MODELLING AND SIMULATION

Arke Ltd

Thank you for your interest in Arke – how can we help **you**?

We simplify complexity to enable better strategic decisions.

Arke is a small independent SME consultancy based in Wiltshire. We provide our clients with independent and objective Research, Strategic Analysis & Decision Support services. Whether it's with strategic, complex, novel technology options or tough organisational challenges, we help you to make the right decisions.

Our mission is to make a difference – to our clients, our community and each other. We pride ourselves on delivering outstanding analysis expertise for our clients. We instil our values of being collaborative, innovative and agile in all our projects. This underpins our approach of working in partnership with our clients to fully understand all challenges and to determine how we can provide high quality, pragmatic, tailored, sustainable solutions.

1 ABOUT US

We understand the benefit of experience, creativity and new ways of thinking.

Our highly professional team consists of people at all stages of careers from graduates through to recognised industry experts. This ensures we create teams that provide our clients with the right blend of knowledge and experience, innovation and challenging thinking.

2 OUR TEAM

OUR SERVICES 3

We made our reputation providing cost engineering and evidence-based decision support across Defence. As we have grown, we have expanded to support our clients across the public and private sectors with our **Cost, Decision Support, P3M, Business Analysis, Modelling and Simulation, Technology Design, Sustainability, Futures** and **Stakeholder Communications** services.

We work for UK and overseas public and private sector organisations. We have considerable experience of working with all tiers of Government departments and agencies, enabling our clients to get the best from novel and disruptive technology, maximising the value of research and better understanding barriers to change.

We have assessed options for satellite communications capability and technology. We have provided cost and benefits analysis delivering digital business and capability change in open systems architectures, communications systems and technologies. We have provided planning and analysis services for the development of novel technology concepts such as adoption of networked architectures, Edge processing and AI.

Our demonstrable track record of delivering responsive and innovative cloud and digital projects across our service catalogue has ensured we are a trusted supplier that offers high value for money for our clients.

> If you need help to understand your challenges, assess your options and provide you with all the evidence you need to make the right decisions, please get in touch.

4 AN OVERVIEW OF OUR SERVICE

Arke is an experienced creator of models and simulations to address a wide range of client challenges.

We recognise the importance to our clients of understanding the impacts of their decisions prior to committing time, money and other resources. Our modelling and simulation service aligns with best practices and delivers insights efficiently from existing products or through bespoke development, to meet your needs.

Our tailored service provides analysis that will give you robust and actionable insights that are grounded in reality. Our team of experienced model developers will select the most appropriate tools and techniques to help you deepen your understanding of the problem space and address your specific challenges.

We specialise in working within highly regulated industries and where data can be scarce. This is a modelling challenge that we address through a range of techniques that focus on understanding the level of confidence in insights gained, rather than generating results that are heavily caveated. We have provided this support across government and particularly to Defence and the Home Office.

Our service offerings include:

- **Data Analysis & Modelling:** Big Data, Model Development, AI and Machine Learning
- **Simulation & Optimisation:** Simulation (Monte Carlo, Discrete Event), Operational Analysis, Optimisation
- **Systems Thinking & Modelling:** Causal Mapping, System Dynamics, Systems Modelling, Stock & Flow Modelling
- **Digital Transformation Technologies:** Digital Thread, Digital Twin, Digital Transformation
- **Decision Support & Analysis:** Multi-Criteria Decision Analysis, Wargaming, Verification & Validation
- **Logistics & Supply Chain Management:** Logistics & Supply Chain Modelling, Network Graphing

We work with you to understand your goals and design and deliver a uniquely tailored solution that provides you with the outputs and benefits you need to achieve them.

Recent examples include:

System Dynamics Simulation of Logistics Operating Options:
We built a system dynamics simulation of a logistics supply chain that provided insights for our client into the best way to deploy constrained resources alleviating bottlenecks. The features of system dynamics as a technique made it possible to conduct thorough sensitivity analysis and run several different options giving confidence that the selected solution had the resilience to withstand real-world operations.

Alternative Operating Model Assessment Tool:
We built a tool to support the assessment of alternative operating models. This bespoke, innovative tool allowed our clients to build options from the bottom up – allocating assets, infrastructure and people as required and comparing the costs of those options against their current operating baseline. Overlaying this tool onto a series of cost estimates also enabled our client to understand the financial implications of the options under consideration. This provided the information and confidence needed for our client to choose the right options.

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OUR SERVICE IN DETAIL

AI & Machine Learning

Arke's Artificial Intelligence services provide a sociotechnical perspective on the implementation of emerging technology within a wide range of systems and capabilities. We are at the cutting edge of research for AI via our involvement in multiple research programmes. We do not implement AI solutions and therefore are well-placed to deliver our core analysis and assessment services in an impartial and independent way. We assist clients with understanding and defining:

- How AI can be used within your organisation for maximum benefit
- Concepts and designs that use AI to deliver particular capabilities
- AI verification, test, experimentation and prototyping
- Integration into existing and future workflows
- Sociotechnical perspectives on AI
- Issues such as AI ethics, trust, verification, transparency, explainability and that must be considered when implementing AI
- Integration into existing processes and developing new AI-specific workflows and tools
- Exploitation planning

Our existing frameworks for decision-making about AI capability include:

- Data definition and properties within an AI-based system and data lifecycles
- Holistic information management
- Trustworthiness and user perspectives

Our services enable you to identify where and how AI technology is of benefit to your enterprise or project, so that the value of your investment is maximised.

We often find that key enablers and blockers to this value are not in the technology itself, but in the processes and systems that are needed to support it, so our approach complements technical design services by making sure that your AI projects deliver the benefits that you expect.

Big Data

Our Big Data service entails the systematic collection, processing and analysis of large datasets to extract valuable insights. It involves employing robust methodologies to identify data requirements, format data and process it efficiently.

We generate comprehensive reports, predictive models and actionable recommendations. Our output includes visualisations, statistical summaries and predictive analytics tailored to your needs. The benefit of this output lies in its ability to uncover hidden patterns, trends and correlations within the data, enabling informed decision-making, targeted marketing strategies and optimized operations.

By properly using Big Data, you can gain deeper insights into client behaviour, market dynamics and operational efficiency, leading to enhanced performance and profitability.

Causal Mapping

Causal Mapping involves interacting with stakeholders and existing research to generate a representation of a complex system or problem space. It considers not just technical components of the system but the interaction between wider components such as human factors, policy and, financial aspects, etc. The resulting Causal Map gives a graphic representation of the system and can be used for further analysis or as a means of efficient communication between stakeholders.

Our Causal Mapping process provides you with a deeper and more realistic understanding of the systems of which you are trying to implement or make changes. This enables you to make informed decisions, maximise positive outcomes, reduce the chance of unintended negative outcomes and effectively communicate your decisions to wider stakeholders.

Digital Thread

Implementing a Digital Thread requires understanding technical, organisational, enterprise level and human requirements to deliver the desired outcomes. Our holistic, system-based approach means that we can weave together services that you need to take full advantage of digital thread approaches. We can provide services to assist you in:

- Understanding and defining your data requirements
- Linking data and information to operations
- Developing digital thread concepts
- Understanding organisational priorities
- Making best use of data and information
- Road-mapping your organisational journey
- Using benefits-driven approaches
- Achieving a focus on outcomes
- Exploitation planning

We are experts in understanding and working with complex systems and systems-of-systems. Working with us to deliver a digital transformation means that you will be able to quickly navigate complexity and identify, define and realise the required transformation that is core to obtaining value-for-money in meeting your unique requirements.

Digital Twin

Arke support the development of digital twins by creating high level, quick-to-run prototypes, ensuring any digital twin development is tailored to reflect the most important aspects of the system and consider the benefits of different approaches.

We do this using techniques such as System Dynamics or Discrete Event Simulation modelling to:

- Identify bottlenecks / points of opportunity and risk
- Test where particular data has a large impact on results and hence identifying where a lack of data provides a challenge and where it doesn't
- Identify the knock on impact of an option within node(s) of a system
- Assess system level changes, e.g. changes to policy.

Using this rapid approach enables you to refine requirements and understand the high level impact, support validation of data and generate inputs to more complex modelling approaches.

Multi Criteria Decision Analysis

Multi-Criteria Decision Analysis involves identifying the criteria that define a good outcome and assessing a number of possible decisions against them. This provides a ranking of possible decisions based on the extent to which they will provide a positive outcome.

By understanding and comparing all available decisions in this way, you will not only be able to make decisions that deliver the best outcome, but also have a basis to justify and communicate your decisions to stakeholders. The process of defining criteria will also give you a clearer understanding of what you are trying to achieve and "what good looks like".

By using MCDA you are ensuring that your decisions are based on an objective comparison of alternatives, which will remove bias from decision making and ensure the outcome is the best way to meet your objectives.

Digital Transformation

Digital Transformation requires understanding technical, organisational, enterprise level and human requirements to deliver the desired outcomes. Our holistic, system-based approach means that we can weave together services that support every aspect of your digital transformation.

We can provide services to assist you in:

- Defining requirements
- Developing digital transformation concepts
- Understanding organisational priorities
- Making best use of technology
- Road-mapping your organisational journey
- Using benefits-driven approaches
- Achieving a focus on outcomes
- Exploitation planning

We are experts in understanding and working with complex systems and systems-of-systems. Working with us to deliver a digital transformation means that you will be able to quickly navigate complexity and realise the transformation rooted in obtaining value-for-money given your unique requirements.

Network Graphing

Network graphing is a method used to visualise relationships between different entities, such as people, objects, or concepts. It involves creating a map of nodes (entities) and edges (relationships between entities). Examples of our service include mapping out the relationships between different departments in a company or visualising the flow of information within a project team.

Our network graphing service generates a visual map of relationships, which we use to identify patterns, clusters, or anomalies within the network. Our service helps you understand complex systems or networks more easily, identify potential issues or bottlenecks and make informed decisions based on this understanding.

Model Development

Developing models requires a clear understanding of the requirements and stakeholder needs. We employ robust methodologies to create and maintain essential documentation of requirements capture, specification design, testing, verifying and validating that delivers assurance that the resultant model is fit for purpose.

Whether using 'harder' mathematical techniques or 'softer' methods, and if it is relatively simple or highly complex, a model enables you to increase understanding of real-world behaviours without the need for expensive experimentation. Our model development service provides decision makers with the ability to explore, test and analyse impacts and possible outcomes of decisions before enacting them with assurance that outputs can be believed.

The benefits of building a bespoke model are that you can truly tailor requirements to your needs. Granularity and scope will be conscious and only added where it is required – we maintain simplicity and read across of existing models where that is sufficient to understand the problem at hand.

Operational Analysis and Operational Research

Operational Analysis / Research (OA/OR) encompasses the use of intellectually rigorous and structured approaches to inform strategic, operational, tactical and policy decisions, to determine the best practical course of action and assess the effectiveness of different options.

To achieve this, we select the tools and techniques most appropriate for your problem, whether its people, technology, or resource centric. Our OA/OR service provides the methods needed to articulate and model realistic options and analyse the outputs of the modelling to truly support decision makers with a tailored analysis.

The benefits of OA/OR are the ability to design analysis with a situational focus that aligns to the questions that you need to answer. We explore risks, uncertainties and gain understanding the implications of trade-offs. This is all delivered with a rigorous approach and an audit trail of data, assumption and analysis methods and decisions.

Optimisation

Optimisation is the ability to identify the best or most effective solution to a problem from the set of available solutions with respect to key criteria. Using a tailored approach from mathematical modelling, simulation and softer techniques, we identify the optimal solution to achieve your overarching objectives.

Deciding what to optimise for is just as important as the optimisation itself. We combine optimisation with systems thinking allowing us to find the optimal solution for the system that does not subsequently create new issues elsewhere. This provides you with a greater understanding of the implicit trade-offs involved when assessing optimisation options.

Our optimisation techniques enable you to explore and test solutions, make decisions with confidence and realise the best possible outcome, making the most of the resources available to you.

Logistics & Supply Chain Modelling

Logistics and supply chain modelling involves analysing the flow of goods, information and resources throughout the supply chain network. We identify key nodes, such as suppliers, manufacturers, retailers and warehouses, as well as the flows of materials and information between them. By mapping out these relationships, our logistics and supply chain modelling service provides a holistic view of the supply chain dynamics.

By using our logistics and supply chain modelling service, you will be able to evaluate different strategies and scenarios to enhance efficiency, reduce costs and improve service levels. Simulating the flow of goods and information will highlight potential bottlenecks, optimal inventory levels and where processes can be streamlined across your supply chain network. You will also gain insight to the impact of external influences, such as shifts in demand or disruptions in supply and be able to develop proactive strategies to mitigate these risks.

We use our service to facilitate collaboration and coordination among supply chain partners by providing a common framework for decision-making. We visualise the supply chain dynamics and quantify the impact of different decisions, enabling you and your stakeholders to align your objectives and work together towards common goals. Our logistics and supply chain modelling enables you to make informed decisions, improve operational performance and enhance the overall resilience and competitiveness of your supply chain.

Systems Modelling

Systems modelling involves creating simplified representations of complex systems, such as business processes, enterprise structure or communication systems. It involves gathering data, analysing it and then creating a model that captures the interactions and relationships within the system. Our analysis team collaborates with your stakeholders to ensure the model accurately reflects the system in question.

The outputs of systems modelling include visual representations or simulations that illustrate how different components of the system interact and influence each other. They provide insights into how changes in one part of the system might impact other parts, helping you make informed decisions and identifying areas for improvement or optimisation.

Systems modelling provides you with a roadmap for greater understanding of complex systems better that enables you to make more informed strategic decisions. It offers you a clearer picture of how different factors within your system interact and provides insights into potential outcomes of different scenarios. The benefits include improved efficiency, decision-making and the ability to anticipate and mitigate risks within your organisation's operations.

System Dynamics

System dynamics is a method used to understand and predict how complex systems change over time. It involves creating models that represent the relationships between different parts of a system and any associated feedback loops and delays. By simulating these models, system dynamics helps identify how changes in one part of the system can affect other parts, allowing for better decision-making and policy analysis.

System Dynamics generates insights into the behaviour of systems by simulating various scenarios and observing their outcomes.

These simulations can reveal potential bottlenecks in the system, opportunities for improvement, or unintended consequences of proposed actions.

The output of system dynamics modelling includes visual representations of the system's behaviour over time, along with reports summarising key findings and recommendations for action. The benefit of this output is that it provides you with a deeper understanding of complex systems and helps you make more informed decisions to achieve your goals effectively.

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OUR SERVICE

Stock & Flow Modelling

Stock and flow modelling involves analysing the accumulation and change of quantities within a system over time. By identifying the stocks (accumulated quantities) and flows (rates of change), this method enables a comprehensive understanding of how different variables interact and evolve within the system. Through simulation and analysis, stock and flow modelling provides insights into the behaviour of complex systems, helping you to anticipate outcomes and design effective strategies.

Our stock and flow modelling, evaluates various scenarios and their potential impacts on the system, enabling identification of optimal decisions that lead to desired outcomes. Using stock and flow modelling ensures that decisions are grounded in objective analysis, removing bias and subjectivity from the decision-making process. Stakeholders can justify their decisions based on the quantitative assessment of alternative scenarios and their projected outcomes. Stock and flow modelling provides a robust framework for decision-making, enabling you to navigate complex systems effectively and achieve your objectives with clarity and confidence.

Simulation

A simulation imitates the operation of real world processes or systems over defined time periods. Generating a simulation involves gathering information, data and assumptions about how the process or system behaves or is expected to behave and creating a mathematical representation of that behaviour.

Our simulation service enables you to to play out scenarios, validate behaviours against the real world and alter assumptions by asking the simulation, 'what happens if...'. Pushing the virtual system to its limits allows us to analyse system behaviours and increase understanding of what could go wrong, when and to test what mitigations are most effective.

Our simulation methods are designed and tailored to meet your needs. Our designs are based on the level of detail required to sufficiently understand and explore the task and its outputs. We work with you to understand your communication requirements and thus ensure all simulations can be explained and demonstrated to your stakeholders in a way that is tailored to their levels of knowledge and experience.

The benefits of this are we add clarity to your problem space, providing a 'safe' test space for ideas without requiring expensive experimentation.

Verification & Validation

Verification & Validation (V&V) are key to ensuring that your model and the data feeding it meet the required standards and that it is fit for purpose. We provide independent V&V services, adhering to appropriate standards to give you peace of mind and assurance that your model does what it says on the tin.

Our independent V&V service not only assures models, but highlights areas for improvement or missing content, bolstering the robustness of a model's final output. Our service ensures that a model functions correctly, that the outputs are logical and are what were expected, that all required documentation exists and are accurate and complete. This provides you with an audit trail of evidence you need to trust and therefore use models and their outputs.

Our service provides enhanced efficiency, effectiveness and sustainability within the system by producing detailed analyses, visual representations of system structures and actionable recommendations.

Wargaming

Wargaming and Table Top Exercises provide an opportunity to test ideas, strategies or changes and their implications. These techniques are particularly powerful where there are many moving parts and different aspects to a system including those of a competitor, adversary or organisations with conflicting objectives.

Our teams design, facilitate and support analysis of wargame events. Wargaming provides the opportunity to put people at the heart of analysis: immersing players in a scenario that allows them to try out ideas and learn from the decisions they make.

A wargame enables players and analysts to test, assess and learn about new ideas/strategies/changes. When you consider new technologies, our wargaming service allows unforeseen problems and opportunities to be identified early when they otherwise may have been missed.

Systems Thinking

Systems thinking involves understanding and analysing complex systems. It requires looking beyond individual parts by considering how they interact and influence each other as a whole. We identify patterns, feedback loops and relationships within the system to give you insights into its functioning and potential areas for improvement. It involves techniques such as mapping out system structures, identifying key stakeholders and analysing data to develop a comprehensive understanding.

Our systems thinking service generates holistic insights into the underlying dynamics of a system, allowing you a deeper understanding of issues and opportunities. We use it to uncover the underlying causes of problems rather than just addressing symptoms, enabling more effective solutions. Our service provides enhanced efficiency, effectiveness and sustainability within the system by producing detailed analyses, visual representations of system structures and actionable recommendations.

To find out more about how we can help you please contact:

Jess Green, Director: jgreen@arkeltd.co.uk
And visit our website: www.arkeltd.co.uk

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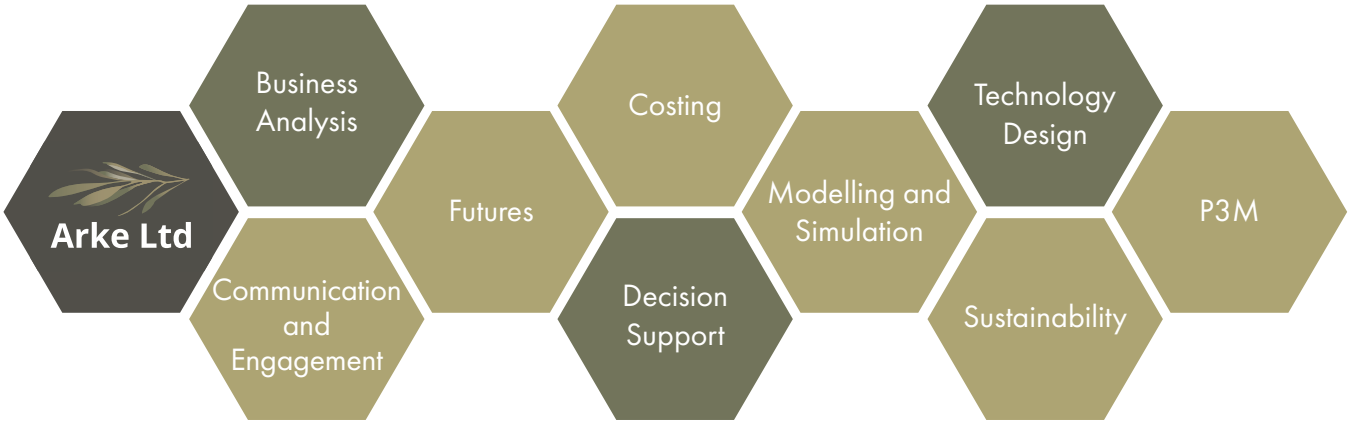
Company Accreditations
We are ISO9001 and ISO14001 compliant. We hold Cyber Essentials + and hold a Silver Award in the Armed Forces Covenant Employer Recognition Scheme.

Social Value
We are committed to the creation of social value through all aspects of our operations. As members of the Arke family, all staff are invited to engage and be part in the creation of social value as an integral part of their working life. We aim to create positive value for our clients and our community in all we do.



Arke offers a range of services to help you make the right decisions
Details of all our services can be found by simply using the G-Cloud search facility.