ROKE

INNOVATION THOUGHT LEADERSHIP

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THE SENSORIUM

This paper highlights Roke's pioneering approach to enabling better decision-making by leveraging the power of the Sensorium. The Sensorium serves as the central decision-making environment, where physical and digital agents collaborate seamlessly. Roke's commitment to collaboration, innovation, and pushing technological boundaries positions them as leaders in revolutionising decision-making for military, government, and commercial applications.

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INTRODUCTION

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The world is undergoing transformative changes that demand new approaches to decision-making. Roke, at the forefront of innovation, recognises several key trends. Autonomy is increasingly being embraced, offering opportunities for enhanced operational efficiency. Augmentation, in terms of user experience and intelligence, is becoming more important. The exponential growth of data volumes presents challenges, particularly with the proliferation of misinformation. Intelligent sensors and effectors require different levels of control. Cross-domain operations are necessary for operational effectiveness, ensuring the coordination of activities in both the physical and digital domains.

In response to these challenges, Roke is developing the Sensorium as the future environment for effective decision-making. This dynamic and interactive platform empowers senior decision-makers to collaborate with autonomous agents and make faster, better informed decisions based on near real time information with visualisations that bring the information to life.

Roke's Sensorium offers several essential capabilities. Firstly, decision-makers must have confidence in the accuracy and reliability of the information available to them, and the Sensorium achieves this by providing clear assessment and indication of the quality of the information presented to the user. Additionally, the Sensorium provides options to improve the quality of that information by autonomously deploying or retasking sensors and agents in the operational environment to provide new insights. Rapid evaluation through visualisation and impact analysis allows decision-makers to make swift, informed choices. Furthermore, the Sensorium provides command and control for operational tasking in support of overall mission objectives.

CALL TO ACTION:

Roke acknowledges that the Sensorium is still in its early stages of development and is not yet a commercial product. However, Roke actively seeks partnerships and collaborations to further explore the concept, conduct experiments, and refine its capabilities. By embracing this visionary approach and working with partners, Roke aims to revolutionize situational awareness and decision-making and unlock the immense potential of the Sensorium in a range of different domains.

WHAT IS THE ROKE SENSORIUM?

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The Sensorium is a visionary concept developed by Roke that represents the future of decision-making environments. It is designed to address the evolving challenges posed by increasing autonomy, the need for augmentation, exponential data growth, and the convergence of physical and digital realms.

At its core, the Sensorium is an advanced platform that brings together physical and digital elements, enabling the sensing, modelling, understanding, and influencing of complex systems and environments. It goes beyond traditional command and control frameworks, offering a new approach to decision-making that combines human expertise with the capabilities of autonomous agents.

Within the Sensorium, senior decision-makers have the opportunity to interact and collaborate with autonomous squads comprising heterogeneous robotic systems; we recently published a paper titled "Squads not Swarms" that elaborates this concept further. These squads possess diverse physical and digital capabilities, allowing them to work together towards complex objectives. Decision-makers do not dictate specific actions to the squads but instead provide high-level objectives and deploy them to specific geographic locations or areas of cyberspace. Once deployed, the squads operate autonomously, continuously collecting information and reporting back to the Sensorium.

To ensure correct and effective decisions are taken, the Sensorium prioritises the accuracy and reliability of intelligence, information, and data. Users must have confidence in the quality of the inputs they receive, and the Sensorium provides mechanisms to report and improve the quality of information to better influence operational decision-making.

The Sensorium leverages rapid data ingest, advanced analytics pipelines, automated correlation and conflict detection, and secure development practices to support the decision-making process. It enables the creation of digital twins and simulations, facilitating mission rehearsal, analysis and prediction of outcomes.

In terms of user experience, the Sensorium pioneers innovative methods of visualising data, allowing decision-makers to quickly comprehend complex information and prioritise decisions based on their objectives. The goal is to provide decision-makers with a comprehensive situational awareness interface that contextualises information based on mission goals and helps them understand the potential impacts of their options and choices.

The key differentiators embodied in the Sensorium are the concepts of supervision rather than direct control of sensors, freeing up the human in the loop to make higher-value decisions, and making the information gathering cycle shorter and more effective by enabling the system to identify missing or conflicting information and tasking agents to address it. These aspects make the effectiveness of decision making to advance to new levels not seen in current technologies.
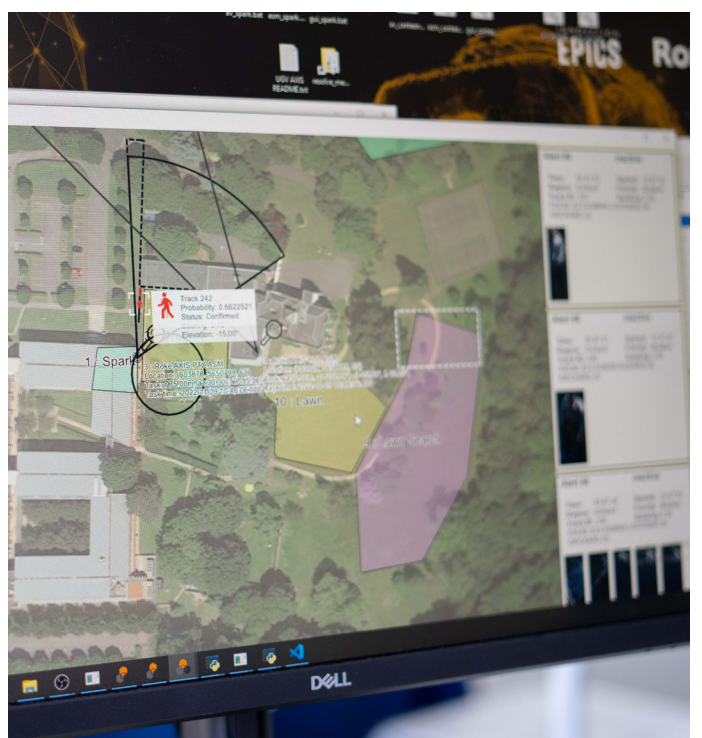
TECHNOLOGY CHALLENGES & APPROACH

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In the pursuit of revolutionising decision-making, Roke acknowledges a series of formidable technology challenges that must be overcome to bring the Sensorium concept to fruition. These challenges encompass critical aspects such as rapid analytics pipeline creation, seamless data ingest, automated correlation and conflict detection, low-code development, security and assurance, as well as data visualisation and prioritisation. Addressing these challenges head-on, Roke is propelling the development of the Sensorium, forging a path towards a future where decision-makers can navigate complex environments with unprecedented clarity and confidence.

The core areas of technological challenge and our approach to addressing them include the following areas:

- Efficient just-in-time creation of new analytics pipelines is crucial to harness the full potential of the Sensorium. Roke is developing streamlined processes to accelerate this capability.

- The Sensorium must be capable of rapidly ingesting data from diverse sources. Roke is focusing on new automated mechanisms to facilitate seamless integration of new data sources.

- Automated correlation and conflict detection mechanisms are essential to ensure data integrity and coherence within the Sensorium. Roke is actively addressing this challenge by creating and testing new algorithms to automate these processes as far as possible.

- Enabling low-code development is crucial to promote agility and facilitate the creation of new capabilities within the Sensorium. Roke is committed to simplifying the development process to empower users with diverse backgrounds without having to learn new programming or scripting languages.

- Creating a secure and assured environment within the Sensorium is of paramount importance to Roke. Robust security measures are being implemented to safeguard critical information and operational security.

- Roke recognises the need for innovative methods of visualising data, presenting the most relevant information, and enabling prioritisation of decisions. Efforts are underway to develop cutting-edge visualisation techniques tailored to the unique demands of the Sensorium.

- Seamless connectivity and robust communication infrastructure are crucial for the Sensorium to operate effectively. Roke places great emphasis on building reliable networking and communication channels that ensure uninterrupted information flow and enable real-time collaboration within the Sensorium environment.

- The Sensorium must be capable of effectively integrating and fusing data from diverse sensor types. Roke recognises the challenge of aggregating and reconciling data from such sources, necessitating standardised protocols and interoperability to enable a cohesive and comprehensive view of the operational environment without conflicting information being presented.

- Digital twins play a pivotal role in the Sensorium concept, enabling advanced analysis, prediction, and optimisation. Roke places great importance on developing streamlined processes for the rapid creation and application of digital twins. This allows decision-makers to gain deep insights into complex systems, supporting informed decision-making and operational efficiency.

Roke's commitment to innovation ensures that these challenges are met head-on, propelling the Sensorium towards a future where decision-makers can navigate complex environments with unparalleled clarity, agility, and transformative insights.

VISION POINTS

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There are so many exciting areas to explore and exploit within the framework offered by the Sensorium, and it would be easy to try to boil oceans yet not have clear focus in the sea around us. So here are some vision points to consider:

a. Roke envisages a future where decision-making centres are radically different, addressing the challenges presented by increasing autonomy, the need for augmentation, and the exponential growth of data volumes. The Sensorium represents a transformative approach to decision-making that empowers senior leaders to interact with autonomous agents and make better decisions faster.

b. Roke recognises the importance of bringing together the physical and digital realms within the Sensorium. By seamlessly integrating physical and digital agents, Roke enables the sensing, modelling, understanding, and influencing of complex systems and environments. This fusion of capabilities opens up new possibilities for gathering information and delivering impactful outcomes.

c. At the core of the Sensorium vision is the assurance of accurate and reliable intelligence, information, and data. Roke aims to provide decision-makers with a trustworthy decision-making environment, ensuring that the insights and inputs they rely on are of the highest quality.

d. The Sensorium empowers decision-makers by offering them a range of options to improve the quality of available intelligence and exert influence over their operational environment. Decision-makers have the ability to evaluate and analyse different courses of action rapidly, enabling them to make informed choices and take decisive action.

e. Roke's vision for the Sensorium emphasises collaboration and experimentation. We seek partnerships and collaborations at multiple levels, inviting others to contribute ideas, run experiments, showcase technological advancements, and participate in mission-based simulations. This open and collaborative approach fosters innovation and drives the development of the Sensorium concept.

f. Roke is committed to revolutionising decision-making interfaces within the Sensorium. We are exploring novel visualisation techniques that provide clear situational awareness, present the most relevant data and enable rapid prioritisation of decisions. By contextualising information and tailoring it to specific goals and objectives, Roke aims to enhance decision-making capabilities and improve operational effectiveness.

g. Roke is actively addressing technology challenges to realise the Sensorium vision. We are focused on rapidly creating new analytics pipelines, seamlessly ingesting diverse data sources, automating correlation and conflict detection, enabling low-code development, and ensuring a secure and assured environment. Through pioneering technological solutions, Roke aims to unlock the full potential of the Sensorium and revolutionise decision-making processes.

h. Roke's vision extends beyond the Sensorium concept itself. We envisage shaping the future of decision-making across military, government, and commercial sectors. By pushing technological boundaries, fostering innovation, and collaborating with partners, Roke aims to create a paradigm shift in decision-making approaches and empower organisations to navigate dynamic environments with confidence and agility.

WHAT IS ROKE CURRENTLY DOING TO DEVELOP THE SENSORIUM CONCEPT?

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In the Sensorium environment, through our internal investment in Innovation Epics at Roke, we are not only continuing to develop the architecture but also we have now created a prioritised Capability Model which incrementally delivers capabilities into the Sensorium. New ideas and future customer requirements are being developed into mission scenarios and integrated with many other capabilities at various Technology Readiness Levels (TRL), from very low TRL concepts to products already in service with end users.

The Sensorium is creating a dynamic operational environment where Unmanned Air Vehicles (UAVs), robots, and a diverse range of highly capable Unmanned Ground Vehicles (UGVs) work together both locally and on remote sites anywhere in the world. This collaborative ecosystem empowers decision-makers by providing an array of capabilities, enabling them to tackle complex missions with precision, flexibility and efficiency. Roke's emphasis on developing advanced control systems and interoperability protocols ensures seamless coordination and integration across these platforms.

The integration of electronic warfare RF sensors and alert systems, along with the creation of a multifaceted operational environment incorporating UAVs, robots, highly capable UGVs, and Roke's low-cost, easily configurable Silverfish platform, further enrich the capabilities and scope of the Sensorium. Roke's commitment to advancing these technologies underscores its dedication to developing a comprehensive and transformative decision-making environment that enables operational superiority in complex and evolving landscapes.

Additionally, Roke is investing in networking and communications infrastructure to enable seamless connectivity and real-time collaboration within the Sensorium environment. Standardised protocols and interoperability are prioritised for the integration of diverse sensor types. The creation of digital twins and simulations is streamlined to support advanced analysis and prediction. Furthermore, the utilisation of large data sets and the implementation of plain language control are facilitated through advanced data analytics techniques and the integration of language models and artificial intelligence.

At Roke, we actively engage in conducting war games and mission-based scenarios to test and validate the capabilities of the Sensorium. These simulated exercises provide a realistic and immersive environment to evaluate the performance of integrated technologies and assess their effectiveness in real-world operational contexts. Through these scenarios, we analyse and refine the decision-making processes, assess the way information is presented, evaluate the interoperability of various systems, and identify areas for improvement. By replicating complex scenarios and challenging our solutions, we continuously enhance the Sensorium's capabilities, ensuring its readiness for diverse operational challenges. Our commitment to rigorous testing and validation drives innovation and enables us to deliver robust and reliable solutions to our clients and partners.

ASSURANCE AND GOVERNANCE

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Assurance is a critical aspect of the Sensorium, encompassing multiple perspectives to ensure the integrity, reliability, and security of its operation. Specifically, there are three key areas where assurance plays a significant role: data, analytics and code.

The Sensorium relies on accurate and trustworthy data for decision-making. Assurance measures are necessary to verify the authenticity, integrity, and non-tampering of data sources. This includes implementing robust data collection processes, secure data transmission protocols, and encryption techniques to protect against unauthorised access or manipulation of data.

The performance and integrity of analytics within the Sensorium are crucial to avoid presentation of misleading information or its misinterpretation. Assurance measures are implemented to validate that analytics algorithms are designed and executed transparently, repeatably and in an explainable way. This involves rigorous testing, verification, and validation of the analytics processes to ensure they deliver accurate, unbiased, and reliable insights.

The dynamic and low-code infrastructure within the Sensorium requires assurance to mitigate the risk of malicious behaviour. This includes verifying that the underlying code and algorithms powering the system are free from vulnerabilities or malicious intent. Robust security practices, such as secure coding standards, regular in-depth code reviews and penetration testing, are employed to detect and address potential vulnerabilities.

Regular auditing and evaluation of the system's performance and behaviour ensure that it operates within the intended boundaries and aligns with the principles of responsible and accountable decision-making.

It is also important to consider privacy assurance, bias mitigation and cybersecurity assurance.

• The Sensorium may handle sensitive and potentially classified information. Protecting privacy and maintaining the confidentiality of data are essential for upholding legal and ethical obligations. Robust privacy policies, data anonymization techniques, access controls, and encryption mechanisms should be implemented to safeguard personal, sensitive and classified information.

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As the Sensorium relies on data and analytics, it is important to address potential biases that may arise from data sources or algorithm outputs. Bias can adversely impact the fairness and objectivity of decision-making. Regular evaluation and auditing of analytics algorithms, diversity in training data, and employing bias detection and mitigation techniques are necessary to minimize the risk of biased outcomes.

The Sensorium operates within a complex digital environment, making it vulnerable to cyber threats. Robust cybersecurity measures, including network security, intrusion detection and prevention systems, continuous monitoring, and incident response plans, are crucial to protect the system from unauthorized access, data breaches, and cyber-attacks.

The Sensorium should adhere to applicable regulations, industry standards, and ethical frameworks. Establishing governance structures, compliance frameworks and audit processes ensures that the system operates within legal and ethical boundaries. It also helps in maintaining transparency, accountability, and trust among stakeholders.

Overall, assurance plays a crucial role in the Sensorium by ensuring the factual accuracy and the reliability of data, the accuracy and transparency of analytics processes, and the secure and trustworthy behaviour of the underlying code infrastructure. By addressing these assurance aspects, Roke strives to instil confidence in decision-makers, protect against malicious intent, and enable the Sensorium to operate as a robust and dependable decision-making environment.

CALL TO ACTION

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In the relentless pursuit of revolutionising decision-making, Roke acknowledges a multitude of formidable technological challenges that must be conquered to bring the visionary Sensorium concept to fruition. These challenges extend beyond data ingest, analytics pipelines, correlation, and low-code development, encompassing crucial networking and communications aspects, as well as security and reliability considerations. By addressing these significant challenges, Roke is steadily advancing the development of the Sensorium and paving the way for a future where decision-makers can navigate complex environments with unparalleled clarity, efficiency, resilience, and unwavering confidence.

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Although we have a vast range of highly skilled engineers at Roke, we recognise that we cannot address all these challenges in a timely fashion alone. Roke extends a call to all interested parties to join the debate, and to technology companies to collaborate in the development and integration of cutting-edge technologies within the Sensorium.

We invite technology companies to work hand in hand with Roke, leveraging their expertise and innovative solutions to enhance the capabilities of the Sensorium. Through collaboration and synergy, we can create an environment which fosters rapid development, testing, and integration of novel technologies.

Participate in our 12-week sprint showcase cycle, where we provide a platform for technology companies to demonstrate their solutions within the Sensorium ecosystem. Showcase your technology's potential and its ability to augment decision-making processes, presenting its value and real-world applications. Bring your ideas and proposals for experiments and hackathons that can push the boundaries of the Sensorium. Collaboratively design scenarios that challenge existing capabilities and explore new avenues for technology integration.

Together, let's explore the full potential of the Sensorium in diverse operational contexts. Show us how your technology can add value to the Sensorium and contribute to its overarching vision.

Whether it's integrating EW RF sensors and alerting systems, UAVs, robots or UGVs, we welcome demonstrations that showcase the versatility and effectiveness of your solutions when integrated with the Sensorium.

Run mission simulations and conduct user experience tests within the Sensorium environment. Demonstrate how your technology enhances decision-making, streamlines workflows, and improves situational awareness. By testing and refining the user experience, we can collectively shape a more intuitive and efficient decision-making ecosystem.

Together, we can shape the future of decision-making, integrate innovative technologies, and unleash the full potential of the Sensorium. Join Roke in this exciting journey of collaboration, experimentation, and technological advancement.

Let's redefine decision-making environments and drive transformative solutions for the challenges of today and tomorrow.

We believe in improving the world through innovation. We do it by bringing the physical and digital together in ways that revolutionise industries.

That's why we've fostered an environment where some of the world's finest minds have the freedom, support and trust to succeed.

Roke is a team of curious and deeply technical engineers dedicated to safely unlocking the economic and societal potential of connected real-world assets. Our 60 year heritage and deep knowledge in sensors, communications, cyber and AI means our people are uniquely placed to combine and apply these technologies in ways that keep people safe whilst unlocking value. For our clients, we're a trusted partner that welcomes any problem confident that our consulting, research, innovation and product development will help them revolutionise and improve their world.

 If you're bringing the physical and digital worlds together, we'd love to talk.