ITSD Information and Technology Solutions Directorate

Jet Propulsion Laboratory
California Institute of Technology

Realizing institutional digital transformation through graph data modeling and information reuse and integration

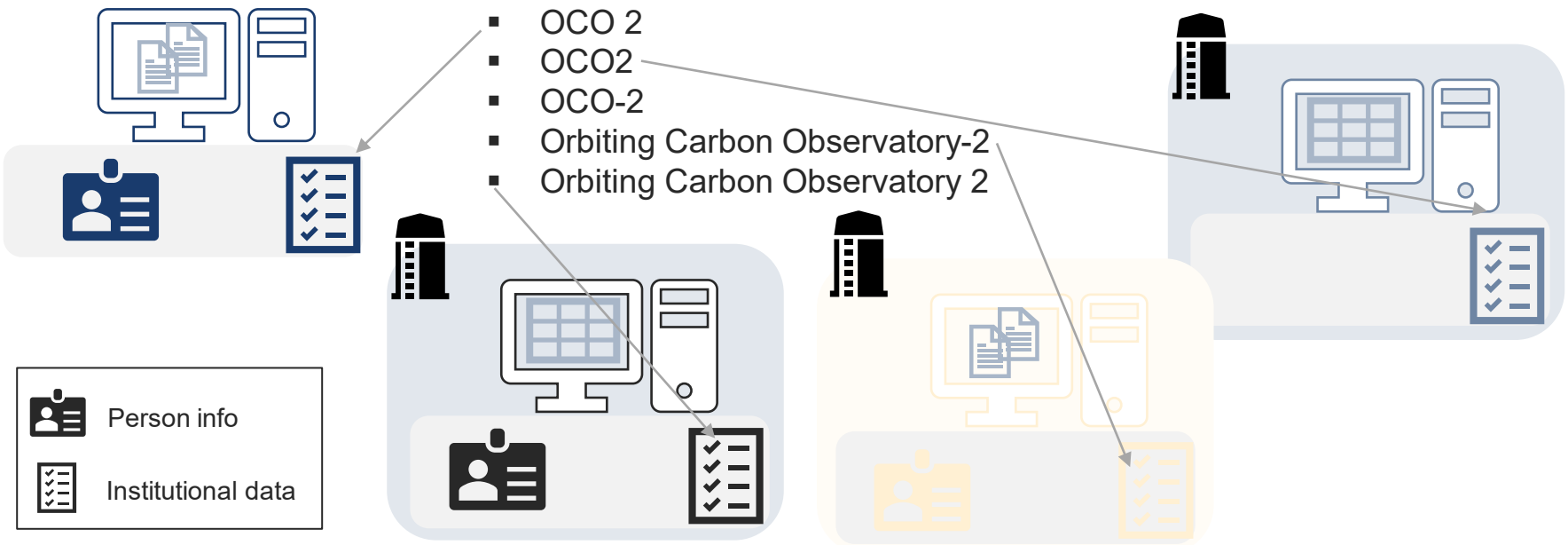
Dr. Lewis J. McGibbney, Content and Search Services Program Technologist
Collaborative Engineering and Information Capture (172A)
Application, Consulting, Development and Engineering Section (1722)

- JPL's Content and Search Services Program Technologist (Data Scientist III).
- Information retrieval, Web search, databases, natural language processing, semantic technologies, software and data engineering.
- Apache Software Foundation Member – Open Source Software practitioner.
- History of participating and leading standardization efforts across W3C, OGC, NASA's ESDSWG, OASIS, ESIP

Part 1 – data engineering and information modeling activities; introducing JPL's Institutional Knowledge Graph (IKG)

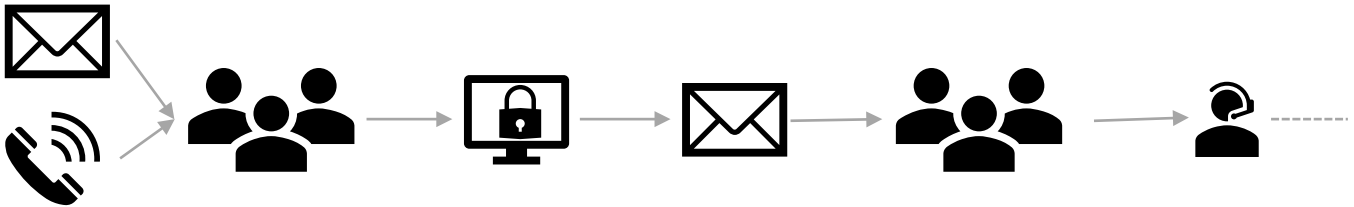
Are you like us?

Does your organization have multiple systems that maintain their own copies of enterprise data often resulting in out-of-sync data?



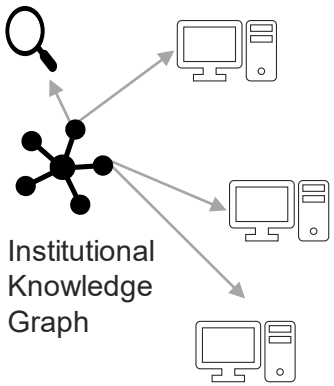
Current state: Institutional info & expertise is hard to find

Who has a background in chemistry?
Where's the Robotics Lab?
Who do I call if there's a hazard?
Who has experience on recent Mars lander missions? …



Desired state

“One-stop shopping”



Institutional Context

Topics

- ❑ Projects
  - ❑ Mars 2020
- ❑ Mission Targets
  - ❑ Mars
- ❑ Organizations
  - ❑ Engineering and Science
- ❑ Applications
  - ❑ Issue Tracking
- ❑ Publications
  - ❑ Science
- ❑ People

…

Answers to questions

Who worked on recent Mars lander missions?

MSL

Jane Brown

Mars 2020

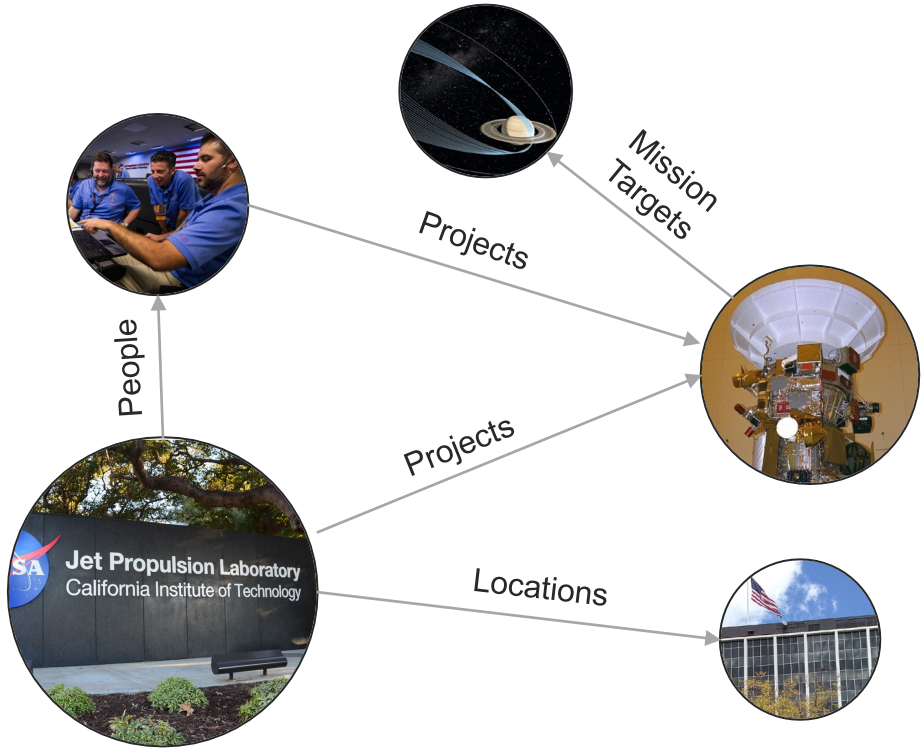
John Brown

Mars Sample Return

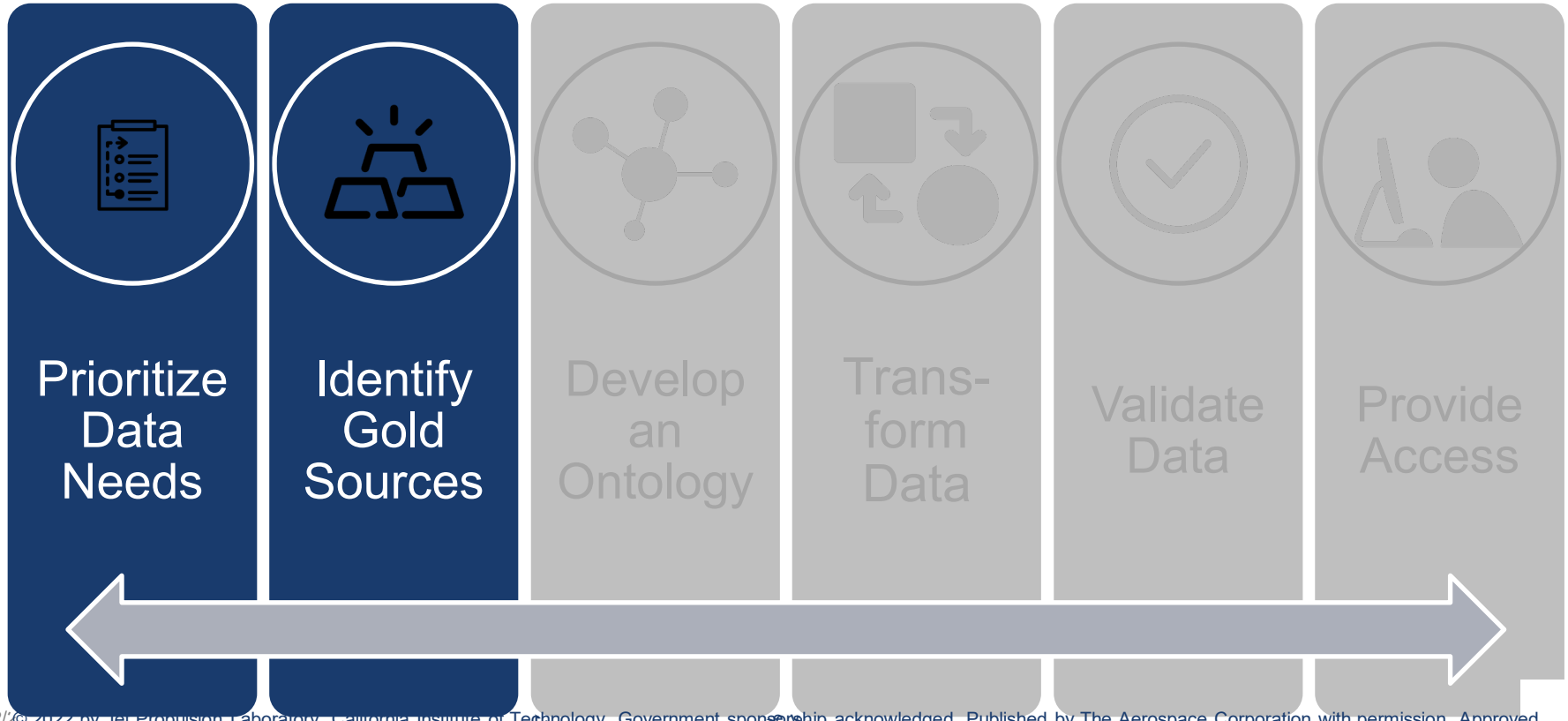
Red Green

The Institutional Knowledge Graph (IKG) provides…

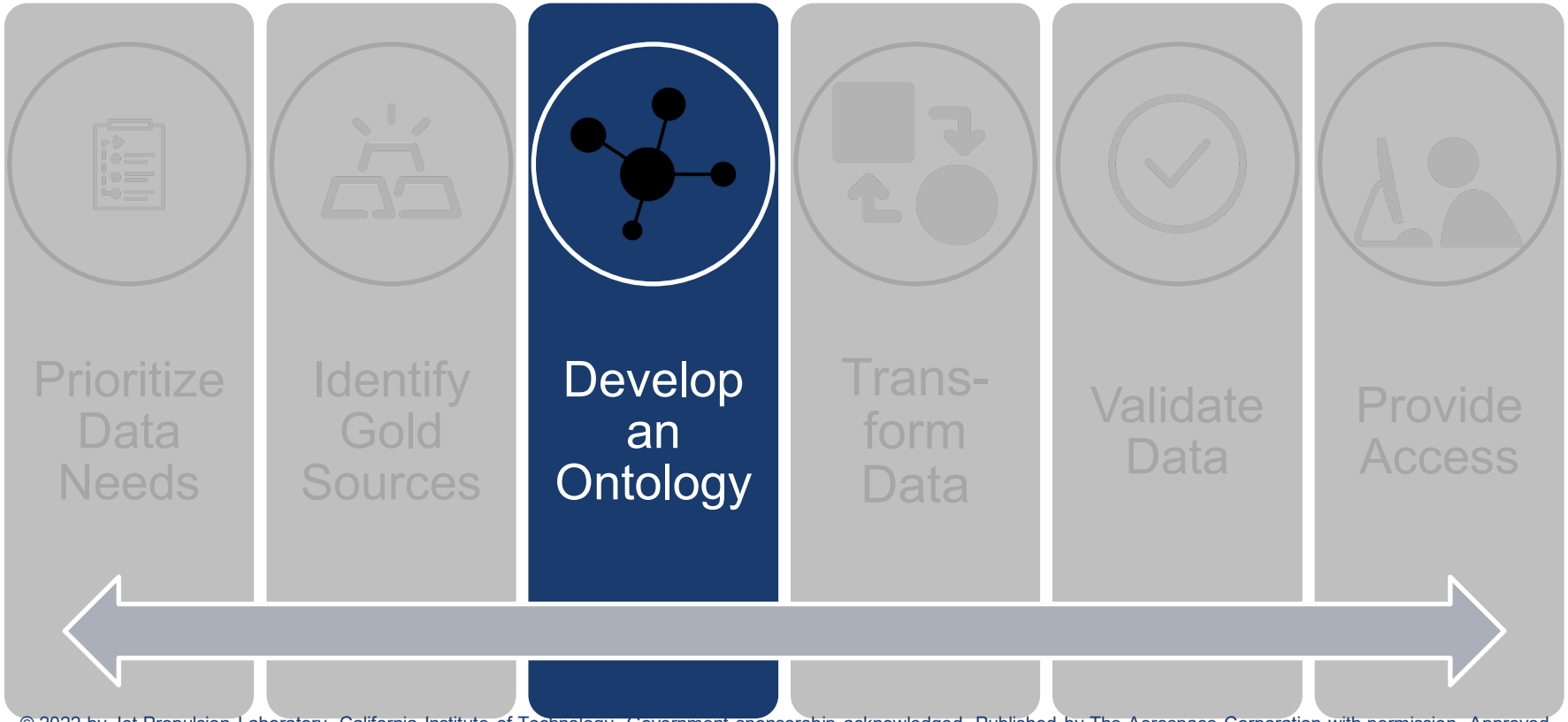
"a centrally managed knowledge graph that identifies and describes JPL's common concepts, taxonomies, and enterprise-wide real-world entities and the relationships between them."



Making the Institutional Knowledge Graph



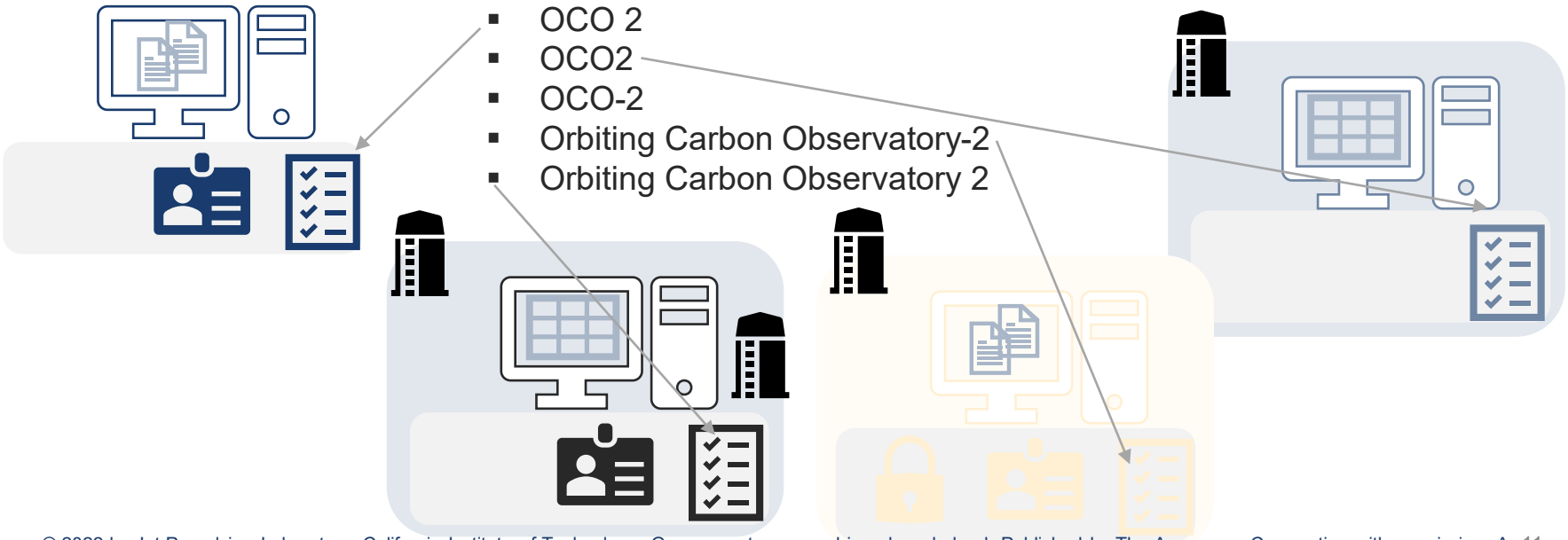
Making the Institutional Knowledge Graph



Making the Institutional Knowledge Graph

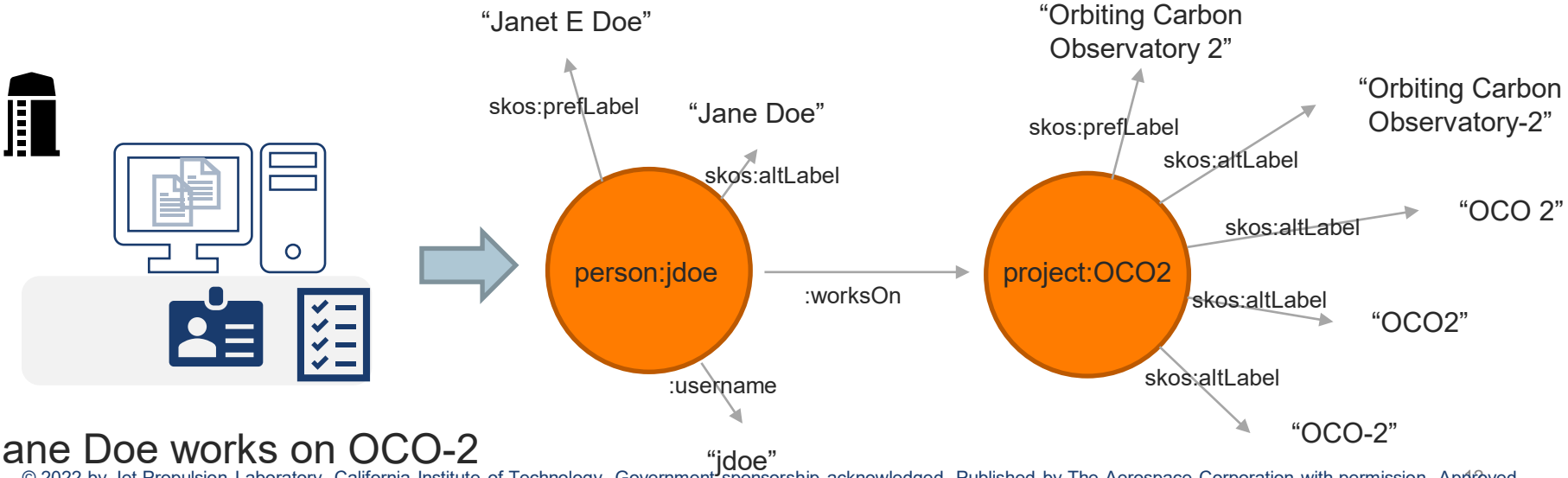
Inconsistent data

Remember our duplicate data about projects in siloed systems?



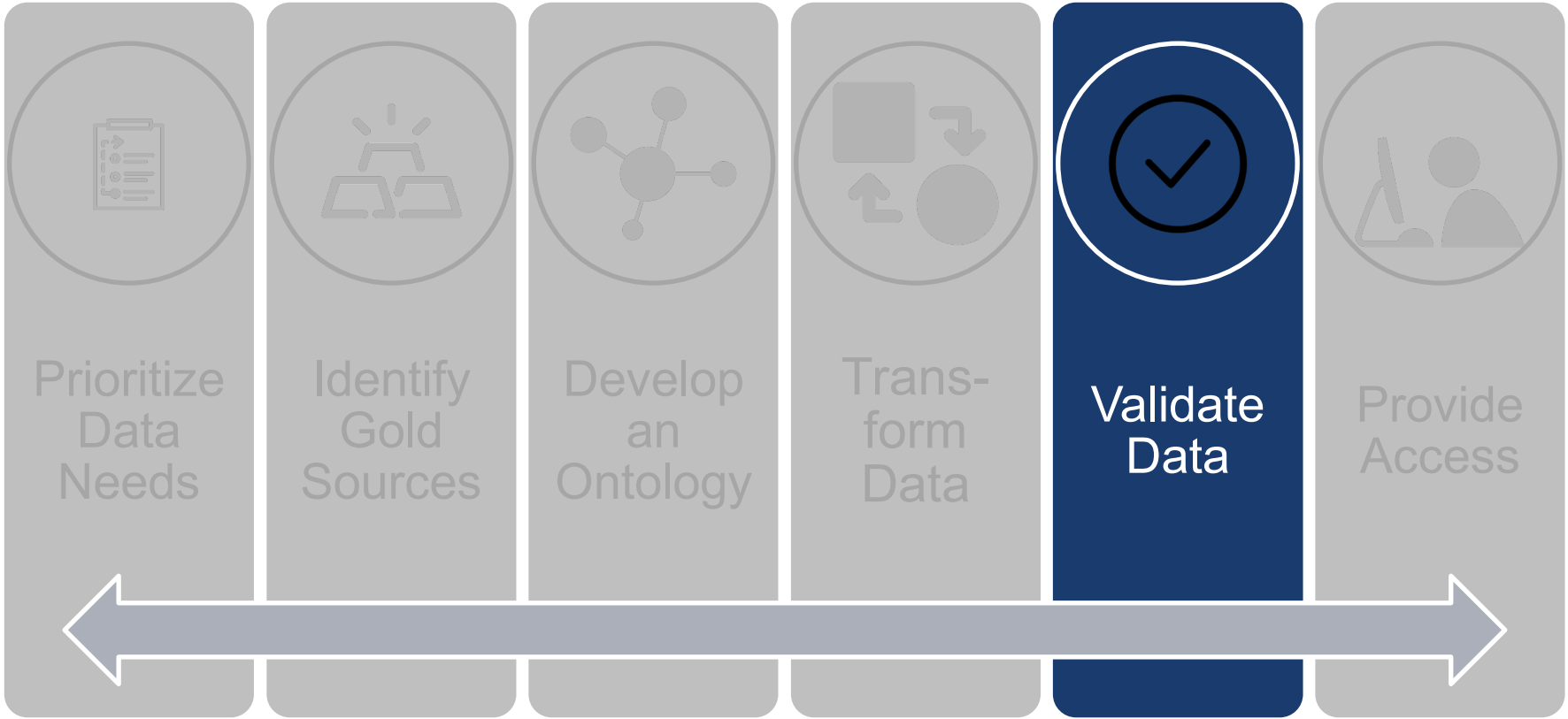
Standardization Against the IKG

Extraction against the data in the graph helps with the transformation, allowing us to standardize/match references to projects in one system to our institutional concept for that project



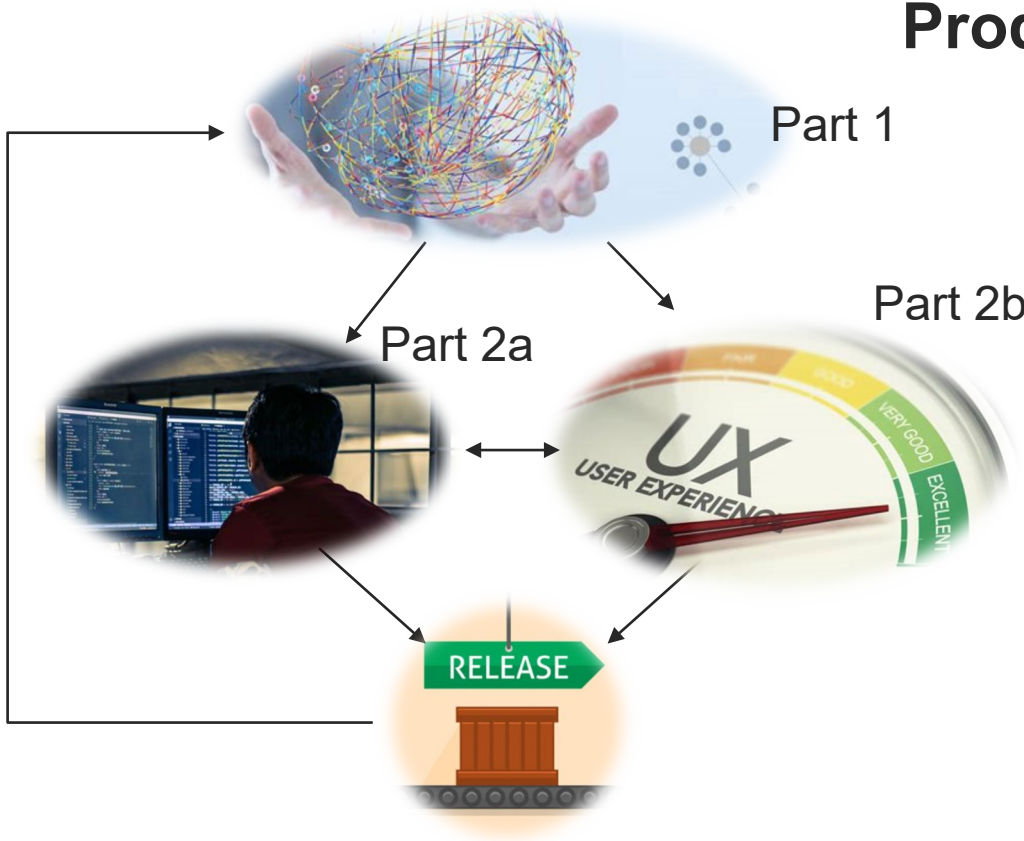
Jane Doe works on OCO-2

Making the Institutional Knowledge Graph



Part 2a – information reuse and integration (IRI); how gold source data powers JPL's search and discovery platform a.k.a JSearch

Product Delivery Workflow



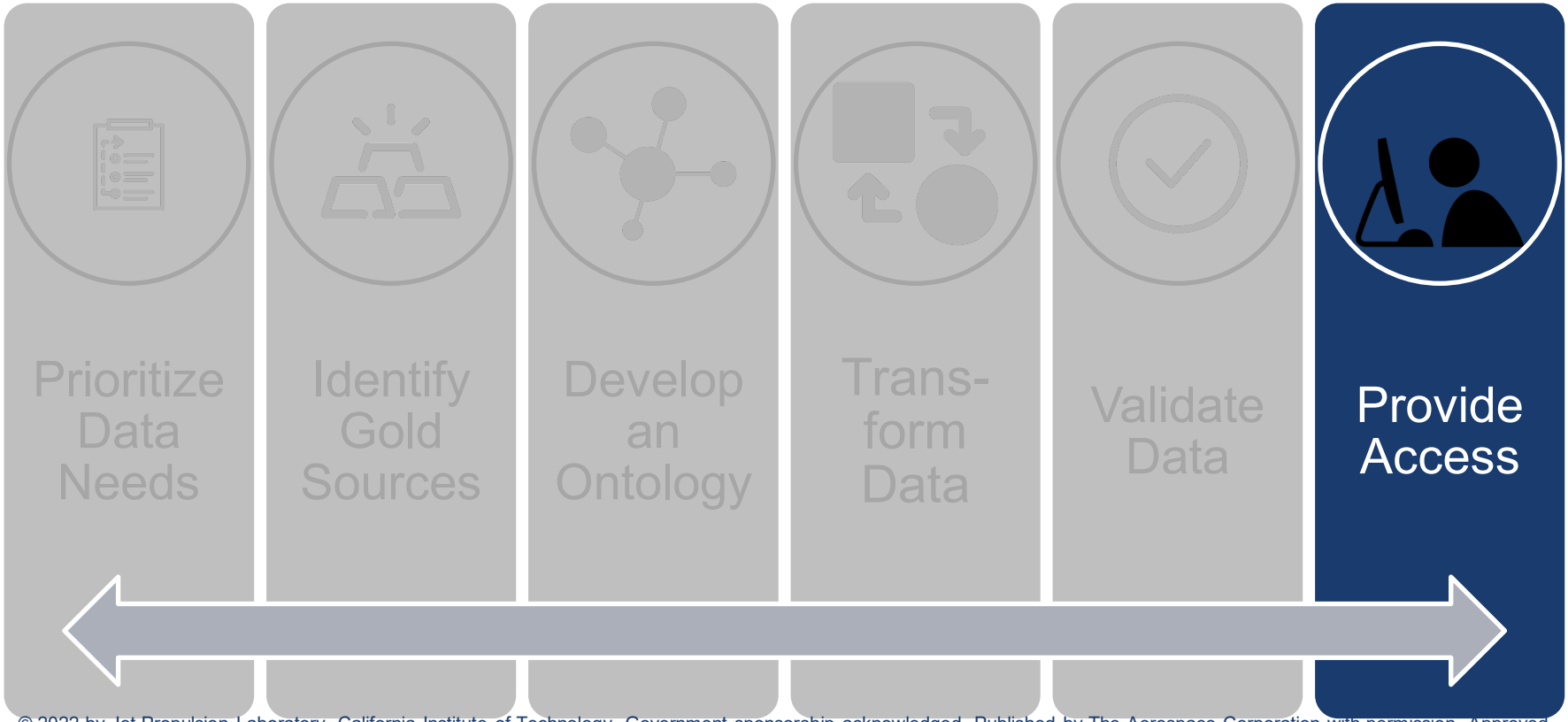
Part 1: Data Eng, Info Mod, IKG

Part 2a: IRI AND Part 2b UX Research & Design in parallel

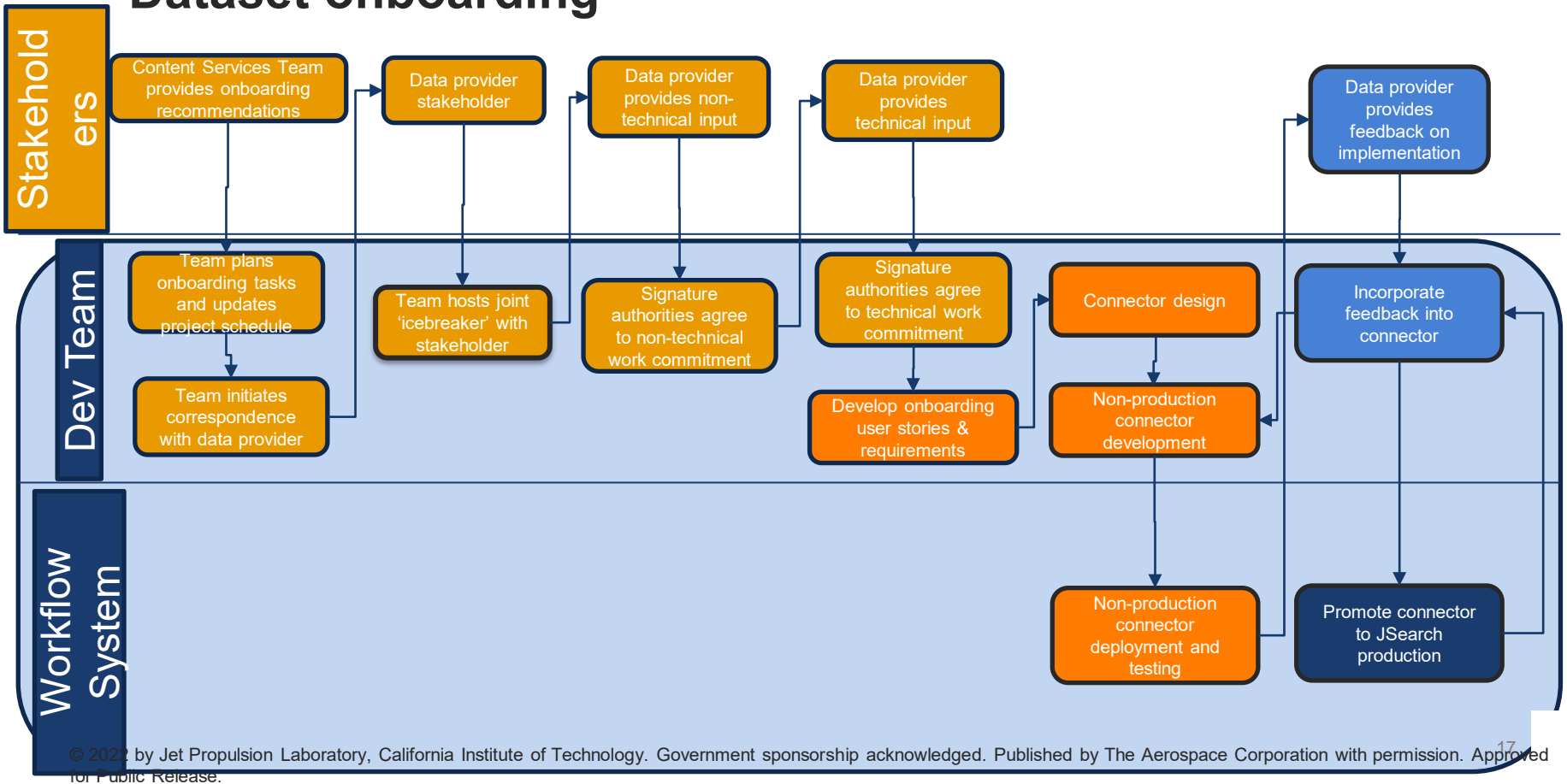
Product Delivery

Iterate…

Accelerating search and discovery across the enterprise



Dataset onboarding

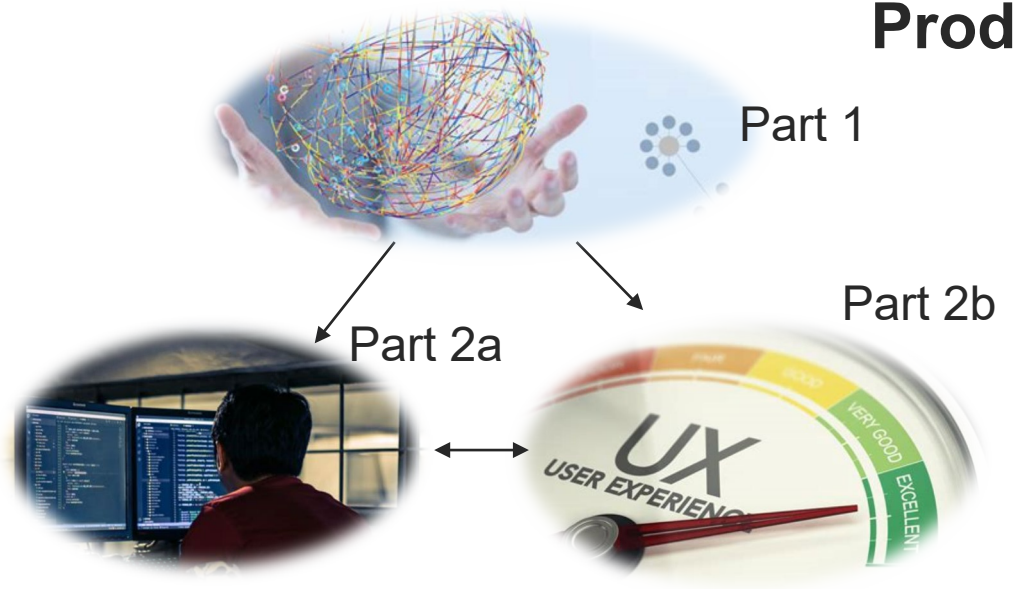


… what this about "*gold source*" data?

- Runs (or supports) organizational information retrieval processes
  - Who was the cognizant engineer of XYZ subsystem on the M2020 project during mission launch?
- We screen/evaluate data during the technical phase of the onboarding process for Elements (schema), Formats (mimetype) and Volume, Provenance, Veracity, Integrity, Currency, Sensitivity, Movement, and Lifecycle.

Part 2b – the essential role of user experience research and design

Product Delivery Workflow



Part 1: Data Eng, Info Mod, IKG

Part 2a: IRI AND Part 2b UX Research & Design in parallel

When does UX get involved?

Stakeholders

Content Services Team provides onboarding recommendations

Data provider stakeholder

Data provider provides non-technical input

Data provider provides technical input

Data provider provides feedback on implementation

Dev Team

Team plans onboarding tasks and updates project schedule

Team initiates correspondence with data provider

Team hosts joint 'icebreaker' with stakeholder

Signature authorities agree to non-technical work commitment

Signature authorities agree to technical work commitment

Develop onboarding user stories & requirements

Connector design

Non-production connector development

Incorporate feedback into connector

Workflow System

Non-production connector deployment and testing

Promote connector to JSearch production

Do you have examples of UX delivering value?

UX Research: User Interviews

Purpose: Understand user search and discovery behaviors, needs, and motivations through observation techniques, task analysis, and other feedback.

Methodology: Utilized a ***user-centered design process*** to create new designs of JSearch that are truly relevant to users.

Scheduling: As soon as gold source data is ready

Data Analysis: Quantitative interviews

Outcome: Design mockups and recommendations for JSearch client a.k.a **Aperture**.

UX Research: Usability Testing

Purpose: Evaluate **Aperture** by testing it with representative users. Identify any usability problems, collect qualitative and quantitative data and determine the participant's satisfaction with the product.

Scheduling: Four testing sessions were conducted in a month

Data Analysis: qualitative and quantitative involving video, audio and researcher notes.

Outcome: Determine the participant's satisfaction with **Aperture.** Provide design recommendations for next **Aperture** iteration.

UX Research: Design Recommendations

Purpose: Utilize research to drive design and non-functional requirements.

Scheduling: Aperture development/post-dataset onboarding

Outcome: Provided numerous design recommendations related to ***Search Relevancy***, ***Search Result Display, QuickFind, Tabs & Filters and Feedback Report***

Top Tip: The Neilsen Norman Group have developed a UX Research Cheat Sheet

https://www.nngroup.com/articles/ux-research-cheat-sheet/

In conclusion

- This work is ongoing, JPL's Enterprise 2.0 effort is monumental and involves many stakeholders fulfilling many roles over a number of years.
- The work presented herein demonstrates how JPL's Content and Search Services Program is realizing institutional digital transformation through graph data modeling and IRI.
- This strategy combines several disciplines and stakeholder groups to provide a modern, adaptive, fitting enterprise search experience which strives to meet JPL'ers expectations.

Thank you to my colleagues

Specifically, in alphabetical order…

Ann M. Bernath, Bess P. Schrader, Daniel T. Phipps, Daria Topousis, Eric Chiu, Eric C. Martens, Jeffrey Ma, Chun Fang (Jennifer) Yang, Jonathan Young, Laurel Woods, Randal Moss, Rebecca M. Townsend and Sophia N. Conover

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Lewis John McGibbney Ph.D.
Content and Search Services Program Technologist
Collaborative Engineering and Information Capture (172A)
Application, Consulting, Development and Engineering Section (1722)
Information and Technology Solutions Directorate
O (818) 393-7402 | **M** (626) 487-3476
lewis.j.mcgibbney@jpl.nasa.gov
https://jpl.webex.com/meet/lmcgibbn

JPL | jpl.nasa.gov

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