MAKING TIME. VISIBLE.

MAXIMIZE PROJECT SUCCESS
IN GEOTHERMAL ENERGY, CARBON MANAGEMENT, GEOSPATIAL ANALYTICS, AND GEOSCIENCE

Jul 14, 2025

OVERVIEW

HOW CERTAINTY HELPS:

Certainty is critical because project success and profitability are significantly hampered by **resource spread**—when resources across five essential categories (**knowledge/data, goods/services, people, funding, and leadership**) are dispersed over time and space rather than being tightly focused on a shared window of opportunity. This diffusion leads to:

- **Increased communication delays and difficulties**
- **Slower error correction and resource allocation**
- **Reduced efficiency and resource availability**
- **Significant financial losses** (e.g., $10-20M per non-producing well in geothermal)
- **Stalled industry growth** due to funding uncertainty and risk

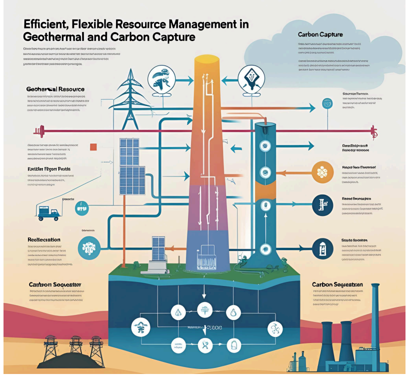
By identifying spread and variations in resource intensity, we help projects achieve **tighter focusing**, leading to:

- **Earlier task completion and increased efficiency**
- **Optimized resource utilization and allocation**
- **Maximized return on investment**
- **Accelerated revenue realization**
- **Enhanced project viability and growth**

Our approach treats a project as a **group velocity** problem. A project's resources are modeled as part of a wave packet propagating in time. Optimizing resource deployments benefits project certainty by ensuring resources converge effectively and quickly for the window necessary to achieve revenue. Afterward, dispersing to re-converge onto another project will maintain the high activity characteristic of strong growth while minimizing losses.

WHAT WE DO:

Through our development and use of sophisticated visualization tools and strategies, TerraNexum seeks to enable **greater project certainty**, particularly in complex geoscience domains. Our core idea is to transform a company's understanding of **where** resources are into a precise **when** and **for how long** those resources will be effectively utilized.



HOW WE WORK

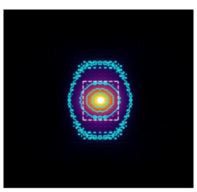
WE IDENTIFY RESOURCE SPREAD TO CORRECT, FOR PROJECT SUCCESS

We dynamically visualize the evolving **spread** of project resources, to determine corrective measures so resources cam remain tightly focused as project activity propagates forward in time. Specifically, we:

- Visualize the **spread** of project resources/focus around its optimal point.
- Model the project as a **wave packet** propagating through time, where resource density changes may occur, creating inefficiencies and resource dispersal if not corrected.
- Calculate **corrections** to counteract this dispersion, so resources can be kept focused at the **point of greatest intensity** (the optimal effective center of project resources).

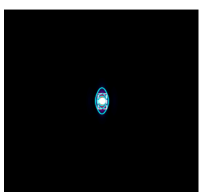
ALERT

SPREAD DETECTED

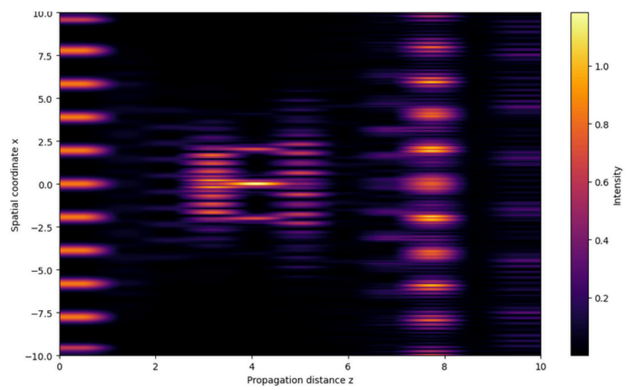


SUCCESS

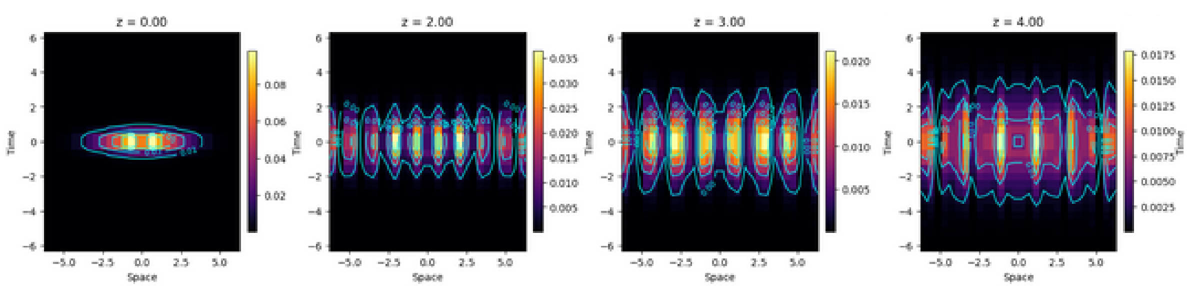
SPREAD REFOCUSED



Propagation of a project's wave packet, identifying spatiotemporal resource distributions and intensities



SPREAD: DIFFRACTION OVER SPACE, DISPERSION OVER TIME. AVOID SPREAD TO DELIVER TIGHTER PROJECTS, FOR FASTER RETURNS.



The following pages describe how our visualizations may be applied across geothermal energy development, carbon management, and geospatial analytics to improve project outcomes. They may also serve in data exploration, and in technical integrations for subsurface and aerial geoscience.

1. GEOTHERMAL ENERGY DEVELOPMENT

PROBLEM CONTEXT: Geothermal projects struggle with **$10-20M losses** on each low-permeability well. This indicates a **spread** of resources (drilling time, capital, expertise) away from the effective center of maximizing productive revenue flow from the heat flow of completed projects. The project **wave packet** (the overall drilling campaign) is dispersing, leading to inefficient resource use for growing the geothermal industry.

VISUALIZE SPREAD & INTENSITY: We can visualize spatiotemporal contours of **resource intensity** around a geothermal project. The **point of greatest intensity** would represent the **optimal locus** for all drilling-related resources: the ideal combination of rig availability, specialized personnel (drillers, geologists), specific drilling fluids, and downhole tools.

Contour maps would show the **temporal spread** of **equipment availability or expert personnel** (e.g., "when is the top directional driller available vs. when the rig is ready"). A tighter contour around the point of greatest intensity signifies great alignment. If rig A is ready but the specialized casing crew is 3 weeks out, the contour widens, showing the "spread" of available resources.

We could also visualize the **spread of confidence in reservoir characteristics**. The point of greatest intensity would be the sweet spot of high confidence in permeability and temperature. If drilling moves away from this confidence center, resource spread (inefficiency/waste) would increase.

CORRECT & PROPAGATE: We can model the **drilling campaign as a propagating wave packet**: the sequence of activities from site prep, drilling, casing, completion, and testing. This wave packet moves through time towards the **revenue realization date**. **Corrections for spread** are computed by identifying and mitigating resource diffraction and dispersion within the project's wave packet.

Dispersion: Unexpected geological formations (e.g., highly fractured zones causing lost circulation, or hard stringers slowing progress) can cause the project's wave packet to disperse, meaning activities take longer, and resources are tied up inefficiently. Correction could involve adapting drilling parameters, mud chemistry, or bit design to re-focus the drilling effort.

Diffraction: Logistical delays (e.g., late delivery of critical components like casing, or personnel unavailability) diffract the project wave packet, spreading out the timeline. Correction would involve dynamic re-scheduling, alternative sourcing, or pre-positioning resources to bring the project back into a tighter "focus" around its original timeline.

OUTCOME: By visualizing the spread of drilling resources around the point of greatest intensity and correcting for the dispersion/diffraction of the project's wave packet, project managers can **significantly reduce** the **$10-20M losses** by ensuring all resources **converge effectively** on the **high-certainty target**.

2. GEOSPATIAL DATA & ANALYTICS

PROBLEM CONTEXT: Large-scale geospatial data acquisition (e.g., LiDAR surveys, environmental mapping) and geological field campaigns often involve significant **spread** of personnel and equipment, leading to **inefficiencies**. The goal is to **maximize data density** (point of greatest intensity) while ensuring efficient **propagation** of the survey across an area.

VISUALIZE SPREAD & INTENSITY: We can visualize spatiotemporal contours of **data collection density** or **mapping completeness** over a survey area. The point of greatest intensity would be the **optimal concentration of sensors/personnel** for maximizing thoroughness and efficiency at any given time.

Contour maps would show the **temporal spread of survey coverage**: if teams are too far apart, the data collection density contours might be wide and sparse, indicating inefficient spread. As teams converge, the contours become tighter and more intense around the current operational hot spot.

CORRECT & PROPAGATE: We can model the **survey or mapping team's movement as a propagating wave packet**. In a case of spotters and sprayers treating noxious weeds on a hillside, the wave packet is the dynamic configuration of spotters and sprayers (or equivalently, sensors/field geologists) moving across the hillside. Their **propagation** is their collective advance, and their **spread** is how far apart they are. **Corrections for spread** are then computed to optimize the team's configuration to ensure thoroughness and efficiency.

Dispersion: If spotters are too far apart, or the sprayer moves too quickly relative to spotting time, the wave packet disperses, leading to missed weeds/data gaps (loss of thoroughness). Correction involves adjusting the spread – bringing spotters closer, or slowing the sprayer's oscillation between spotters to allow more search time for weeds.

Diffraction: Obstacles (dense brush, steep terrain) can diffract the team's movement, causing them to spread out unevenly or slow down. Correction can involve re-routing, adjusting roles, or re-assigning resources to maintain optimal progression and data capture.

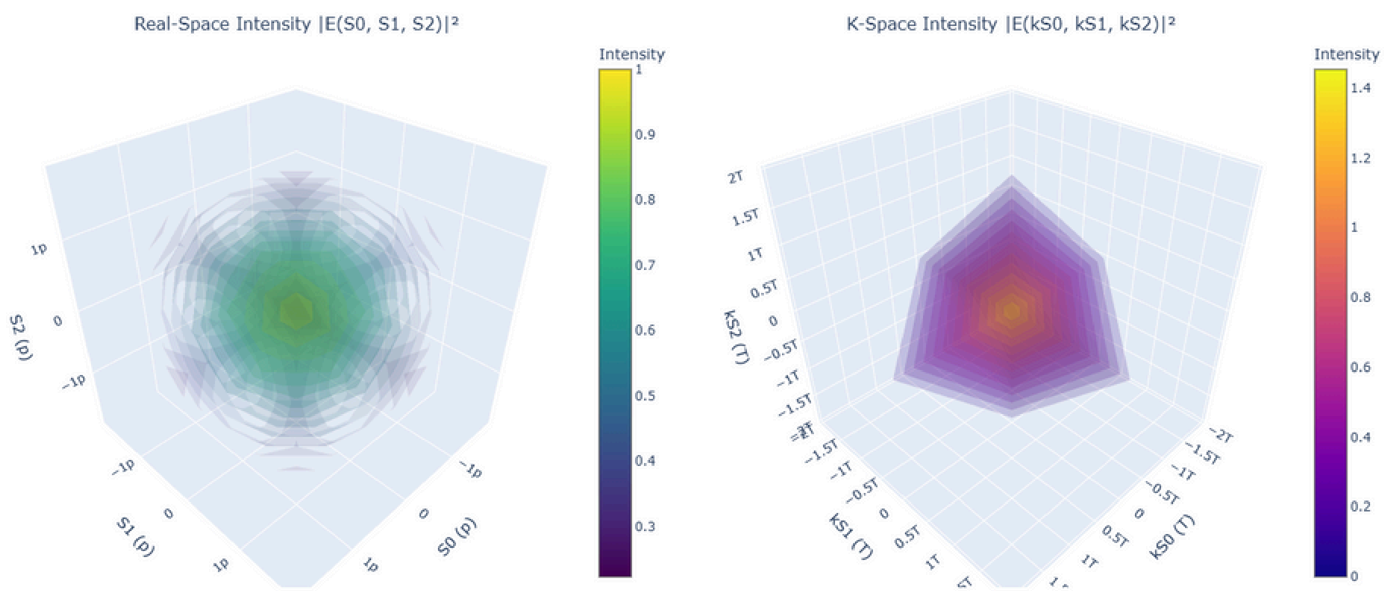
OUTCOME: By visualizing the **spread** of the field team (sensor array) around its point of greatest intensity (optimal density for thoroughness) and correcting for the dispersion/diffraction of its propagating wave packet (movement across the area), great efficiencies can be achieved. This directly translates to more efficient data acquisition, faster mapping, and optimized surveys by ensuring resources are always focused for maximum output.

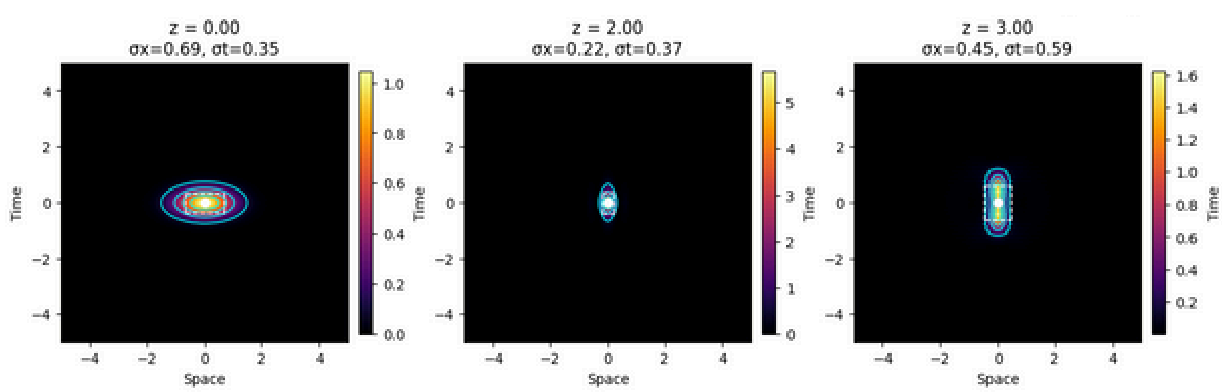
DATA EXPLORATION

1. PROJECT WAVE PACKET MODELING IN MULTI-DIMENSIONAL SPACES

Geothermal/Carbon Management: We can plot the **interplay of multiple project parameters** (e.g., pressure, temperature, fluid flow rates, reservoir integrity, financial investment) as a multi-dimensional wave packet. The reciprocal space could represent the inverse of risk or efficiency, allowing engineers to visualize **project health** and quickly identify parameters trending towards suboptimal conditions.

Geospatial Analytics: We can analyze **complex correlations between diverse geospatial datasets** (e.g., satellite imagery, topographic data, socioeconomic indicators, environmental stressors) in a multi-dimensional space. This could reveal hidden patterns or dependencies for urban planning, disaster response, or agricultural yield optimization, where the wave packet represents the confluence of factors driving a specific outcome.

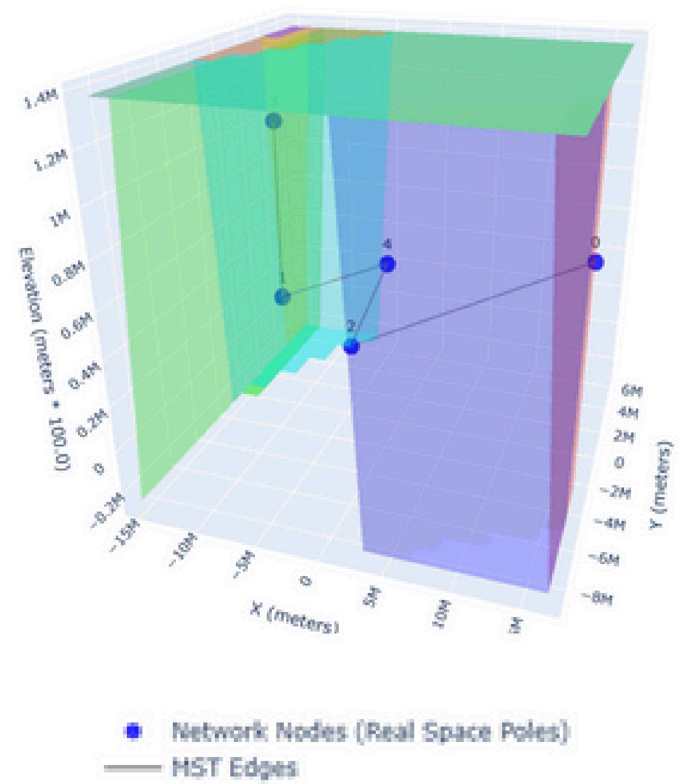




DATA EXPLORATION

2. HYPERPLANE PLOTS FOR IDENTIFYING RESOURCE OVERLAPS

Geothermal/Carbon Management: We can identify **overlapping resource requirements** for different phases of a geothermal drilling project (e.g., specialized equipment needed for both drilling and completion phases). Our hyperplane plots can represent the **resource budget** and **time window** for each activity, quickly highlighting where shared resources create bottlenecks or opportunities for optimization. Potential synergies between both project types (geothermal development and CO2 storage) may be found by visualizing how the **resource overlap** for both projects align.



Geospatial Analytics: Identify **overlaps in operational areas or resource distribution networks** for large-scale geospatial data acquisition campaigns or logistics planning. For example, visualize the intersection of optimal sensor placement with available power sources or communication infrastructure.

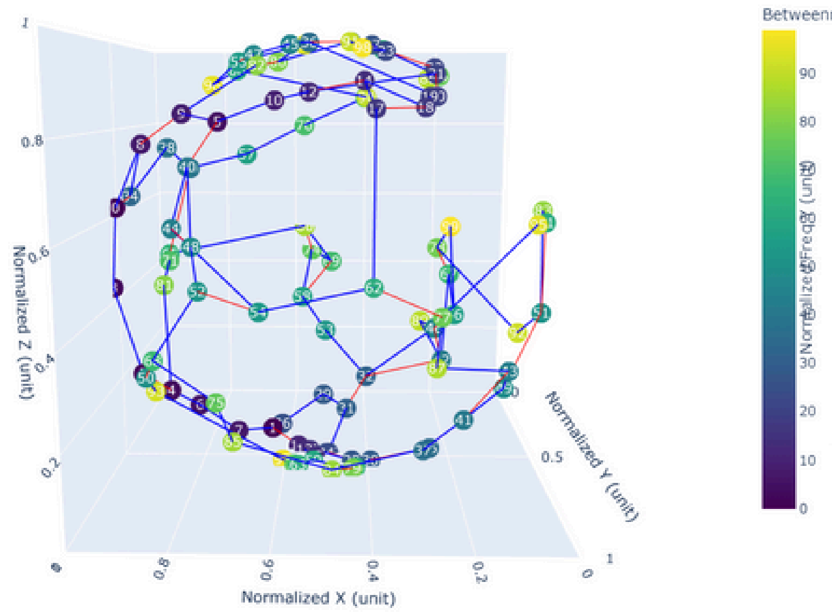
K-Space Polar Hyperplane Coefficients (m)

Node ID	X0 (T0) [m]	X1 (T1) [m]	X2 (T2) [m]	X3 (T3) [m]	X4 (S0) [m]	X5 (S1) [m]	X6 (S2) [m]
0	1.00e+03	1.00e+03	1.00e+03	1.00e+03	1.67e+07	-2.51e+06	7.32e+03
1	1.00e+03	1.00e+03	1.00e+03	1.00e+03	-1.31e+07	1.97e+06	1.56e+03
2	1.00e+03	1.00e+03	1.00e+03	1.00e+03	2.66e+06	-8.84e+06	6.01e+03
3	1.00e+03	1.00e+03	1.00e+03	1.00e+03	-1.52e+07	4.16e+06	9.70e+03
4	1.00e+03	1.00e+03	1.00e+03	1.00e+03	-5.79e+06	6.65e+06	1.82e+03

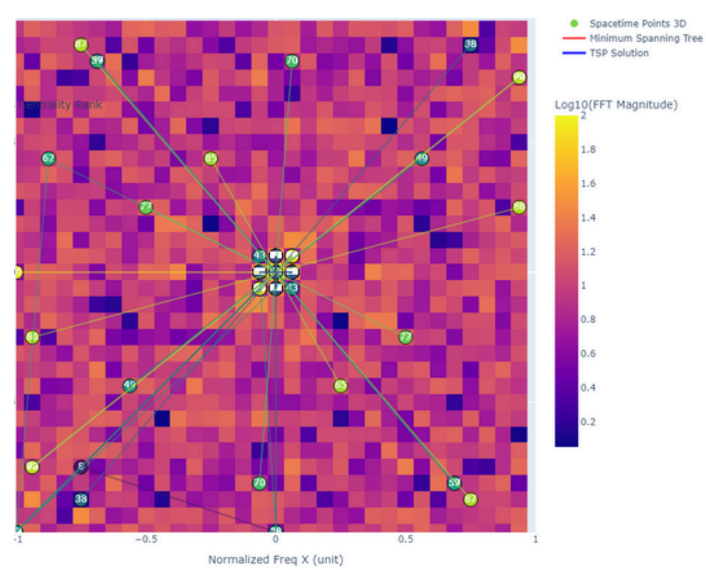
DATA EXPLORATION

3. NETWORK OPTIMIZATION: IMPROVING SUPPLY/VALUE CHAIN EFFICIENCIES

Geothermal/Carbon Management: We can analyze the **efficiency of the entire supply chain and personnel network** for a drilling campaign. Quickly compute the performance difference from a "99.9% perfect" scenario to identify and visualize bottlenecks in equipment delivery, contractor availability, or decision-making processes. This could pinpoint loss sources, leading to targeted improvements in risk mitigation and cost recovery.



Geospatial Analytics: We can evaluate the **efficiency of a complex sensor network or data processing pipeline**. For instance, in assessing how quickly data flows from collection points through processing centers to end-users, highlighting any nodes causing delays or inefficiencies.

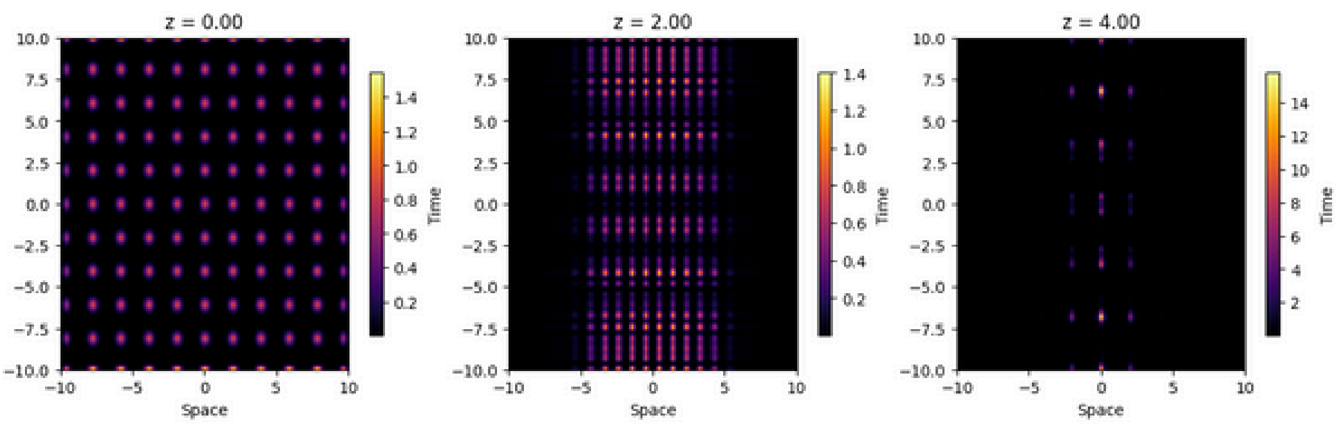


TECHNICAL INTEGRATIONS

POTENTIAL APPLICATIONS IN SUBSURFACE AND AERIAL GEOSCIENCE

VISUALIZE SPREAD & INTENSITY

- **Geothermal/Carbon Management:** Visualize the **spread of uncertainty** in subsurface models (e.g., permeability, temperature, CO2 plume migration) over time. Simultaneously, identify the **optimal drilling location or injection point** as the point of greatest intensity for resource convergence (heat, storage capacity). This allows for dynamic visualization of how new data reduces uncertainty and shifts the ideal target.
- **Geospatial Analytics:** Map the temporal evolution of **resource availability or demand** (e.g., water resources, mineral deposits) across a region. Identify "hot spots" of resource concentration or areas of highest operational intensity for optimal deployment of surveying teams or equipment.



CORRECT & PROPAGATE

- **Geothermal/Carbon Management:** Model the **propagation of drilling or injection operations** as a wave packet through different geological formations. Use correction for spread to account for geological heterogeneities that might cause delays or resource dispersal. For instance, predict how unforeseen fault lines (dispersion) might affect drilling progress and adjust resource allocation (rigs, personnel) to maintain a tight project timeline.
- **Geospatial Analytics:** Simulate the **optimal path and speed for mobile sensing platforms** (e.g., drones for geophysical surveys, autonomous vehicles for environmental monitoring). Correct for environmental factors (wind, terrain) that might **disperse** the data collection effort, ensuring consistent coverage and efficient resource use.

SUMMARY

ACHIEVE GREATER CERTAINTY OF A PROJECT'S WHEN AND FOR HOW LONG.

Project success does not solely depend on **where** or **how much** of a resource exists. It also depends on **when** it can be effectively accessed and for **how long** resources need to be focused toward project completion.

When it is only at completion that a project changes from being a cost to a source of revenue, strategic development means arriving there as soon as possible.

Certainty is valuable. So are the tools that **make time visible.**




What project or resource allocation challenge are you interested in exploring further with our visualization tools? Let us know.

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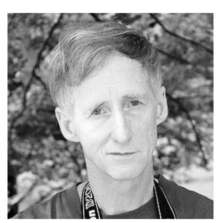

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