

Pipebots

Our Vision

www.pipebots.ac.uk

In collaboration with



UNIVERSITY OF
BIRMINGHAM



Supported by



Engineering and
Physical Sciences
Research Council



Our Vision

- is intelligent, robust and resilient buried pipe systems
- these systems are smart and failure free
- so there are no service disruption to society such as unnecessary and unplanned road excavation.

A 'future world' with robots below
our feet ...

but not so very far into the future



The Team

21 academic staff

12 research staff

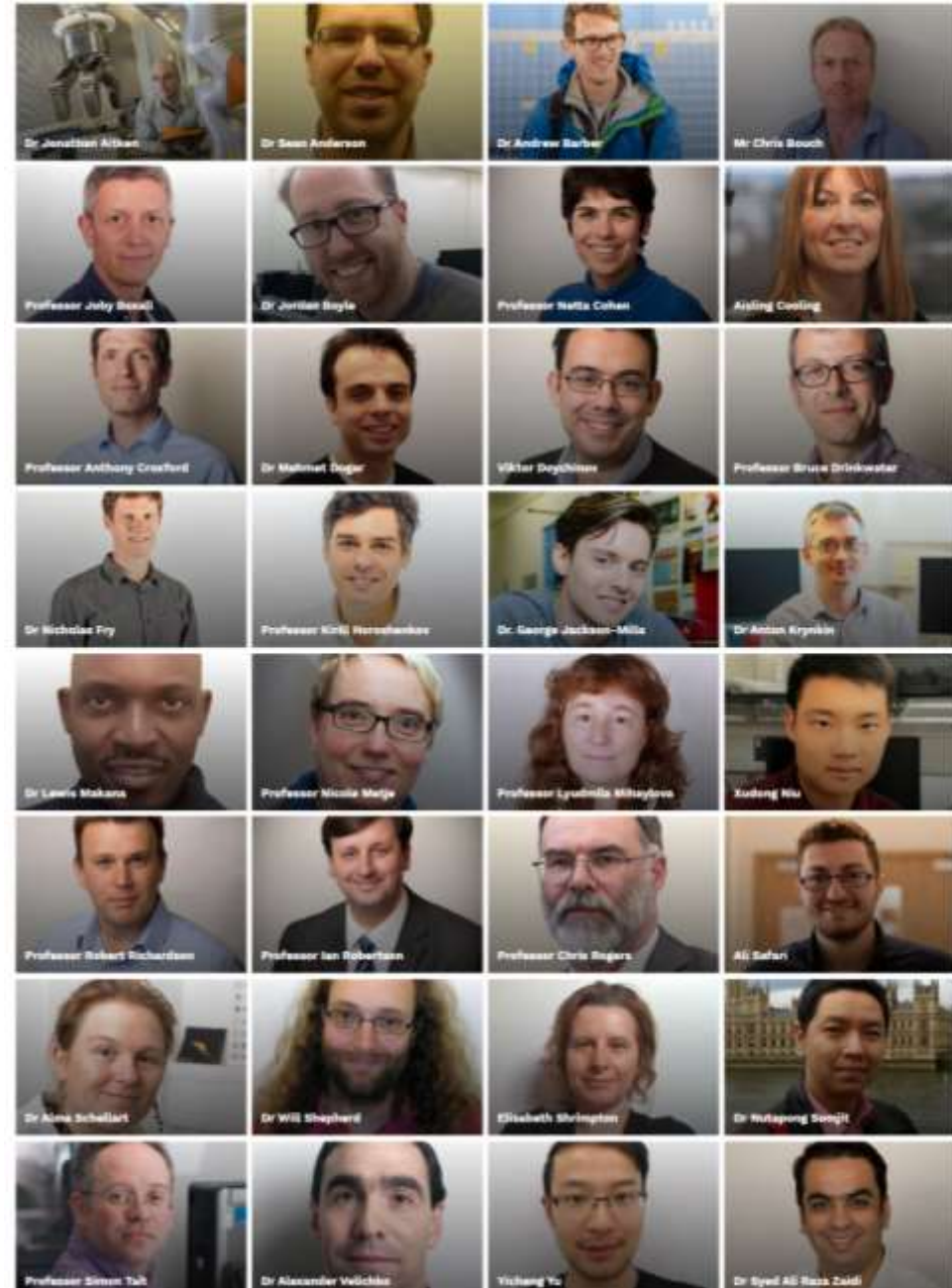
3 experimental officer

5 technical staff

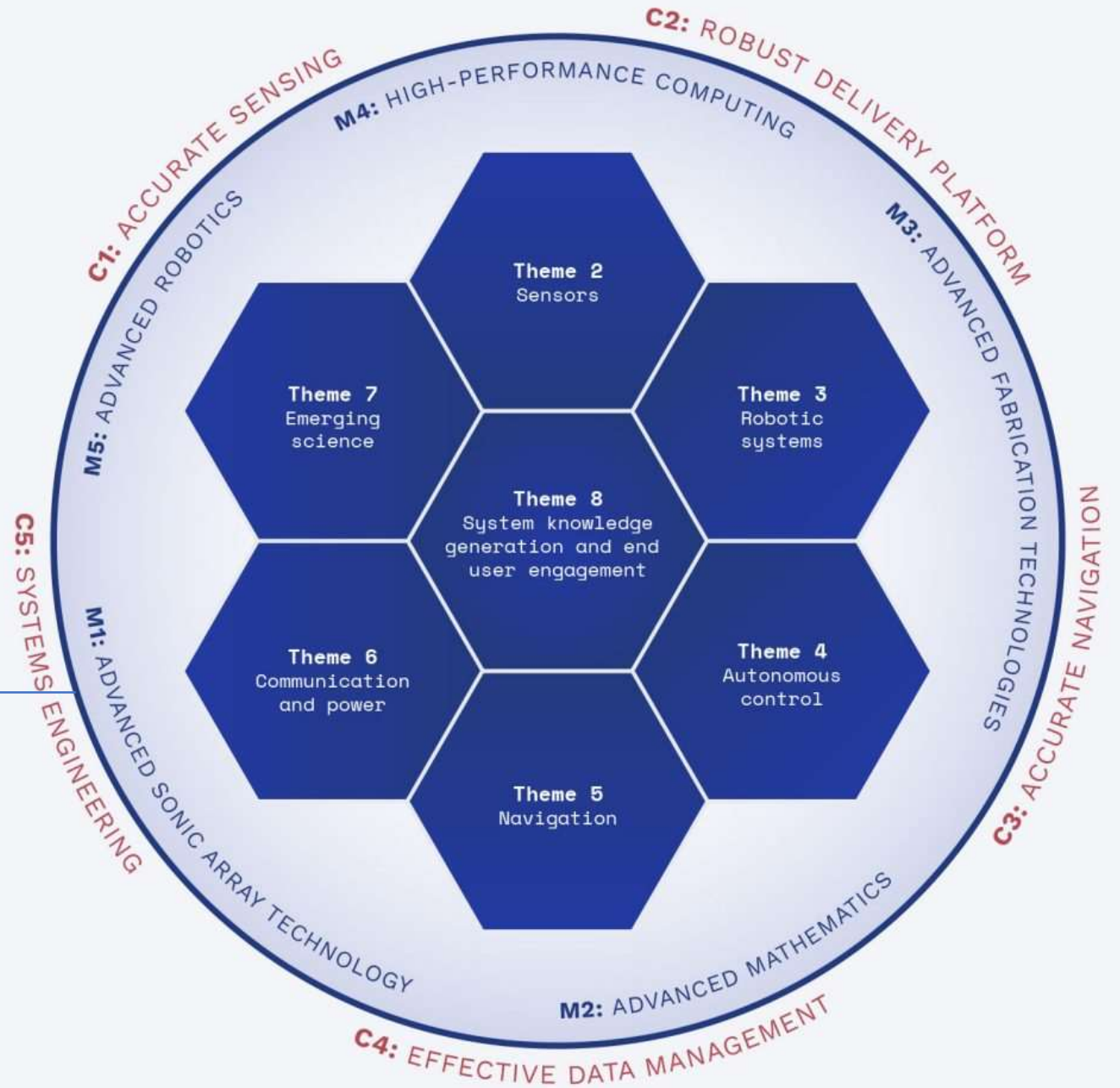
4 Phd students

1 Programme Grant Manager

We will appoint 10-20 PhD students by year 2



Pipebots Grant Structure



Launch Event

- to learn more about Pipebots Grant
- to help shape the future of this research
- to contribute early to its academic and non-academic impacts.

Day Structure

- Programme Grant presentations
- Facilitated discussions on Pipebots' Themes (14:00 – 16:00)
- Industrially-focussed discussions (16:00 – 17:00)
- Networking reception (17:00 – 19:00).

Pipebots

Technical Directions

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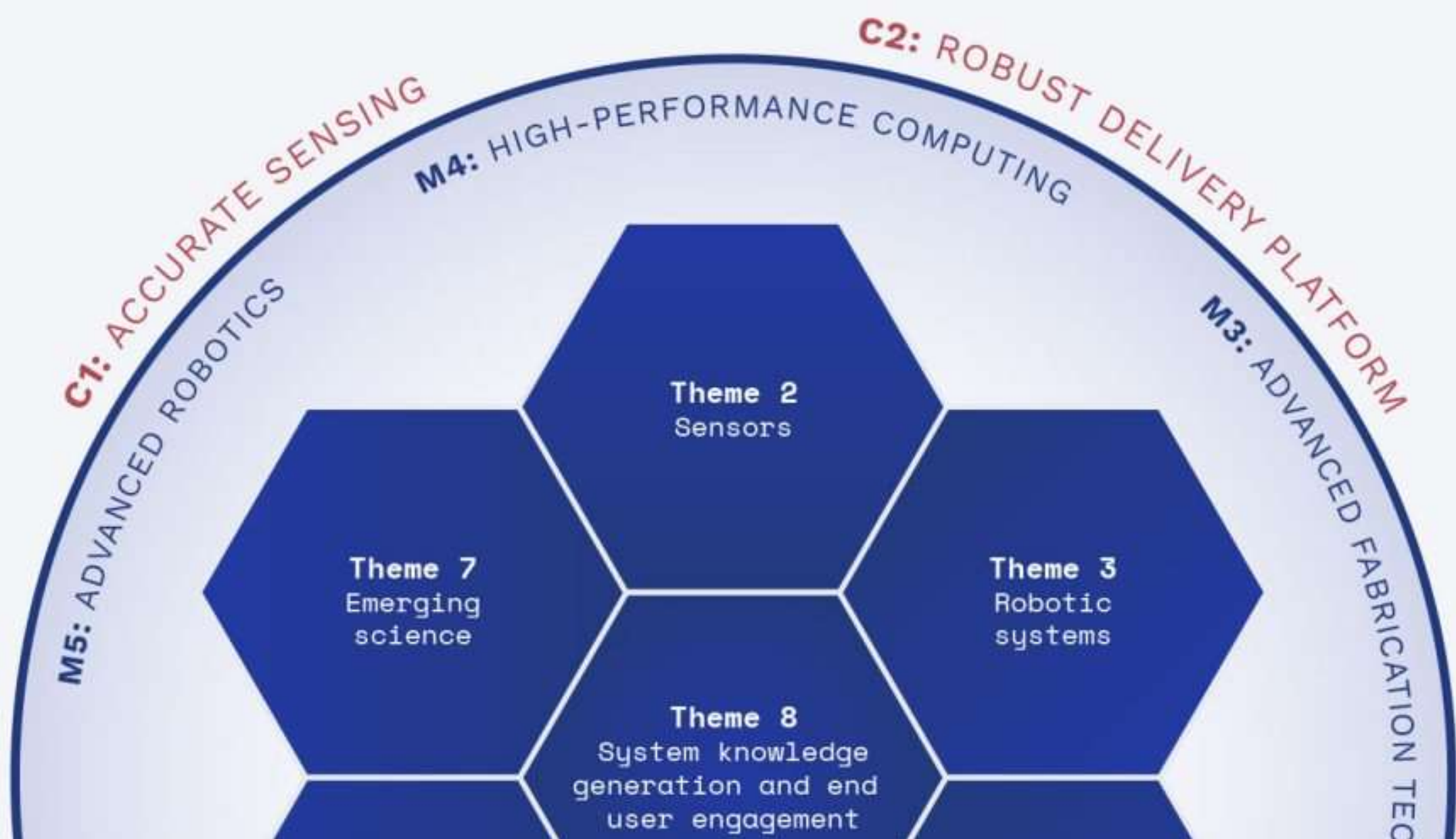
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C5: S



M5: ADVANCED ROBOTICS

C1: ACCURATE SENSING

M4: HIGH-PERFORMANCE COMPUTING

C2: ROBUST DELIVERY PLATFORM

M3: ADVANCED FABRICATION TECHNOLOGY

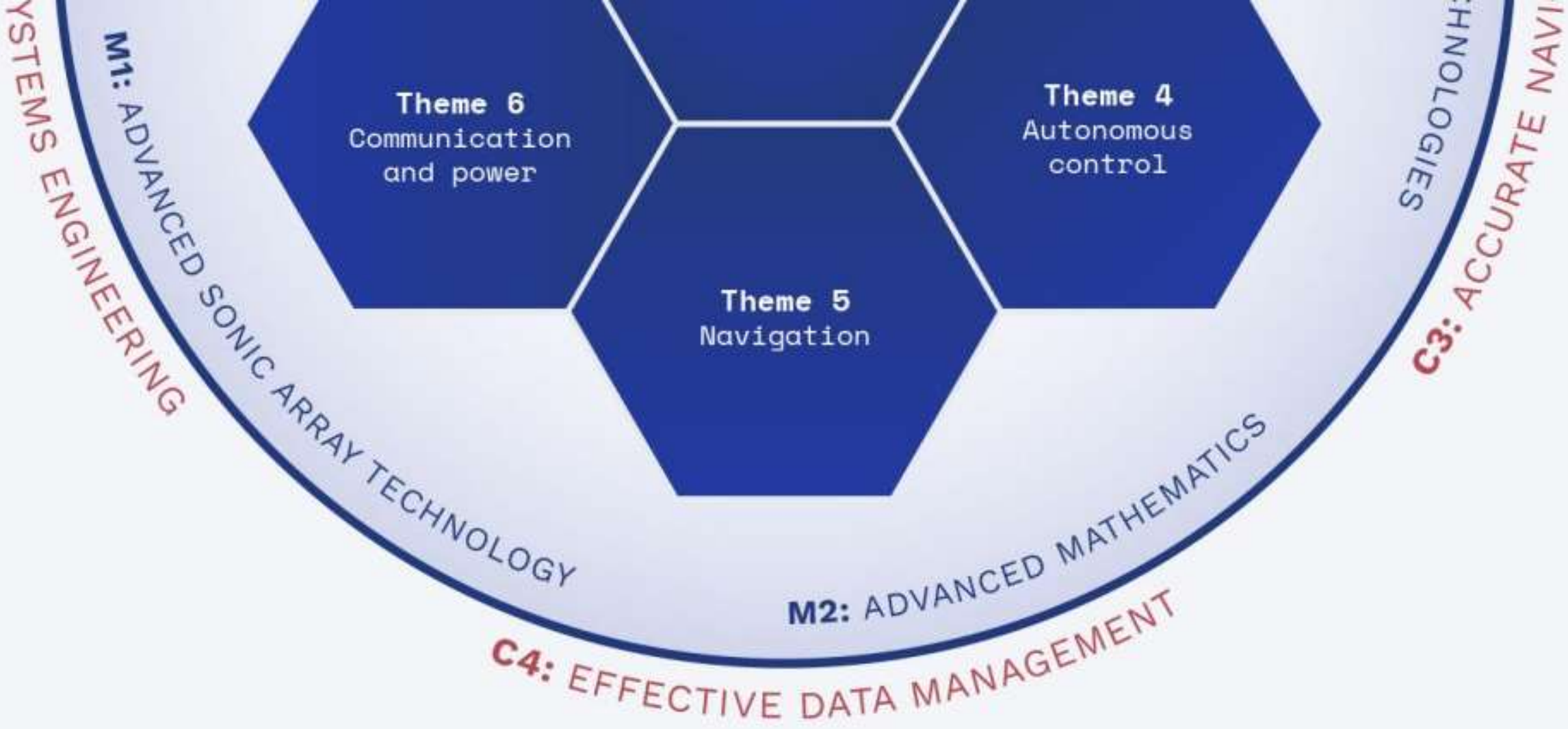
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Theme 7
Emerging science

Theme 2
Sensors

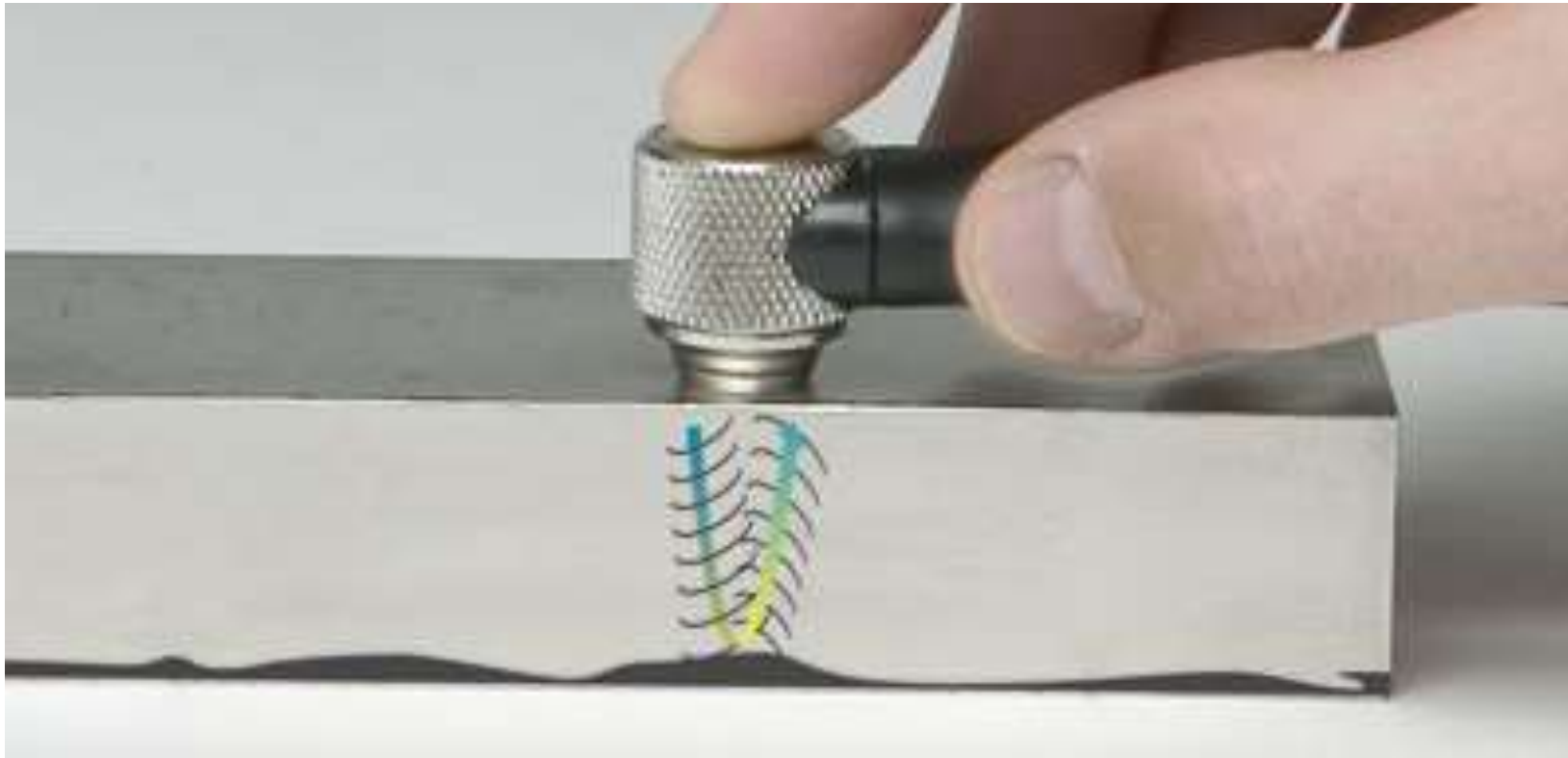
Theme 3
Robotic systems

Theme 8
System knowledge generation and end user engagement



Theme 2: Sensing

- Inspection strategy design and optimisation
- Understanding and coping with measurement uncertainty
- Development of the inspection system hardware



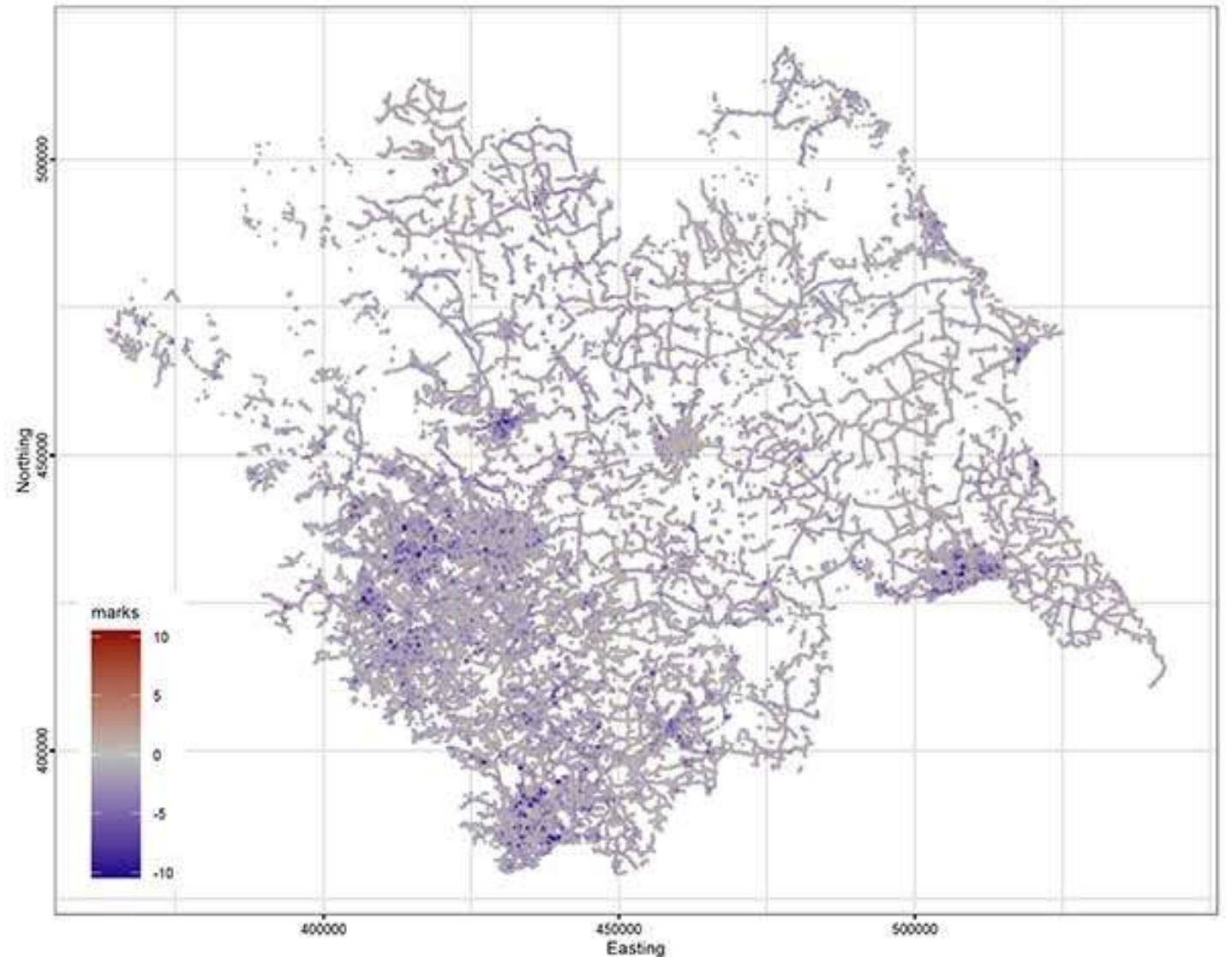
Theme 3: Robotic Platforms

- Locomotion
 - Maintains traction
 - Able to propel in water flow
- Environmental Resistance and Protection
 - Waterproof/ Spark-proof
 - Long term operational concerns
- Miniaturisation
 - Manufacture of small components
 - Required degrees of freedom



Theme 4: Autonomous control

- Low level sensorimotor control
- Integrated individual control for autonomous operation
- Swarm control algorithms for real world pipe networks

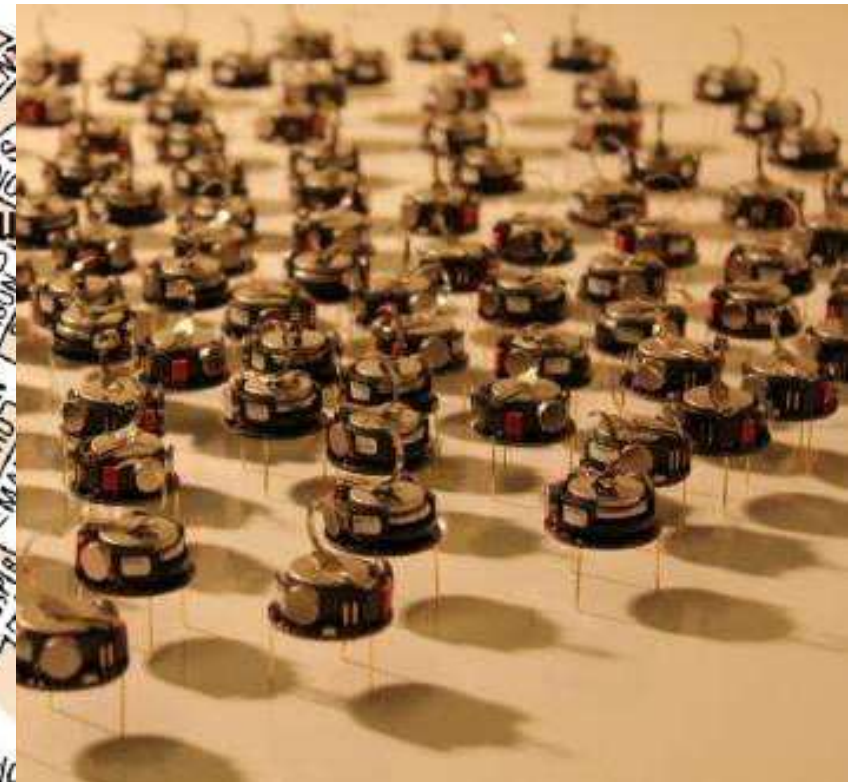


Theme 5: Navigation

1. Pipe network mapping and robot localisation
-Sensor choice and fusion
-SLAM algorithms

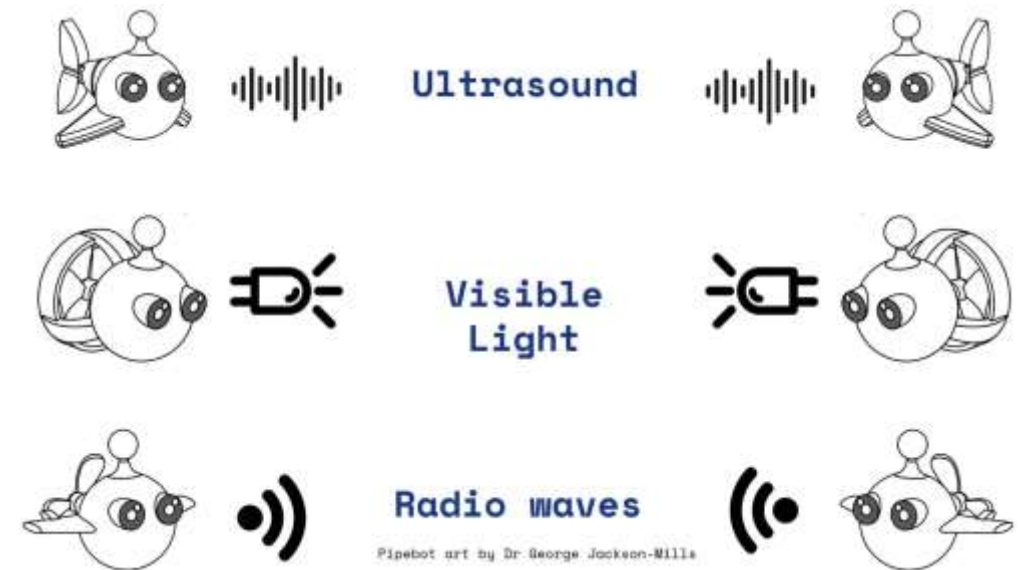
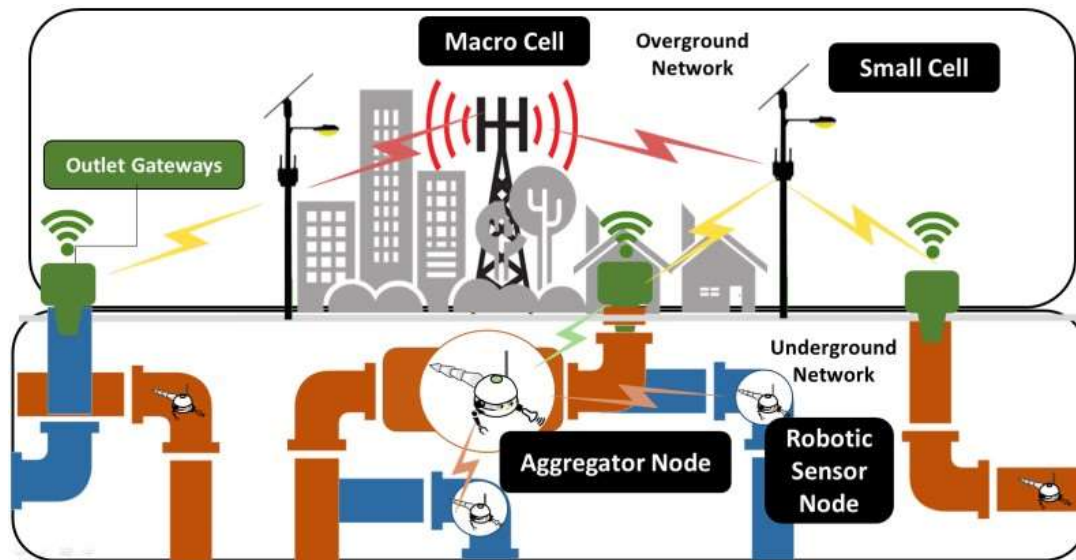
2. Incorporating prior map information
-Prior maps from data
-SLAM with priors

3. Multi-robot cooperative mapping and localisation
-Multirobot SLAM
-Multirobot navigation



Theme 6: Communications

- Power supply and energy harvesting
- Wireless Communication in all possible environments, both pipe-to-pipe and pipe-to-above ground
- Network coverage and connectivity



Theme 7: Emerging Science

- Understand and map the dynamically evolving infrastructure and urban systems
- Explore and trial technologies emerging from other spheres
- Create the political, economic and social environment
- Develop real-time asset management protocols based on 'huge data' advances



Theme 8: System knowledge generation and end user engagement

- Understanding the needs of industry
- Determining what is feasible
- Tighten Challenge Specifications
- Understanding needs for testing
- Transforming Pervasive Data into Actionable Knowledge



THANK YOU
FOR YOUR
PATIENCE

KELLY BROS. SOLAR SIGNS 01454 312675

Hydrex



The background is a dark blue isometric illustration of a cityscape. It features numerous rectangular buildings of varying heights and widths, arranged in a grid-like pattern. The buildings are rendered with white outlines and some internal grid patterns, giving them a three-dimensional appearance. The overall style is clean and modern, typical of digital art or architectural visualization.

Pipebots

Buried piped networks

Roadmap and Impact

Roadmap

- Developed Challenge Specifications: - strong end user input tempered with realism
- Six Challenges:
 - (i) No Disruption, (ii) Cost-benefit (iii) Impact on Environment
 - (iv) Asset Mapping (v) Condition Monitoring (vi) Leakage
- Technical Requirements
- Theme programs of work – Sensing/Robotics/Navigation/Autonomy/Communication/Emerging Science/Asset Data
- Collaborative “roadmap” with deliverables and milestones



Roadmap

- Tension between scientific investigation and technology development
- Challenge of evidence for implementation
- Highlight inter-dependencies – communication/power/on-board data processing/speed/resolution
- Next 12 months need to focus on 3-4 “case studies” drive technological developments
- Range of robotic based solutions



Impact

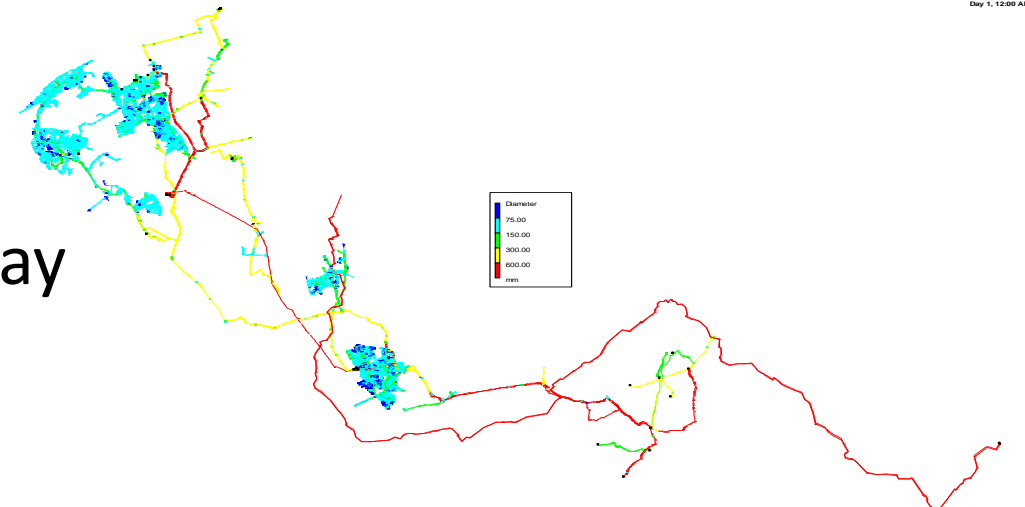
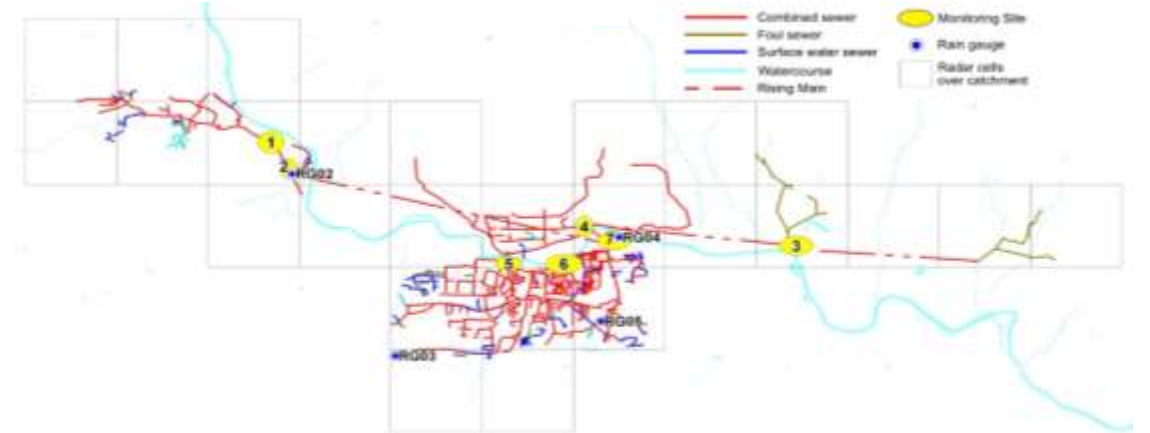
- Around 1M km of water supply and sewer/drainage pipes in UK
- Network failures and impact on public and environment

around 150 mains burst/day

around 800 water supply interruptions/day

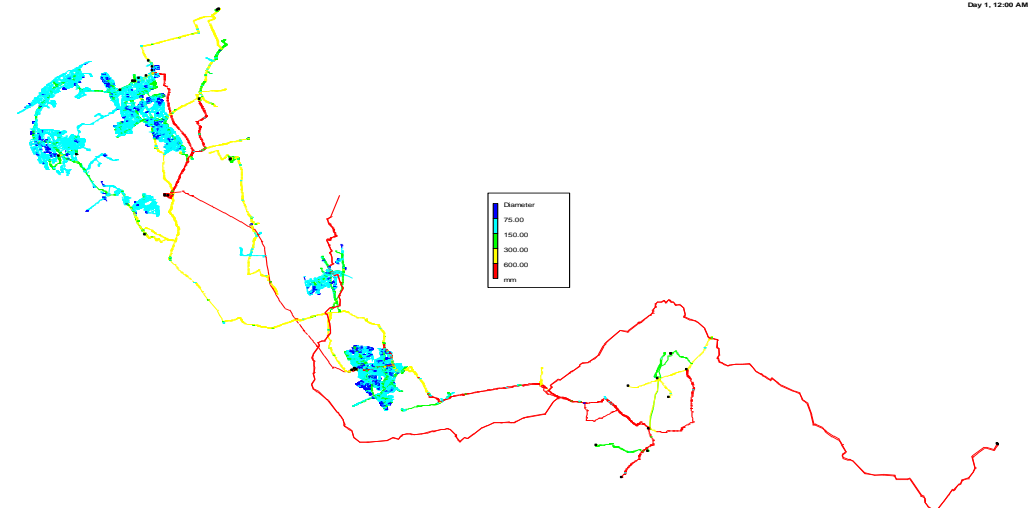
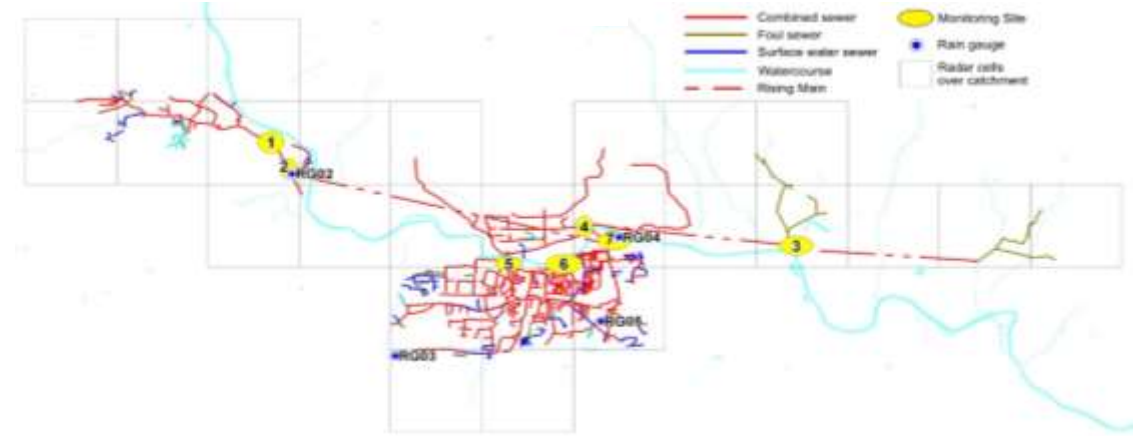
around 8000 sewer collapses

around 6000 properties flooded



Impact

- Water companies face a future of reducing financial resources and increasing pressures on their pipe networks.
- Regulatory system offers opportunities for better asset data
- Pipebots team need to develop an understanding of tension between pervasive data and high resolutions sensing.
- “No failure” approach – UKWIR’s long term future vision



Thank you

Pipebots Engagement Form

<http://pipebots.ac.uk/contact/>