SIF Project Registration

Date of Submission

Apr 2022

Project Reference Number

10027059

Project Registration

Project Title

Digital Twin - Exploring the societal, operational, and cross industry whole system benefits on the Gas Distribution Network

Project Reference Number

10027059

Project Licensee(s)

SGN

Project Start

March 2022

Project Duration

2 Months

Nominated Project Contact(s)

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Project Budget

£119,127.00

Project Summary

SGN will, with support from its partners NGGT, IBM and AWS and project supporters (Centre for Digital Built Britain and local authorities), will research and identify ways to deal with these challenges so we can act more rapidly and frequently to handle the events; ultimately improving situation awareness, business outcomes and delivery value for the industry, our customers, and society. We will assess what it will take to create a digital twin of the SGN distribution network and business processes that delivers better value to our customers. In the alpha phase this implemented digital twin will connect critical entities, through their life-cycle phases, across the SGN Gas Distribution Network, business processes.
In assessing the creating of a digital team project scope includes:

- Identification and prioritisation of candidate users, user stories and their pain points.
- For user stories assess the data flows/digital threads within and between itself and potentially other organisations to determine what data exists, would need creating.
- Determine how to improve transparency and visibility of SGN infrastructure asset data to stakeholders.
- Determine how to integrate the Digital Twin with other national Digital Twins, in a secure and open way.
- Assess SGNs multitude of IT and OT applications systems that support the business today to determine how they would be integrated into a digital twin.

SGN has limited experience of digital twins and so we've proposed to collaborate with NGGT, IBM and AWS for this project. NGGT will bring knowledge and learnings to SGN to best align data and digital systems -- they will also be collaborating on the Gas Network Interoperable Digital Twin SIF to share knowledge and bridge gaps around digital systems to enable a collaborative approach around future Digital Twins.

Nominated Contact Email Address(es)

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Problem Being Solved

The energy industry is changing at pace, both business and customers are facing unprecedented challenges. Customers are incentivised to move from fossil fuels to carbon free alternatives, consequently the gas industry needs to rapidly prepare for decarbonising the network and managing a business with fewer customers but a large, fixed cost component.
The gas distributors must optimise their operations in order to safely drive down costs and accommodate carbon neutral fuels, all within ever tightening regulatory constraints. This requires changes that are not incremental. There are big choices to be made. The problem for Gas distributors will be having to model complex multi-vector scenarios to determine optimal solutions. This will not be cost effective nor timely enough using traditional approaches.
Other industries facing similar challenges have used Digital Twins to tackle this complexity. A Digital Twin is a dynamic, virtual representation of an asset and / or process. It uses real-world data combined with engineering, simulation, or machine learning models to enhance operations and support human decision making. Digital Twins rely on access to vast amounts of data that are ideally provided by a data fabric that encompasses the complete Digital Thread (asset lifecycle data).
For Gas Networks a Digital Twin will guide decisions by its employees, customers, the public, suppliers, other energy suppliers and legislators.

Examples of the type of problems a Digital Twin can address:

- Improve gas transmission and distribution network and management by utilising simulation and prediction models in near real time reducing the reliance on human intervention. (e.g., to manage increased variability of renewable gas injection sources, safety, pressure, quality). Simulate and predict maintenance across gas network assets to improve the "first-time fix rate" and reduce engineer visits and the spares inventory that's carried by the field service teams to improve operational efficiency.
- Simulate and predict gas leakage/shrinkage across the network to identify multiple mitigation options to determine the most cost-effective shrinkage reduction strategy
- Modelling calorific value at meter points given diverse network sources (natural, biogas and hydrogen).
- Improve holistic view, visibility, and efficiency of public working sites for key stakeholders and network customer. (e.g., safe site, equipment, traffic volumes, public footfall, safety permits).

The innovation opportunity for SGN and its partners is to test and demonstrate the use of a Digital Twin to enhance decision making across a range of challenges driven by energy transition to a sustainable future.

Project Approaches And Desired Outcomes

The Big Idea

We envision the Digital Twin to become the cornerstone of all key decisions ranging from strategic choices between scenarios to optimised operations. This will transform the network to a variable, renewables-based system and bring the benefits of new technologies and energy advances to our customers.
It will enable an open data foundation and framework that can be exploited across the UK energy ecosystem by key participants.
SGN have a multitude of IT and OT systems that support the business today and will be exploited to create a Digital Twin that synthesises data from these systems to exploit opportunities and address pain points across the SGN business.
Creating a Digital Twin by combining data sets from across the energy industry can also bring a deeper understanding of customer behaviour. This allows us to start answering the more prominent considerations for digitalisation of the energy system, such as needing to deliver security, value and sustainability for customers.
Digital Twins have already been successfully deployed in industries ranging from logistics (Port of Rotterdam) to auto sport (Formula One). The underlying technology is gaining maturity, we intend to use horizontal innovation to exploit these advances in the gas distribution business at a manageable level of risk.
IBM has a vast range of products and offerings that provide data, AI, integration, automation, security, and other services critical to developing digital twins.
We have gained significant know-how on how to develop digital twins much of which has been embodied in our Digital Twin service offering. Any prior art that the participants bring to the project will remain the IP of said participants, while new IP created by the project will be available to the industry.
In addition to the IBM capabilities, any Digital Twin built on AWS technology, will come with benefits such as: 1) unmatched security features, 2) limitless scalability for IoT data velocity and volume, storage, machine learning processing, compute needs, increased user loading, etc, 3) eliminating data silos between internal organizations while making data available to external stakeholders, 4) interoperability with partner digital twin solution through API-based architectures.
The Discovery project will identify high value customer use cases to take through to the Alpha phase.

Innovation Justification

This is a First Of A Kind(FOAK) project for the UK gas industry, which by nature will require testing of new ideas, concepts etc. The aim is to create a solution that is interoperable with other digital twins across the UK, that can share data openly and freely, and the outputs and design can be shared with other networks to allow creation of digital twins across the energy sector.
There are potential unique and valuable operational capabilities enabled in E&U by extracting value from a Digital Twin at the intersection of OT and IT systems and identifying new use cases for the UK gas market

- Drive human-centric insights with advanced visualisation, powered by diverse data sources, real-time sensors, historical data.
- Simulate and optimise complex systems; enhanced bottleneck identification; Improve process design testing; enhance risk monitoring and emergency simulation.
- Implement sophisticated, intelligent automated workflows across IT and OT systems to enable and optimise business processes and operational areas.
- Capability to emulate or simulate the behaviour of systems throughout the entities life cycle phases, either by the use of advanced modelling (AI, ML) and visualisation technologies (Augmented Reality, Virtual Reality, Remote Operations) of prediction/simulation technologies (e.g., what if analysis, pattern recognition etc.).

Project Plans And Milestones

Project Plan And Milestones

Week 1 and 2 -- Business Requirements gathering and research

Business Requirements gathering and research across SGN, its partners and key project supporters, to confirm scope and value for stakeholders. This will also include co-education sessions to share knowledge and thought leadership. Key project supporters are Local Authorities, Customer Groups, Digital Britain. IGT and within SGN.

Work products and Deliverables:

User, Business Context and requirements, candidate use cases, hypothesises that need investigating, agreed project scope.

Week 3-5 - Multiple Enterprise design thinking, data science and solutioning workshops

IBM will facilitate multiple workshops for the project team, that will use enterprise design thinking, elements from data science and its project delivery methodologies to orient and align the project members around specific customers. They will seek to understand the customers, the customer scenarios and stories and their pain points. The team will step back and also identify overall vision and solutions outlines, architectures, designs and technology requirements.

Work product and/or Deliverables:

A Clear problem definition, impacted customers, pain points and potential solution
options derived from

- Customer personas, empathy maps, as-is scenarios, pain points, north star vision and solution goals. Overall north star vision that address specific scenarios and pain points.
- Client ways of working and challenges, KPIs and benchmark
- Preliminary Design options to show art of the possible.
- Systems and Data assessment
- Use Case identification and prioritisation
- Technology requirements
- Data requirements and reference models

Week 5-6 - Develop Use Cases and Define Value

Develop Use Cases and Define Value, using information previously gathered a Value proposition document is created including what are the Use cases that will be addressed, based on workshops, value proposition and technological and data possibilities to ensure solution feasibility.

Work product and/or deliverable:

Draft Use Cases and Value Proposition Document.

Week 6-8 - Validate Value Proposition and Roadmap Definition

Playback of high-level value proposition and delivery roadmap for prioritise use cases that identifies opportunities for improvements in operational efficiency and cost reduction. Confirm SGN aspirations for digital twin and risks, issues
assumptions.

Work product and/or deliverable:

Agreed Value Proposition, Roadmap of Use Cases.

Week 8 -- Document for Alpha Phase

all findings and final conclusions are documented into a Project Initiation Plan that can help launching the Alpha phase, including a high level architecture, project plan, etc....

Work product and/or deliverable:

Project Initiation Plan

Route To Market

Once we have identified candidate digital twins, we move into a Continuous Innovation and delivery approach. For digital twins this is a strategy phase which is particularly important given the potential scale of a twin. The focus is to get clarity on what the twin will look like for SGN for the benefits of the customer and the wider energy stakeholders.

- The blueprint will be shared across energy industry stakeholders for reuse.
- We will consider a whole systems and open data approach.
- SGN and NGGT will aim for interoperability and governance.
- Build trust across the industry.

As our idea becomes business as usual, we will also look to:

- Work cross-industry to ensure interoperability and leveraging initiatives from other industries.
- Enable open data access to the data for relevant stakeholders, partners and collaborations.
- Redeploy assets; some assets and components created for the digital twin could easily be redeployed in similar industries, reenforcing the interoperability mentioned on the first point.

Getting the network to support more distributed injection points, more biomethane plants. Potential to introduce different grades of gas and blends of future hydrogen blends.
SGN partners NGGT, IBM and AWS have accelerators to help with this process. The maturity assessment from IBM Research will help to understand where the data systems are in terms of relationship to each other, ability to connect, and use of IoT sensors. This will help identify the technical foundation for the twin. We also want to establish the design direction, laying the foundation for the visualisation.
Digital Twins grow over many months to years, so establishing a digital twin roadmap will help navigate and scale for long-term success. Cloud technology, such as from AWS, has enabled software-based solutions to become almost ubiquitous within our everyday business activities, and we believe will enable the same outcome for this digital twin solution.

Costs

Total Project Costs

300322

SIF Funding

119127

This project has been approved by a senior member of staff

☑ Yes