



Situational Intelligence and RIIO:

***Supporting Great Britain's Distribution
Companies for a Low-Carbon Future***

Space-Time Insight White Paper

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Introduction

The RIIO (Revenue = Incentives + Innovation + Outputs) price control framework requires electricity and gas distribution companies to develop and submit well-justified business plans setting out what they will deliver over the 8-year price control period.

Two overarching objectives of RIIO are motivating and guiding network companies to deliver value for money in network services, and integrating low carbon and renewable energy sources for a sustainable energy future. Companies will meet these objectives by delivering specific outputs in six areas.

With the incentives and innovation components of RIIO, companies can realize additional revenues and enjoy financial bonuses for meeting or exceeding output goals, and for working with greater efficiency. They can also face penalties for falling short of goals or being less efficient.

Network companies now face the challenge of meeting - and exceeding – targets on the identified outputs. But the challenge is significant. Network operators face a time of perhaps unprecedented change: the transition to a low carbon, sustainable energy sector at a better value for money effects on all aspects of business.

This paper outlines some of the ways that Situational Intelligence can help network companies deliver on, and outperform, their output targets, whilst adopting the most efficient approach to doing so.

RIIO Outputs

- Customer Satisfaction
- Reliability and Availability
- Safe Network Services
- Environmental Impact
- Connection Terms
- Social Obligations

Source: *Handbook for implementing the RIIO model*,
Office of Gas and Electricity
Markets

Situational Intelligence Defined

Situational Intelligence brings together six different domains of information.



- Real-time Operations information: Real-time data from meters, sensors, and other monitoring devices, correlated with enterprise and external data to aid in the understanding of asset performance and behaviour.
- Physical Location information: where an asset is physically located at any given time, whether stationary or mobile.
- External information: the context and physical environment surrounding an asset. This can include relatively static features such as bodies of water, trees, hills, and buildings, as well as dynamic or temporal environmental factors such as temperature, precipitation, storms, and flood as well as feeds of such as news or market prices.
- Analytical models: Predictions and anomalies about asset performance and behaviour based on software analysis of huge quantities of data.
- Mobile data: Location and status of mobile workforces, traffic information, and even monitoring of social media activity.

- Business systems information: assets, personnel, financials, schematics, floor or site plans, and other business-related information.

Situational intelligence implies and includes the ability to take immediate action based on the understandings gained from the holistic analysis of these six domains of information. That action can be automated based on customer-defined rules, or presented to system operators as choices to make.

The different types of information that comprise situational intelligence often exist in different formats and reside in different systems.



Situational Intelligence can acquire and combine in real time the extremely large data sets from the six domains of information used in situational intelligence related to utility assets.

For energy delivery organizations, these information sources can include SCADA, GIS, MDM, DMS, OMS, EMS, CIS, financial management, asset management, weather and price data, and social media.

Space-Time Insight delivers Situational Intelligence through several different applications which run in-memory on the customer's SI Server platform. The applications access disparate forms of data across a wide range of systems, and then correlate that data across the nodes of a network in space and time. Space-Time Insight provides a wide range of powerful analytics that are continuously calculated to facilitate situational understanding. That analysis is then accessible to various system users based on their needs and permissions, and presented in a number of intuitive visual formats.

Objective: Delivering Value for Money

One overarching objective of RIIO is ensuring utilities deliver value for money received from customers.

The RIIO framework provides companies with incentives for delivering consistent and increasing value for their customers' money.

Examples of how Situational Intelligence helps companies deliver better value for money include:

- Using predictive analytics with the risk scores of utility assets to plan preventive maintenance, thus heading off outages.
- Better justification, planning, and allocation of operational versus capital expenditures based on the known and predicted condition and risk of assets.
- Combining user-defined alerts, real-time analytics, and visualization to help operators pinpoint network problems and optimise solutions.

Hydro One in Ontario, Canada uses Space-Time Insight software to deliver value for money. Hydro One manages more than 4 million utility assets through Space-Time Insight software. They now have the analytics and visualization to optimally improve system redundancy, thereby reducing outages; save millions of dollars per year through more efficient operations and field services; and use predictive analysis of asset risk to build more transparent and better-justified operational and capital expenditure plans.

Objective: Integrating Low Carbon and Renewable Technologies

The second overarching objective of RIIO is regulating and supporting energy networks to meet the challenges and opportunities of a sustainable, low carbon energy sector. Across the world, energy companies must adapt to integrate renewable and low carbon technologies.

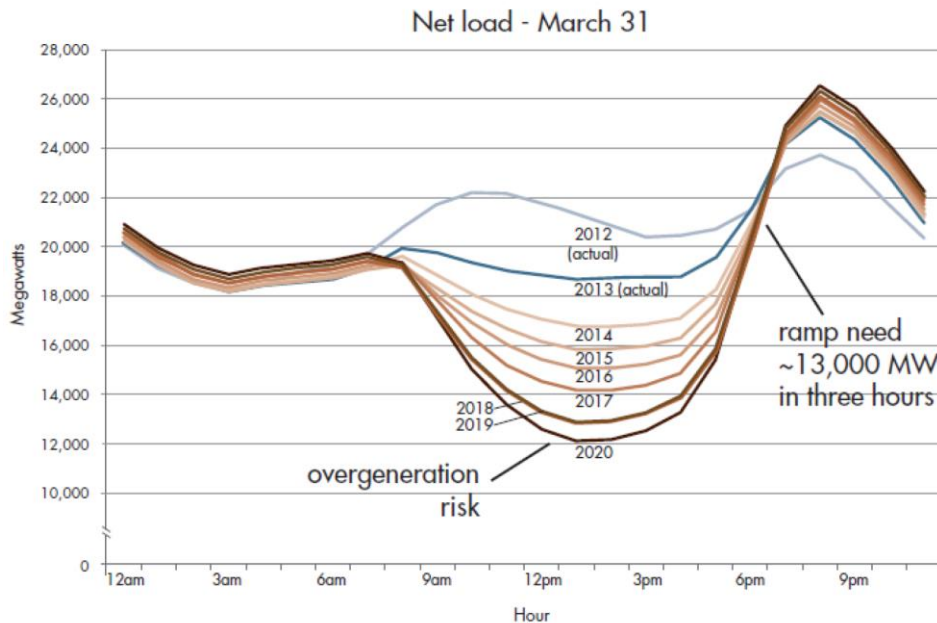
Situational Intelligence helps network companies support a sustainable, low carbon energy sector by:

- Increasing customer participation and overall program performance for demand response and energy efficiency initiatives.
- Combining external weather and calendar information with operations and IT information to better predict the output of embedded solar and wind generation, and its impact on network assets.
- Managing market signals to optimize the transmission and distribution of energy from renewable sources.

The California Independent System Operator (CAISO) uses Space-Time Insight software for a sustainable, low carbon energy sector. CAISO uses Space-Time Insight's software in its state-of-the-art control centre to manage the state's power grid. Situational intelligence applications include analysing and visualizing the condition of the grid, the monitoring the effect of congestion on market prices, and optimizing the use of renewable energy to meet the state's goals. By California law, renewable energy resources must comprise 33% of total energy procurement by 2020.

Renewable generation has not yet had the impact in Great Britain that it has in California (where the so-called "duck curve" as shown in chart 1 illustrates the steep ramps that conventional generation needs to meet to compensate for the variability in renewable generation) or in Germany (in May 2014, there was a moment when nearly 75% of demand was served by renewable generation).

Chart 1: Renewable energy requires increased network flexibility



Source: *2014-2015 Transmission Planning Process Unified Planning Assumptions and Study Plan*, California Independent System Operator

Nevertheless, by March 2014 around 2.4GW of total installed capacity in Great Britain had been registered under the Feed-In Tariff scheme. As this installed capacity increases it will become more important for distribution network operators (DNOs) to understand the effect on their networks. By bringing together multiple sources of data such as asset information, customer demand and weather forecast, it becomes possible to predict periods of high embedded generation (for example on a sunny, windy day) and the effect this has on assets.

Outputs Drive RIIO

The six output types defined by RIIO work together to help create the networks for a sustainable, low-carbon future, and these primary outputs are designed to be controllable by the network company, measurable, auditable and comparable. Base revenues and incentives are linked to the delivery of these outputs.

Under RIIO, regulators and companies work together to determine exactly what outputs make sense as targets for companies to drive delivering value and creating a sustainable energy system.

Outputs, Rewards and Penalties

RIIO provides for financial rewards and penalties for organizations that exceed or miss their goals for delivering primary outputs and secondary deliverables at value for money. It also includes reputational incentives which might involve public acknowledgement of attaining goals or censure for missing goals.

In order to maximise return, therefore, companies must attend to the most cost-effective and revenue-enhancing methods for planning and delivering outputs.

Output: Customer Satisfaction

The Customer Satisfaction output drives network operators to provide good customer service. Under RIIO, customer satisfaction is measured by qualitative and quantitative evidence using the Broad Measure of Customer Satisfaction (BMCS) with components including (i) a customer satisfaction survey, (ii) a complaints metric and (iii) stakeholder engagement activities. Ensuring excellent customer satisfaction is demanding; customers can interact with multiple functions within the network company such as connections, general enquiries, complaints and interruptions. Furthermore, the smart metering rollout is likely to increase the number and variety of customer contacts with network companies.

Understanding customer satisfaction (or lack of) therefore requires tabulating those interactions from many systems, and an understanding of the quality of those interactions:

- How long did it take to answer the phone?
- Was the call centre representative able to resolve the customer's query?
- How long did it take to resolve a complaint?
- How did the customer feel they were kept informed during the new connection process?
- Has the customer who is reporting an interruption suffered other interruptions in the last year – and did the customer contact us about those?

How Situational Intelligence Helps Utilities Deliver Customer Satisfaction

Perhaps one of the most important functions of customer service is to listen to the customer. Isolating customer interaction data from other operations systems can have the effect of not listening. A single customer dashboard, on the other hand, enables all staff to “listen” to the customer, and to understand what they want.

For example, Florida Power and Light use Situational Intelligence applications from Space-Time Insight significantly to collate data from across the organisation in a single dashboard for call centre representatives. Reusing and correlating data from across the organisation greatly reduces the time required to resolve customer inquiries and the need to transfer customers between departments. In addition, likely customer sentiment can be calculated; every interaction can then be modulated with a personalised understanding of the customer’s experience with the organisation.

Output: Reliability and Availability

Reliability and availability are essential outputs for customers. Front of mind are Customer Minutes Lost

Florida Power and Light's customer service dashboard collates data from multiple utility systems into a single dashboard.

(CML) and Customer Interruption (CI) metrics. Smart meter data – when it becomes available – will add another dimension to the view that DNOs already have of outages. Combining existing and new data sources will enhance the accuracy of CML and CI metrics, in turn leading to opportunities for further optimisation of incentives under the Interruptions Incentive Scheme.

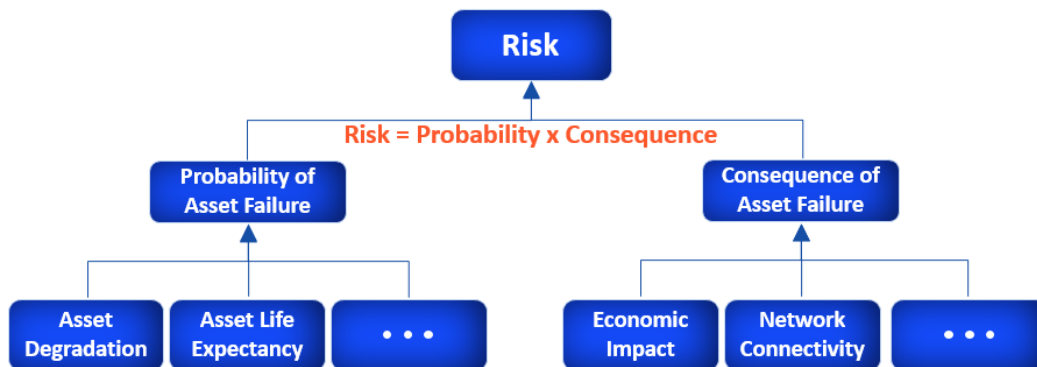
How Situational Intelligence Helps Utilities Deliver Reliability and Availability

A Situational Intelligence approach can improve reliability and availability through:

- Providing a single view of the cost (in terms of CML, CI or other metrics) of incidents and driving an optimal response plan.
- Using smart meter data correlated with OMS and customer data to gain new insight into outage areas.
- Identify patterns of emerging abnormal behaviour.

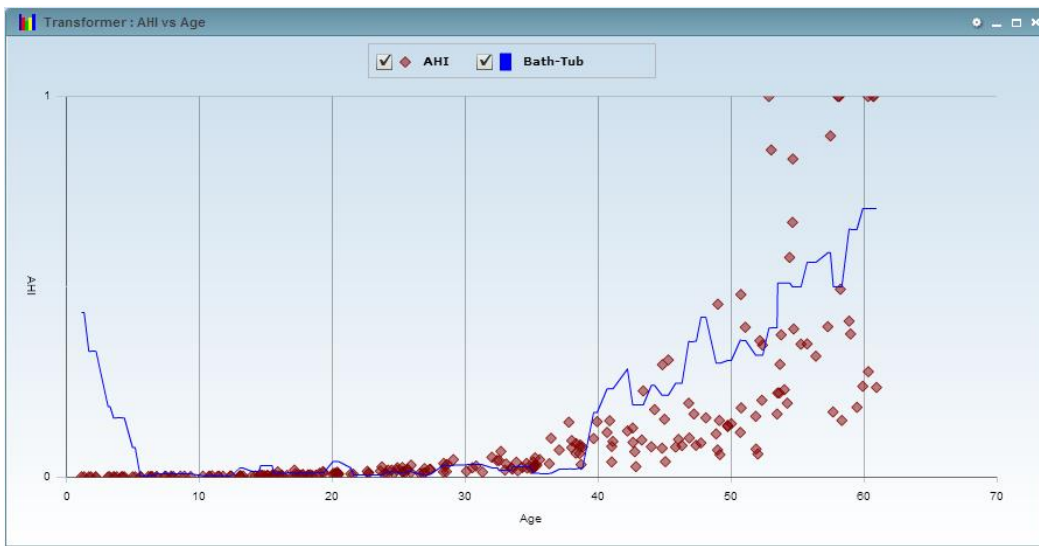
Asset health, criticality and load indices are secondary deliverables under RIIO. A clear view of these indices across each asset class is required to form well-justified business plans and investment profiles.

Calculation of these key indices often means collecting data from multiple systems such as the Asset Management System and GIS. For each asset category, rules encode the relevant asset management policies and methodologies so that a health index per asset can be calculated. A Criticality Index for each individual asset (of which there are tens or hundreds of thousands) is also calculated. Like the Health Index, computation of Criticality Index requires data from across several systems so that an accurate measure of the consequence of failure can be computed. Finally, an overall risk score is calculated as the product of health and criticality.



A situational intelligence approach to asset health, criticality and risk involves a robust and sustainable computation of all the relevant indices using all the relevant input data. For example, loading of assets may change significantly and unpredictably over a price control period depending on the penetration of electric vehicles and distributed generation. Using real load data therefore leads to a more accurate calculation of health on a day-by-day basis. Similarly, criticality can change as more, or different, customers connect.

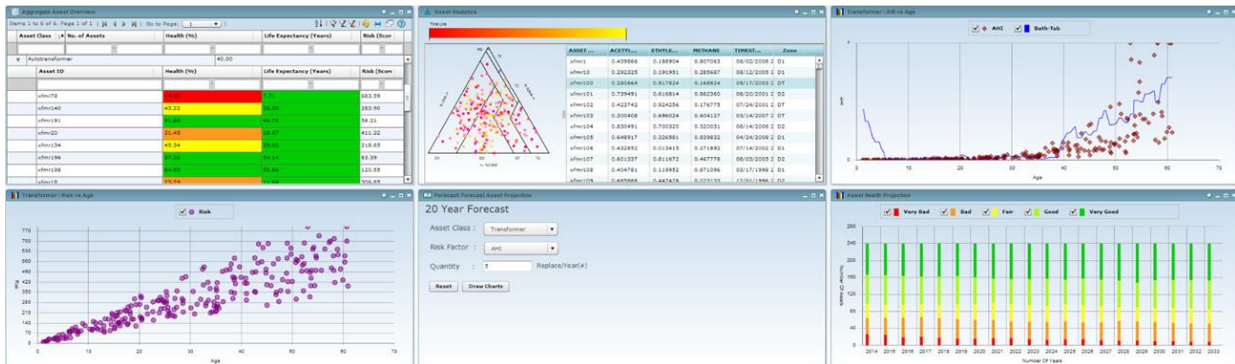
Space-Time Insight's Asset Intelligence application correlates and analyses data from any number of business, operational and external systems and provides a 360-degree understanding of every asset and asset class. Using Space-Time Insight's patented spatial-temporal-nodal (STN) technology, Asset Intelligence analyses and visualizes asset lifespan and risk, accurately predicts failure and simulates the impact of asset replacement strategies. The STN asset health index (STN-AHI) incorporates statistical and heuristic analysis of asset failures, asset loading, gas analysis, field samples, temperature and weather, to name a few, providing actionable insight into the risk level of every asset.



Plot asset health by age and compute a projected failure curve

This analysis can deliver significant benefits:

- Optimise investment: understand why, where and when failures are likely, enabling better decisions about maintaining versus replacing on a per-asset basis. This is significant because the efficiency incentive has been modified to apply to the total of operating and capital expenditure. Under the efficiency incentive, network operators share with consumers the benefits of delivering outputs at a lower cost than envisaged. Thus it becomes even more important to understand specifically which assets within each asset class can be economically maintained rather than replaced.
- Improve safety and reliability: proactively identify and prioritize asset maintenance needs before catastrophic events occur, reducing unplanned outages and the duration of outages.
- Increase plan effectiveness: make more accurate and informed decisions with centralized access to data that is correlated and analysed across all systems.
- Improve transparency: build compelling business cases (and the data to back them up) with a comprehensive and transparent understanding of which assets are most at risk.



Situational Intelligence delivers predictive analytics of correlated data to support more accurate informed decisions about network operations and capital planning.

Output: Safe Network Services

Safety is clearly a key priority for all stakeholders and compliance with all relevant legislation and regulation is essential.

How Situational Intelligence Helps Utilities Deliver Safe Network Services

The Health and Safety Executive's Iron Mains Safety Risk Reduction Programme now requires gas distribution networks (GDNs) to replace the same length of tier 1 iron mains as would have been done under the old policy, but replacement can now be prioritised based on an assessment of a range of benefits including reductions in shrinkage and operating cost, as well as improvements in safety risk. By bringing together multiple sources of data, Space-Time Insight's software can help distribution asset managers identify and assess the benefit of replacing certain pipes based on condition rather than on risk-based policy. Replacing pipes based on condition helps meet replacement requirements while also deriving value from the shrinkage incentive.

For example, mono ethylene glycol (MEG) saturation levels, the position of test points and pressure regulators – and therefore predicted saturation levels – can be visualised along with network, colour-coded according to pipe material. Dynamic scenarios with respect to pressure changes and relative MEG saturation can be played out with built in cost-benefit calculations enabling optimal replacement programmes to be determined.

Output: Connection Terms

Connection terms relate to companies providing customers with value through safe, timely, affordable, and predictable connection terms and services. This is measured primarily through the time required to establish or modify an energy connection.

How Situational Intelligence Helps Utilities Deliver Connection Terms

Situational Intelligence allows operators to view outstanding connection requests across their network. This helps them prioritize and plan field work more efficiently, track requests that are behind schedule, and

even anticipate where new connection requests might cluster, such as around new commercial developments.

Situational Intelligence can help operators:

- Monitor outstanding connection notices stored in multiple databases and display them in a single pane of glass, color-coded according to time.
- Dispatch and monitor mobile workforce crews to improve the efficiency of field services and thereby reduce connection times.
- Enable customer service to handle connection-related inquiries better through access to correlated data available in intuitive maps, charts, and tables.

Output: Social Obligations

Network operators face social obligations – principally in supporting customers in vulnerable situations - as part of regulatory compliance and perhaps corporate social responsibility.

How Situational Intelligence Helps Utilities Meet Social Obligations

Through analytics and visualization, Situational Intelligence can help network companies by:

- Correctly identifying vulnerable customers.
- Mapping and profiling fuel-poor customers, enabling targeted support programs.
- Cross referencing with external data sets such as those provided by local authorities, health agencies and community groups.
- In times of incident or outage, rapidly providing relevant services to affected customers.
- Tracking outreach to in-need customers concerning existing programs and avenues of support
- Analysing program participation by in-need customers

Output: Environmental Impact

Managing environmental impact directly supports the RIIO objective of creating a sustainable, low-carbon energy system.

As well as being a cost burden on consumers, network losses of course result in unnecessary carbon emissions. The regulator highlighted in RIIO-ED1 their belief that there is currently not a reliable source of data common to DNOs for measuring distribution losses. The loss reduction mechanism has therefore been implemented as a mechanism comprising the components of licence obligation, loss reduction expenditure, annual reporting and discretionary reward.

Improving a DNOs understanding of their losses, and preparation for a measurable loss incentive under ED2 is one measure that is likely to score well under the discretionary reward component. With data becoming available from smart meters in the period, there is clearly an opportunity for DNOs to calculate losses more accurately by simply comparing energy delivered at the meter point, energy generation embedded, and energy delivered into the network. By also accounting for unmetered consumption and modelling technical losses, an accurate picture of network losses can be built up. This forms a baseline for future investment in loss reduction. The energy balancing approach is one method that Space-Time Insight customers use to calculate network losses.

How Situational Intelligence Helps Utilities Deliver Environmental Impact

Situational Intelligence can help network companies:

- Identify and act to reduce technical losses.
- Estimate, analyse, and visualize their business carbon footprint.
- Visualize the visual impact of asset placement and operation.
- Increase the effectiveness of energy efficiency and demand response to shift or reduce consumption.
- Support reputational reporting on broad environmental impact.

Summary

Gas distribution networks are already operating under RIIO-GD1 and electricity distribution companies will commence under RIIO-ED1 in April 2015. The environment – technical, regulatory and commercial - in which networks companies operate is rapidly changing, but the RIIO framework provides opportunities for revenue enhancement. Accessing those opportunities depends on meeting or exceeding output goals and innovating to work in more efficient ways.

Adopting a Situational Intelligence approach is a proven, effective way in which companies can make better use of their existing investments and data to drive the innovation required in order to deliver outputs at better value for money.

About Space-Time Insight

Space-Time Insight transforms the vast quantities of disparate information spreading across organizations, into intuitive visual displays that businesses can use to make informed real-time decisions. From traditional transmission, communications and transportation networks to Smart Grids and Cities, our next-generation situational intelligence solution is making critical infrastructure smarter, safer and more reliable. With Space-Time Insight, enterprises can visualize and analyse their resources across location and time, rapidly respond to disruptions in service, and lower risk while increasing customer satisfaction and profitability. Major organizations around the world rely on our high performance software to gain actionable insights into their businesses and make real-time operational decisions. Space-Time Insight is privately held and based in Fremont, CA. For more information, visit <http://www.spacetimeinsight.com>.

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