



**Arizona State  
University**

*KGA Founding Member*



# Proto-OKN: Supply and Demand Open Knowledge Network (SUDOKN): Empowering small and medium-sized manufacturers by bolstering their resilience, visibility, and agility

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September 2023







National Science Foundation  
Directorate for Technology, Innovation and Partnerships

## Part 1:

# Proto-OKN: Building the Prototype Open Knowledge Network

Chaitan Baru, Jemin George, TIP Directorate

# Proto-OKN Vision

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- An **interconnected network of public data** to help **power the next wave of artificial intelligence** exploration, while addressing various societal challenges.
- It would transform our ability to unlock **actionable insights from data** by **semantically linking information** about related entities.
- Largest investment ever by NSF in the KG area (close to \$27M).
- Proto-OKN creates an **open platform** that benefits government and non-government users alike, **driving innovation and collaboration**.

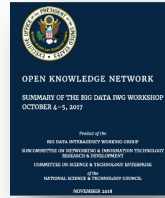


# Where it came from ...



NSF Harnessing the Data Revolution Big Idea

2017



Big Data Interagency Working Group Workshop on OKN @ NLM

Oct 2018



Convergence Accelerator Track A: Open Knowledge Network 2019-2022

Sept 2019



Report of the National Security Commission on AI. Recognizes the need for OKN

March 2021

March 2022



Special Issue of the AI Magazine on OKN

Sept 2022



Proto-OKN Innovation Sprint, Feb-June 2022. Design Workshop, June 2022, OKN Roadmap Report, Sept 2022

March 2023



Building the Prototype Open Knowledge Network (Proto-OKN)

October 2023

OKN Kickoff

# OKN Themes

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- **Theme 1s:** focus on the application and use cases, not so much the tech
- **Theme 2s:** focus on a common fabric architecture and supporting Theme 1s.
- **Theme 3:** focus on education, training, outreach, and coordination
- Proto-OKN projects involve **multidisciplinary teams** consisting of key constituents, e.g., **end-users, data providers, industry leaders, technical experts.**

# OKN Projects (18 Projects)

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- BioBricks-OKG – **Biology & Toxicology**
- Integrated Justice Platform - **Criminal Justice**
- DREAM-KG - **Homelessness**
- KG Warehouse for Neighborhood Information – **Firearm Incidents**
- Integrated Health and Justice for Rural Resilience - **Social determinants of health and justice**
- **SUDOKN – Manufacturing supply chains**
- CollabNet – **Network of academic researchers**
- Software Supply Chains – **software development**
- Connecting Biomedical information via SPOKE - **biomedical**
- Integrating Biomedical Insights with Social Determinants of Health – **biomedical**
- WEN-OKN – **Water & Energy Nexus**
- SAWGraph – **Agriculture & Water**
- Evaluation and Development of Climate Models – **Climate**
- Knowledge Graph Informing Soil Carbon Modeling – **Agriculture**
- Wildlife Management under Climate Change – **Climate**

Theme 2: FRINK  
Theme 2: SPIDER  
Theme 3: EduGate

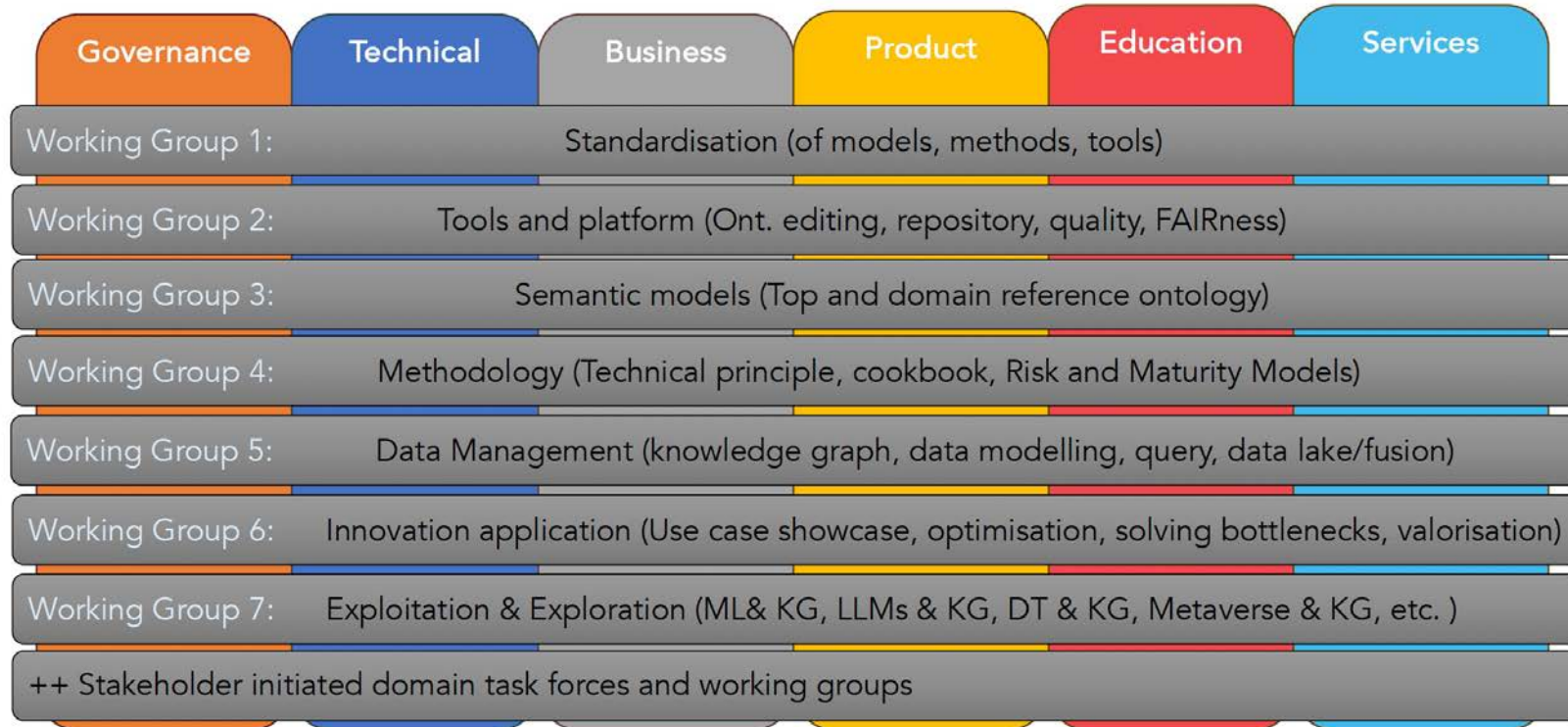
Kickoff Meeting on Oct. 17<sup>th</sup> in Alexandria, VA .. Perfect Timing !!





# Proto-OKN and KGA

EduGate



FRINK , SPIDER (OKN Fabric)

Theme 1 projects



# Part 2: Supply and Demand Open Knowledge Network

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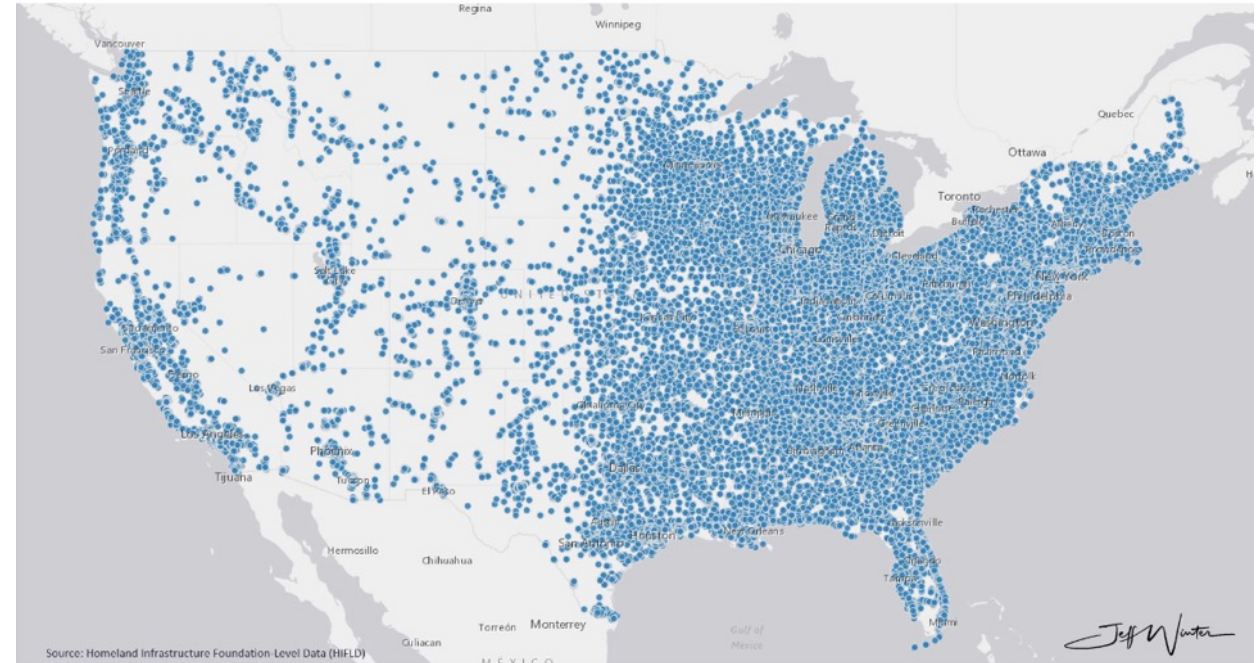
## Investigators:

- Dr. Farhad Ameri
- Dr. Srividya Bansal
- Dr. Hyuoonwoong Ko
- Dr. Binil Starly

# Motivations and Significance

- There are 292,825 manufacturing facilities in the US
- About 90% of them have less than 100 employees.
- SMMs account for %75 of all US manufacturing output.

Manufacturing Facilities in the United States



Despite their critical role in the US economy, **Small and medium-sized manufacturers (SMMs)** are especially challenged with sustaining operations.

One Reason: **Limited access to accurate data and analytical capabilities**







# Project Objectives

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- SUDOKN aims at democratizing access to publicly available manufacturing data and maximizing its utility for SMMs by proposing a three-pronged approach:

1. Develop a set of principle-based, accurately axiomatized, and reusable ontologies.
2. Develop and deploy the tools and methods for collecting, ingesting, validating, visualizing, and analyzing and manufacturing data
3. Use these tools and ontologies to develop and deploy an open **Manufacturing Capability Network (MCN)** and other supporting knowledge graphs from diverse datasets .

# Vision

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- SUDOKN will become a **shared and public body of manufacturing capability knowledge** that will evolve and expand through direct participation of communities of users and domain experts.
- It will transform SMMs ability to unlock actionable insights from data, bolstering their **visibility, resilience, and agility.**

*Promote Interoperability and Common Data Culture in Manufacturing*

**In 5 years, SUDOKN's manufacturing capability network will contain manufacturing data for all manufacturing businesses in the 50 states**

# Collaborators Roles

1. Provide access to datasets
2. Provide use cases (related to supplier discovery, SC resilience, and capacity scale-up)
3. Contribute engineering time toward developing domain ontologies
4. Engage end users in testing and validation of the products

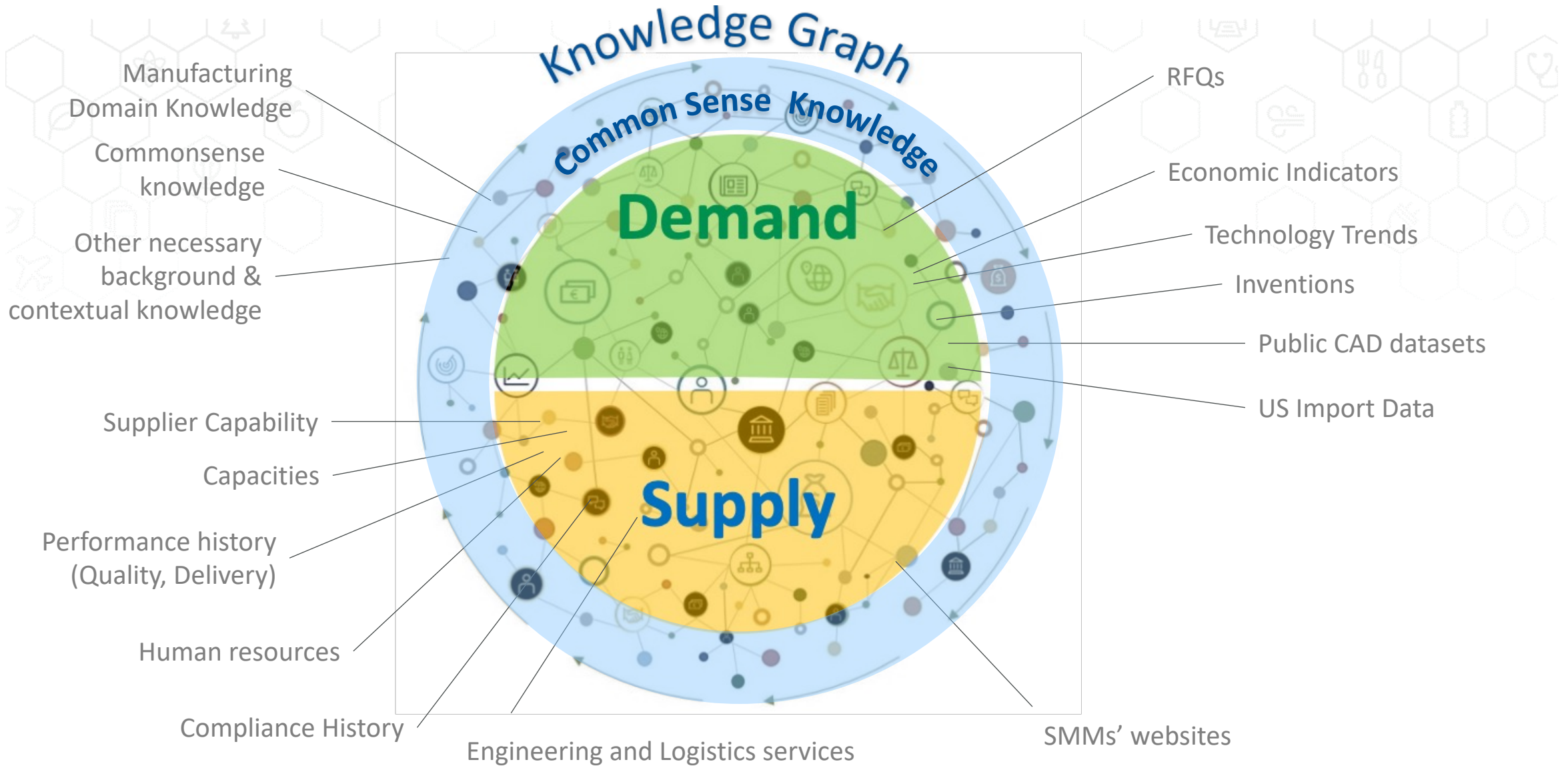


Industrial  
Ontologies  
Foundry

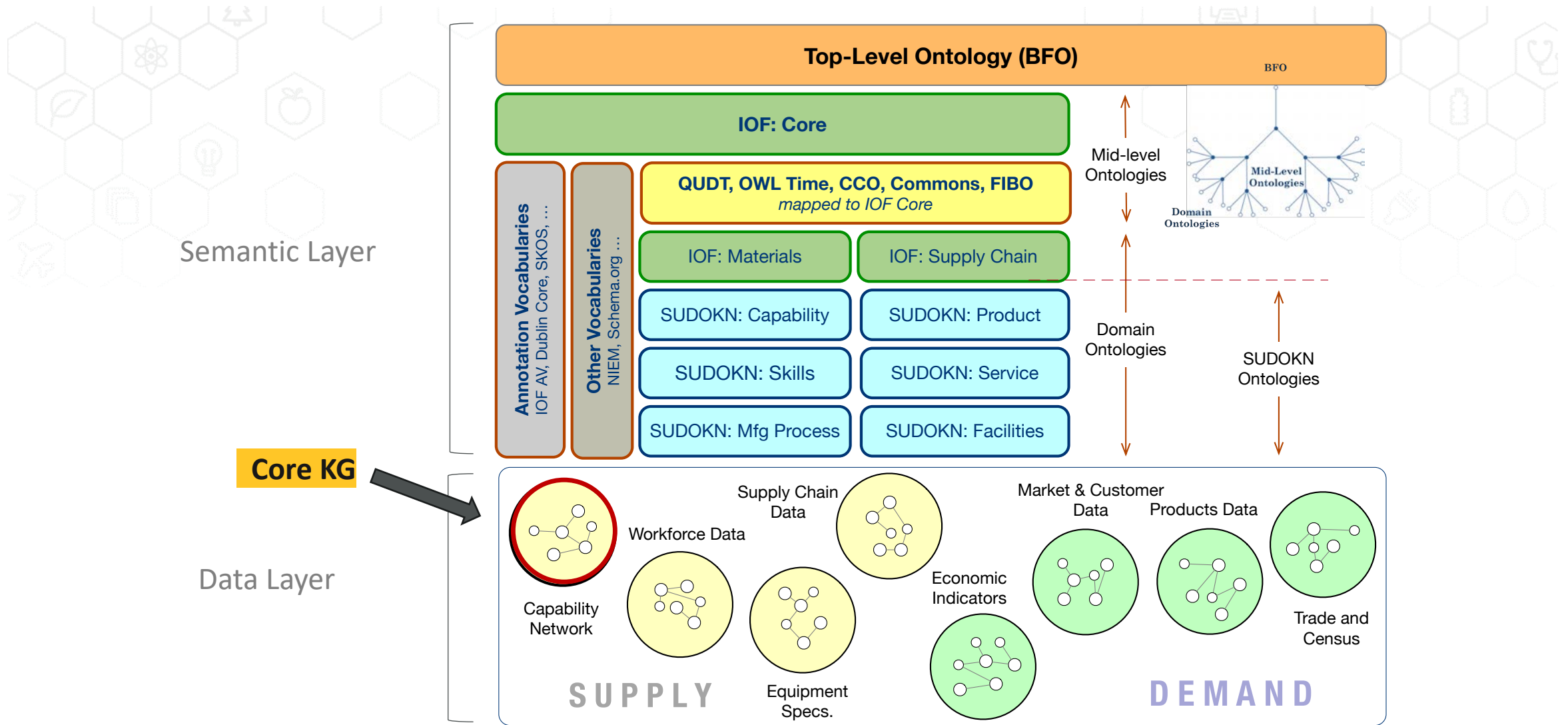


1. Ontology development and validation methods/tools
2. Reference/mid-level ontology modules





# Architecture



# Manufacturing Capability Network



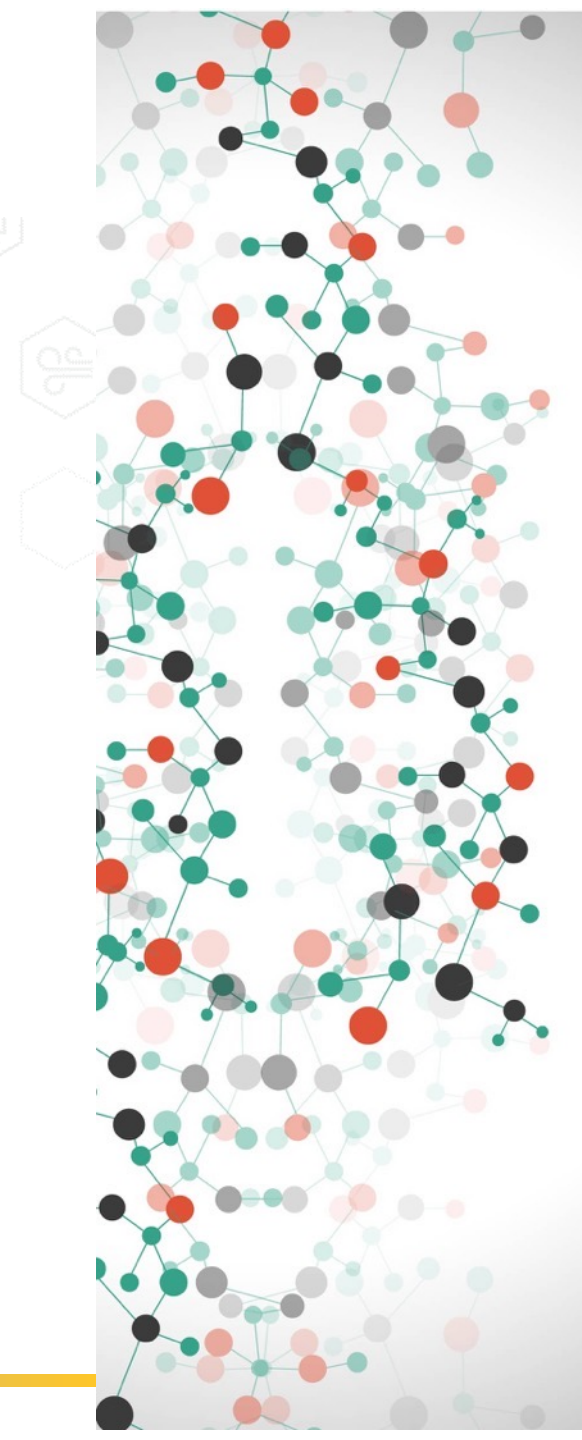
Millions of nodes



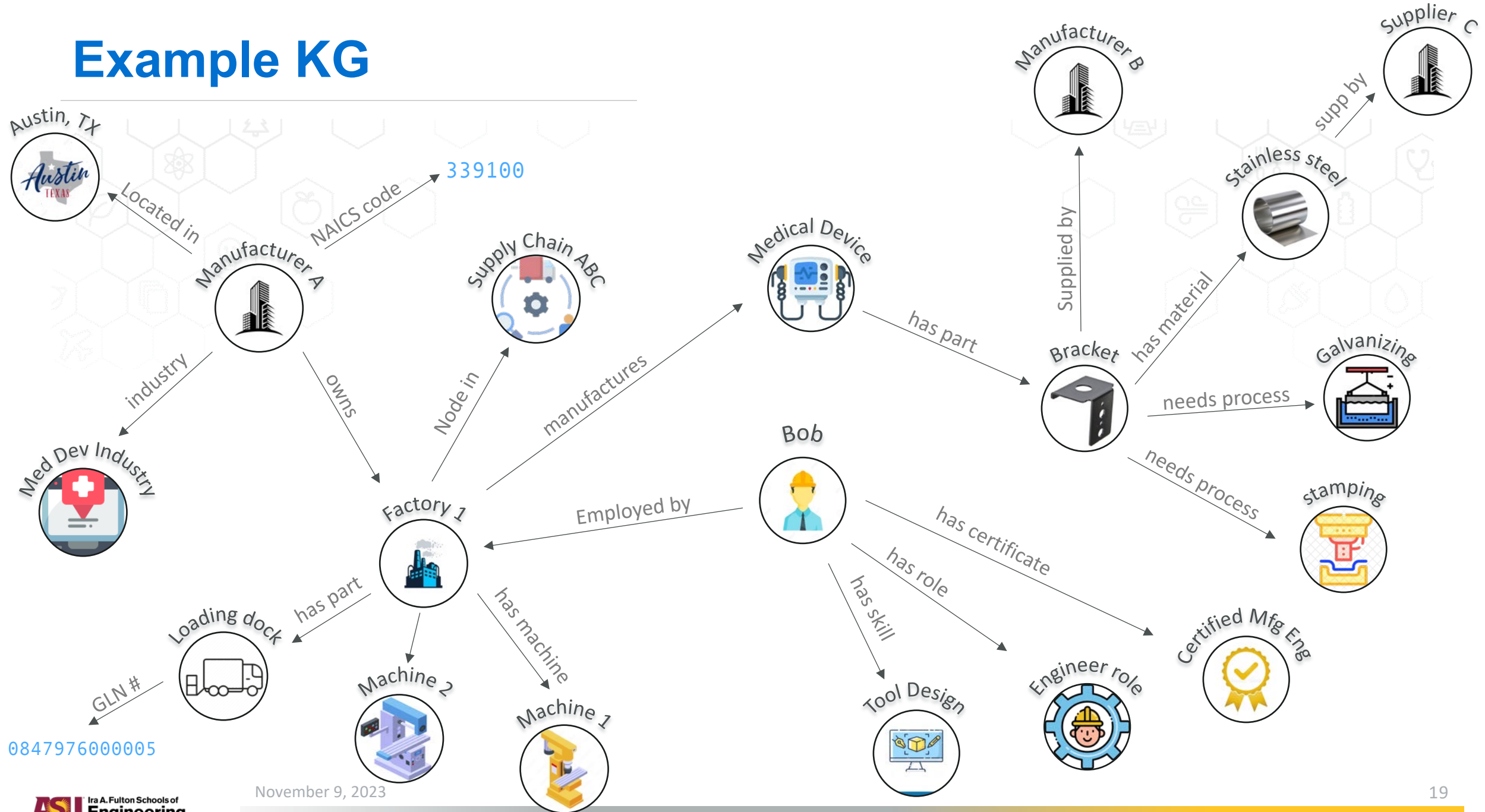
# Objects (nodes of the graph)

- Machines
- Factories/Facilities
- Human (Operators, Engineers, Managers, etc)
- Companies
- Locations
- Processes
- Products
- CAD Models
- Materials
- Certificates
- Skills and capabilities
- ...

November 9, 2023

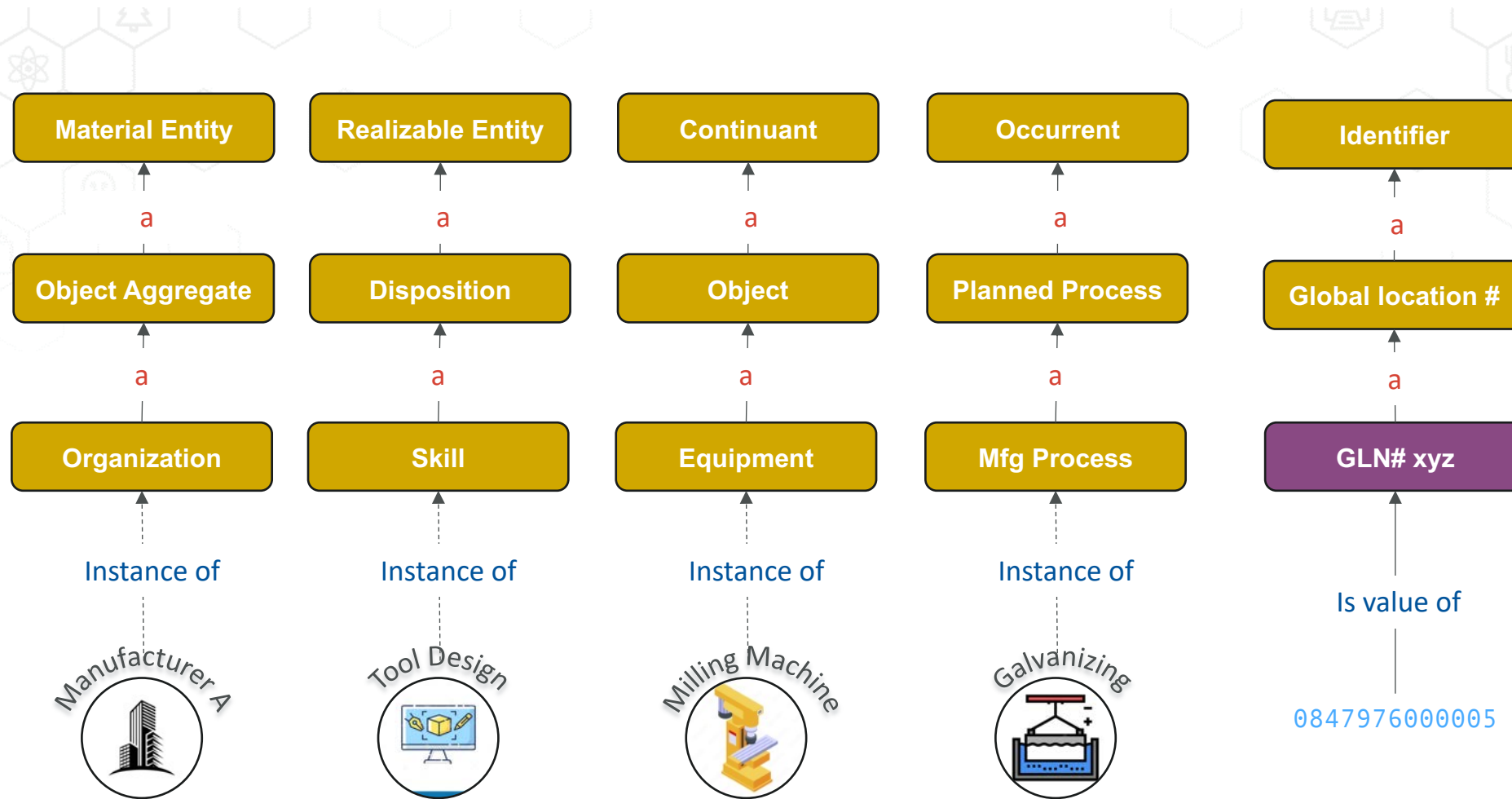


# Example KG

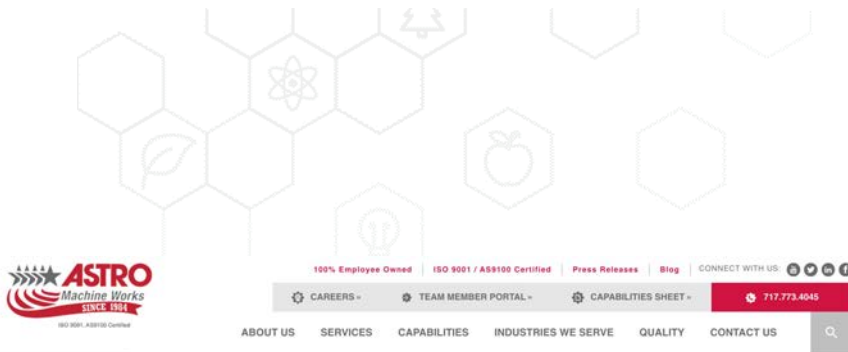


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# Mapping to Ontological Entities



# From Text to Graph



## MACHINING SPECIALISTS WITH A FULL RANGE OF CAPABILITIES

Astro Machine Works specializes in **custom machine building**, **precision parts machining** and **reverse engineering of components**. Astro Machine Works with more than 30 years of experience as a leading custom machine builder, will meet or exceed even your most exacting specifications.

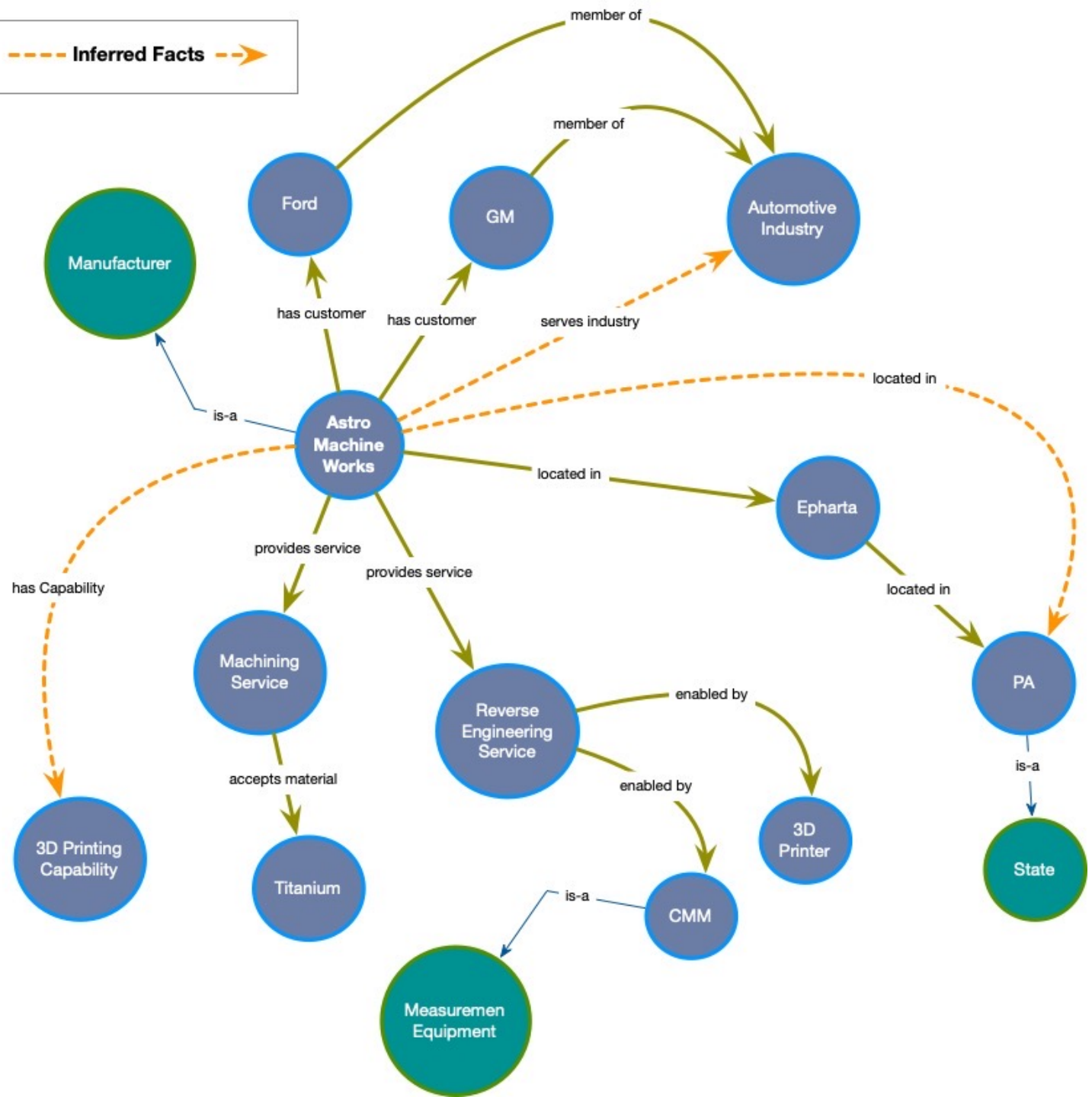
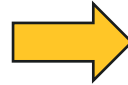
Our expert engineers, professional machining specialists and metal welding service professionals recognize how time-sensitive projects can be, and we are committed to completing your project accurately, on time and on budget. This applies to all aspects of our work from **five-axis machining** and CNC precision machining, to **panel-wiring services**, precision parts development and **machine rebuilding**.

At Astro Machine Works, we are proud to be an American manufacturing company focused on providing exceptional quality and value for all of the custom machine building, repair and rebuilding we do.

We have a custom machine shop dedicated to building custom machinery and providing full machine repair, precision parts machining and **metal welding and fabrication services** to a broad range of businesses. Our products are improving efficiencies and generating significant gains worldwide for industries such as:

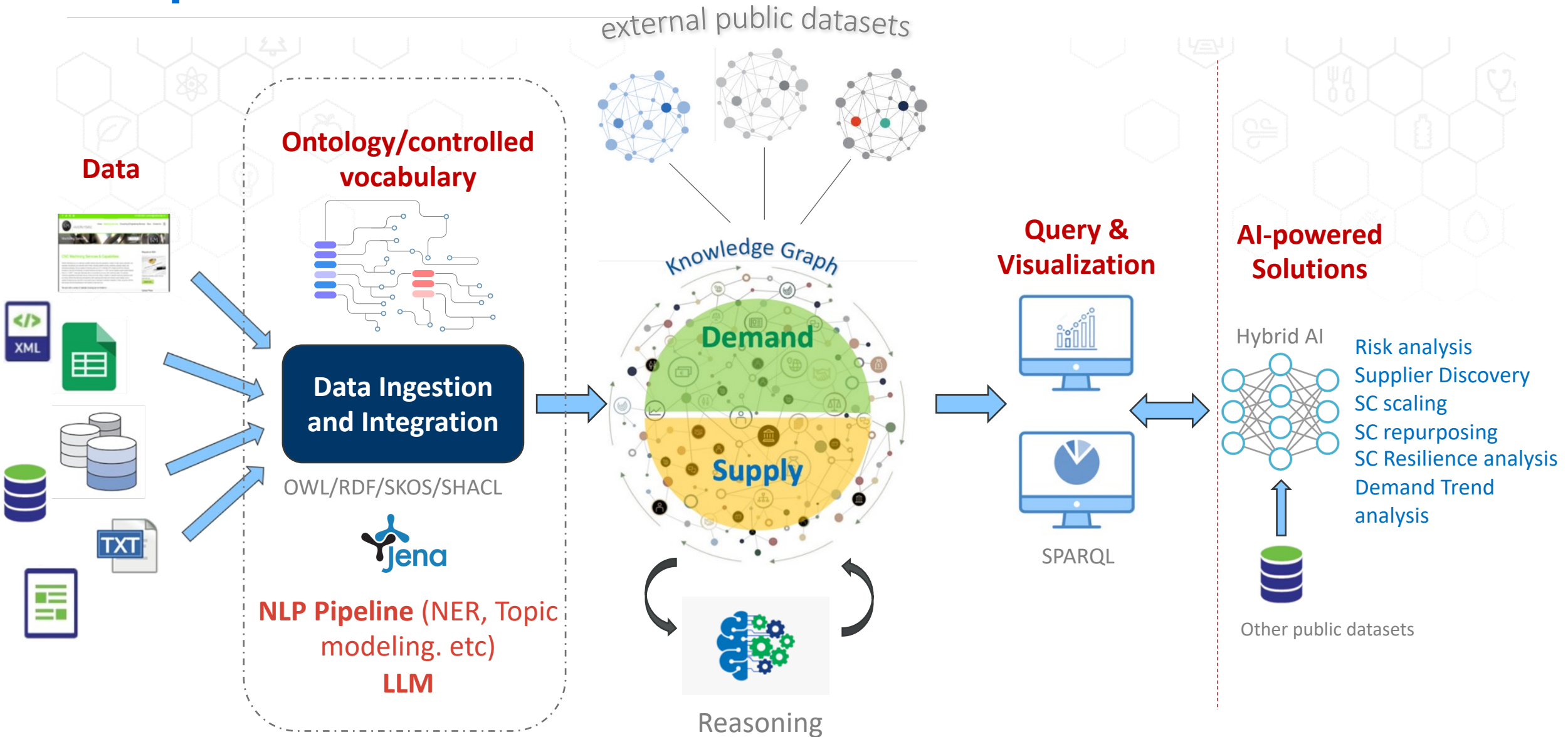


--- Inferred Facts --->





# Proposed Framework



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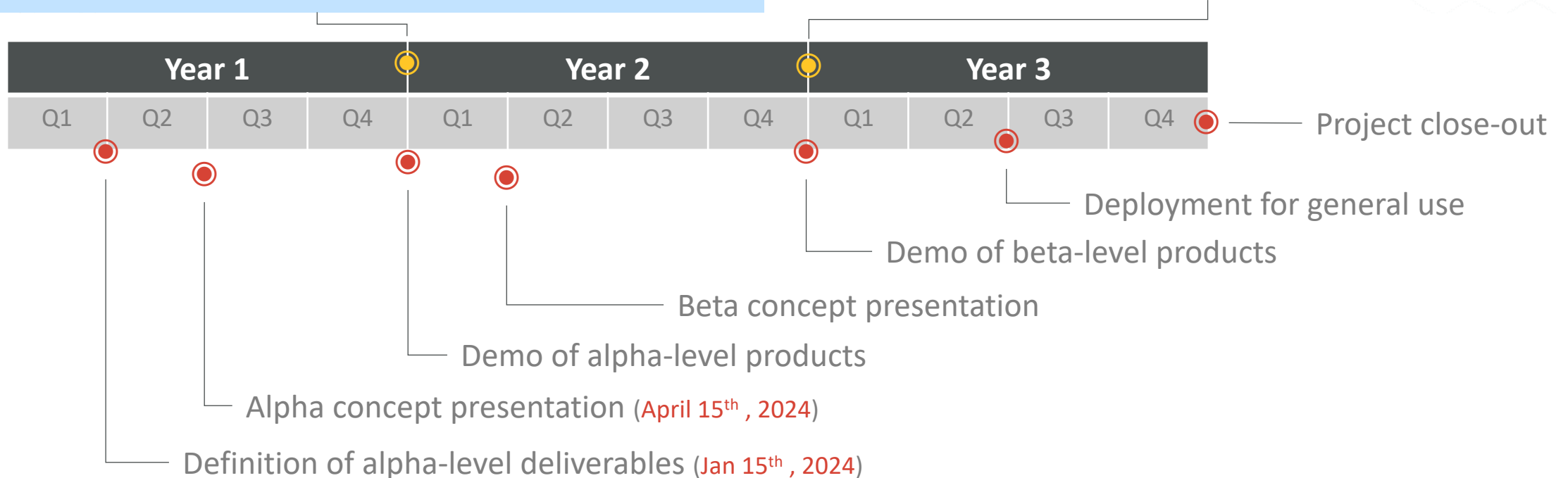
# Deliverables

Use case descriptions  
 SUDOKN ontologies  
**Pilot Manufacturing Capability Network (10,000 SMMs)**  
 Pilot KGs for Mfg Workforce, Patents, Equipment Specs for the selected industry sector(s)  
 Data ingestion pipeline  
 Pilot query and visualization Uis (in collaboration with theme 2)

## Alpha

MCN based on 30,000 manufacturers  
 Fully axiomatized ontologies (rules and constraints)  
 Reasoning & inference models  
 Validated data curation, ingestion, and markup tools  
 Schema.org extension with manufacturing vocabulary  
 Fully functional query and visualization Uis  
 NLP pipeline & training datasets  
 Training Materials

## Beta



# Open Industrial Digital Ecosystem Summit

Enabling Vendor-neutral, Standards-based Interoperability

**February 6th - 9th, 2024**  
**Tempe, AZ**

Hosted by Arizona State University

**A NIST, IOF and OAGi Event**

**Registration begins November 10th, 2023 at 9:00 AM Eastern**







# Thank You!

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