Digital Twins:

Breaking down the barriers of dysfunctional data

We live in an information age where data has become pervasive. As consumers and citizens freely expand their online presence, they're leaving behind an ever-increasing digital footprint.

So, the volume, velocity and variety of data continues to increase exponentially. And so too does its value – if you know what to do with it! But organisations everywhere are struggling to cope with the challenge of managing and processing this vast volume of data being generated.

In this paper we evaluate this challenge, and how using a semantic data fabric to build digital twins can break down the barriers of dysfunctional and disconnected data to improve interoperability. In doing so, important information can be connected, rapidly generating valuable insight that improves future decision-making.

Drowning in data

As the size of their data pool continues to swell, organisations everywhere are struggling to understand and manage the information they collect. Faced with political, legal, financial and security restrictions, along with the limitations of legacy technology systems, the process of bringing this data together in a meaningful way is extremely challenging. It's expensive, time-consuming and resource intensive. And as time moves on, the value of the data is greatly diminished.

Having the capability to connect this data from the myriad of sources from where it is being generated can enable organisations to better understand the present as well as predict the future.

Being able to bring that data together in a relatively quick, cost-effective and simple manner can enable organisations to operate smarter and reach their potential by becoming more responsive to citizens and consumers, whose expectations are continually increasing.

Forrester reports that between

60-73%

of all data within an enterprise goes unused for analytics[1]

1. https://www.forrester.com/blogs/hadoop-is-datas-darling-for-a-reason/

Evolution of the Digital Twin

According to Gartner: "A digital twin is a digital representation of a real-world entity or system. The implementation of a digital twin is an encapsulated software object or model that mirrors a unique physical object, process, organization, person or other abstraction. Data from multiple digital twins can be aggregated for a composite view across a number of real-world entities, such as a power plant or a city, and their related processes."[2]

So, a digital twin is a live digital version of any endpoint, physical or non-physical – that could be an asset, a manufacturing process, a financial system, a piece of equipment or even a person. Modelling human behaviour and their interactions with real world objects and events has further expanded the scope of digital twins. For example, organisations are developing 'social' digital twins to measure the societal impact of prospective public policy decisions.

While definitions of a digital twin may vary, where common ground does seem to exist is in agreeing what they are not.

The digital twin has access to this entity's data throughout its entire life, and they exist within digital ecosystems, where twins securely and selectively share information across boundaries in real-time via brokered interactions.

Given the increasing substance – and value – of data, this capacity to break down the barriers between disconnected or dysfunctional data is becoming ever more important. Investing in a digital twin as the foundation for a data-centric architecture is a possible solution but can be seen as a daunting and complex endeavour. Yet the benefits can far outstrip initial expectations and deliver valuable insights that would previously be impossible. Here are just a few examples of potential opportunities real-time data presents to transform operations:

Potential opportunities real-time data presents to transform operations

01 — Utilise data that has been updated at the point of change, not just at the last upload ▶ Increased effectiveness in detecting and combating error or fraud, as well as reducing business risk

02 — Access high-value data, independent of source, and build a single view ▶ Significantly reduce reliance on data silos, transform internal operations and reduce costs

03 — Improve staff utilisation and morale by avoiding manual interventions to establish information ▶ Improving staff experience and allowing time for higher impact activities

04 — Gain a greater understanding of the relationships held in different data sets ▶ Improving quality of searches and improved decision-making support

05 — Meet data initiatives in a timely manner ▶ Create a consistent data ontology and democratise data across departments

Enabling Digital Twins – the role of a Semantic Data Fabric

With the emergence of more and more digital twins from different sources, perhaps the most critical issue to address becomes the interaction between twins from heterogeneous systems. Combining digital twins at ever greater scales leads to an expansion of value. Failure to facilitate that interoperability will limit the potential.

Core to solving this interoperability problem is a semantic data fabric, a completely technology agnostic architecture for modern data management that acknowledges the need to connect data across the enterprise, regardless of its source. A flexible, reusable layer, the semantic data fabric[3] provides meaning and context to both structured and unstructured data from any source - social media platforms, IoT devices, enterprise applications, cloud compute and SaaS.

Interoperability across twins is facilitated through a web of data sources, handing them semantic capabilities to provide answers to complex queries. It can provide a generic framework for defining the interoperability of digital twins through metadata. This framework allows us to set out a twins 'meaning' by establishing a common ontology that people agree to use.

More specifically, semantic web technologies make the metadata self-described, fostering automation while providing progressive scaling.

3. Semantic Web technologies enable people to create data stores on the Web, build vocabularies, and write rules for handling data. https://www.w3.org/2001/sw/wiki/Main_Page

Fujitsu is working with our dedicated partner, IOTICS, who enable digital cooperation between enterprises using boundless, digital ecosystems.

Critically, using a semantic data fabric is the key to overcoming the difficulties of connecting such vast volumes of data that we alluded to earlier, namely technological, procedural, financial and legal obstacles – whilst still maintaining all the necessary controls and security. Each entity's twin is secured in spaces. Each space and twin both have agreed permissions, so with these permissions defined, we can confidently exchange data across low trust networks, within procedural, security and legal frameworks.

Applications can then use the fabric as consumers of the enriched data, to leverage the power of enhanced information and potential for comprehending new relationships in patterns or use it to produce enhanced simulations.

Schematic diagram of boundless ecosystem platform
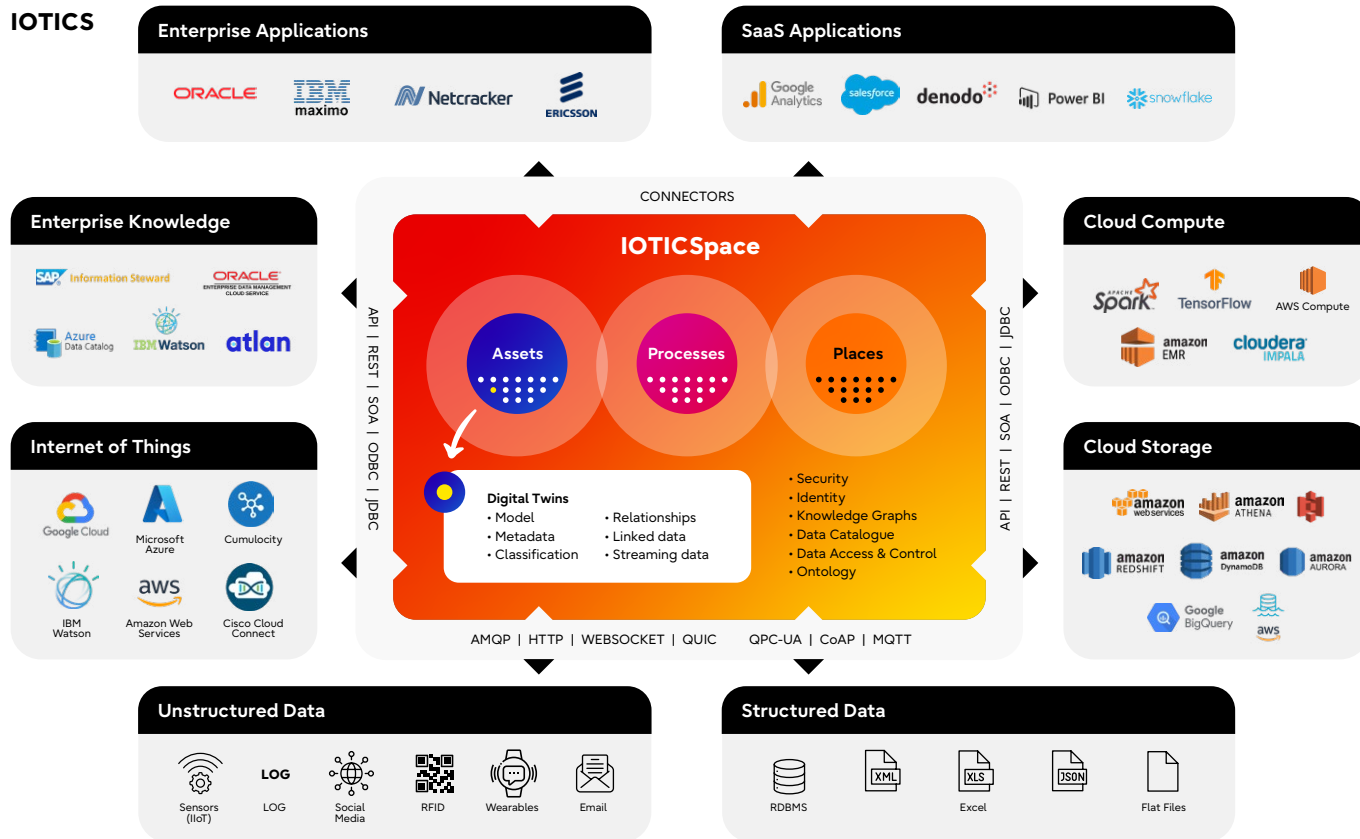
The scope for enhanced simulation

An augmented data set that unites those sources and is able to pull in a raft of other external sources, such as social media, has the potential to escalate insights to another level and identify potential abuse or fraudulent use of public sector services, for instance. But it can also improve quality of life, save resources and make the world more responsive to the changing needs of citizens. This congregation of data can also lend itself to proving the provenance of an activity. Crucially, it enables enhanced simulations, whose potential will only expand as the ecosystem of digital twins grows.

Enhanced simulations are the outcome of modelling and stressing different scenarios to understand the effect they have at a number of levels.

The potential use cases of these enhanced simulations vary enormously, for instance:

Determine where an office might be relocated

Inform and drive sustainability goals

Enhance productivity and reduce time-to-market

Inform how supply chains may react to changes in policy or legislation

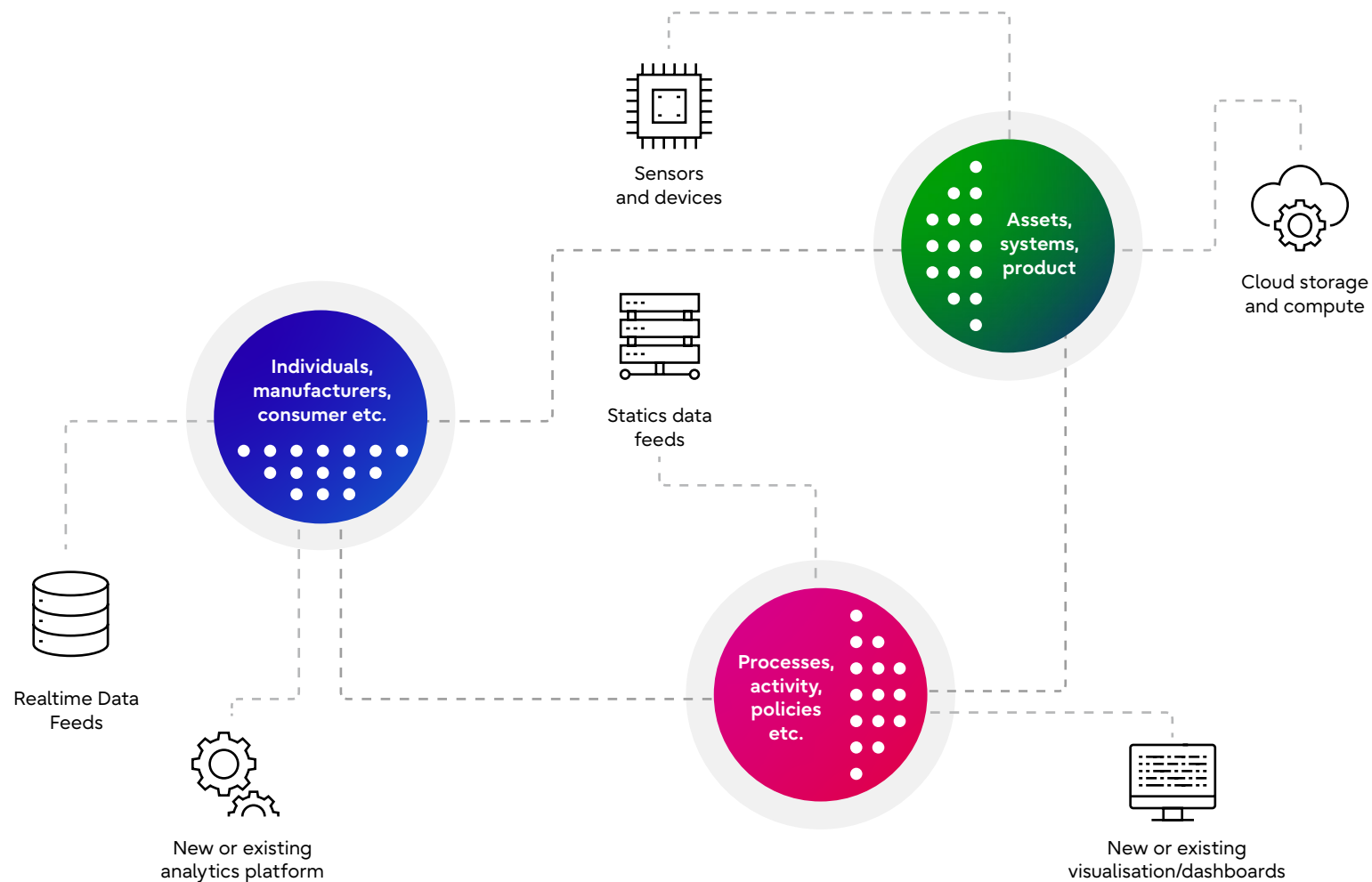How border agencies might mitigate the impact of potential rule or technology changes

Creation of a single, trusted, shareable view of an entity based on multiple data sources.

Social digital twins also allow policymakers to explore how to evaluate potential behavioural change and seek optimum social outcomes. The abstraction provided by the semantic data fabric allows organisations to run any number of simulations, given enough data.

Sensors and devices

Assets, systems, product

Cloud storage and compute

Individuals, manufacturers, consumer etc.

Statics data feeds

Realtime Data Feeds

Processes, activity, policies etc.

New or existing analytics platform

New or existing visualisation/dashboards

What next?

There is little debate around the benefits to be gained by the efficient consolidation of disparate data silos. Establishing a framework that creates connections between previously disconnected or unconnectable spaces and expands on this, pulling in more and more data sources, is vital to unlocking the potential of insights from patterns alone. Adding digital twins and enhanced simulations goes a step further to delivering actionable insights from the vast potential of that data.

Working together, Fujitsu and IOTICS are co-creating digital twin solutions:

- **Interoperability across sectors, partners and suppliers –** we create a web of data sources available to consumers internally and externally

- **Technology agnostic –** integrate with any existing or future hardware and software

- **Secure data interactions –** control your data's visibility and accessibility; share with all, none or specific others

- **Integrate once, use many –** find, access, interoperate and reuse your data, no matter how many use cases and applications

- **Right data at the right time –** share and reuse semantically described data streams to inform insights and actions

- **Machine readable and actionable –** configure data points to interact dynamically and autonomously

- **Decentralised –** data is held at source, can be accessed from anywhere and can grow/scale, along with your business

Why Fujitsu

We are a global leader in technology and business solutions that transform organisations and the world around us. This is pivotal to our purpose: to make the world more sustainable by building trust in society through innovation.

It's a vision which is central to our presence in the UK and our support for the country's National Digital Twin (NDT) programme, designed to increase infrastructure resilience, optimise the UK's use of resources and boost quality of life for citizens.

The UK is also home to Fujitsu's Centre for Cognitive and Advanced Technologies. The Centre brings together innovation in areas including digital twin technology, quantum computing and artificial intelligence, as part of Fujitsu's commitment to developing a high-skills UK economy. Providing a direct link to our work in Japan, the Centre will provide a focal point for collaboration between industry, Government and academia, as well as enhancing the UK's ability to draw on Japan's leadership in areas such as super computing.

The Centre forms part of Fujitsu's workforce across the country, driving digital innovation in both the public and private sectors. Our technology contributes to some of the UK's critical systems, from enabling online tax returns with HMRC and providing the Flood Warnings Direct service, to delivering secure communications to our Armed Forces.

Fujitsu is committed to investing in the UK and drawing from our global expertise to create a new model of innovation that helps realise the country's scientific superpower potential.

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