Digital Twin

Strong Asset Management

Optimized Process

Streamlined Operations

November 4, 2024 CRRBC Conference – Kelowna, BC

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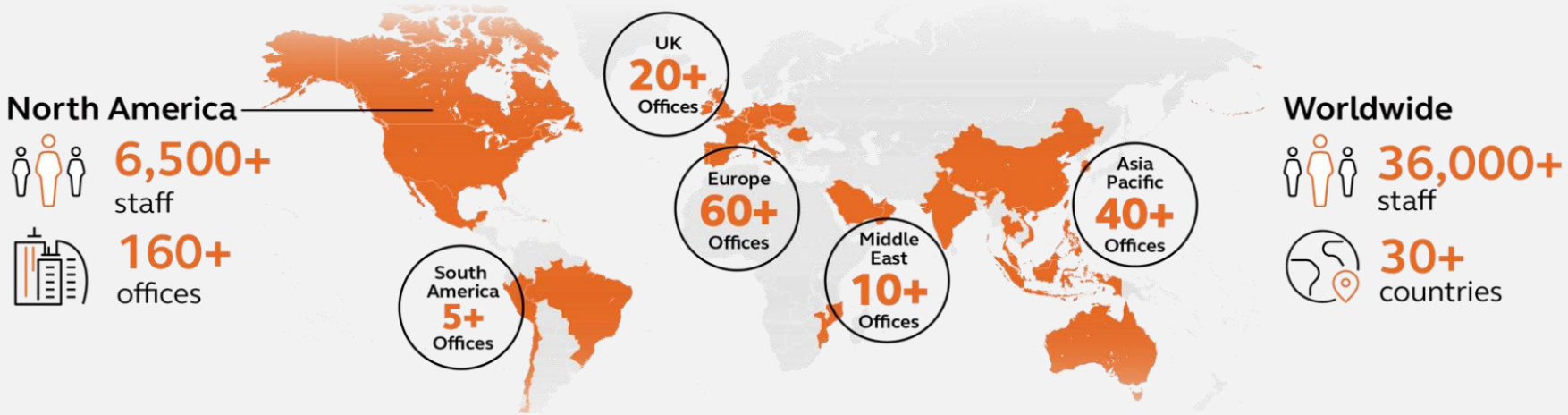
OSP Designer & Product Design Lead

Jason is a BICSI certified Outside Plant Designer (OSP) specializing in Fiber Optic Networks, with a focus on infrastructure durability and longevity in hostile climates. He is practised in the full life cycle of projects, including strategic planning, conceptual development, estimation and budgeting, detailed design, permitting and planning, construction oversight, and quality management. He has led efforts to develop and implement preventative maintenance programs, emergency response programs, asset management systems, and underground locate programs. Jason has participated in projects of residential, commercial, and industrial fiber-to-the-premises builds (FTTP, FTTx) and continually exercises best-practises to plan, design, deploy and operate networks of many types and sizes.

Arcadis was founded in the Netherlands in 1888 and has grown into a global industry leader through innovation, the expansion of services and a series of strategic acquisitions.

Arcadis has been working in the field of intelligent systems for over 35 years **–** *we* have been involved as technical advisors, consultants, designers, project managers, systems integrators, and operators of fiber networks across various projects within the field of ICT/Telecommunication.



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Woven Services

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Woven seeks to provide specific or a comprehensive suite of services for any subscriber, service provider, network owner, or network operator to facilitate all aspects of network development. Services include consultation on strategy and infrastructure assessment, business case development, design and program management in addition to providing complete control of all network management and administration.

engage is the communication, marketing, digital education, and community consultation designed to drive and assess network demand.

empower is a complete asset management solution which begins at the construction phase and empowers network operators by allowing complete control of network facilitation and administration.

exchange is the customer marketplace, workflow engine, and meet-me-point for networks and service providers.

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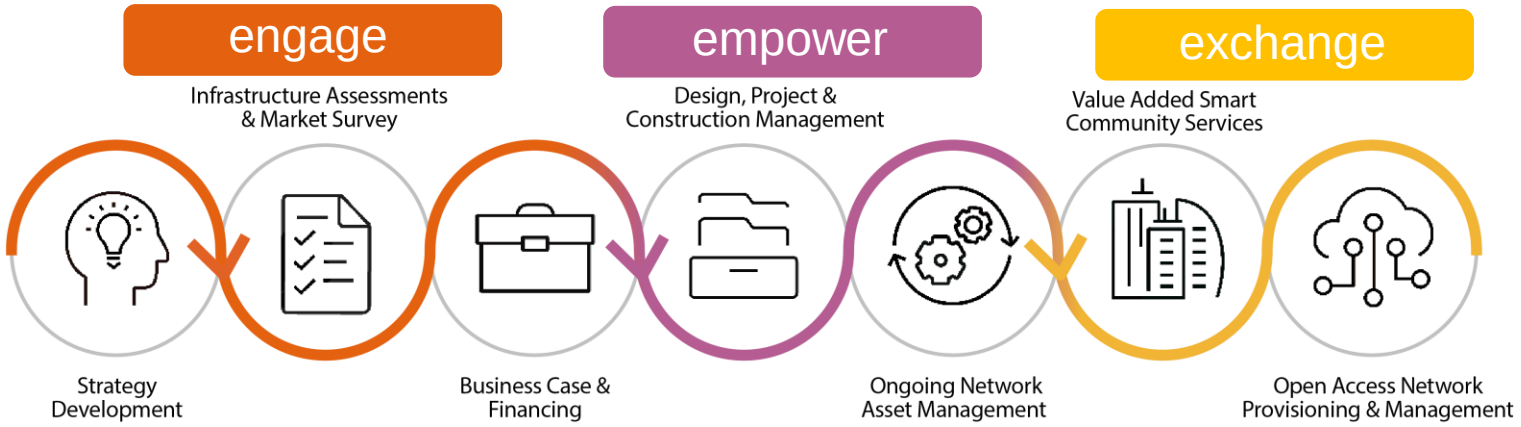

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Woven offers individualized services designed to meet our client needs.

Programs are defined and may evolve through stages of broadband development, delivering a unique and comprehensive solution at any point throughout the entire network life cycle.

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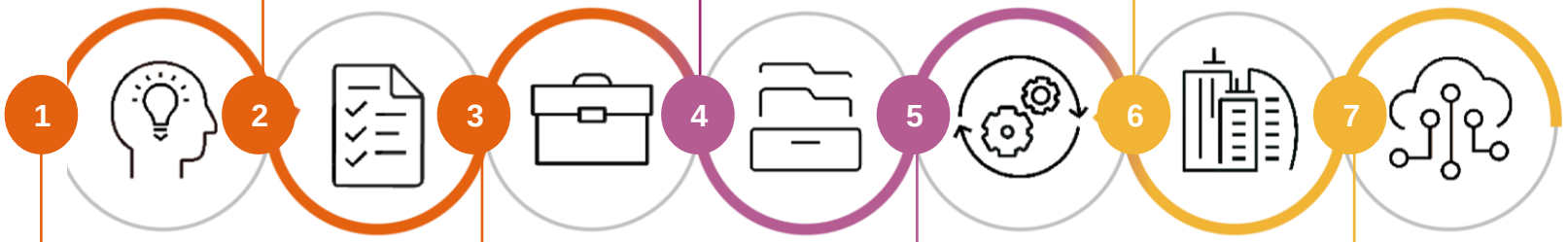

1
Strategy Development

- Competitive Market Analysis
- Marketing and Social Media
- Community Engagement and Outreach
- Needs Assessment and Survey

2
Infrastructure Assessments & Market Survey

- Demographics
- Speed Test Results
- National Standards
- Network Performance

3
Business Case & Financing

- Partnerships
- Grant Proposals
- Investment Advisor

4
Design, Project & Construction Management

- Project Schedule
- Construction
- Design

5
Ongoing Network Asset Management

- Field Work Orders
- Capacity Planning
- Fault Management Services
- Fibre Asset Management
- GIS Visualization

6
Value Asset Smart Community Services

- Connected Renewables
- Energy Management
- Community Wifi
- Online Education
- Wellness Healthcare
- Smart Security
- Connected Mobility

7
Open Network Management & Service Provisioning

- Open Access Network Model

Agenda

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Benefits of quality records

- A Single Source of Truth for Everyone, Everywhere
- User Use Cases
- Operational Case Study

Digital Twinning in Telecommunications Networks

- Breakdown the Buzz – What is a Digital Twin
- CAD, GIS & Other Systems
- Data Quality and Functionality
- Evolving & Updating the Data

Systems, Process & Finding the Efficiency

- Selecting & Implementing the best Systems to utilize the data
- Implementation Case Study
- Overcoming Challenges

Asset Management

good records are needed to be effective and efficient

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It is the strategic management of physical assets (such as network infrastructure, equipment, facilities, etc.) to maximize their value and performance while minimizing costs and risks. Asset Management involves activities like: asset inventory, maintenance planning, lifecycle management, risk assessment, and optimization of asset utilization.

What makes good records?

Accuracy:
Records should be precise and free from errors

Completeness:
All relevant details should be populated consistently across the records

Consistency:
Data formats should be consistent across all records

Accessibility:
Easily accessible to authorized personnel promoting efficiency in decision-making and operations.

Relevance:
Only essential information is included to prevent clutter and facilitate quick retrieval

Benefits of Good Records: A Single Source of Truth

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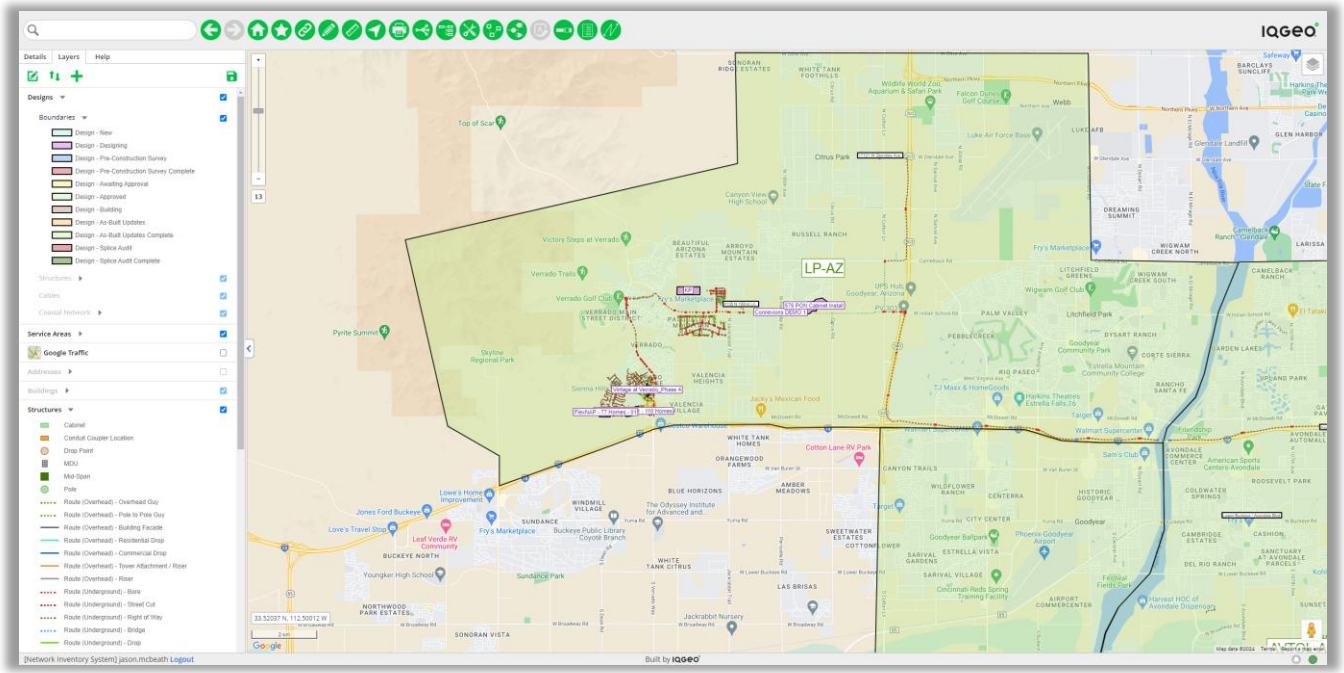
By creating and maintaining accurate records we can create a *'single source of truth'*.

Having a single source of truth enables rapid access to information for all network stakeholders. Assess, strategize and execute with maximum effect. All network stakeholders know where to access data on-demand and utilize it for their individual needs.



- Planning & Design
- Operations & Maintenance
- Reporting & Compliance

Network Lifecycle Support

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Data requirements through Planning and Design, Construction, and Operational stages are all connected, so create a fully connected project process to allow for clearer communication throughout.

Avoid confusion and drive efficiency with a single **source of truth for all stakeholders.**

The result is less confusion, the greatest efficiency and efficient execution from the start

Engineering & Design Services

Project & Construction Management

Infrastructure Support Services

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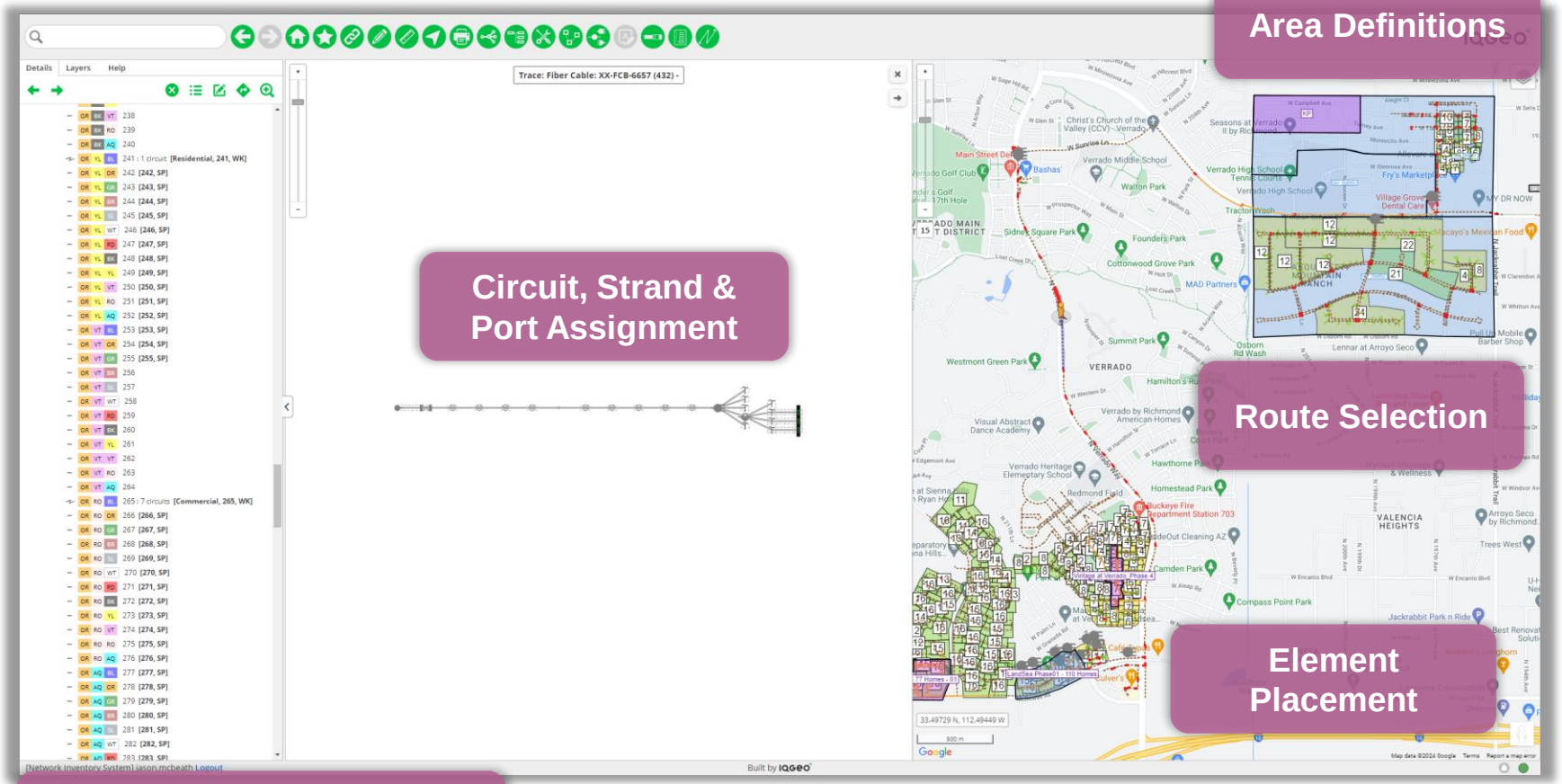
Planning & Design Type Users

Planners & Designers explore and design within their own space – Design Polygons.

Polygons act as sandboxes and can be manipulated without affecting the master dataset.

As designs progress to construction /as-builts, they can be written to the master dataset.



Operations & Maintenance Type Users

The solution is fully functional in the field both online and offline – enabled through browser access or native apps.

Field Technicians can extract important information at critical times, enabling the most efficient and accurate troubleshooting and incident response.

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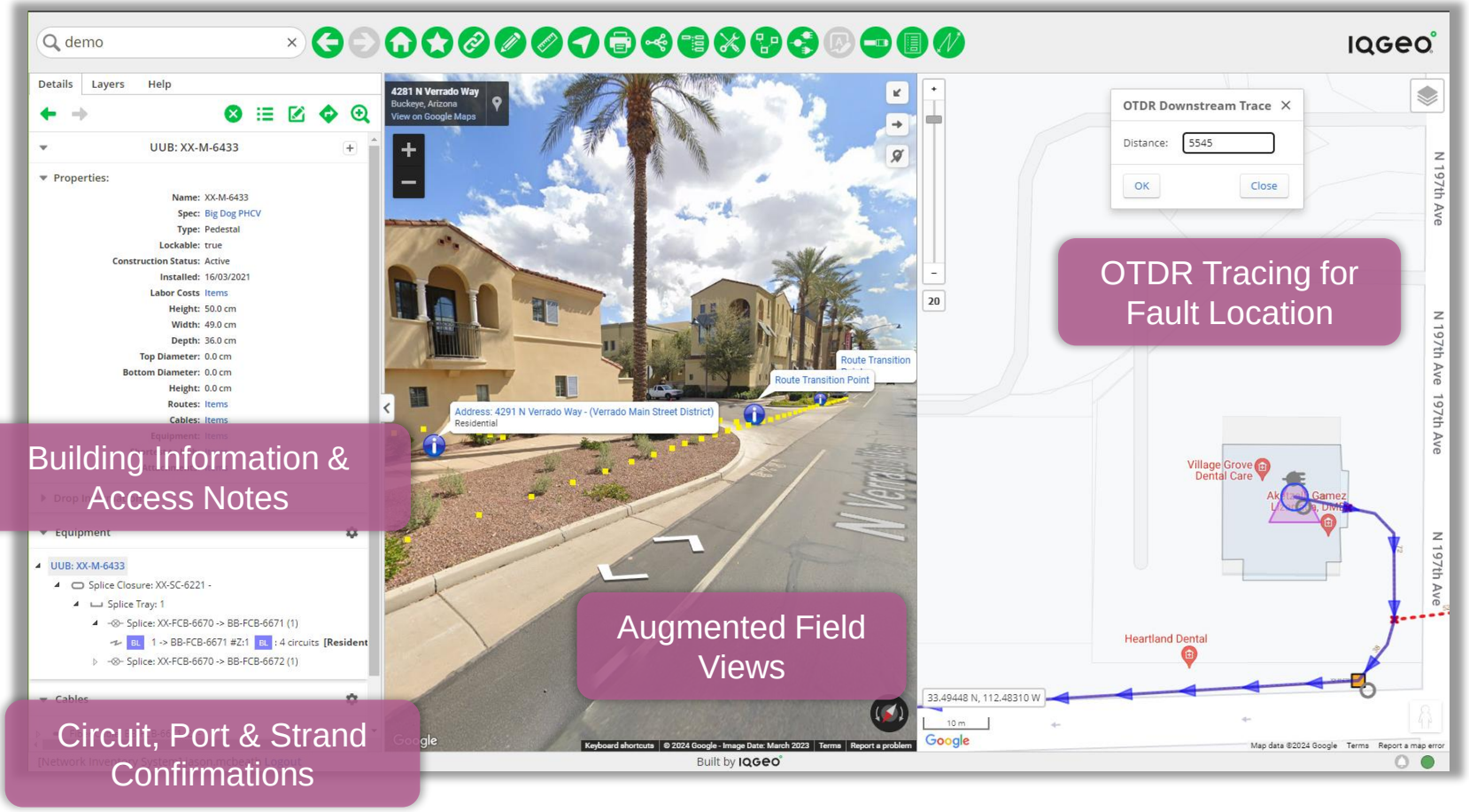
Schematics & Splice Reports

Circuit Reports for SLA Priority Tracking



Building Information & Access Notes

OTDR Tracing for Fault Location

Augmented Field Views

Circuit, Port & Strand Confirmations

Reporting & Compliance

Specific Reports are available for export directly from the solution.

GIS data can be exported in various formats for external processing.

Accurate and up-to-date information as needed to provide real-time network elements data.

- Circuit Reports for SLA Prioritization
- Bill of Materials
- Installation Date Tracking for Maintenance & Depreciation
- Linear Infrastructure Inventories
- Address & Location Status Lists
- Homes/Locations Passed Lists
- Data Warehouse

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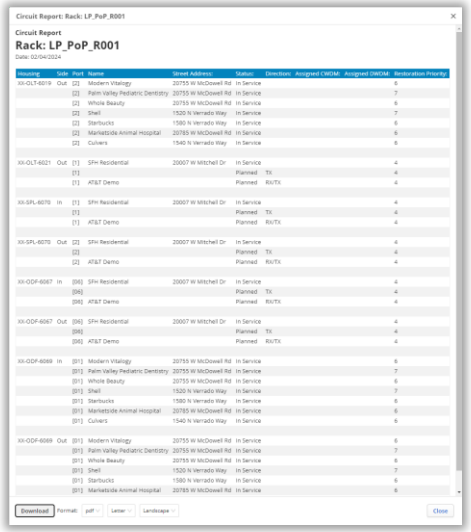

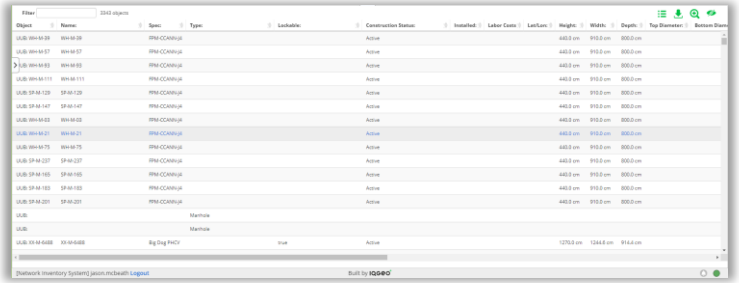

Finance Role: Network Valuation

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Investor & Funding Application Common Questions that can be answered with the solution:

- [x] What is the current coverage area of the fiber optic network?
- [x] What is the network's capacity and bandwidth capabilities?
- [x] What is the age and condition of the fiber optic infrastructure?
- [x] Are there any existing or potential regulatory or compliance issues associated with the network?
- [x] What are the long-term maintenance and upgrade requirements for the network?
- [x] Can the network support future technology advancements and increased demand?
- [x] What is the level of redundancy and resilience built into the network architecture?
- [x] Are there any existing service level agreements (SLAs) or contracts with customers or partners?

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Network Valuation is Driven from Actual Figures rather than Estimated Figures

- When looking to secure funding, investment partners and grant agencies seek clarity in valuation
- Certainty in the current state of the network translates directly to confidence from investment sources

Operational Programs

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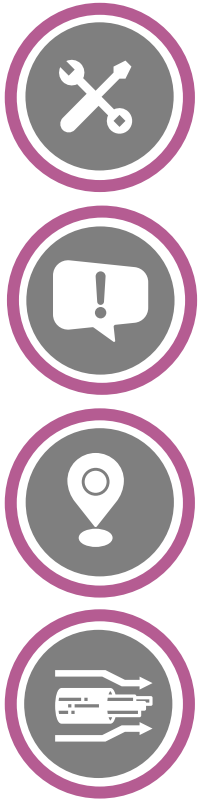
Critical Operational Programs are enabled by access to quality records – efficiency in access is key



Preventative Maintenance Programs

Creating and executing on PM programs for our clients, including creation of a PM program document, scheduling and dispatch of contractors, QA/QC and database updates

Emergency Response Programs

Creating and executing on ERP programs for our clients, including creation of a ERP program framework, call center support, scheduling and dispatch of contractors, QA/QC and database updates

Underground Locate Programs

Creating and executing on locate programs for our clients, including creation of a locate program framework, call center support, excavation request triage, crossing and proximity agreement management, scheduling and dispatch of contractors, QA/QC and database updates

Drop Programs

Creating and executing on drop programs for our clients, including scheduling and dispatching contractors, QA/QC and database updates

Legacy Scenario – Spreadsheets, PDF's and Coffee-Stained Notepads

Let's examine the response time of a Fibre Line Strike incident in a FTTH Network. This incident follows the process from when the line strike occurs to when a critical customer is back online.

The fibre line has been damaged, customers are calling in to report outage.

Customer Service Reps begin Emergency Response Program

Field Tech is mobilized with very limited information:

List of Address' Affected
ONT Port(s) that Affected Customers are on

Field Tech drives around and finds an excavation site where a cable is damaged and starts a list of questions:

- What cable is it?
- What is the cable size, make and model?
- What end points are affected?

Field Tech drives to the office to search through spreadsheets and PDF drawings to find the answers. The office is 15 minutes away from the incident site.

FOSCs & Cable Loaded
Drive Back to Site
Repairs Commence

Strands are spliced in order #1 to #288
Critical customer resides on Strand 176 but this information not found in drawings

Splicing is complete. NetOPS team calls customer and requests power cycle.

INCIDENT OCCURS	FIELD TECH GOES TO LOCATION	PROBLEMS FOUND	FIELD TECH FINDS ANSWERS	FIELD TECH TEMPORARILY FIXES BREAK	FOSCs + CABLES INSTALLED + SPLICING	CUSTOMER REACTIVATED
0 Minutes	5 Minutes	20 Minutes	1 Hour	3.5 Hours	5.25 Hours	**7+ Hours**

TOTAL DURATION: 5 STEPS - 7+HOURS

Woven Empower Scenario: Digital Records Enabling Precision Restoration

Let's examine the response time of a Fibre Line Strike incident in a FTTH Network. This incident follows the same process from when the line strike occurs to when a critical customer is back online, but the team has access to our high-quality asset management system.

empower

The fibre line has been damaged, customers are calling in to report outage.

Customer Service Reps begin Emergency Response Program

Field Tech looks at customers reported out, does circuit trace and finds a cable they collect on.
Field Tech notices excavation ticket on said cable planned for today

FOSCs & Cable Loaded

Repairs Commence

Field tech immediately pulls circuit report, talks to NetOPS to provide list of affected customers
Tech has material in van so they get right to work on restoration

Strand 176 identified as critical customer in circuit report
Strand 176 is the first strand re-spliced

Splicing pauses after strand 176. NetOPS team calls customer and requests power cycle.

INCIDENT OCCURS	FIELD TECH LOGS ONTO IQGEO	FIELD TECH LOADS MATERIALS + DRIVES TO LOCATION	FIELD TECH FINDS INCIDENT SITE	FOSCs + CABLES INSTALLED + SPLICING	CUSTOMER REACTIVATED
0 Minutes	5 Minutes	30 Minutes	1.25 Hours	3.25 Hours	**3.75 Hours**

TOTAL DURATION: 4 STEPS - 3+HOURS

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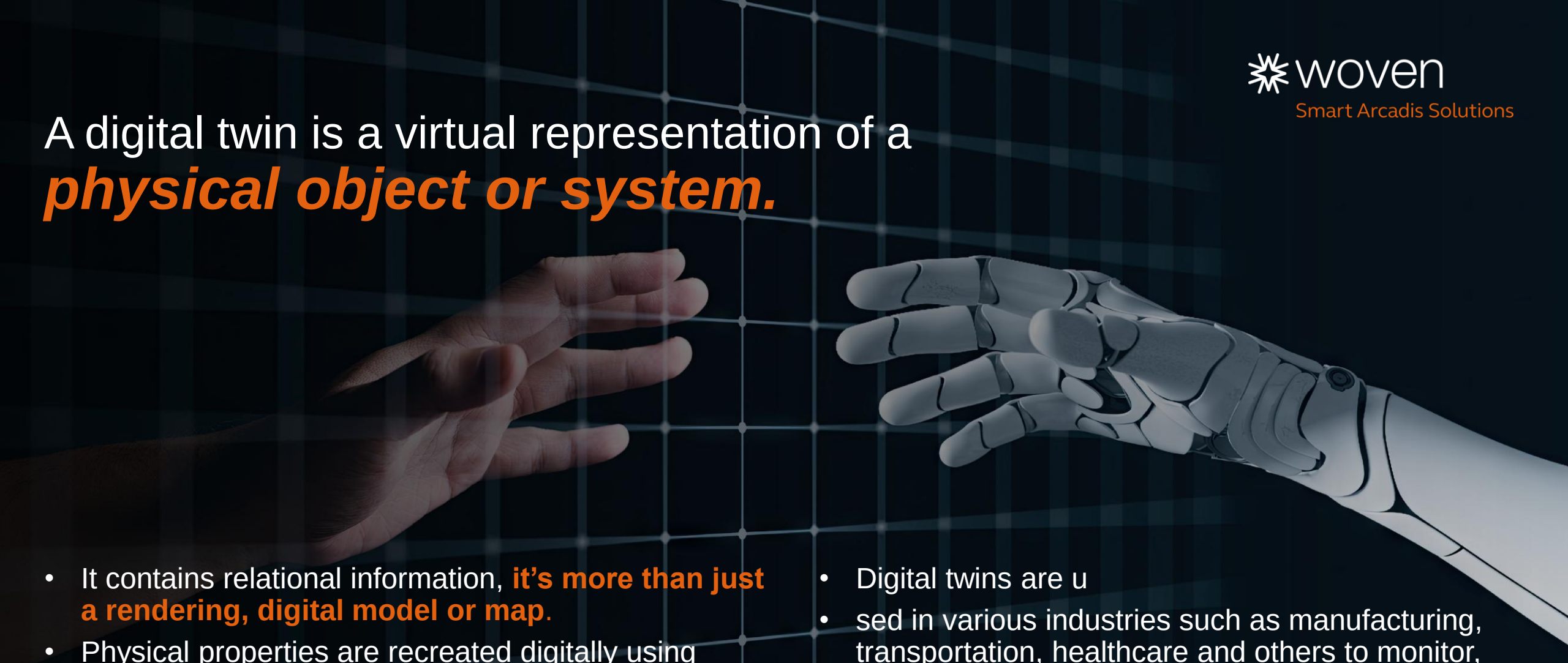
A digital twin is a virtual representation of a ***physical object or system.***



- It contains relational information, **it's more than just a rendering, digital model or map**.
- Physical properties are recreated digitally using captured data from design, engineering, construction and operational processes, and people.
- Often populated with **real-time data** from sensors embedded in the physical object or system.

- Digital twins are u
- sed in various industries such as manufacturing, transportation, healthcare and others to monitor, analyze, and optimize the performance of the physical counterpart.
- They **enable simulations and predictions**, and overall improved understanding of how the physical object or system behaves, or may behave under different circumstances.

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Data is the Digital Twin –
where to get the building blocks?

Quality Data capture, creation and manipulation is critical
in creating a twin – bad data creates a bad twin

Legacy Information Sources

- Open & Closed Data Sources
- Historical Records Documents
  (PDF, spreadsheet, pictures, paper, etc)
- Field data collection & Verification

Advanced Information Sources

- Satellite Imagery
- LIDAR
- Ground Penetrating Radar
- Network Sensor and Device Data

All data going into the digital twin requires deep scrutiny, scrubbing and quality assurance

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The systems and platforms are not the twin,
they are how we interact with it.

Examples of systems and platforms that have been associated to digital twinning in telecommunications:

- AutoCAD (and less so BIM/Revit) Drafting Systems
- ESRI & QGIS Geospatial Information Systems (GIS)
- Google, Bing, OSM, and other web-based map platforms
- Relational Database Management Systems such as MySQL, PostgreSQL
- IoT Platforms like AWS IoT, IBM Watson IoT
- Simulation Software such as ANSYS, Simulink
- Augmented Reality (AR) and Virtual Reality (VR) platforms
- Machine Learning and AI frameworks like TensorFlow, PyTorch
- Network Management Systems (NMS) like Cisco Prime, SolarWinds
- Cloud Computing Platforms such as AWS, Azure, Google Cloud

Data Quality & Useability

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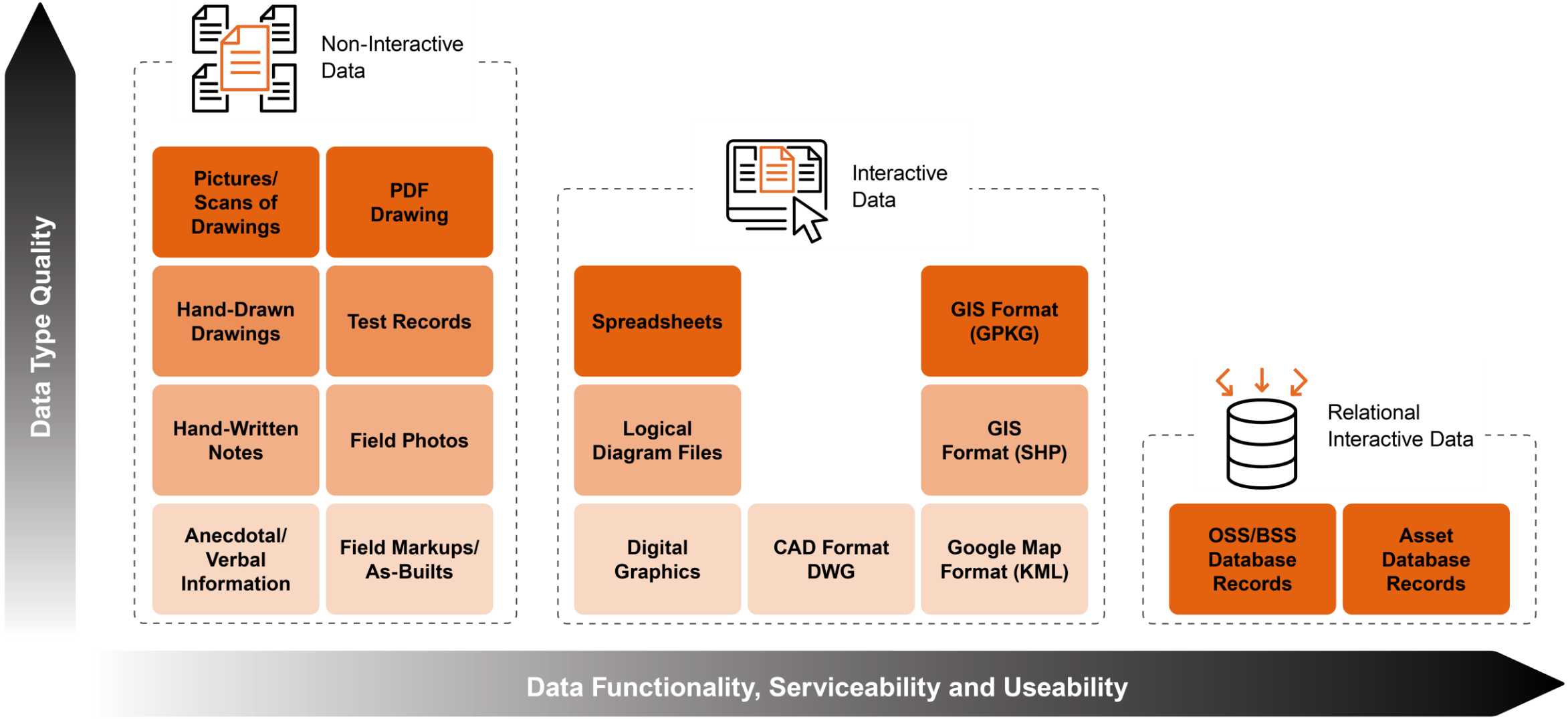

Data Quality & Useability

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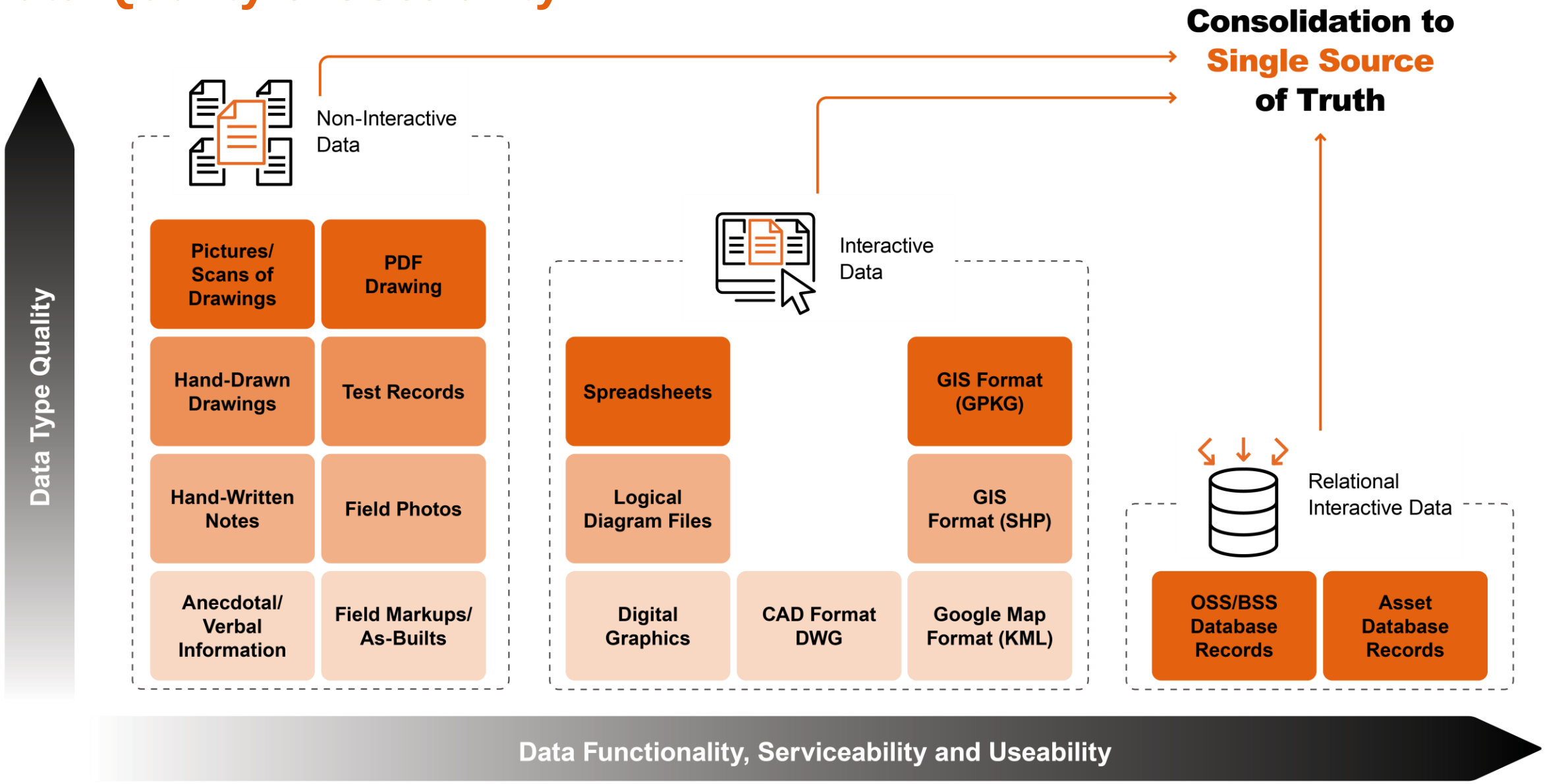

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Digital Twinning –
What does this all mean?

Digital Twinning is in rapid evolution, and the flashiest technologies get tremendous exposure

- Data Collection technologies such as LIDAR, Ground Penetrating Radar
- Interface systems such as Augmented or Virtual Reality
- Data formatting & Storage such as Data Warehousing & Data Lakes
- AI Data processing

Many Agencies are paralyzed – either overwhelmed or uncertain.

To avoid this paralysis:

Start Simple and Evolve

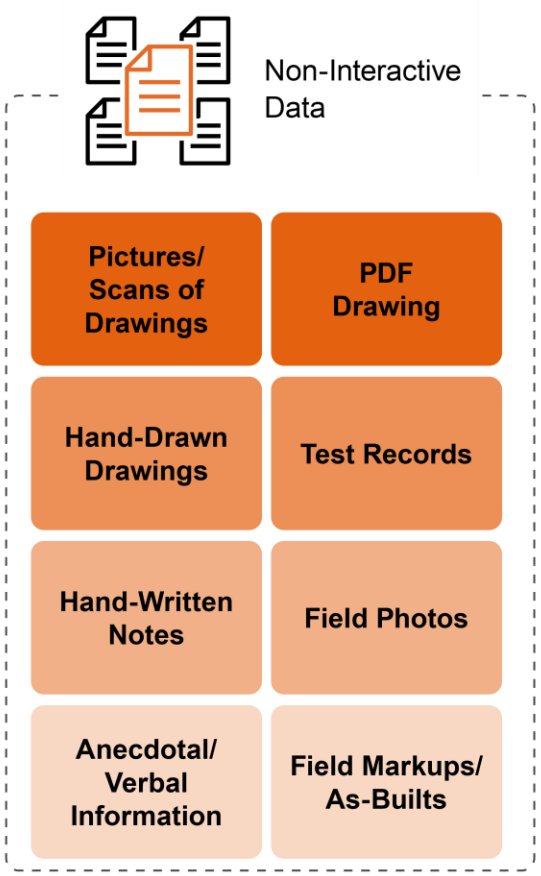
Roadmap the Plan

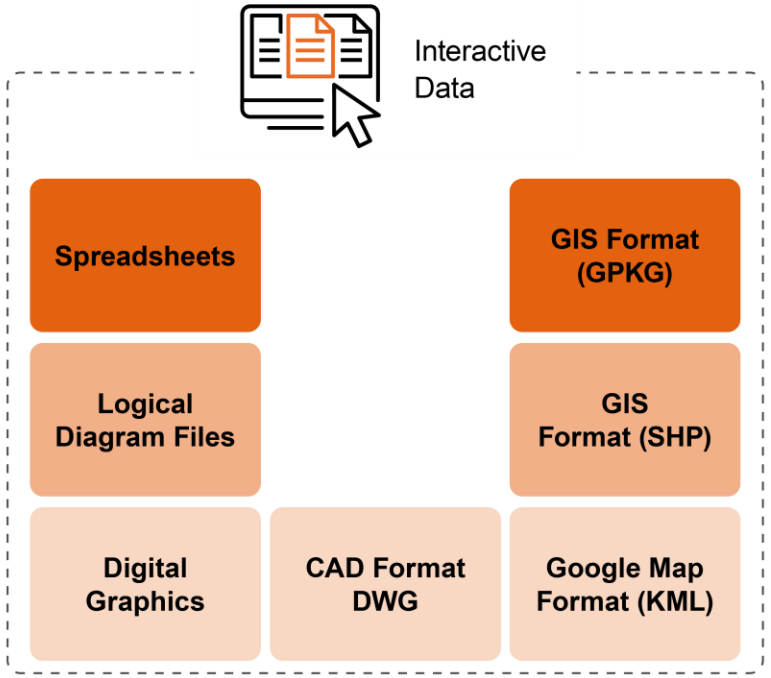
Answer the following Questions and connect the blocks:

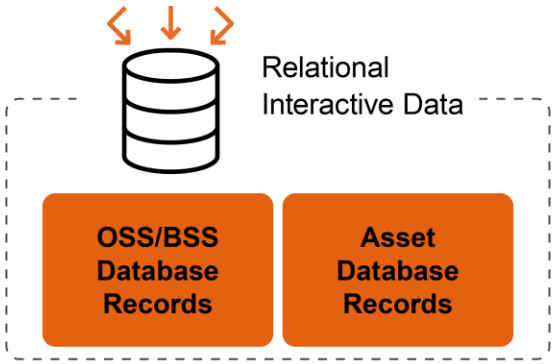
Where are we at?

What Tools and resources for progression do we have available to us?

*What are the costs of progressing and what are the costs of **not** progressing?*







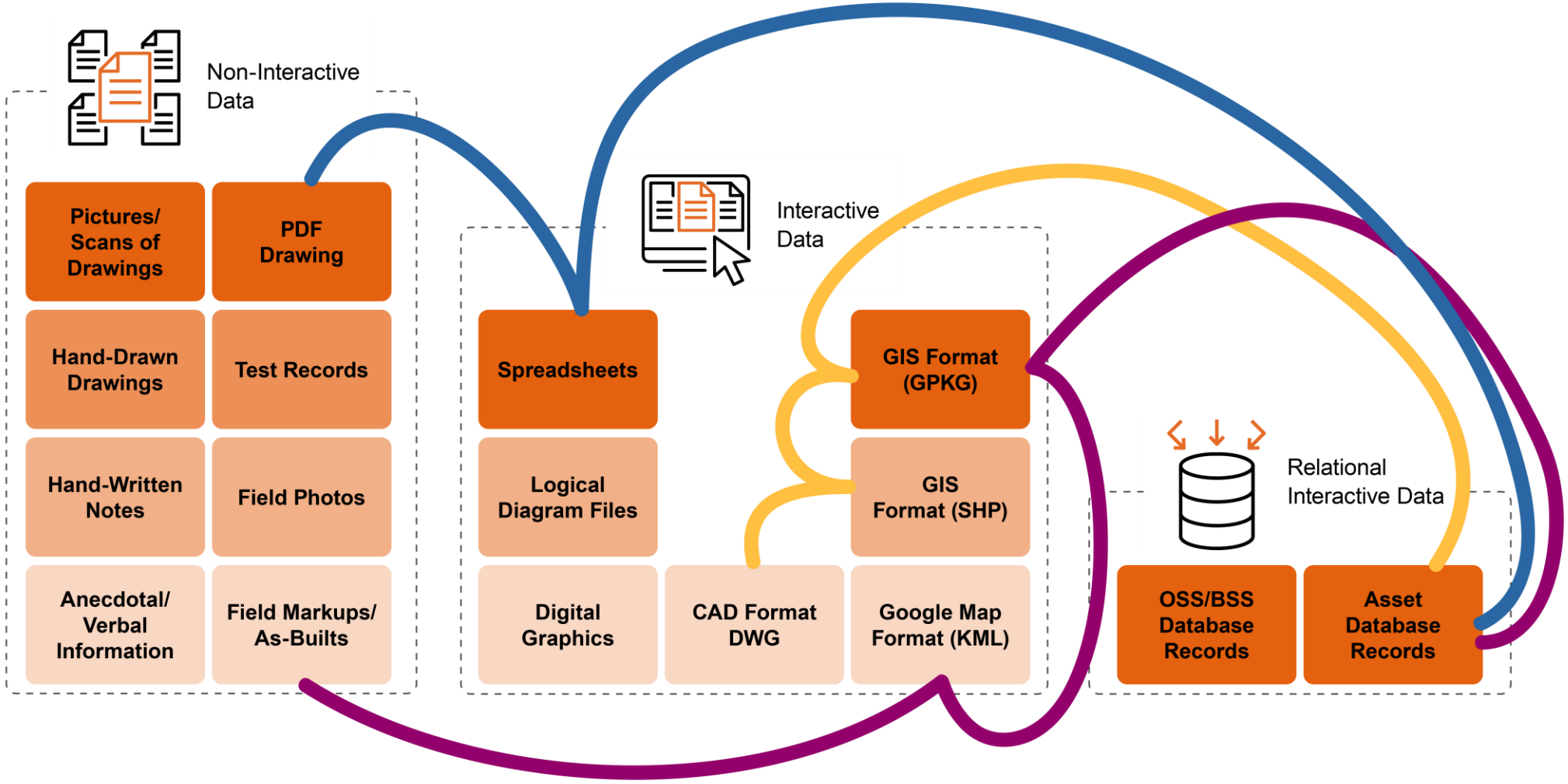
Roadmap the Plan

Answer the following Questions and connect the blocks:

Where are we at?

What Tools and resources do we have available to us to progress?

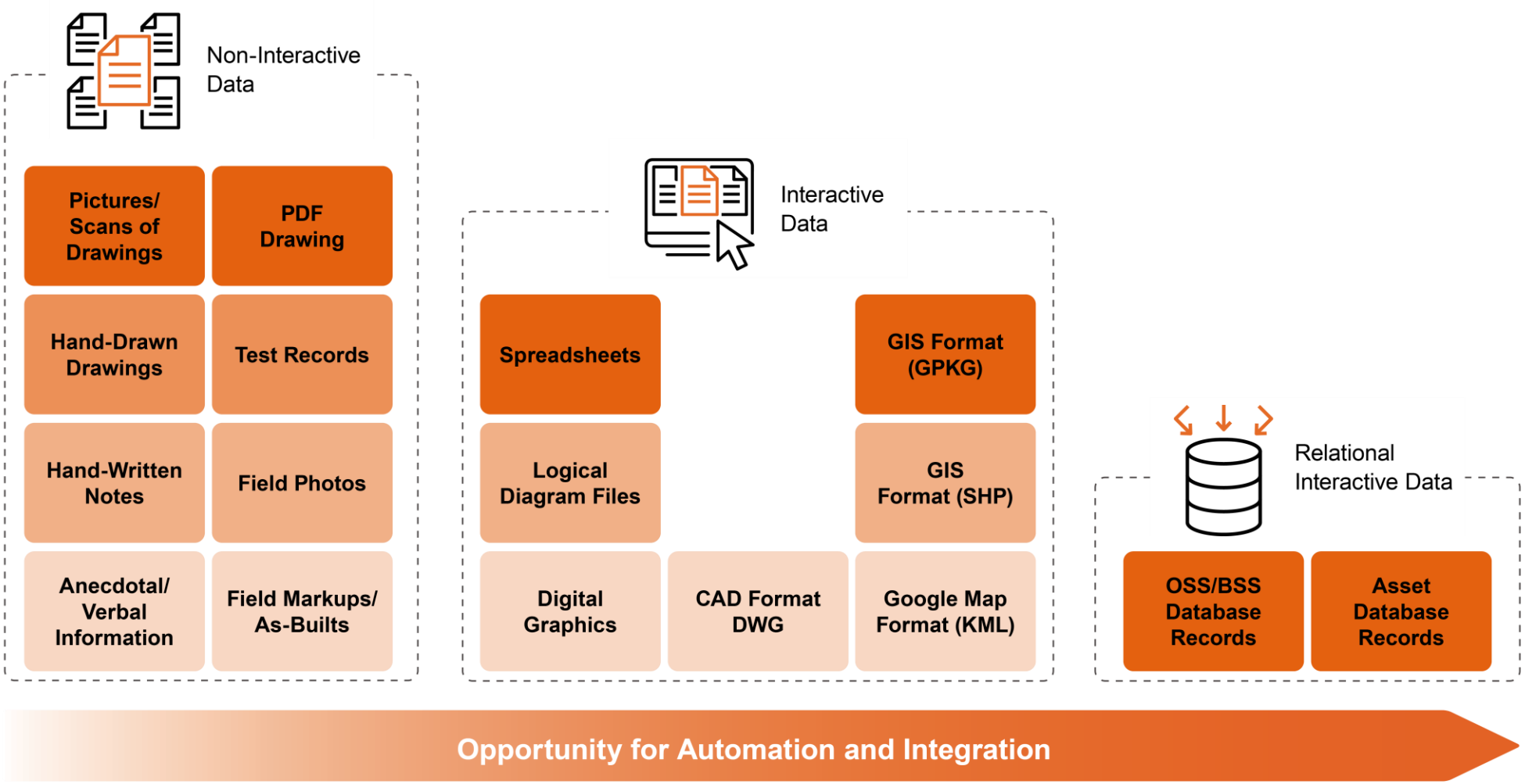
*What are the costs of progressing and what are the costs of **not** progressing?*



Updates and Integration

Data will always require update, how is that achieved?

- Manual Input & Update is common but inefficient
- Through this progress, opportunity for integrated systems increases
- All New Data should be landing in a “future friendly” format, no matter what stage an organization is at



Accessing the data and interacting with the Digital Twin

Broadband Digital Twins require Broadband Characteristics

Data needs to have RELATIONSHIPS to be a Digital Twin

Lines on a map versus twins of duct, cable, splices and equipment

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- Routes contain ducts or cables
- Ducts contain cables
- Cables contain strands
- Structures contain splice cases
- Cabinets contain equipment
- Buildings contain equipment
- Equipment requires ports
- Connectivity is linear– not a water pipe

A Broadband spatial solution needs to be different than other generic GIS tools

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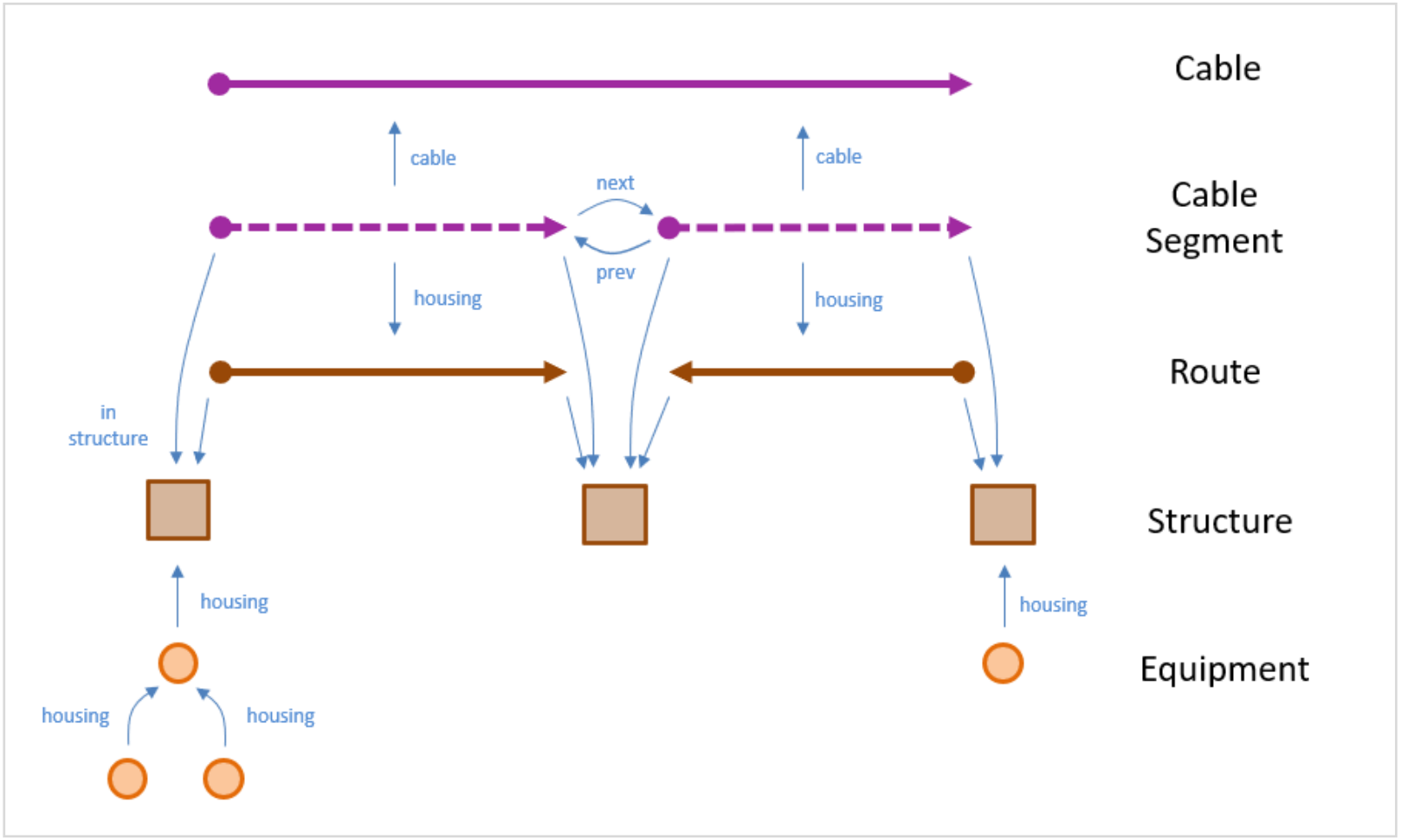
We can’t draw a stack of lines and points that pile on top of each other…
We draw base routes and structures and **establish network elements within them.**



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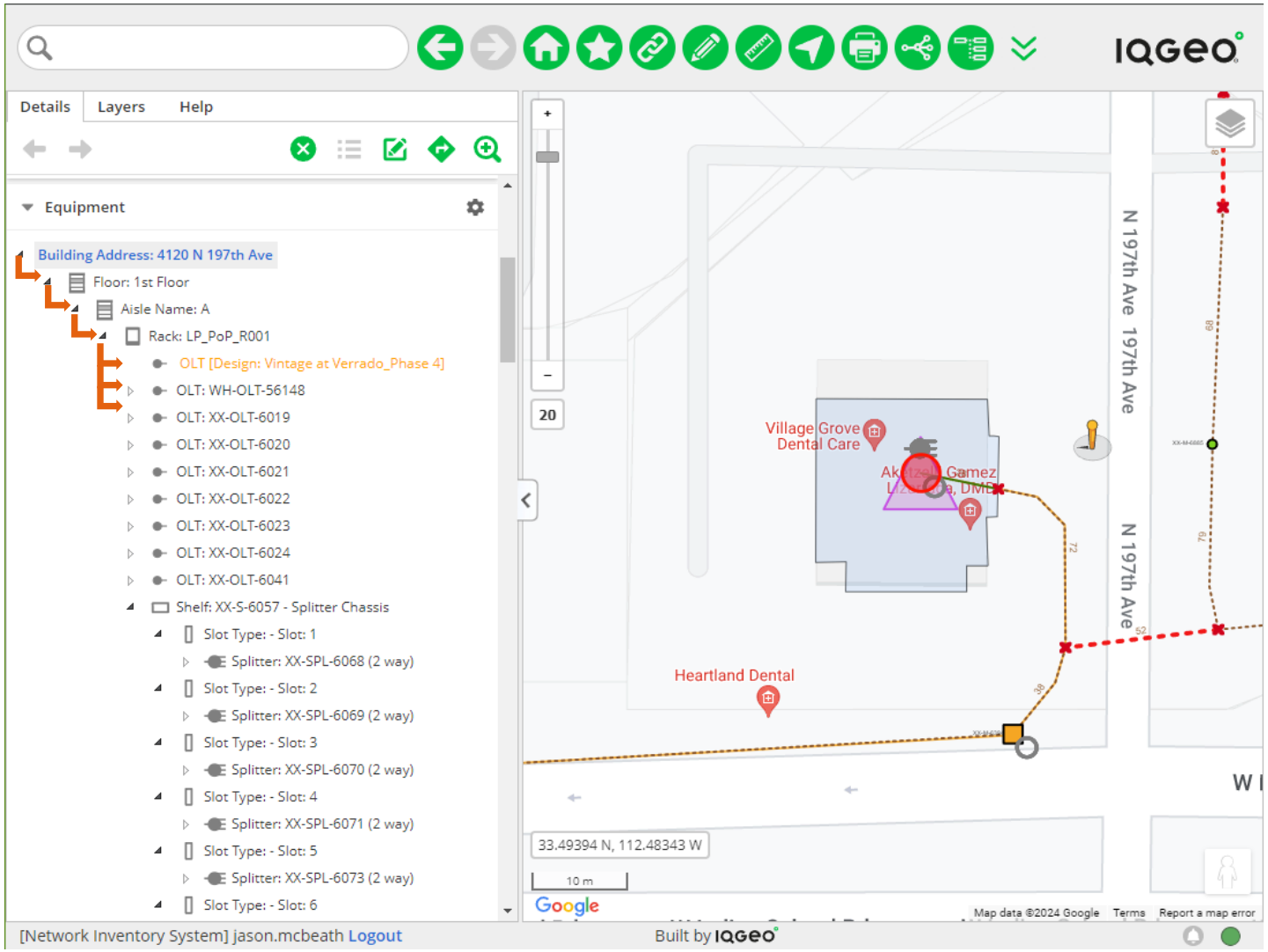
BULDINGS are the points on the map which *contain* elements such as Floors, Aisles, Racks and Equipment.

The elements are all configurable – they can be utilized to organize data and recreate the physical infrastructure and spaces of the network.

This allows for a very detailed digital recreation of the network, a **digital twin**



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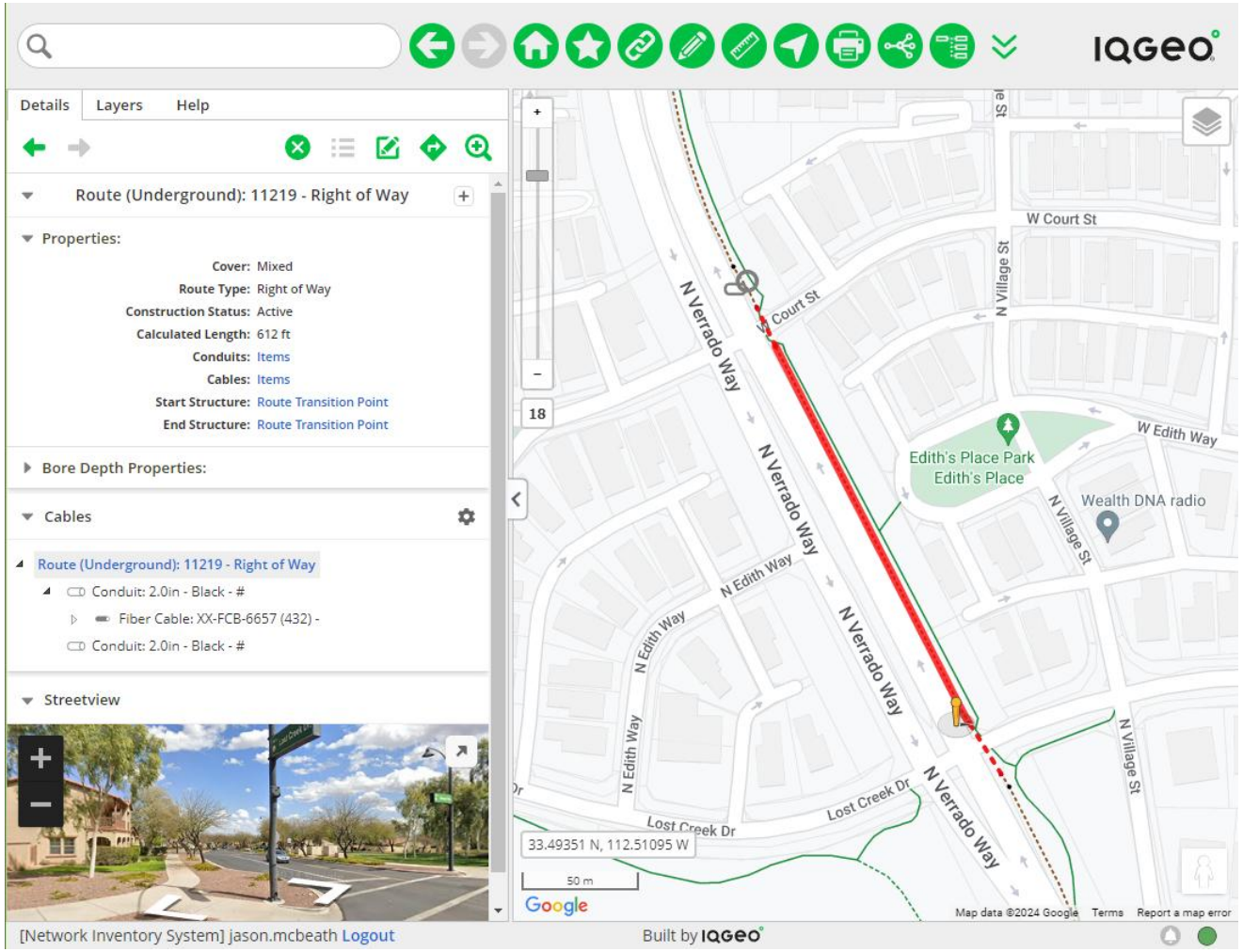
ROUTES are the lines on the map which *contain* elements such as Conduit & Cables

The routes are used to accurately recreate the running lines, and cables and ducts can then be contained within the route.



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Building Better Networks

Technology Challenges

What do you need to think about when making a long-term system of record decision?

- All in one or specific function
  - Design automation
  - Asset Management
- How do I get existing data in my system?
- Standard GIS integrations
- Who owns the data?
- Field / web access – both cloud connected and offline
- Construction -> Operations: Workflows to keep the system up to date
- Cyber security – cloud based / on-prem solutions

Design and Network Data Solutions

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We see value in end-to-end project framework that is **empowered** through a combination of powerful software solutions as well as process and communications toolsets to enable **all stakeholders** access to consistent data.

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Linear Data Stream that brings people to the data rather than data to the people

A Single Source of Truth

Broadband Network Planning providing automated network planning and design software to help fiber operators rapidly design the networks of the future.

Project & Construction Management utilizing user level controls and geospatially controlled data sharing, managers can distribute various tasks to different team members, all from one centralized platform.

Network Maintenance & Operations Field personnel can access the full database and complete functionality of the system, from anywhere at any time, offline or online.

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Case Study:
4500 Premise FTTH Network Example

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Legacy systems were spreadsheets and PDF drawings

- Manual exercise to check all network ports in the field - 13 FDH and 400+ Drop Terminals
- ~30 splice cases opened on an active network
- Data was converted and created in a sub-par system – Old telecom software not suited for fiber

Result

250 Field Hours on Inspections

400+ Hours on data conversion and implementation

18 months of schedule eaten trying to catch up after only 5.5 years of operations

- Legacy system never added any efficiency to operations and became an administrative burden
- Records were found to be “rotting” 6 months after this effort

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Is it too late to implement?

No, and today is better than tomorrow to get started

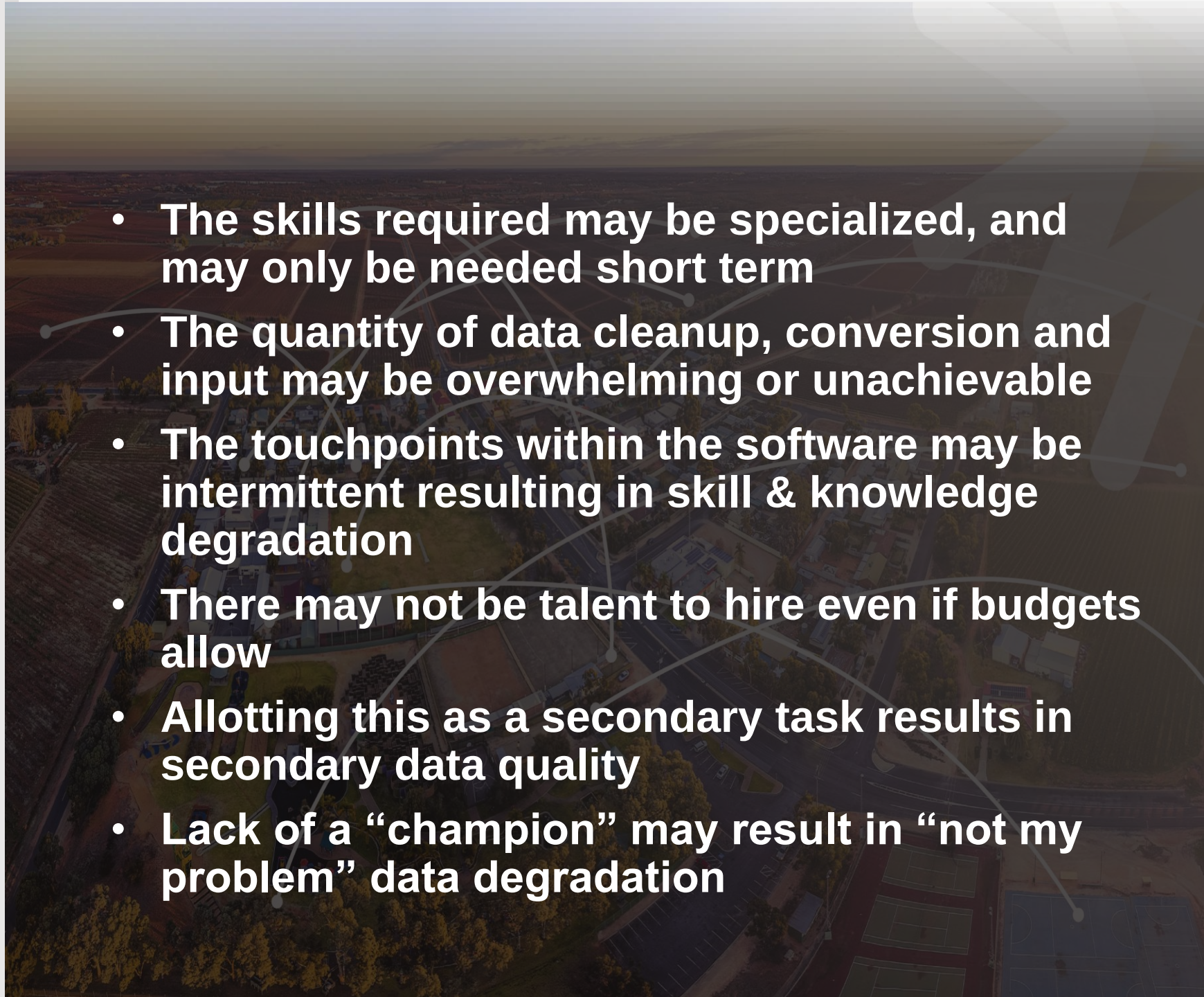
Implementation Strategies

Through a strategic project framework, any size of network owner can roadmap and execute

- **Take a step-by-step approach**
- **Evolve the model as you get it– find systems that support adding data now or later**
- **Assess current asset management practices and identify gaps**
- **Establish clear goals and objectives**
- **Develop a comprehensive asset inventory and data management plan**
- **Train staff and establish processes for ongoing asset management.**

Challenges

We at Arcadis have experienced the evolution of these challenges first-hand and have created a service offering to help network owners of any size.



- **The skills required may be specialized, and may only be needed short term**
- **The quantity of data cleanup, conversion and input may be overwhelming or unachievable**
- **The touchpoints within the software may be intermittent resulting in skill & knowledge degradation**
- **There may not be talent to hire even if budgets allow**
- **Allotting this as a secondary task results in secondary data quality**
- **Lack of a “champion” may result in “not my problem” data degradation**

Questions

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