The Wider Context – A More Sustainable Approach to Streetworks

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We need to be aware of the consequences of excavating trenches in the streets – *ideally before rather than after doing it*
We need to be aware also of the social and environmental consequences of excavating trenches in the streets.
Mapping the Underworld Timeline

- **Water / Gas Industry Vision:** Bodyscanner in the Street
- **Location of Underground Plant and Equipment Initiative:** Minimising Streetworks Disruption
  - **UKWIR - AWWARF - KIWA 3-Day Workshop**
  - MTU Project
    - Location
    - Mapping
    - Data integration
    - Asset tags
    - Network
  - MTU Location Project: Multi-Sensor Device Generation, Assessment, Protocols
- **Streetworks become more sustainable**
  - Road occupation minimised
  - Night surveys
  - Trenchless installation / replacement / rehabilitation
  - Congestion reduced

**Timeline**

- **1996**
- **2000**
- **2004**
- **2008**
- **2012**
- **2016**
- **2020**

- **UKWIR Commissions Location Trials**
- **Idea Factory:** ‘Mapping The Underworld’ term coined
- **NETTWORK Workshop:** Underground Mapping Pipeline Location and Condition Assessment
- **Project VISTA advances Mapping and Knowledge Management elements of MTU**
- **Assessing the Underworld:** Creating Multi-Sensor Device for Remote Assessment Monitoring of Asset Condition
- **... and more sustainable forms of utility service provision researched**
Mapping the Underworld Timeline

Assessing the Underworld – Creating a Multi-Sensor device for Remote Assessment Monitoring of Asset Condition
We contend that what is buried in, and on, the ground is to some degree controlled by the ground

... if the ground properties change, or the ground moves, the adjacent / overlying infrastructure responds accordingly

Considering buried utility services – we seek to create a system able to manage, coherently, what we do to the buried infrastructure (add new services, repair / renovate existing services, leave it alone for now). For this

... we need to be informed by the ground conditions and how the ground might react to any new activity or intervention

The same argument holds true for the transport infrastructure
ATU’s Core Proposition

ATU is using MTU’s multi-sensor platform, with amendments and additions, and robotic in-pipe pigs to assess the condition of buried pipelines and cables, and of the ground in which they are buried, and of the surface infrastructure that overlies it.
ATU’s Conceptual Framework

ATU’s vision is to prove the concept of a single, integrated national ‘model’ for the UK’s infrastructure

... and explore how remote sensing technologies data can reveal the infrastructure’s condition

The only sensible base into which to add details of the utility service and transport infrastructures, and their condition, is the 3D geological ‘map’ (or ‘model’) held by the British Geological Survey

The ultimate outcome is any civil engineering intervention in this system can be undertaken intelligently

... being informed by a level of integrated and coherent information heretofore unavailable
Where are UK’s Future Infrastructure Needs?

How will the UK accommodate an additional 10 million citizens?

- London-centric
- Major city empowerment
- Smaller cities focus
... and what are the consequences? – Scenario Narratives

3 ‘what-if’ scenarios of distribution of projected population and employment: a basis for exploring potential future paths for UK cities.

- **Baseline 2037**
  - Manchester, Liverpool, Leeds population growth is double that of baseline projection.
    - **What are the implications for housing provision and local economies?**
  - London’s population grows by 34%.
    - Five cities go into population decline.
      - **How can we manage population decline?**
  - Several towns in northern England have population growth rates exceeding 30%.
  - **Where might cities expand?**

Source: Foresight Future of Cities
Conceptualising the Streetworks Sustainability Assessment Framework (SSAF) framework uses two approaches:
  ... Decision making tool (SPeAR-based methodology)
  ... Social and environmental accounting (whole-life costing)

SPeAR® is being adapted to assess utility streetworks projects
Based on the impacts on the three pillars of sustainability
  ... with an additional focus on indirect economic costs

Four sets of indicators are being developed, with the impacts clustered under four categories:
  ... Direct Economic Impacts
  ... Indirect Economic Impacts
  ... Social Impacts
  ... Environmental Impacts
Each category of impact is considered for both the Construction and Maintenance phases of streetworks projects as *Headline Indicators*, and each has associated sub-indicators. For example:

<table>
<thead>
<tr>
<th>Headline Indicator</th>
<th>Indicator Category</th>
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<tbody>
<tr>
<td></td>
<td>Planning and Design</td>
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<td>Labour and machinery</td>
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<td>Construction materials</td>
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<td>Construction works</td>
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<td>Traffic management</td>
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<td>Construction Direct Economic Impact</td>
<td>Planned maintenance</td>
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<td>Monitoring</td>
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<td>Access</td>
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<td>Emergency repairs</td>
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<td>Decommissioning</td>
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<td>Maintenance Direct Economic Impact</td>
<td>Third Party utility damage</td>
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<td>Compensation to businesses for loss of profit</td>
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<td>Compensation to customers for interruptions to services</td>
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<td></td>
<td>Loss of income to asset owners or utilities</td>
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<td>Compensation to local authorities for damage to their assets</td>
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<td>Goodwill</td>
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<td>Required Training (upskill)</td>
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<td>Insurance</td>
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<td>Loss of business to competitors</td>
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<td>Lost Opportunity Cost</td>
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# Sustainability Assessment of Streetworks

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<td>Construction Social Impact</td>
<td>Disruption to businesses</td>
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<td>Disruption to local community</td>
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The detailed impacts are being established for each sub-indicator
Total Sustainability Cost (TSC) of streetworks is defined as:

\[
TSC = \text{Direct [economic]} + \text{Indirect [economic]} + \text{Social} + \text{Environmental}
\]
New EPSRC-Funded Research

Balancing the Impact of City Infrastructure Engineering on Natural Systems using Robots

Ambition: *Zero disruption from Streetworks in UK Cities by 2050*

Vision: *A city where infrastructure is autonomously maintained and dynamically responsive to secure the health & wellbeing of its citizens, contribute to flourishing and sustainable natural systems, and create positive economic and societal outlook*

... to rid our cities of the socially and environmentally damaging air, noise, light and waste pollution that occurs from infrastructure maintenance associated with streetworks
The topics to be researched are:

- **autonomous systems for minimally invasive infrastructure sensing, diagnosis and repair**
- **advanced robots for deployment in complex live city environments**
- **the socio-technical intricacy of the robot – human – natural systems interfaces**

We will start with three case study systems:

- **“Perch and Repair”** – remote maintenance and modernisation of lighting columns to promote their use as multifunctional platforms for city communication nodes
- **“Perceive and Patch”** – swarms of flying vehicles for autonomous inspection, diagnostics, repair and prevention of highway defects (e.g. potholes)
- **“Fire and forget”** – hybrid robots designed to operate indefinitely within live utility pipes performing inspection, repair, metering and reporting tasks
The move towards more sustainable streetworks requires a comprehensive evidence base of the consequences of the alternative streetworks activities

*this is being captured in the bespoke streetworks assessment framework*

The wider context of the future of the UK’s city systems, and the UK’s system of cities, needs to be considered also

*population growth, demographics, migration, citizen demands and expectations ...*

*... both in terms of service provision, and lack of disruption*

The development of new and smart technologies must be accommodated into this thinking

*... and all must be captured in ATU’s Decision Support*
Propose one change to practice that you would wish to see happen, and when. 

*This could be in terms of design, construction, operation, maintenance or whatever associated with streetworks*

Propose one change to governance of streetworks that you would wish to see happen, and when. 

*This could relate to policy, regulation, legislation, financial arrangements / taxation, or whatever*

Propose one new research programme that you would commission if you were in charge of the Government’s research budget

*Title and aims*

We’d like you to

*Record these on post-it notes, add to flip chart sheets, and discuss in breakout groups*