INTUS smartcities	Economic Benefits from GIS Technologies	Cost / Benefits Analysis November, 2020

Economic Benefits from GIS Technologies

Efficient geospatial data management is the key to sustainable development for modern Cities. Crowded urbanized areas across the globe are presently being challenged to address complex matters such as aging infrastructure, underfunding, crumbling public transportation, environmental concerns, overdevelopment and more while provide uninterrupted services to its citizens.

Geospatial technology is central to providing a technology platform that forms the backbone of a City. GIS applications change the way Cities do business as it allows users to visualize and analyze assets and attributes through a centralized spatial database at a glance. Via GIS, Cities can integrate, analyze and process massive amounts of georeferenced information captured by sensors and sub-systems, while distribute and visualize cross-sectoral data in real-time, transcending multiple key areas .

Benefits of GIS Application

In the U.K. The Geospatial Commission has estimated that a national underground infrastructure map could deliver **£245 million per year** to the UK economy.

In New Zealand A study conducted by Land Information New Zealand (LINZ), the Department of Conservation (DOC) and the Ministry for Economic Development (MED) that estimates the contribution spatial information makes to the New Zealand economy. According to the report the use of spatial information added at least **$1.2 billion,** about 0.6% of GDP

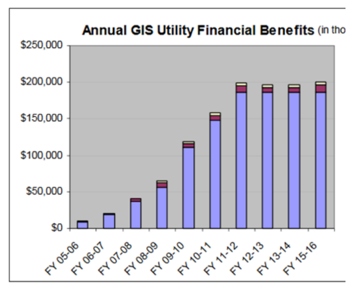
Oregon, U.S.A. A business case for the development of a state-wide GIS Utility released by the State of Oregon has shows that State agency operational/efficiency improvement benefit lies along the lines of **$81 million annually** while Local Government (cities and counties) operational/efficiency improvement is estimated at about **$105 million.**

GIS Applications

- Local Government & Public Information
- Land Management & Properties Taxation
- Public Health, Education & Human Services
- Public Safety & Public Transportation
- Crime Analysis
- Wayfinding & Points of Attraction
- Real-Estate
- Demographics
- Traffic control
- Facilities Management
- Community Development & Engineering
- Emergency Response & Disaster Planning
- Fleet Management & Logistics
- City-owned Utilities Management, Maintenance & Damage Prevention
- Tourism Promotion & Points of Interest
- Local Business Promotion & Retail Advertising
- Economic Development Zoning & Investment Opportunities

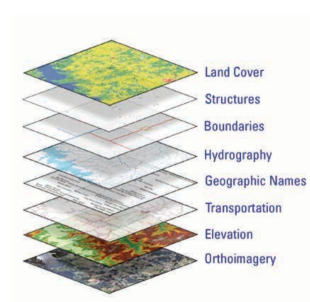
GIS technologies are playing a major role in allowing Cities to protect and manage their assets, enabling automation and real-time integrated City monitoring and planning.

A major challenge for Cities across the globe is the evaluation of the current state of civic the infrastructure and projection of its lifecycle. In addition to that, all legacy maps data and as-builds originated out of years of construction and maintenance records have to be converted and integrated into the GIS.



The Benefits of GIS:

- Facilitate Operational Planning
- Offers Real-Time Access to Information
- Improves Transparency and Decision Making
- Reduces Costs
- Improves Resource and Asset Management



The Digital Utilities Challenge

In 2010, the largest five companies in the world were Exxon, Apple, PetroChina, Shell, and ICBC. Today, it is Apple, Google, Microsoft, Amazon, and Facebook. There is no doubt that digital is fundamentally changing the world and reshaping how companies and society operate.

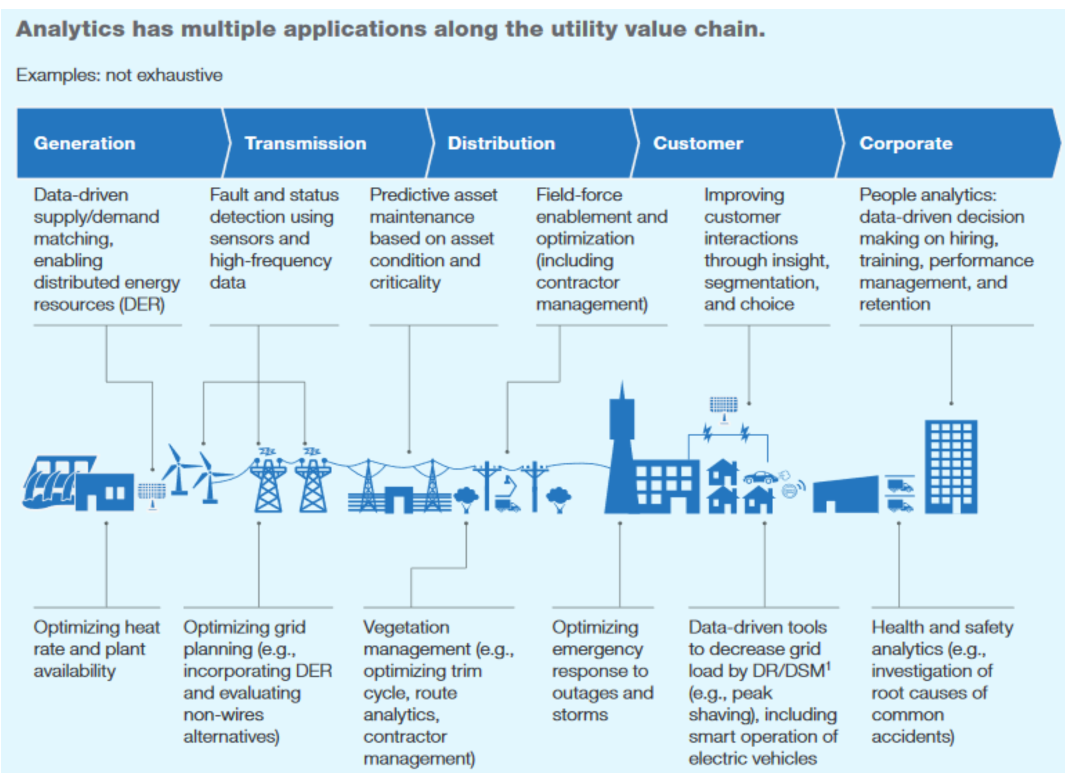
Utilities trying to reinvent themselves as digital enterprises have found it hard to scale up from digital pilots. Adopting digital ways of working, adding talent, and modernizing IT will hasten transformation .

**** McKinsey & Company, Global management consulting***

Forces such as rising customer expectations, evolving technologies, growing competition, increasing regulatory pressures, and aging infrastructure are driving gas, water, and electricity providers to become digital organizations.

Ongoing business disruption, data growth, and the decarbonization trend are putting businesses to the test, but utilities today stand on the edge of something big: a new era of opportunities and previously unimagined outcomes.

**** Deloitte, the largest professional services network in the world***



INTUS smartcities

Economic Benefits from the Subsurface Utilities Engineering process

Cost / Benefits Analysis

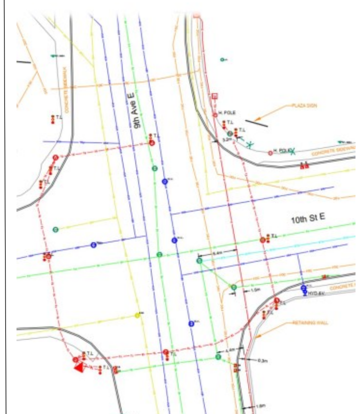
November, 2020

The “SUE” Advantage

A clear image of the underground utility facilities in a particular area is one of the biggest challenges during the design stage of an infrastructure project. Available records sometimes are obsolete, incomplete, or inaccessible for project managers, engineers, and designers. This can lead to a costly redesign of projects and damage to utilities during excavation. For this reason, the practice of Subsurface Utility investigation which is an integral part of the **Design and Permitting for New Utility Installations**, becomes an essential prerequisite for all new infrastructure projects.

Subsurface utility engineering (S.U.E.) consists of engineering processes that identify and characterize underground utility facilities precisely and thoroughly. It covers the three key designations: locating, and data management activities. In combination with traditional records research, coordination with utility providers, and site surveys, these activities provide useful information for the development and project design. This means that S.U.E. provides an existing sub-surface utility data classification system which improves the reliability of information substantially .

Subsurface Utility Engineering “S.U.E.” as a prevailing engineering practice that has evolved considerably over the past few decades, is now becoming a routine requirement for the industry and an integral part of the preliminary engineering processes, addressing exactly the afore-mentioned issues and making accurate subsurface utility information available to infrastructure owners, early enough in the development of a project to design around many potential conflicts.



ROI for Subsurface Utilities Engineering

The National Academies of Sciences and Engineering m U.S.A.

A study took an in-depth look at 9 large municipal and highway reconstruction projects that utilized SUE to provide an enhanced depiction of buried utilities. All projects showed a positive return-on-investment (ROI) that ranged from **$2.05 to $6.59 for every dollar spent on SUE**.

The Federal Highway Administration, U.S.A.

A study conducted by Purdue University on behalf of the Federal Highway Administration (Lew 2000) investigated 71 highway construction projects in four states (Ohio, Virginia, North Carolina, and Texas) that had incorporated SUE. The study found that on an average project, a total of **US$4.62 was saved for each US$1.00 spent on SUE** in comparison to a wider range identified by DOTs (between US$7.00–US$18.00). Return-on-investment (ROI) figures varied considerably between projects, with one project reporting a ROI of 206 .

The Pennsylvania Department of Transportation, U.S.A.

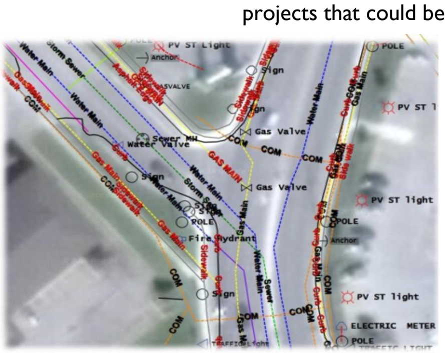
The most recent analysis for the Pennsylvania Department of Transportation (PennDOT) estimated **$11.39 in savings for every $1 spent on SUE.**

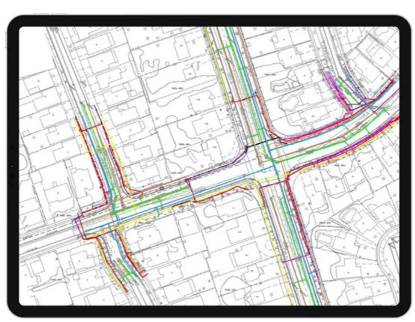
The Florida Department of Transportation, U.S.A.

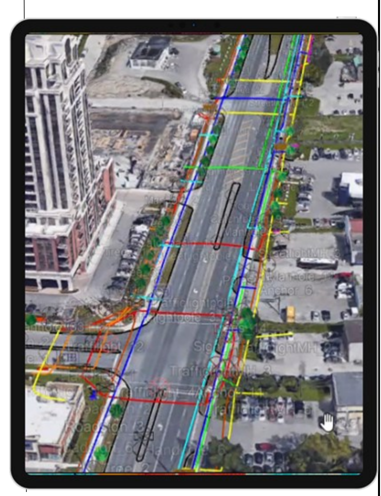
The Florida DOT analyzed the use of SUE on major projects in Tallahassee and Miami and found that it **saved $3 in contractor construction delay claims for every $1 spent** for subsurface utility engineering.

Sewer and Water Association, Ontario, Canada

In 2004, the University of Toronto investigated several large infrastructure projects in Ontario. This study determined that the average rate of return for each dollar spent improved visibility of underground utilities on those projects that could be quantified **was $3.41**







Geospatial data is of primary importance for organizations of all sizes in almost every industry with its economic and strategic value is becoming increasingly important to infrastructure owners.

Damage Prevention & Subsurface Utilities Locating

Anytime underground digging is needed, whether it be for construction, utilities installations, or another project, it is key to understand what underground facilities are located in that specific location to avoid damage to property and loss of life once digging begins.

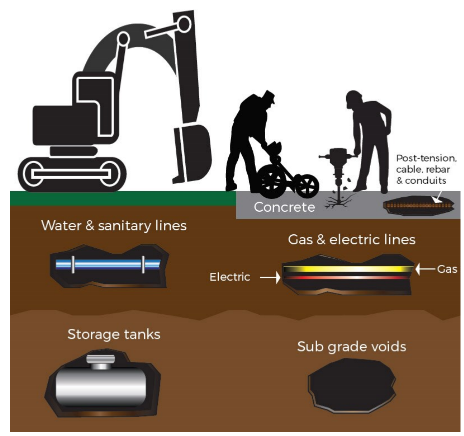
Facility	Avg cost per strike in 2016
Electricity	£ 970
Gas	£485
Telecom	£400
Fibre-optic	£2800
Water	£300-980

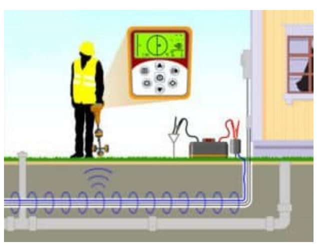
About 4 million excavations are carried out on the UK road network each year to install or repair buried utility pipes and cables. Research at the University of Birmingham on **3348 incidents of damage to underground utilities** determined the direct costs of utility damage during construction.

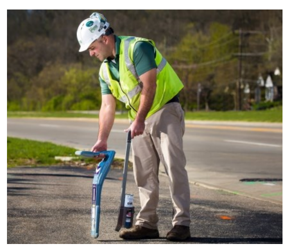
The total cost of underground utility damage costs the **Dutch** economy is estimated to about **€ 1 billion annually .**

Facility	Avg cost per damage 2016
Natural gas	$5,914.00
Telecom	$3,022.00
Electric	$4,905.00
Cable TV	$2,190.00
Water	$3,003.00
Sewer	$5,163.00
Liquid pipeline	$7,711.00
Steam	$1,800.00
Average	**$4,021.00**

At an average cost of $4000 per hit, the CGA (Common Ground Alliance) estimates that the direct cost to the **U.S. Economy is about $1.5 billion** .







In 2002 only 40% of **International Heathrow's Airport** under-ground facilities were mapped to within half a meter. A decade later 72% of the underground facilities were mapped to half a meter.

In Ontario, **Canada** the damage ratio for the number of incidents per 1000 notifications since 2007 reveals a decreasing trend through 2014 .

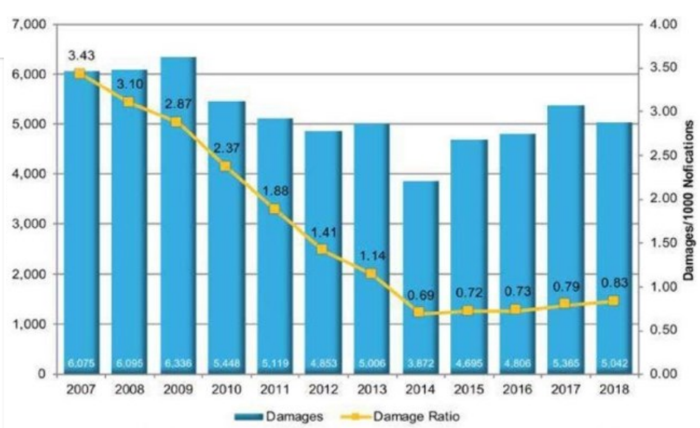


Figure 17: Damage Ratio- Damages/1000 Notifications

Damage Prevention- EU Activities

In the U.K.

"The Geospatial Commission (U.K.) was created in April 2018 in the centre of government, as an independent, expert committee. We aim to unlock the significant economic opportunities offered by geospatial data and to reinforce the UK's geospatial expertise on the global stage.
Our first 2019/20 project is an investment of £3.9 million into two regional pilots that will help us test our assumptions, develop data models and provide open documentation of key findings to inform whether and how to proceed with rollout of a National Underground Asset Register.

In Belgium

Network owners are obliged to provide the plans of their infrastructure when someone requests them via a "call before you dig" solution, but then fully digital. The plans should be delivered in the IMKL format, based on the INSPIRE initiative from the European Directive. Merkator supports the netwoners to convert the existing plans to this new format, and provides a SaaS solution that automatically sends the plans when they are requested. Learn more about GeoMerk KLIC KLIM KLIP. Contractors are obliged to request plans of the underground cables and ducts before they dig. The result is a single digital plan in IMKL format. It contains a lot of information, but this plan comes in a format that cannot be viewed in typical engineering software as AutoCAD or ArcMap.

In the Netherlands

2010 the Netherlands switched to a digital information system (KLIC-Online) that worked in a similar way except that everything could be done online. With KLIC the turnaround time was reduced to hours. Both the manual and KLIC-Online One-Call systems were voluntary until 2008 when a law was passed which made KLIC mandatory for both network operators and excavators with severe penalties for excavators who circumvented the system. There is also a charge of € 29.50 for every excavation request.

Anyone who is going to have mechanical excavation work or has it carried out is legally obliged to report this in advance to the Land Registry. This is called a Digging Notification. After the report you will receive digital information about the location of underground cables and pipes that you use to dig carefully. The cable and pipeline information must be present on site when the excavation work takes place.

In Germany

A new standard for documenting and exchanging information about underground infrastructure exposed during construction has been developed. Referred to as DIN SPEC 91419 it provides a standardized way to capture and share a wide range of information about the underground and has important implications for the continuous improvement in the reliability of location and other information about underground infrastructure. Information about the underground that is inaccurate, out of date and often missing means that engineering designs often have to be modified on site after construction has begun. This results in inconsistencies between design and what is actually built which are largely undocumented. "As-designed" are submitted as "as-builts" and the viscous cycle continues.

In Denmark

The Danish Register of Underground Cable Owners (LER) was launched to prevent accidental damages to underground utility cables and to lower administration costs in the construction sector. LER contains information on all companies and associations who own underground cables in Denmark. Since 2005, all companies performing underground construction activities are legally obligated to notify the register before the beginning of excavation.

Other International Initiatives

- France has mandated that all critical Utilities infrastructure must be mapped in 3D to an accuracy of 40 cm .
- Colorado mandates open maps of underground oil and gas infrastructure .
- Montana mandates survey grade as-builts for new underground infrastructure .
- Singapore plans to develop national map of the underground.