or near the surface of the earth. To accomplish this, each of the 31 satellites emits signals that enable receivers to determine their location and time through a combination of signals from at least four satellites. GPS satellites carry atomic clocks that provide extremely accurate time. The time information is placed in the codes broadcast by the satellite so that a receiver can continuously determine the time the signal was broadcast. The signal contains data that a receiver uses to compute the locations of the satellites and to make other adjustments needed for accurate positioning. The receiver uses the time difference between the time of signal reception and the broadcast time to compute the distance, or range, from the receiver to the satellite. The receiver must account for propagation delays or decreases in the signal's speed caused by the ionosphere and the troposphere. With information about the ranges of three satellites and the location of the satellite when the signal was sent, the receiver can compute its three-dimensional position. An atomic clock synchronized to GPS is required to compute ranges from these three signals. However, by measuring the fourth satellite, the receiver avoids the need for an atomic clock. Thus, the receiver uses four satellites to compute latitude, longitude, altitude, and time.

Source: <https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/gps/howitworks>

**Applications**

**Section 3.4:**

**Integrated transportation system**

**Why is integrated transportation needed?**

At present, the computer „revolution” is over and we participate in fascinating communication „revolution” which creates the practical and technical basis for all integration mechanisms in the new transportation systems. For the foreseeable future, the communication costs will halve, and speed will double every 18 months (Gilder’s Law), distance becomes technically irrelevant (i.e. full decentralization of decisions will be possible). In such a situation, the management and control strategy and process knowledge will be more valuable than the transportation process in which they execute. In this context, integration may be one of the most beneficial determinants of the efficiency of transportation problem solutions. This is why the Integrated Transportation Management Systems endeavors to integrate all modes and all roads into a „system of systems” focuses the interest of researchers, in consideration of benefits anticipated within the transport community in elevating current transportation systems to an integrated operation

**Integration mechanisms in transportation systems**

In transportation systems the integration may concern different system aspects:

  Integration of subsystems e.g. UTC, public transport (PT), Car Park management and guidance (PGM), environmental monitoring and prediction systems (EMP) traffic and transport supervision (TTS), information service systems (PAT, ATIS, radio RDSTMC, TV, VMS) individual route guidance and tracking (RGT). The integrated multi-centers technical system architecture with open standards may be a good example.

Integration of information (distributed databases, different data sources e.g. video-detectors, GPS). An integrated information system (Traffic Travel Information Centre) operating in real-time to influence travel behavior and public transport use may an example.

  Integration of systems functions and computational power.  Integration of different system soft and hard operational tools (e.g. for analyzing, monitoring, supervision, control, DSS, visualization, maintenance, and diagnosis).  Integration of knowledge and learning tools.

**Examples of different integration tool**

A. DSS dispatching control simulation tool with (LQ, LQG, Dead-beat, punctuality, and regularity dispatching control strategies (SIMULINK)

 B. PIACON traffic adaptive control tool:

The PIACON multi-criteria control method in a natural way represents the observed conflicts in real traffic situations arising because of demands of various users cannot be met simultaneously. In this method, the variety of trade-offs between control criteria is adequately represented. These criteria are connected with operating efficiency (capacity, delays, traffic intrusion into the environment (pollutant emission), economy (fuel consumption), and occasional requirements of various road user groups e.g. priorities for public transport vehicles. The main operating criteria to be minimized (number of vehicle stops, delays, capacity reserve, queue length, drivers discomfort, and measure of differences from their demand for occasional requirements) are included in corresponding "control modes" called accordingly, stop SM, delay DM, capacity CM, queue QM, jam JM and dedicated DEDM modes. Different control aspects represented by these control modes are integrated using given preference order on an optimal non-dominated index surface (i.e. the N-Set determined by operating criteria and given domination structure in criteria space). The other control modes (e.g. fuel consumption FM, pollutant exhaust emission EM) are represented in the N-Set as appropriate points /regions i.e. appropriate compromises between operating

criteria. For example, vehicle fuel consumption and exhaust emission rate minimization may be performed as an appropriate compromise between traffic delays and the number of vehicle stops. The minimal values of all operating criteria create in the criteria space the reference ideal point which in reality may correspond to the multilevel traffic junction. The final

selection of the multi-criteria solution from the parameterized N-Set (called the nominal junction working point) may be determined as the nearest one to this reference point. The diversity of traffic situations encountered on the approaches to the intersection are aggregated into "traffic modes" ranging from sparse to immobile traffic e.g. through the tools of the rough set

[8] using the features extracted from the traffic video-detectors data. In general, various approaches to the intersection may be working in different traffic modes. For a given traffic mode, defined in the real-time way corresponding control aspects are represented by

appropriate compromises of control modes i.e. points in N-Set. This is possible because the N-Set is parameterized both by traffic parameters and control variables. Therefore, it dynamically evolves with traffic demand fluctuations. It is an attractive feature of the proposed control idea which makes it possible to realize online adaptive control actions by

the selection of appropriate working points on the current N-Set using proper adjustment of the domination structure. Moreover, these control actions may possess robust features (at each control step the sensitivity analysis may be readily and immediately performed in the N-Set and robust traffic control actions selected) and secure a smooth transfer between different working points.

 C. Integrated pro-ecological traffic planning and management approach

In this section, an example of integrated pro-ecological traffic planning and management approach is presented and a traffic intelligent control idea for the street canyons in the alert control area is proposed. In particular, the Petri Nets planning and scheduling tools are integrated with control scenarios prepared by an advanced hydro dynamical control model

TEDMAN-H and used in reference mode by PIACON real-time adaptive control method. The approach is substantiated by control plant features i.e. wide-area of operation, multi-form of possible actions, essential interactions with other systems suggest the integrated approach,

broad spectrum of conflicting goals suggest the multi-criteria approach, whereas a high level of uncertainty and ambiguity in the intelligent approach, finally the fast dynamic, essential plant instabilities, incomplete and inaccurate data suggest the adaptive control approach. The main

points of this approach are as follows: Integrated multilayer pro-ecological traffic planning and management methodology which naturally follows from the advanced hierarchical integrated individual and public transport systems [1-3]. It is based on recent technologies and wide-area intelligent network analysis, management, and real-time control

tools with high-quality real-time information supply from integrated data and knowledge bases updated by new traffic data sources e.g. video-detectors, AID, AVL/GPS systems; meteo, pollutant emission and concentration data (e.g. lidar measurements). The operational efficiency is guaranteed by good data-equipped estimation methods, multi-criteria intelligent

planning, management, and control actions supported by automatic decision assistance tools (e.g. human operators DSS supplemented by GIS-visualisation, AI-interpretation, and ATIS

real-time knowledge presentation). In particular, the planning process is integrated with: the real-time operation of the transportation system (i.e. by a rich family of network analysis models

that gives continuous real-time information feedback about the system operation); powerful intelligent analysis support equipped with models and knowledge bases that organize rich bodies of data for analysis and tools capable of dealing with and efficiently searching through

a practical continuum of potential alternatives to match options against policies and objectives; advanced multilevel (national: local, regional, state and international) intelligent

co-ordination support for a variety of planning process participants (professionals, decision-makers, stakeholders, citizens, and interest groups) which improves the efficiency and quality

of the deliberation and consensus-seeking of the national and international group processes.

The management and control processes must be integrated with: a data-rich real-time environment of advanced knowledge, methods, and tool bases; computer-based DSS equipped with high proportions of automated monitoring, surveillance, and intelligent management functions

to ensure real-time beneficial pro-ecological (i.e. reducing the adverse environmental impacts) actions to an on-line detected traffic and environmental situations; library of intelligent multi-criteria control and management methods enabling us to perform integrated (traffic control,

route guidance, public transport control, parking control, traffic priorities, restraints and incentives for using different modes of transport) wide-area tasks. The pro-ecological potential of these integrated tasks (strategies) may be predicted in terms of both demand and supply

side effects. Demand reduction in time-space context due to reducing wasted trip time, emissions, and energy, travelers more rational choices of trip determinants (mode, route, departure times, etc.) based on available up-to-date information about travel alternatives, incidents, navigation, and road use pricing. Significant improvements on the supply side due to

more efficient use of the existing infrastructure capacity (reduction of traffic disturbances, accidents, improving the operation of signals), providing system-level optimum traffic patterns characterized by an overall reduction in delay, emissions, and energy consumption for the same traffic volume and decreasing the system management reaction time on sudden/

unforeseen supply changes which are the prerequisite of congestion. The

two-level control structure at the bottom level selects in real-time optimal traffic signals green splits gi[gmin, gmax] and cycle times C[Cmin, Cmax] on the entrance and exit signalized junctions. The entrance resp. exit control is a general gating type of control which, by the selection of entrance resp. exit traffic signals parameters, and controls the number of vehicles

entering/ leaving the street canyon. Similarly, exit control determines the number of vehicles

in the street canyon. At the upper supervision level the real-time adjustment mechanism estimate

recursively the emission and dispersion parameters pe /PD (e.g. flows and types of vehicles on

entrance and queues on exit junctions, densities and speeds of vehicles inside the street

canyons, meteo parameters) corresponding to on-line detected traffic and environmental

situations. Based on these parameters, the control decision situation markers are determined and the expert controller selects the appropriate control scenario. The scenarios are offline prepared using a sophisticated hydrodynamic model and are represented by Petri Nets which determine the set and the sequence of the control and management actions in the

control area. Formally, the expert controller is a DES (Discrete Event System) system working on the sets of markers symbols and real-time reasoning rules generating the priorities for different scenarios. Therefore, between the expert and conventional controllers, an interface is necessary to realize communication in both directions. In general, the scenarios activate (if it is necessary) two area-wide pollution-sensitive pro-ecological control strategies: the traffic gating strategy which is a dynamic traffic re-routing strategy assigning the traffic to diversion routes (optimal in the sense of travel and environmental standards) to unload the route with estimated and/or predicted environmental alert conditions, and the environmental area licensing strategy which after identification of the "clean" status of each

vehicle restricts the number of non-clean vehicles entering the street canyon. In practice, these strategies are implemented using VMS (Variable Message Signs) and RGE (Onboard Route Guidance Equipment) tools. The feedback control loop at the bottom level follows up the selected scenario. the pro-ecological integrated control idea is presented for illustration. At the upper level, the control area is determined. The entrance (control area avoidance) and priority (control area exit) integrated control strategies are

realized locally on the entrance/exit signalized links in a form of gating/priority actions and by the control area-wide integrated strategy of VMS, ATIS, mass-media, P+R, RG and public transport actions which are based on folded hierarchical Petri Nets traffic model in this control area. The extension of the controlling idea from one street canyon to a network of street canyons in a natural way arises.

 Source: <https://www.researchgate.net/publication/274302740_Integrated_transportation_systems>

**Section 3.1:**

**Surveying**

Source: <https://www.baselineequipment.com/gps-land-surveying-equipment>

Land surveying involves gathering information about the positions of certain points as well as the angles and distance between them. Through the use of certain instruments, surveyors can create maps, establish property lines, and gather important information for architects, engineers, and developers.

The accuracy of land surveying measurements is dependent on the quality of the instruments used to gather the data. With the invention of GPS technology, land surveyors are now able to make complex calculations more quickly and accurately than ever before.

**Best GPS instruments**

GPS survey equipment makes it possible to obtain location, distance, and height measurements almost instantaneously – the only requirement is that the instrument has a clear view of the sky to receive signals from GPS satellites. When used properly, GPS for land surveying offers the highest level of accuracy and is much faster than conventional surveying techniques.

Different types of GPS land survey equipment are used for different purposes, though there are three methods of GPS measurement used most often by surveyors:

1. **Static GPS Baseline** – This method is used to determine the coordinates for survey points by simultaneously recording GPS observations over both a known and unknown survey point for at least 20 minutes. The data is then processed to determine coordinates within 5mm accuracy.
2. **Real-Time Kinematic (RTK) Observations** – In this method, one receiver remains open over a known point (the Base Station) while another receiver moves between different positions (the Rover Station). Using a radio link, the position of the Rover Station can be calculated within a few seconds, ensuring a similar level of accuracy to baseline measurements as long as they are within 10km of the Base Station.
3. **Continuously Operating Reference Stations (CORS)** – In this system, a survey-grade GPS receiver is permanently installed in a particular location as a starting point for any GPS measurements in the area. GPS survey equipment can collect field data and combine it with CORS data to accurately calculate positions.

**The Pros and Cons of GPS for Land Surveying**

The Global Positioning System changed the world of land surveying in many ways, most of them good. There are, however, some downsides to this type of equipment. Here is a quick summary of the pros and cons of GPS land surveying:

**Pros**

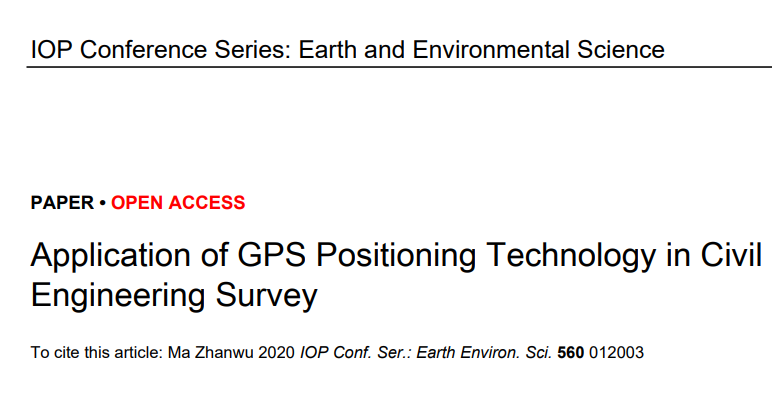
* It offers a higher level of accuracy than conventional surveying methods
* Calculations are made very quickly and with a high degree of accuracy
* GPS technology is not bound by constraints such as visibility between stations
* Land surveyors can carry GPS components easily for fast, accurate data collection
* Some GPS systems can communicate wirelessly for real-time data delivery

**Cons**

* GPS land surveying equipment requires a clear view of the sky to receive the satellite signal
* Interference from dense foliage and other structures can limit function and communication
* All GPS survey equipment is subject to failure from dead batteries and system malfunction
* Special equipment may be required and can be costly

The world of land surveying is constantly changing as new technology replaces old. Commercial survey equipment has made leaps and bounds over the past few decades and, with the help of GPS technology, will only become faster and more accurate over time.

**Source:**



**Bridge Engineering Survey**

Deformation modeling of bridges is an indicator of bridge feasibility. GPS and CRP (Close Range Photogrammetry) can be applied for the modeling of bridges since they are easy, effective, and can be used for multi-temporal applications.

A global Positioning System (GPS) is employed to monitor the deflection in the middle of the bridge by kinematic methods using precise ephemeris data for correcting coordinates. For the entire span bridge, the CRP method is applied using a non-metric camera with self-calibration and space resection processing in the bundle adjustment technique.

In the actual construction processes, we can accurately measure each construction link of the construction site, and GPS measurement technology can also be used in elevation measurement and cross-river inspection and measurement work, so that we can improve the measurement efficiency and ensure the accuracy of the data provides accurate and reliable data support for each link of the bridge construction, thereby enhancing the rationality and scientificity of the bridge construction plan design.

We can scientifically and rationally plan the overall construction process of the entire bridge structure, to improve the efficiency of construction and ensure its progress and quality.

**Urban Engineering Survey**

In the process of urban engineering construction, the construction difficulty is relatively high. When carrying out vertical operations and horizontal operations, long-term monitoring must be carried out to be able to grasp the abnormal changes in the construction operations in time to ensure the safety of construction. In urban engineering, it is necessary not only to carry out survey work in the early stage of construction but also to carry out construction monitoring during the construction process.

The application of GPS positioning technology in the preliminary measurement work can accurately analyze the surrounding buildings and analyze the specific construction terrain at the same time. During the construction monitoring process, the surveyor can use differential GPS technology to locate the building piles and corners. Especially in the process of high-rise building construction, to prevent the groundwater flow changes from adversely affecting the high-rise building construction, we need to use GPS to accurately grasp the groundwater level. At the same time, we can dynamically monitor the settlement deformation of high-rise buildings during the construction process, to control the settlement deformation of high-rise buildings within a reasonable range and improve the safety and quality of high-rise building construction

**Section 3.6:**

**Marine**

In marine, navigation is a crucial aspect and GPS has made it easier to navigate the oceans by providing the coordinates as well as the speed.

There is a vast variety in the applications of GPS systems in marine:

1. **Underwater Surveying** - GPS is essential for its accurate and reliable data and for that it is used for surveying and mapping various activities. Vessels used for surveying are combined with GPS positions which help the mariners to get the depths and dangers of the underwater. Bridge builders have also used GPS for surveillance of the underwater. The GPS also makes the work of the surveyors easy as the work they would have done in weeks, can be done in a day.
2. **Buoy Placement -** A buoy is an object that is put in the middle of the seas to act as a locator and warning point for ships. GPS is fundamental as it is incorporated into the floating buoy and helps mariners to determine better water level models. The GPS data provided is real-time, accurate, and helps in detecting directional changes in water.
3. **Mapping commercial fishing fleets -** Maritime poaching has become a threat to sea life therefore GPS tracking systems are installed on commercial boats to ensure they don’t fish in restricted areas or during forbidden times.
4. **Tracking fish migration -** Researchers attach GPS to fishes and then use it to monitor their movements as it shows the exact place and time of the fish. Fish behavior is determined as well as their migratory pattern which is important information for marine research.
5. **Vessel traffic control around busy seaways -** GPS attached to the maritime vessels allow their position and movement to be monitored and hence, can be used to control the traffic on busy sea routes and efficiently manage the vessels’ fuel and travel time.
6. **Increased safety of vessels using AIS -** The GPS used in monitoring sea vessels comes integrated with an Automatic Identification System (AIS) which improves the efficiency of safety and security of these vessels.
7. **Faster response to accidents -** GPS installed in sea vessels can be used to provide important information to the rescue service in case of emergencies.

**Section 3.3:**

**Environmental Applications**

Source: <https://www.gps.gov/applications/environment/>

By connecting position information with other types of data, it is possible to analyze many environmental problems from a new perspective. Position data collected through GPS can be imported into geographic information system (GIS) software, allowing spatial aspects to be analyzed with other information to create a far more complete understanding of a particular situation than might be possible through conventional means.

Aerial studies of some of the world's most impenetrable wilderness are conducted with the aid of GPS technology to evaluate an area’s wildlife, terrain, and human infrastructure. By tagging imagery with GPS coordinates, it is possible to evaluate conservation efforts and assist in strategic planning.

GPS technology supports efforts to understand and forecast changes in the environment. By integrating GPS measurements into operational methods used by meteorologists, the atmosphere’s water content can be determined, improving the accuracy of weather forecasts. In addition, the proliferation of GPS tidal tracking sites, and improvement in estimating the vertical component of a site’s position from GPS measurements, present a unique opportunity to directly observe the effects of ocean tides.

GPS receivers mounted on buoys track the movement and spread of oil spills. Helicopters use GPS to map the perimeter of forest fires and allow efficient use of fire fighting resources.

The migratory patterns of endangered species, such as the mountain gorillas of Rwanda, are tracked and mapped using GPS, helping to preserve and enhance declining populations.

In earthquake-prone areas such as the Pacific Rim, GPS is playing an increasingly prominent role in helping scientists to anticipate earthquakes. Using the precise position information provided by GPS, scientists can study how strain builds up slowly over time in an attempt to characterize, and in the future perhaps anticipate earthquakes.

The modernization of GPS will further enhance the support of GPS technology for the study and management of the world’s environment. The United States is committed to implementing two additional civilian signals that will provide ecological and conservation applications with increased accuracy, availability, and reliability. Tropical rain forest ecology, for example, will benefit from the increased availability of GPS within heavy foliage areas and the reduction of spatial error in fine-scale vegetation mapping.

**Section 3.2:**

**Construction**

**Structural works in Construction**

GIS allows civil engineers to include a variety of material data and area historical data into their designs. As a result, one of the most extensively utilized GIS applications is [**structural analysis**](https://www.constructionplacements.com/books-on-structural-analysis/).

By merging [**3D GIS maps**](https://click.linksynergy.com/link?id=aJJ7Bc*xGjg&offerid=1060092.3149350&type=2&murl=https%3A%2F%2Fwww.udemy.com%2Fcourse%2Farcgisvsarcgispro2%2F) with normal design techniques, designs can gain from previous mistakes. GIS mapping has a lot of advantages over tabular data. Engineers can use interactive overlays and 3D models to see problems before the first tonne of concrete is poured.

**Infrastructure Management**

A thorough examination of the environment before constructing or updating infrastructure is critical because it aids civil engineers in determining how they will organize their work. As a result, they may reassure the public of the need of visualizing the environment to improve decision-making.

You can only grasp your requirements if you have a complete and accurate picture of your project. A good understanding is necessary since it aids in the reduction of numerous problems and the mitigation of any potential [**environmental**](https://www.constructionplacements.com/environmental-engineering-career/)consequences.

This is only possible if GIS is employed as the primary system for imagining and managing data. With the use of GIS, the information acquired is subsequently presented in an easy-to-understand manner.

**Development of Urban Area including Town planning**

The rising number of people in a country is significant, but it also hurts the economy of that country. This is because when the numbers are high, the economy benefits since there will be a larger workforce that is focused on accomplishing the intended outcomes.

Increased population, on the other hand, produces congestion in many regions, which can lead to issues with sanitation, housing, contamination of the environment, and improper [**waste disposal**](https://tidd.ly/3Lil4go).

Urban areas must be maintained, which can only be accomplished through the creation of development models and urban land use plans. This is accomplished by combining natural resource information in a Geographical Information Systems domain.

**Infrastructure Protection**

Civil engineers must ensure that the structures they develop are safe and secure for the people who live in them. [Bridges](https://www.constructionplacements.com/product/the-art-of-structural-engineering-bridges/) and dams, for example, necessitate complete decision-making equipment that can be employed in disaster response and recovery efforts.

[GIS technology](https://tidd.ly/3tIldno) provides responsive solutions for a variety of situations, including the combining of data from flood occurrences to the evacuation routes that will be used.

To make presenting information on an online-based map considerably easier, this crucial data must be maintained in a geographical database. Furthermore, GIS tools are used to combine and evaluate data needed to complete the tasks.

Source: <https://www.constructionplacements.com/gis-in-construction-industry/#gsc.tab=0>

3.5 Disaster Management

GIS in disaster management acts as a tool for supporting decisions. The application of GIS in disaster management helps in understanding the nature of the disaster and this helps in solving complex management problems. In addition to that, decisions can only be made by analyzing the different Geographic Information System layers. Management and planning of disasters, as well as handling disastrous conditions are currently useful, with the help of geospatial and socio-economic data.

**1. Preparedness for a disaster**

The awareness and preparedness for disaster is one crucial area. Some of the crucial questions that arise from this area include; what is the total number of people in the affected area? What is the location of the buildings and infrastructure around that area? The number of people at risk and the evacuation time and technique? What are some of the structures that can be used as shelters? These questions come up anytime a disaster strikes a particular area and location. The database of critical facilities such as hospitals, police stations, ambulances, fire stations, and schools can be built up by GIS and remote sensing techniques. This helps plan purposes.

**2. Planning and Mitigation**

In the early years, whenever disaster occurred, the role of the government was limited to rescue, relief and rehabilitation. Time has passed and mitigation and mainstreaming of disaster risk reduction are crucial activities, which require the intervention of the government. With the application of Geographic Information Systems, the development of decision support cables for assessing risk from natural disasters is achieved. The effectiveness and the cost of the response and the recovery of the disaster are about the extent of the planning and how appropriate the process is. This helps the government in the mitigation and planning of disasters.

**3. Response and Recovery**

Responding to a disaster in a given area requires detailed information such as where the disaster has occurred, the intensity of the damage caused, where the affected population is located and the resources needed to evacuate the affected individuals. Knowing the above information requires one to understand the geography of the affected area. This helps in modeling the hazard intensity and the level of severity. An understanding of the impact of the disaster on buildings is achieved and at the same time, a response to the disaster for the evacuation and rehabilitation is applied. The usage of drones, together with Geographic Information Systems and satellite imagery, helps in finding the answers to most of these questions and conducts all of the above tasks in a planned, effective and efficient manner. The use of mobile GIS in field recovery provides the capability to integrate and also provides a display of the damaged areas in different locations.

**4. Building a common operating environment**

Solving the damage caused effectively requires the response and recovery team to have all the information required at hand. Geographic Information Systems help in collecting information from sources that are different and combine the information acquired to create intelligence which is used to effectively manage response and recovery.

**5. Data Management**

Consequently, gathering and storing information is essential in disaster management. This is because it helps in attaining a certain level of preparedness. The integration of information from multiple sources is important and possible with GIS. The information, which has been provided in the Geographic Information Systems catalog, needs to be as accurate as possible. The catalog is used in providing useful and relevant information whenever an emergency occurs.

**6. Providing live data**

In the past, solving a disaster required the use of intuition, and most of the decisions, which were taken during disasters, were taken based on prior information, and not the live information, which has been provided. This is different from recent times because live data is provided on many factors such as infrastructures, the geography of the location, the population of the affected individuals, and the topography. This is important in the response and recovery step. The application of Geographic Information Systems is important because it helps in integrating data obtained from various sources, and makes the information gathered accurate and readily available for stakeholders in disaster management.

In addition to that, the applications of GIS help in providing the information required promptly in cases of emergencies. The data that is provided has the capability of rapid exchange that is easy to understand and act on. The relevant authorities then visualize and analyze this information to make an informed decision. Consequently, the decisions that the management could have arrived at help in providing timely and accurate information such as where they should take shelter and evacuation routes among others.

Source:

<https://gissensing.com/gis/applications-of-gis-in-disaster-management/>