AN ENVIRONMENTAL SCAN OF THE GEOSPATIAL INDUSTRY

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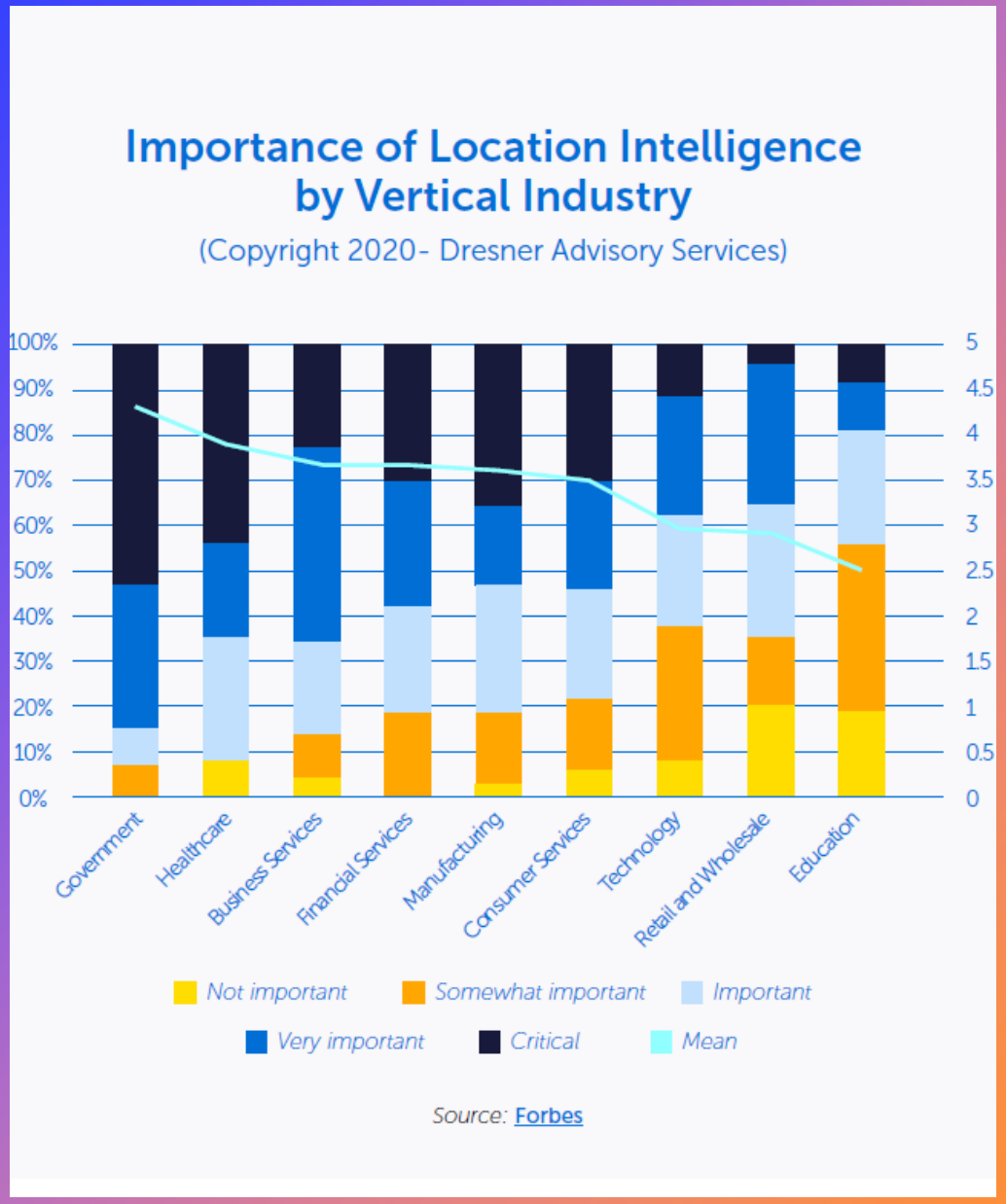
November 2022

Clement Geospatial



Why do we need to invest in geospatial?

Geospatial data and GIS are more than merely making maps. The geospatial analytics market has grown to be worth over $60 billion because leading companies and institutions have realized the central role that location-based data plays in assessing risks and streamlining decision-making.

The presented trends, tools & technologies, workforce issues, customers/users, competitors, and political/economic/societal impacts demonstrate how investing in geospatial will enhance our climate resiliency.

What geospatial trends can we use to enhance our climate resiliency?

Spatial Data Science

- A branch of data science that integrates satellite imagery, remote sensing, and other geospatial technologies with location intelligence.
- Applies techniques such as spatial modeling, clustering and regionalization, and logistics optimalization to find relationships or patterns, and make predictions.

Location Intelligence

- The process of analyzing and visualizing layers of geographic data to identify where events take place, why it happened, and what caused it.
- Powered by geospatial tools and technologies.

Climate-Resilient Infrastructure

Smart City:

- Spatial planning
  - Analyze land use
  - Identify eco-sensitive areas
  - Analyze economic activity and identify potential redevelopment areas
  - Identify eco-development zones with walkable areas and high internet connectivity
- Designed to integrate information communication technologies (ICT) that enhance urban services' quality, performance, and interactivity.

Sustainable Transportation:

- Learn transit pathways and create opportunities to adopt clean energy transportation
- Make walkable zones, bike lanes, zero emission buses and trains, and gondola systems more easily accessible to urban dwellers.

How is spatial data science applied to climate-resilient infrastructure?

Traffic management solutions lower greenhouse gases emissions and reduce energy consumption with traffic light, parking, traffic flow, EV charging, and street light optimization. Sensors can also detect gunshots and monitor air quality.

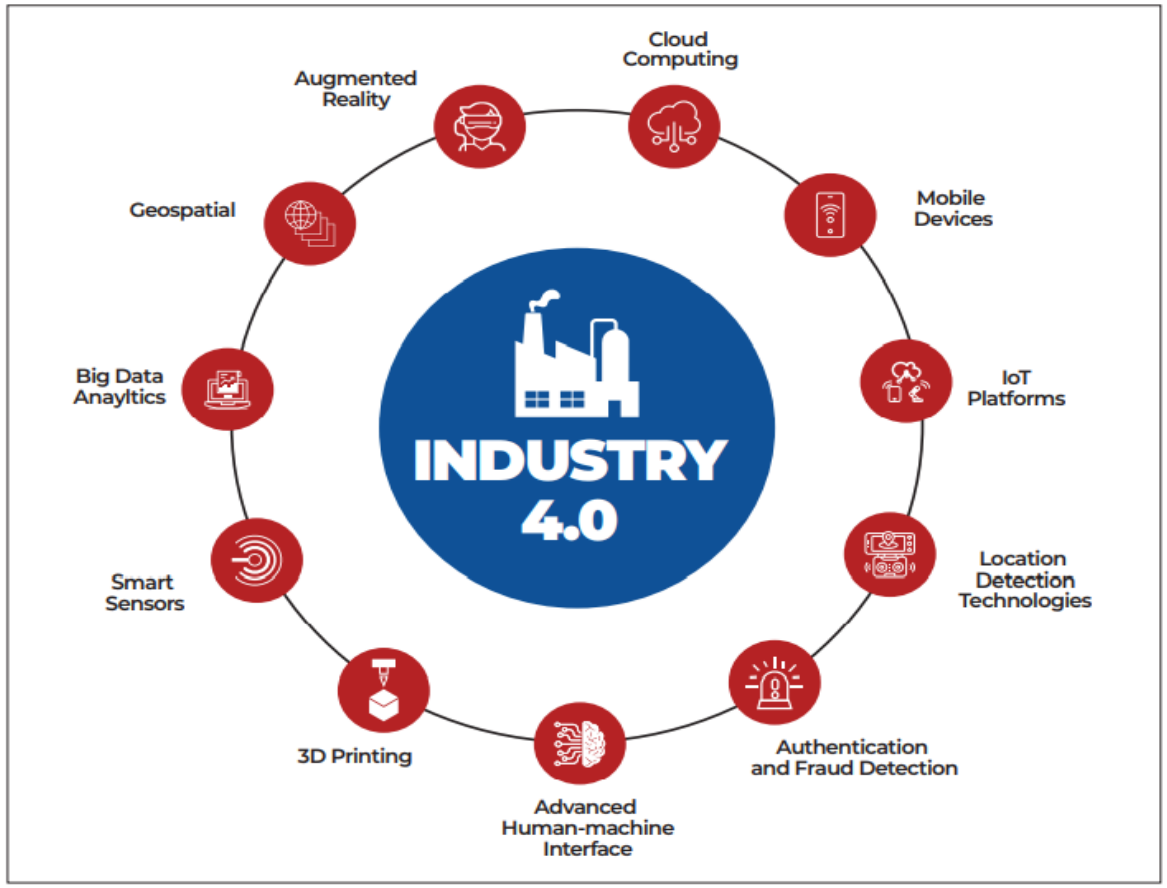
Managing **water resources** is not a “one size fits all” for cities in our region. Instead, adapting to climate change requires advanced technologies that efficiently monitor water quality, levels, and usage from the source and throughout the system.

Monitoring **extreme weather events** such as storms, excessive heat, and wildfires with location intelligence will mitigate risks. Building seawalls, installing cool paving, monitoring droughts and winds patterns, and optimizing emergency services are a few solutions that save lives and money.

Protecting our ecosystem requires monitoring soil and coastal erosion, wetlands, wildlife, and plant populations to ensure a healthy planet for future generations. For instances, flood risk analysis can run simulations over areas to predict flood patterns and assess potential damages.

What geospatial tools & technologies are used for climate-resilient infrastructure?

Figure 1: What are the fourth industrial revolution (4IR) technologies?



ggim.un.org | wfeo.org | wgicouncil.org

Spatial data scientist and GIS Professionals use:

- **Data collection:** satellites, LiDAR, digitizers, drones, radar, Point Cloud
- **Data Storage:** cloud servers and computers
- **Platforms:** R Studio, Postgres SQL, ArcGIS, QGIS, CARTO, Google Earth, Jupyter, AWS, IoT (Internet of Things), BIM Modeling
- **Tools:** Python, R, SQL, JavaScript, Machine Learning, Artificial Intelligence

What are the potential workforce issues?

- Educating management and staff on the benefits of geospatial.
- Lack of data scientists with expertise in spatial data.
  - More schools offering spatial data science programs to fill the gap.
- Building collaborative teams from GIS and data science segments.
- Gaining trust from management/departments to share data and integrate into geospatial workflows.
- Choosing the right technologies and tools to fit the organization’s needs.

Who benefits from climate-resilient infrastructure?

- **Government agencies** implement policies, provide services and infrastructure, act as centralized repository of information, and participate in public-private partnerships.
  - Ex: United Nations, USGS, Metro, etc.
    - City-to-city learning and data sharing initiatives
- **Private companies** are the builders, contractors, data providers, service providers, and participate in public-private partnerships.
  - Ex: Esri, Hexagon, Google, Huawei, etc.
- **Nonprofits** contribute to policy implementation, provide services, and disseminate information.
  - Ex: Climate Reality, Citizens Climate Lobbying (CCL), etc.
- **Community/citizens** use public assets and services.
  - Government agencies working with citizens to improve access to sustainable solutions.

Who are the competitors in climate-resilient infrastructure?

- **Location Intelligence Platforms**
  - Ersi, CARTO, Google, Pitney Bowes, SAP, Hexagon, and others
- **Smart City Companies**
  - Energy , Mobility & Transport, Security, Utilities, Infrastructure
    - Huawei, Hitachi, Schneider Electric, Cisco, IBM, and others
- **Private vs Public data**
  - Satellites and big data
    - SpaceX, Tesla, Google vs. NASA, USGS
- **Government agencies**
  - Organizations competing for climate resiliency awards, recognition, and grants
    - Climate Resilience Fund, Dept of Homeland Security, and other grant programs
- **Opponents of Climate Change Science**
  - Fossil fuel industry, American Petroleum Institute
  - Politicians
  - Media sources
  - Think tanks – Heartland Institute

What are the political/economic/societal impacts?

Research shows that every $1 invested in proactive climate hazard mitigation can save $6-$12 in post-disaster recovery costs. - Climate Mapping for Resilience and Adaptation (CMRA)

- **Bipartisan Infrastructure Bill** – U.S. legislation with the over $50 billion to protect against droughts, heat floods, and wildfires.
  - People of color are more likely to live in areas most vulnerable to flooding and other climate change-related weather events.
- **National Institute of Standards and Technology (U.S. Dept of Commerce)** – In collaboration with the international community, developed new framework for Smart Cities and Communities. (Feb 2022)
- **Paris Agreement** – Executed in November 2016, sets long term goals to reduce global greenhouse emissions and provide financing to developing countries to mitigate climate change, strengthen resilience, adapt to climate change.
- **Intergovernmental Panel on Climate Change** – United Nations body that prepares comprehensive Assessment Reports about the state of scientific, technical, and socio-economic knowledge on climate change, its impacts and future risks, and options for reducing the rate at which climate change is taking place.
- **Science Based Target Initiative** – World's first framework for corporate net-zero target setting in line with climate science and limiting global temperature rise to 1.5°C

SWOT ANALYSIS

Strengths, Weaknesses, Opportunities, and Threats
in the Geospatial Industry

ESRI

A global market leader in geographic information system (GIS) software, location intelligence, and mapping based in Redlands, California.

SWOT

Strengths

Over 300,000 Users worldwide
Long-standing business
Brand Recognition/Marketing
Access to data
Debt free
Reinvestment in R&D

Weaknesses

Expensive platform -

Cost barriers for small companies, nonprofits, or educational institutions

Opportunities

Expanding availability of software and training to small nonprofits, low-income schools

Threats

Open GIS Software

More geospatial companies entering the market

Google

An American multinational technology company specialized in search engine technology, online advertising, cloud computing, software, quantum computing, e-commerce, artificial intelligence, and consumer electronics.

SWOT

Strengths

- Industry leader - cloud computing, big data
- Full suite of geospatial analytics and machine learning, AI
- Google Earth Engine & Maps
- 2021 Annual Revenue-$257 Billion

Weaknesses

- Risky Revenue Model – based on advertising
- Potential security issues
- Google Cloud - profit loser

Opportunities

- Entry into the IoT market
- Expansion in cyber security, quantum computing
- Ability to hire top-notch talent in geospatial

Threats

- Competitors – Apple, Huawei, Open Software
- Some products have limited capability on other interfaces
- Low quality content may impact reputation and revenues
- Antitrust and Regulatory pressures

Apple Inc.

An American multinational technology based in Cupertino, California that specializes in consumer electronics, software and online service.

SWOT

Strengths

Strong brand
Very high profit margin
Multinational company
Expertise in research
GIS capabilities on iPhone – RoomPlan

Weaknesses

Products are expensive
Software incompatibility
Limited GIS products
Limited distribution of products

Opportunities

Ability to hire top-notch talent
Implement widespread and agreesive marketing
Expand distribution
Increase geospatial products and AI

Threats

Competitors – Amazon, Microsoft, Google
Counterfeits
Air Tag technology
Criticism
Adapting to new technology

Tesla, Inc.

An American multinational automotive and clean energy company; specializing in designing and manufacturing eclectic vehicles, battery sources, solar panels, solar roof tiles, and related products and services.

SWOT

Strengths

Vehicle positioning technology
Owner of supply chains
First-to-market technologies
Partnerships with renewable energy companies

Weaknesses

Global expansion
Open-Source Patents
CEO involvement in all levels of business
High price range

Opportunities

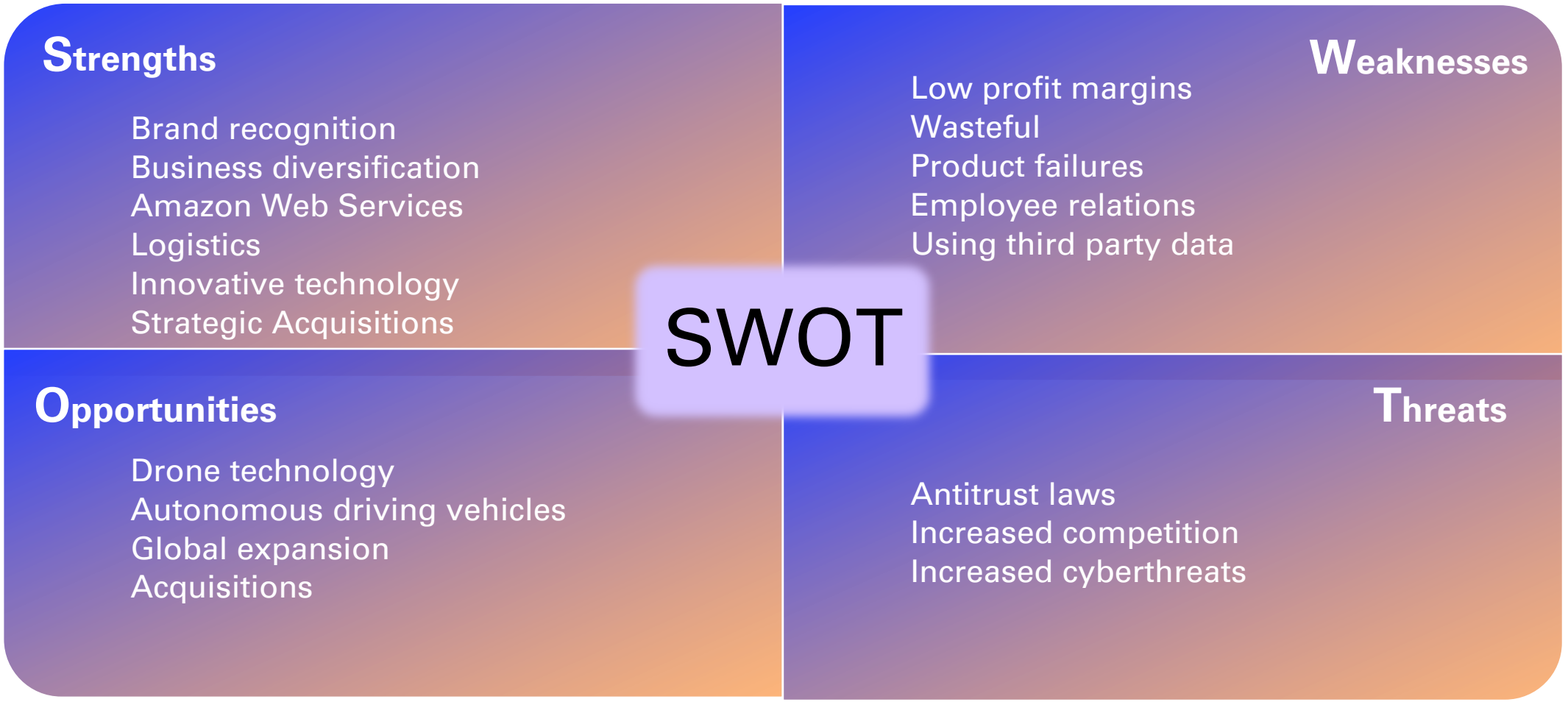
Autonomous driving vehicles
Innovation to reduce pricing
Cost cutting
Assigning more high-level tasks to other executives

Threats

Increased competition
Potential low profit margin
Sustainability
Materials Shortage
Product liability claims

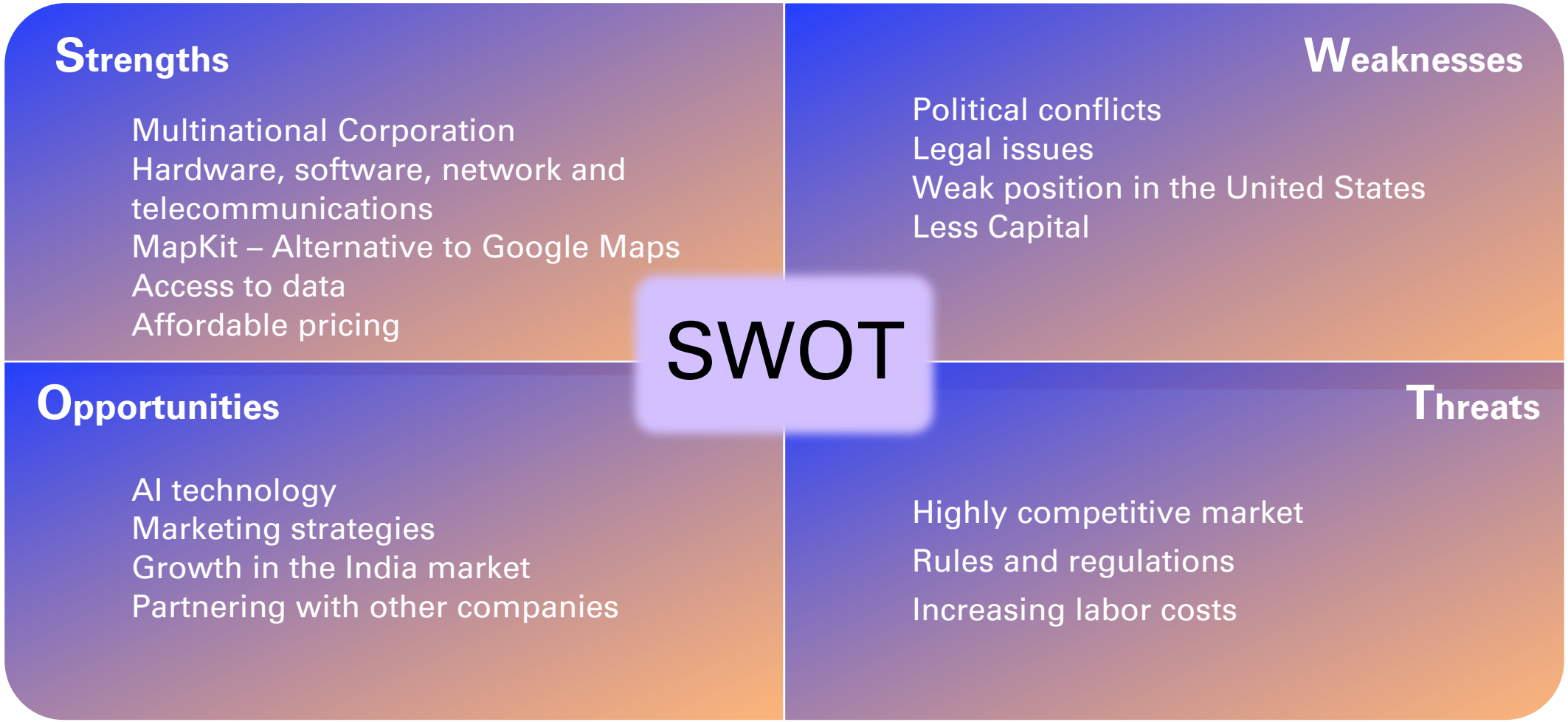
Amazon.com, Inc.

An American multinational technology company specializing in e-commerce, cloud computing, online advertising, digital streaming, and artificial intelligence.



HUAWEI Technologies Co, Ltd.

A Chinese multinational technology corporation that designs, develops, produces, and sells telecommunications equipment, consumer electronics, and various smart devices.



Hexagon AB

A multinational company based in Sweden, specializing in geographic information systems, including digital reality solutions with sensors, software and autonomous technologies.

SWOT

Strengths

Diversified business across several industries
Global leader in GIS technologies – 3D mapping, 5D analysis & visualizations, geospatial sensors.
Steadily deliver enhanced margins
Focused on value-generating customer solutions

Weaknesses

Business region limited to United States, Europe, and Middle East
Dependent on third party for supplies, components, and distribution
Highly indebted

Opportunities

Strategic acquisitions to increase market share.
Use technology and innovative leadership to expand.
Investments in research and development.

Threats

Rapid changes in technology
Environmental regulations increase costs
Decline in sales in sectors due to pandemic

United States Geological Survey

A scientific agency that studies the landscape, natural resources, and natural hazards in the United States.

SWOT

Strengths

Use of advanced geospatial tools and technologies – satellites, machine learning, etc
Public-private partnerships
Technical focused
Expertise in workforce

Weaknesses

Website can be difficult to navigate
Public use of resources may be challenging
Security of assets
Slow-paced of updating policies and procedures

Opportunities

Development of teams with private sector and communities
Hiring top-notch talent
Training on emerging technologies

Threats

Potential cuts in funding
Climate hazards
Potential wasteful spending
Cybersecurity

United Nations

The United Nations Geospatial Network is comprised of a team of geospatial experts in the Office of Information and Communications (OICT) and Global Service Centre that furthers peace operations and field missions worldwide.

SWOT

Strengths

Open GIS Initiative for peace-keeping
Provides Workshops
Access to data
Focus on best practices
International community for GIS

Weaknesses

Large organization with several separate divisions that do not communicate; potentially duplicating efforts

Internal services

Maintaining security in some nations

Opportunities

Access to emerging technologies

Ability to hire top-notch talent

Supporting international initiatives

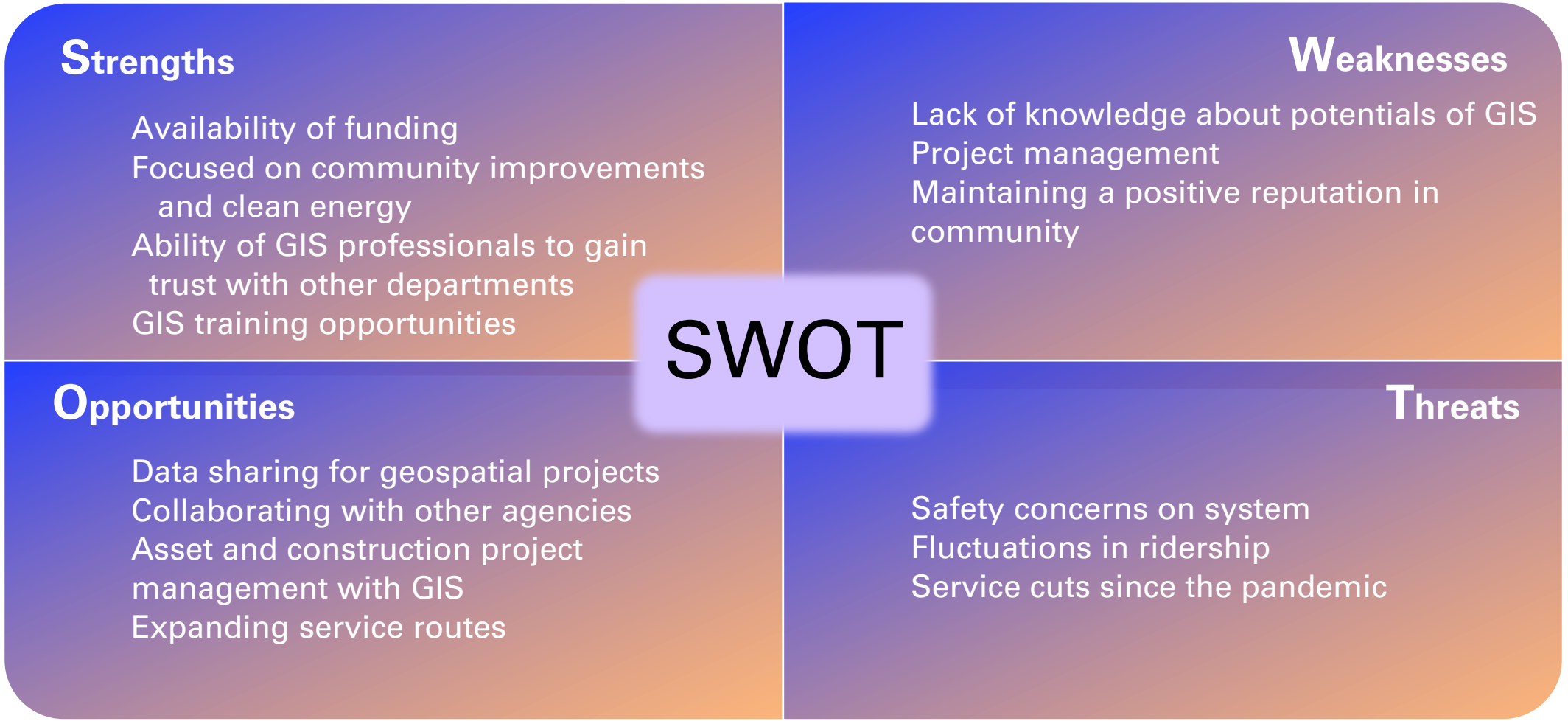
Centralize geospatial duties/teams

Threats

Geopolitics
Access to accurate data in some countries/regions
Gaining support and societal and environmental goals
Providing maps and data to communities

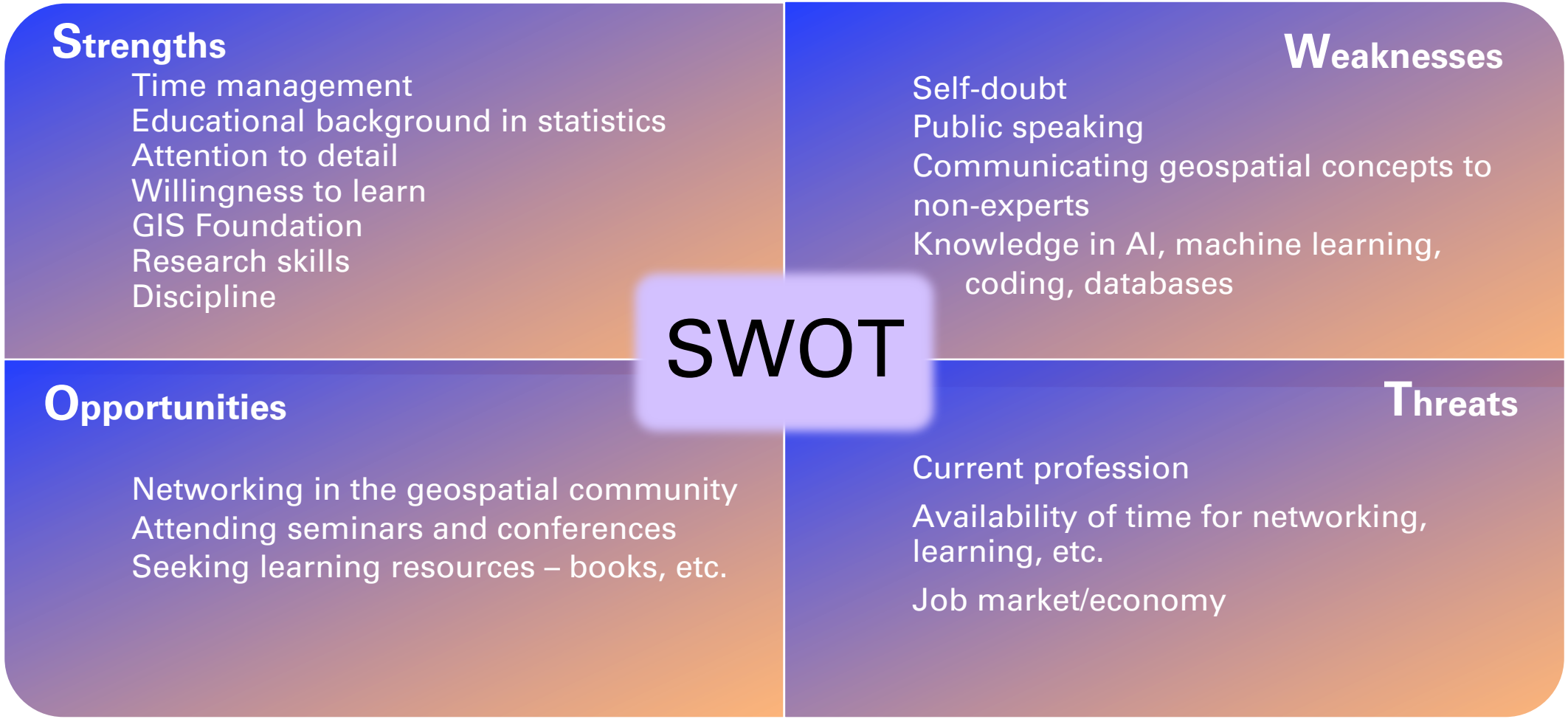
Los Angeles Metropolitan Transportation Authority (METRO)

An agency specializing in transportation planning, coordinating, designing, building, and operating in Los Angeles, California.



Self-Analysis

Shane Clement is a graduate student in the Master of Applied Geospatial Information Systems and Technologies (MAGIST) program at the University of California, Los Angeles.



What’s next?

We need real solutions to mitigate the impacts of extreme storms, droughts, wildfires, and heat waves that endanger our community's safety, health, and prosperity. We spend billions of dollars annually on emergency services and natural disaster programs to manage climate hazards. However, by employing spatial data scientists, applying location intelligence, and building climate-resilient infrastructure, we can use geospatial technologies to monitor the risks and make data-driven decisions that save lives and create a more sustainable future.

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