Algorithms on the Ground: Deploying Digital Tools in National Infrastructure Without Losing Trust

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Introduction

The belief is increasingly spreading that technologies like GIS, AI, and digital twins will allow overcoming two major challenges in planning the national infrastructure — inefficiency and poor route optimization. The rationale behind is quite appealing. An algorithm will be able to evaluate thousands of constraints in a few minutes and find a path that causes minimum harm to the environment, uses less land, and costs less. However, every person who was at a meeting on approving a construction of a new line knows that the most optimal way from a mathematical point of view is not the most socially acceptable.

In this essay, I argue that technologies can increase the speed and the quality of infrastructure development but only when they are used as a decision support system that should involve ground truthing, clear and interpretable logic, and transparency. Otherwise, such consent process may prove to be inefficient and prone to judicial challenges.

What Digital Tools Are (and Are Not) Ready

The use of multi criteria decision analysis based on Geographic Information System (GIS) technologies has been used in UK infrastructure planning since route selection processes began. Newer technologies include machine learning and digital twins. The Triton digital twin, introduced by National Grid, builds a digital model of the network in Great Britain, allowing engineers to deal with thousands of datasets and design reinforcement plans effectively. As per National Grid, the technology cuts down the amount of time needed to assess network reinforcement proposals by 70% (National Grid, 2023). However, Triton is a planning rather than a consent tool. It aids in identifying sites for reinforcement; however, it cannot replace the need for obtaining a Development Consent Order (DCO).

A generative AI might theoretically be able to generate drafts of environmental reports. However, such systems are probabilistic in nature, not deterministic. A system that identifies an area of wetlands as dry grasslands 85 percent of the time would not be fit for purpose under a DCO regime, which is based on evidence rather than probabilities. It is my position that the immediate value does not come from using AI to replace planners but in screening out complex issues that require further investigation by the planner.

The Verification Problem: Why Ground Truthing Is Non Negotiable

This essay prompt seeks to determine whether outputs produced by digital technologies require ground truthing. This requirement is an unequivocal yes with some caveats. It makes sense to employ a multi tiered strategy. Low sensitivity locations may be verified remotely through aerial photography. Medium sensitivity sites must be validated via a rapid site walkover. High sensitivity locations like ancient woodlands and scheduled monuments must not be surveyed by algorithms alone.

An ideal case study would be the planned transmission line between Norwich and Tilbury. National Grid is employing drones to map the proposed transmission line corridor. The drone flights are producing high definition videos at about 100 metres above the ground level for purposes of environmental assessments. The drones have been programmed to capture only landscape data. They do not record any personal data (National Grid, 2024). Crucially, drone surveys will be used to minimize rather than eliminate the number of ground survey teams. According to James Magson, Senior Project Surveyor, "By using this technology, we can reduce the need for teams to walk the entire route on foot,

which helps to minimise disruption for local communities, landowners and the environment" (National Grid, 2024).

What makes this important? Because data is never complete. For instance, one may have data on a public footpath on their GIS layer, but no information on the seasonality of its muddy state. The consequence of failing to conduct ground truthing does not end in environmental damage. This poses procedural difficulties. According to the Planning Act 2008, a DCO is subject to scrutiny when the evidence collected by the developer was insufficient. It is inefficiency at its peak.

Human Interpretation: The Real Bottleneck

One of the least considered aspects of the entire chain of events is the human element in interpreting digital outcomes. Urban planners and environmental inspectors are no data scientists; they are trained to make decisions based on laws and policies. Showing them an AI generated heatmap can cause adverse effects on their judgment due to automation bias where one tends to favor machine output despite contradicting personal knowledge (Cummings, 2017).

The construction of the A303 Stonehenge tunnel exemplifies how technological interventions can complement human intuition in decision making processes. In this case, it is a project that runs across a UNESCO World Heritage site, which also has one of the highest number of burial mounds in Britain (Highways England, 2018). To aid the assessment process, the project used digitally verifiable montages, virtual reality through the use of 360 degrees visualization, animation through drive through modeling and auralization experience.

In addition, National Highways trialled ProjectWise and iTwin for the A303 scheme. Prior to the implementation of the digital approach, engineering data was stored in isolation along the supply chain. The use of the digital solution led to an increased efficiency of 50% in data federation and 70% in data exchange processes (National Highways, 2021). This gave planners additional time to think critically rather than spending more time looking for documents.

This implies a design principle which states that digital systems must reveal their underlying assumptions and not conceal them. A route optimisation system must permit the user to interrogate why a particular cell received a high score in the first place, and what aspects were predominant in the scoring process.

Building Trust With Communities and Regulators

Local communities are suspicious towards infrastructure planning. Adding algorithmic opacity will only make things worse. However, technology could help win local buy in if used differently.

COVID 19 necessitated the quick adoption of digital participation. The Planning Inspectorate adapted its participatory methods to digital, thus ensuring that communities would still be able to participate in NSIP decision making. According to research conducted by Broderick & Durning (2024), digital methods need to be considered a "toolbox" approach where each option depends on both project features and local needs.

London Resort was able to go even further in adapting digital technology. Copper Consultancy organized entirely virtual consultation on the NSIP during the pandemic period. They established a dedicated consultation website, built an interactive virtual exhibition room, and held 20 live public webinars. The outcome: 27,000 unique visitors to the website, over 1,200 consultation responses received and a total reach of over 120,000 persons – far better than any past in person consultation (Copper Consultancy, 2021). As one might see, the use of digital technology facilitated a large scale engagement. Local residents could get acquainted with the proposals online and send their feedback without going anywhere. The crucial element of success here is the focus on accessibility.

For those who regulate, trust necessitates auditability. The applicant needs to provide a full log of all data inputs, the weights applied to various models used, other paths considered and ground truthing conducted. Absent such a record, the inspector can hardly reach the conclusion that reasonable alternatives have been explored.

My suggestion is that NIPA develops a voluntary Code of Practice on Deployment of Digital Tools for the NSIP process. Such a code should feature a mandatory ratio of ground truthing per sensitivity class, an obligation to provide data provenance, and the right of statutory consultees to get algorithm results.

Balancing Efficiency, Cost, and Resilience

But the issue raises questions. If decarbonization and climate resilience are concerns, does the addition of ground truthing slow things down? Perhaps, although not as much as when consent fails. A judicial review takes many months and many millions of pounds. If a public inquiry arises out of the loss of community confidence, the process takes years.

And there is a climate resilience aspect to this too. The computer modeling techniques used by digital applications can be incredibly adept at predicting future floods or erosion events. However, these applications require good ground truth information. For example, an application that can predict surface water flooding but relies on an old map of local drainage will be extremely dangerous to use. Ground truthing in this case means physically going around the site in the aftermath of rainfall and asking local residents where water gathers.

Conclusion

However, technologies are certainly no shortcut when it comes to the challenging process of infrastructure planning. Instead, they act as a magnifying glass, showing the extent of our data and assumptions' validity.

The survey projects of Norwich to Tilbury via drones reveal how remote sensing technology is able to minimize disruptions in communities while ensuring detailed assessment of the project's impact on the environment (National Grid, 2024). The project to upgrade A303 through Stonehenge proves that VR and auralization are great ways to explain complicated implications of construction projects to stakeholders (Highways England, 2018). Finally, the Triton project reveals the ability of AI to speed up planning processes up to 70% (National Grid, 2023).

Feeding incomplete data to algorithms and not verifying the output will only result in efficient wrong outputs. Using technology openly, with mandatory ground truthing and human in the loop, may lead us to find more efficient paths, consult more efficiently, and consent more effectively.

The NIPA campaign must therefore focus on empowering planners, communities, and regulators through technology, rather than replacing planners with technology. The ultimate goal is not simply greater efficiency. It is also trust. Without trust, any algorithmic optimisation will fall short of providing the national infrastructure Britain requires.

References (Harvard Style)

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