KNOWLEDGE ARCHITECTURE: IT'S IMPORTANCE TO AN ORGANIZATION

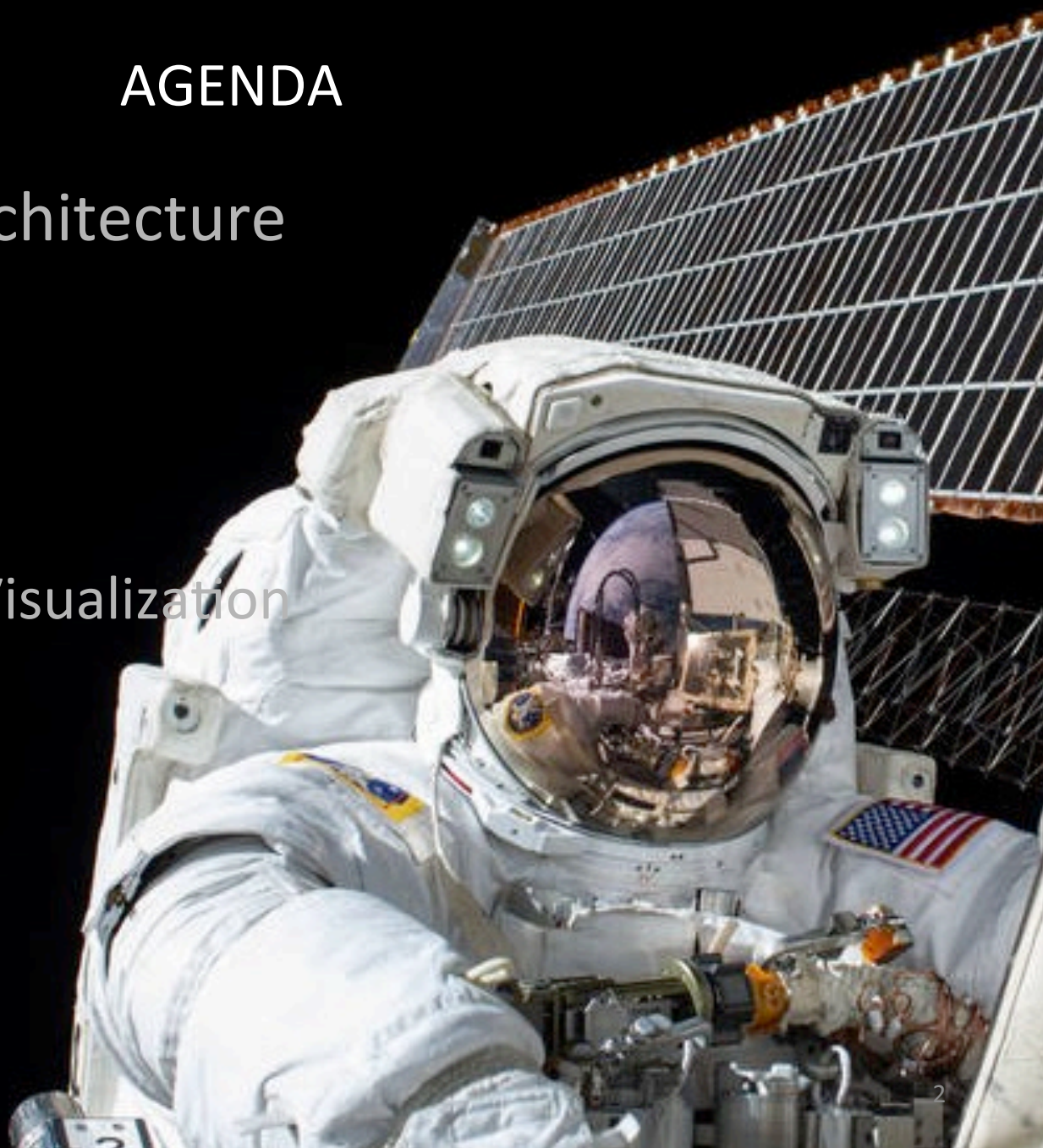
Combining Strategy, Data Science and Information Architecture to Transform Data to Knowledge

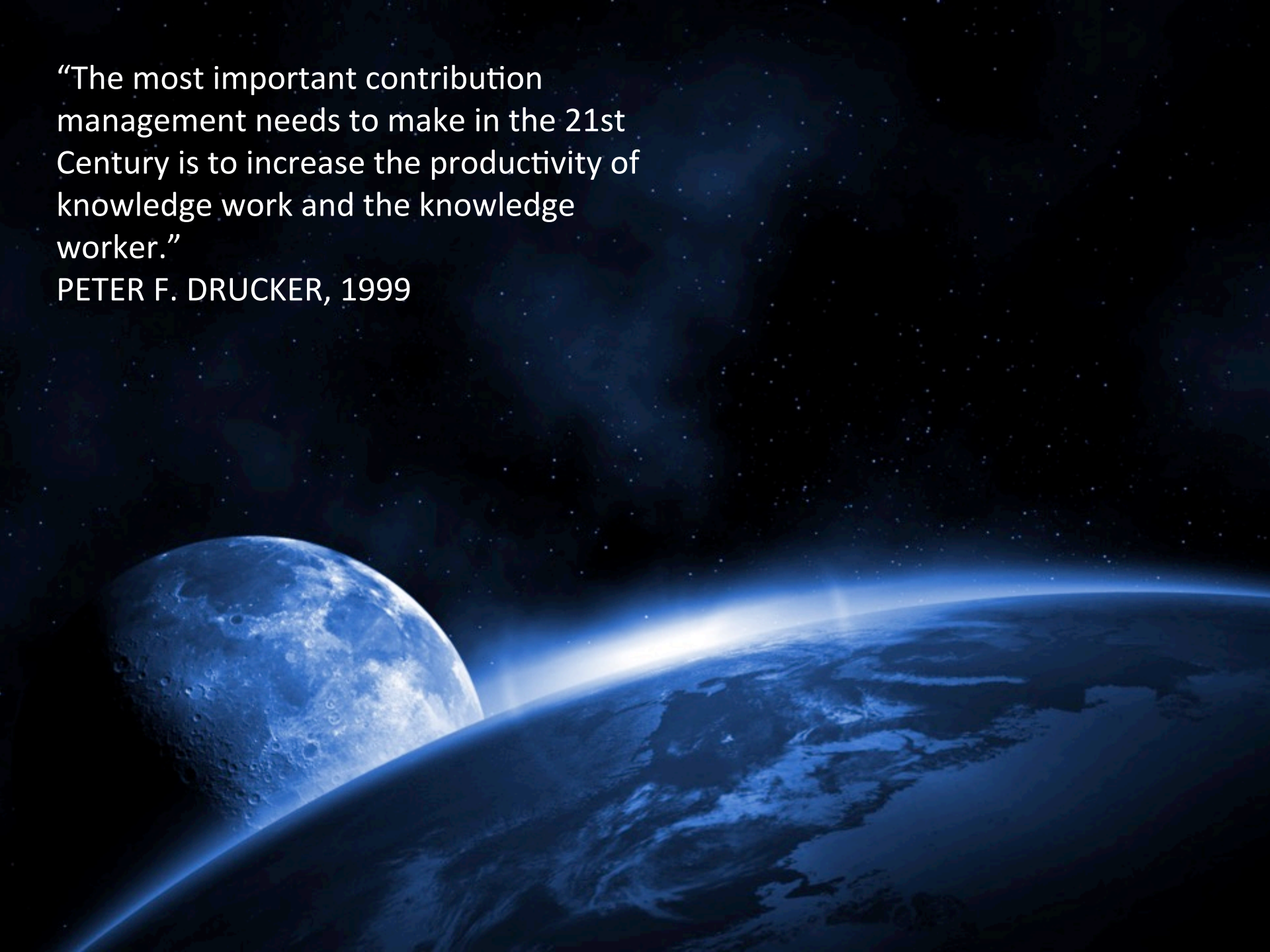
KM2020 – I V & V
May 19, 2016

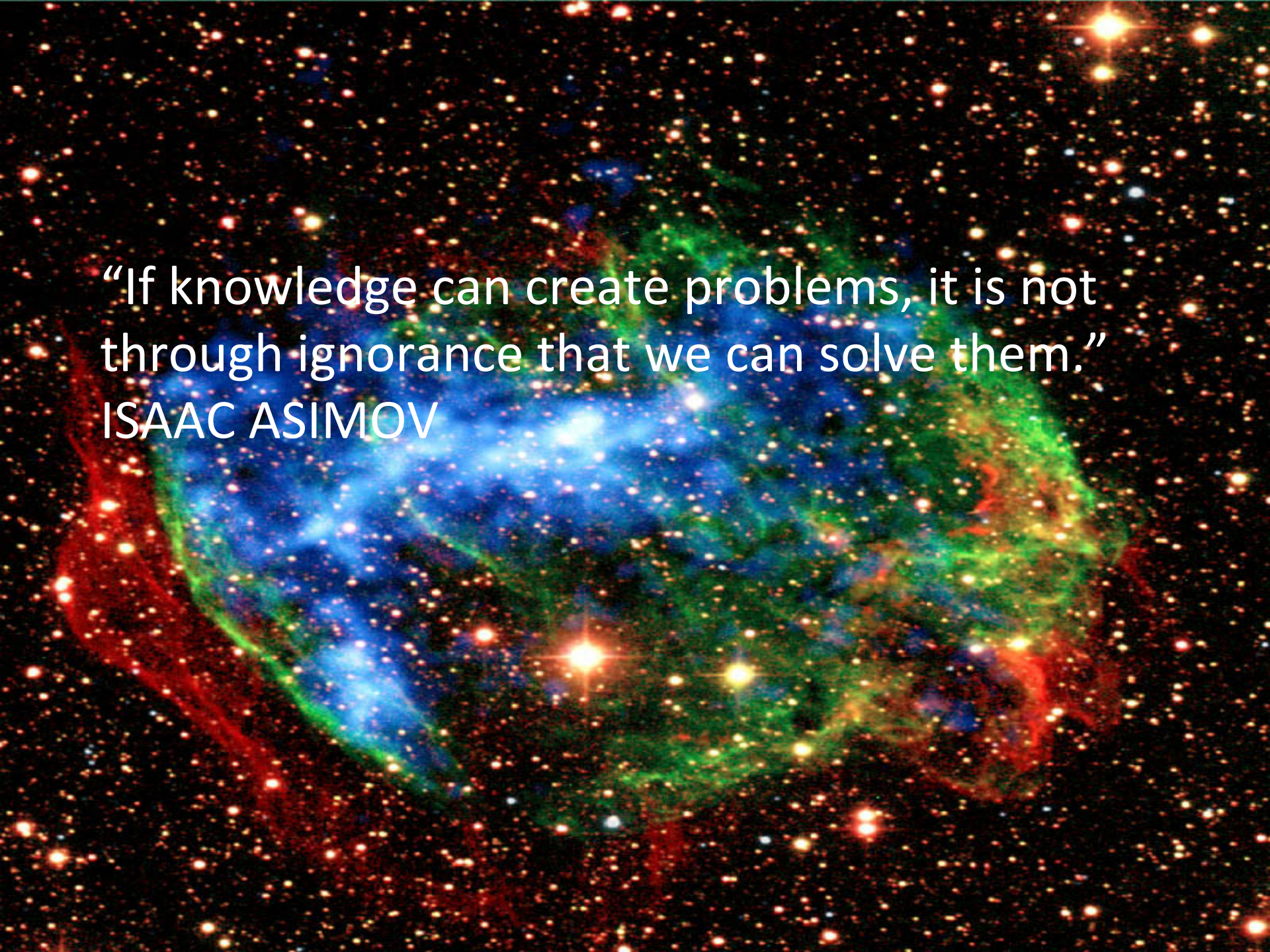
David Meza
Chief Knowledge Architect
NASA Johnson Space Center

AGENDA

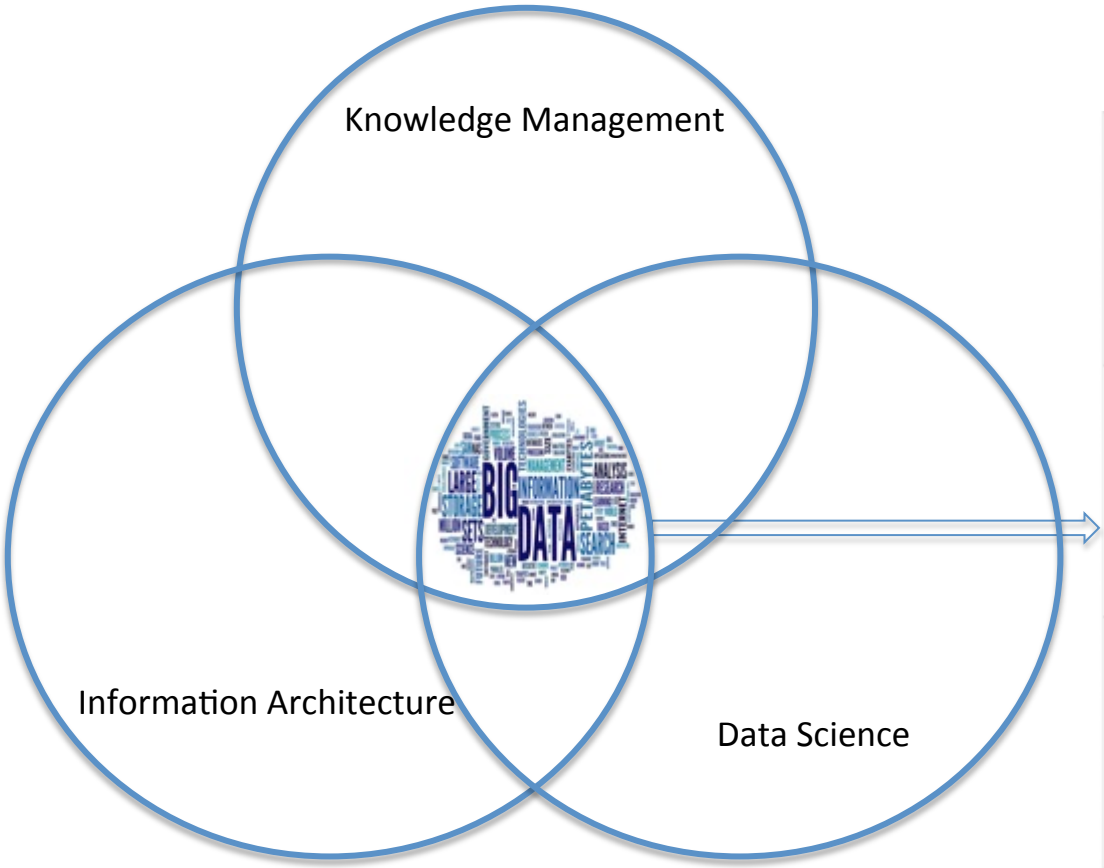
- Knowledge Architecture
- Opportunities
  - Search
  - Storage
  - Data Driven Visualization
- Questions?




“The most important contribution management needs to make in the 21st Century is to increase the productivity of knowledge work and the knowledge worker.”
PETER F. DRUCKER, 1999


“If knowledge can create problems, it is not through ignorance that we can solve them.”
ISAAC ASIMOV

To convert data to knowledge a convergence of Knowledge Management, Information Architecture and Data Science is necessary.



Knowledge Architecture

- The people, processes, and technology of designing, implementing, and applying the intellectual infrastructure of organizations.
- What is an intellectual infrastructure?
  - The set of activities to create, capture, organize, analyze, visualize, present, and utilize the information part of the information age..
- Information + Contexts = Knowledge
- Information Architecture + Knowledge Management + Data Science = Knowledge Architecture
- KM without applications is empty (Strategy Only)
- Applications without KA are blind (IT based KM)
- Data Science transform your data to knowledge

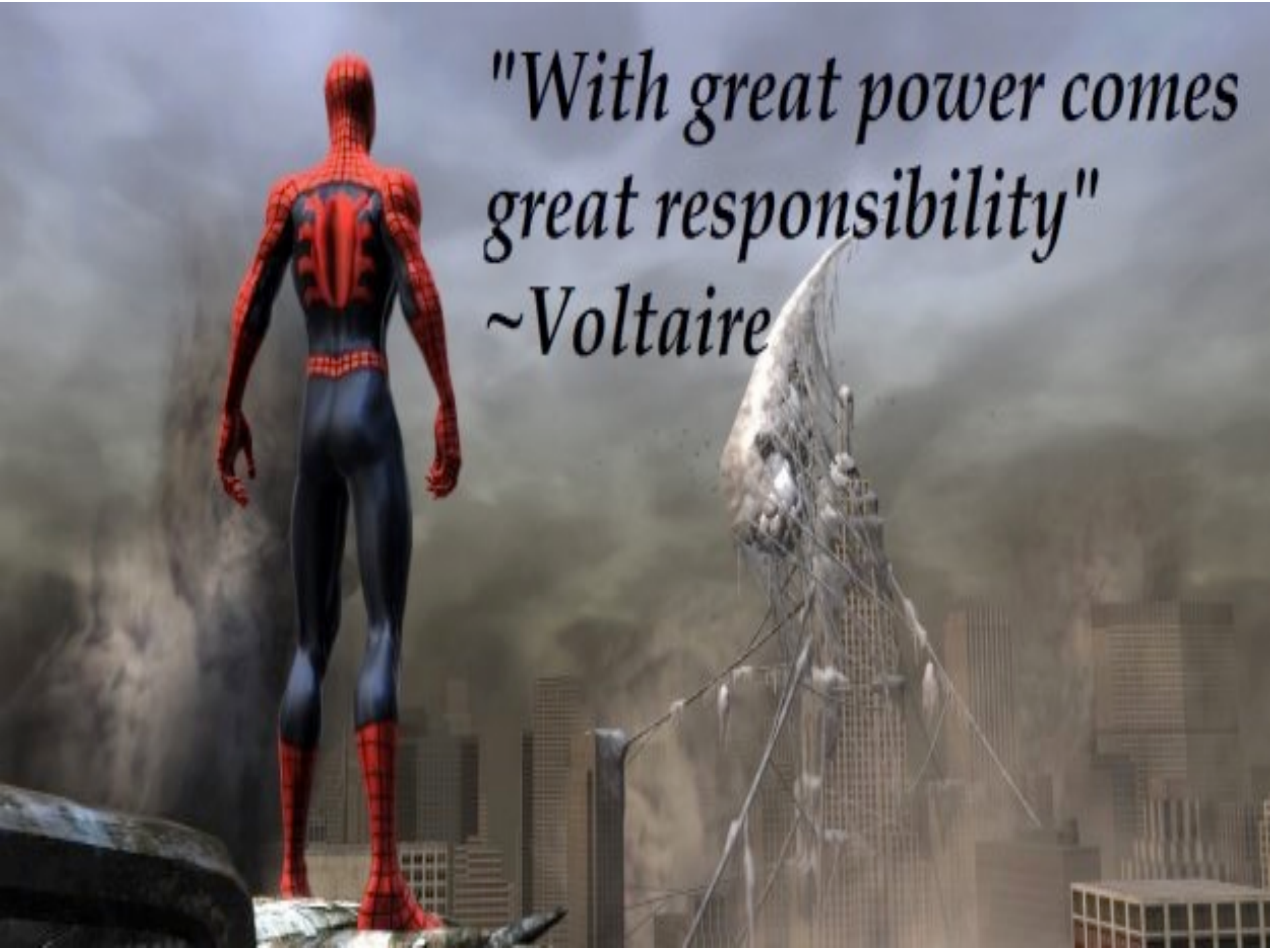
Areas of Opportunity

- Search
- Storage
- Data Driven Visualization

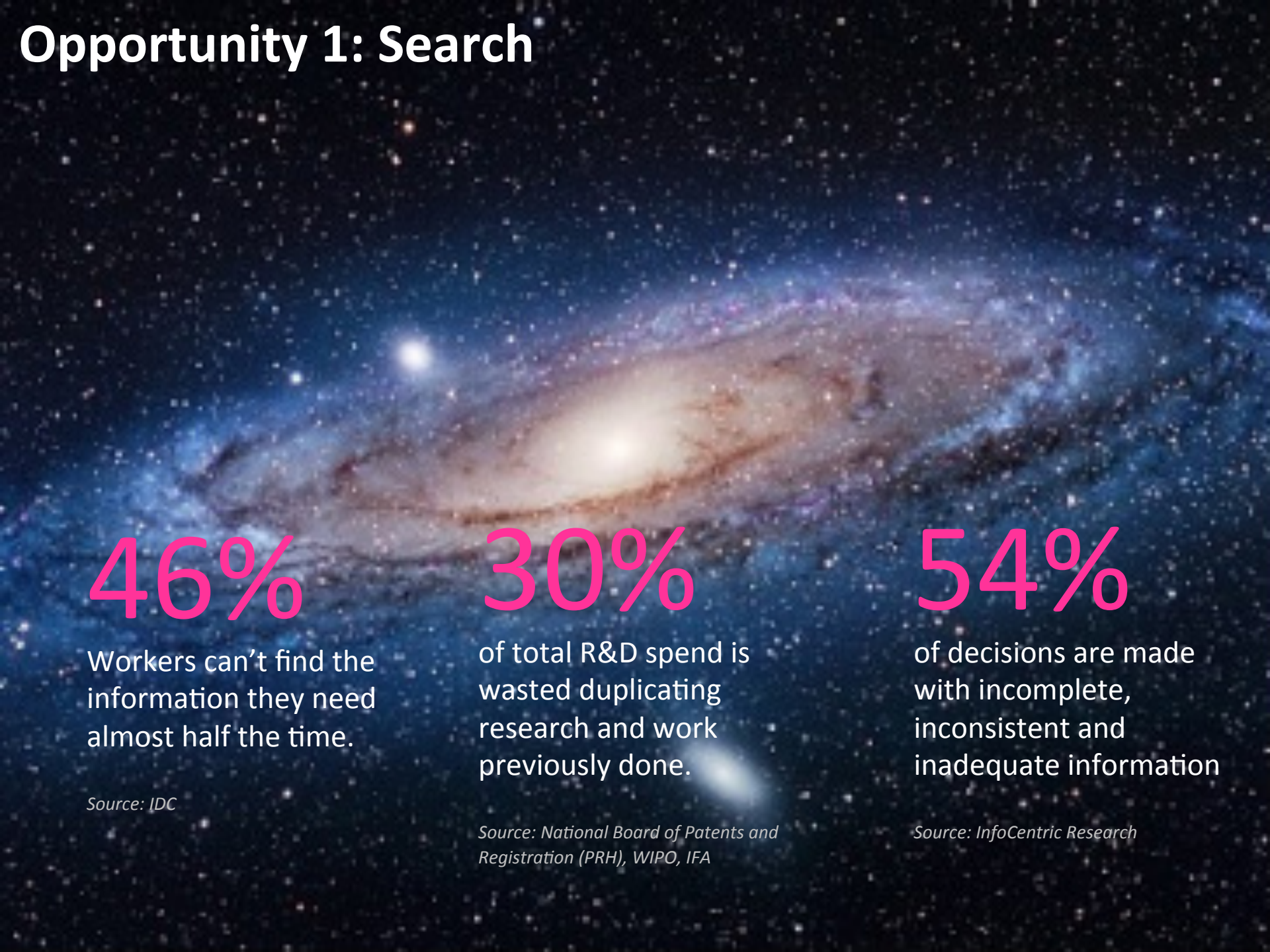
User Discovers Answers

Visualization	Shiny, Jupyter, Linkurious, Tom Sawyer, Keylines, Intuitics, Mathematica CDF
	Creates Data Driven Visualization
Analysis	R, Python, Mathematica, Matlab, Excel
	Gathers data for analysis
Integration	API, Web Scraping, ODBC
	Integrates with data source
Access/Storage	SQL Neo4j MongoDB Excel SharePoint

“We have an opportunity for everyone in the world to have access to all the world’s information. This has never before been possible. Why is ubiquitous information so profound? It is a tremendous equalizer. Information is power.”
ERIC SCHMIDT (FORMER CEO OF GOOGLE)


"With great power comes great responsibility"
~Voltaire

Opportunity 1: Search



46%

Workers can't find the information they need almost half the time.

Source: IDC

30%

of total R&D spend is wasted duplicating research and work previously done.

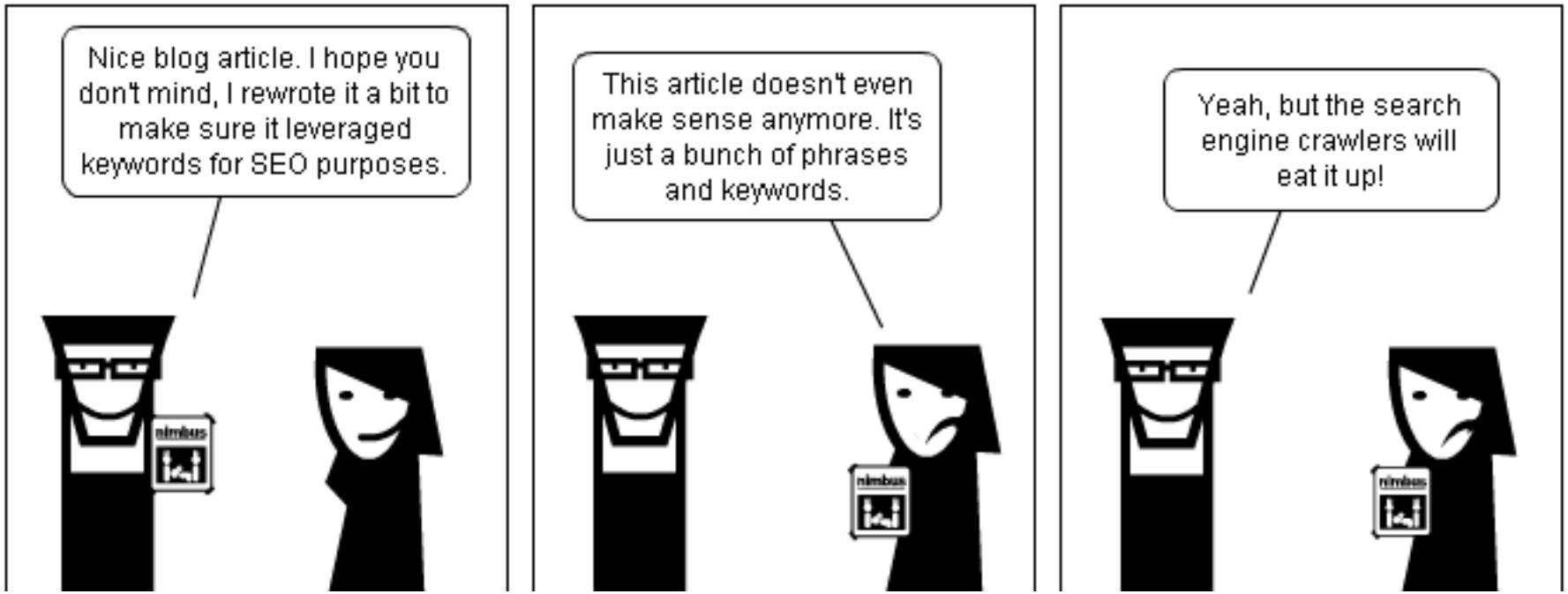
Source: National Board of Patents and Registration (PRH), WIPO, IFA

54%

of decisions are made with incomplete, inconsistent and inadequate information

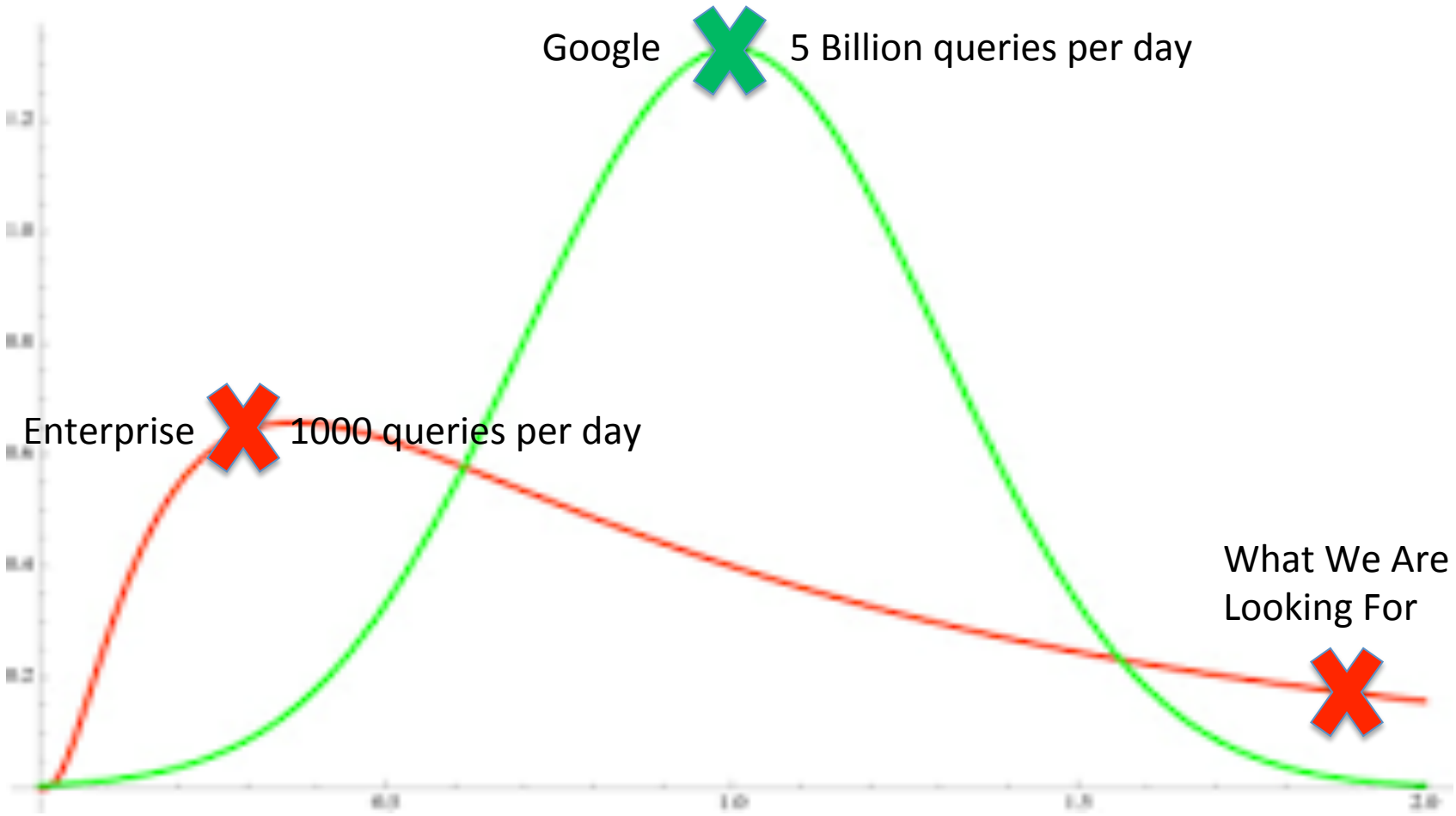
Source: InfoCentric Research

Google It!



Courtesy of SocMedSean.com

Page Rank By The Numbers



NASA SEARCH EVALUATION

- There is No One Solution
- Master Data Management Plan is essential
- Identify Critical Data
- Develop Standards for Government and Contractor created data

TOP USER REQUIREMENTS

- Semantic search
- Clustering or topic modeling algorithms
- Faceting
- Repository specific searches
- Ability to save searches
- Alerts

Search

Results 1 - 10 of about 893 (0.09 seconds)

Next

Sort by date

Limit To ?

Show Full Tree

Content

- Archive
- Document
- PDF
- PowerPoint
- Spreadsheet
- Web Page
- XML

Show all file types

Functional Areas

- Accessibility
- Accession
- Engineering
- Evaluation
- Expectancy
- Experiments
- Pressing
- Programming
- Safety
- Standard
- Switches
- Testing

People

- Directors

Programs & Missions

- Application Technology Satellite Mission

Research Areas

- Base
- Oxygen

Systems & Equipment

- Payloads
- Space Shuttle
- Space Transportation System
- Spacecraft

Taxonomy Feedback

Did you find what you were looking for? Yes No

Certification & Accreditation — KeyMatch
http://ird.jsc.nasa.gov/ITSecurity/C_A/default.aspx

Crew Heath and Safety
https://sashare.jsc.nasa.gov/CHS/SitePages/Home.aspx

IRD Customer Service System
http://ird.jsc.nasa.gov/ComputerServices/css/default.aspx

[MS WORD] 6 [Relevance Score: 10 of 10]
research requests this month which logged 40.5 hours of research time and9 research requests called for extensive research: Constellation: request from JSC Associate Director (Technical) for film footage showing **Apollo Uprighting System** testing in a water tank in the Gulf of Mexico, for reference in developing a similar
library.jsc.nasa.gov/.../jimms/jimms%20surveillance/2009/6.2.3%20april%2009%20surv.doc - 74KB - 2009-05-08 - Request Removal

[MS WORD] [redacted] [Relevance Score: 10 of 10]
available electronic ally , the contractor informed the patron to drop the last digit in the numbers he had provided to access the documents online . STIC staff had a r equest from a Lockheed Martin patron for documents relating to the **Apollo uprighting system** . This is the **system** whereby the **Apollo** capsule was able to land
library.jsc.nasa.gov/.../actvity%20reports%202003-2007/2008/10-05-2007.doc - 104KB - 2007-10-09 - Request Removal

Photo-s66-41852 [Relevance Score: 10 of 10]
Photo-s66-41852 **Apollo** Imagery S66-41852 (1966) --- Spacecraft 012 looking toward -Y axis during installation of heat shield. Note **uprighting system** compressor in aft bay, at right, and Reaction Control **System** (RCS) valve module panel, center of photo.
spaceflight.nasa.gov/gallery/images/apollo/apollo1/html/s66-41852.html - 4KB - 2012-11-01 - Request Removal

Chariots For Apollo, ch11-3 [Relevance Score: 10 of 10]
to briefings on **systems** and experiments, visited the Morehead Planetarium in North Carolina and the Griffith Planetarium in California for celestial navigation training, work ed with the crew **systems** people in getting their suits and supporting equipment ready, and studied mission plans and other documentation. 19 The **Apollo**
www.hq.nasa.gov/office/pao/History/SP-4205/ch11-3.html - 18KB - 2014-07-03 - Request Removal

The Apollo Spacecraft - A Chronology. Vol. I. Part 3 (1962 3rd quarter) [Relevance Score: 10 of 10]
Space Vehicle Board," adopted on October 3, 1961, was revised to read "Spacecraft Launch Vehicle Coordination Charter for the **Apollo** Program MSFC-MSC." The reasons for the revision were: to include the recently formed Management Council, to include the Electrical **Systems** Integration Panel and Instrumentation
www.hq.nasa.gov/office/pao/History/SP-4009/v1p3d.htm - 65KB - 2014-07-03 - Request Removal

[DOCX] 6 [Relevance Score: 10 of 10]
imagery showing the **Apollo** Command Module **uprighting system** bringing a CM floating in water from an upside down to right side up position. Imagery is needed for determining possible crew health risks associated with hanging upside down in the capsule. Constellation support: Compiled table of statistics on #master/original
library.jsc.nasa.gov/.../JIMMS/JIMMS%20Surveillance/2009/6.2.3%202009-10%20Surv%20input.docx - 38KB - 2009-11-05 - Request Removal

History Search Index - Search Results Full [Relevance Score: 10 of 10]
History Search Index - Search Results Full NASA Home Page | JSC Home Page | JSC History Portal | Users Guide | Help | Archive Index History Full Detail Title: **APOLLO** EXPERIENCE REPORT COMMAND MODULE **UPRIGHTING SYSTEM** Information Record Number: 45784 Report Number: TN-D-7081 Date: 03/31/1973 Author/Interviewer: WHITE
historycollection.jsc.nasa.gov/getSingleDetail.cfm?id=45784 - 0KB - 2015-10-16 - Request Removal

JSC Digital Image Collection [Relevance Score: 10 of 10]
on aft bay (41851); Spacecraft 012 looking toward -Y axis during installation of heat shield. Note **uprighting system** compressor in aft bay, at right, and Reaction Control **System** (RCS) valve module panel, center of photo (41852); Crew compartment heat shield being prepared for installation (41853). Subject Terms:**APOLLO** 1
images.jsc.nasa.gov/luceneweb/caption.jsp?searchpage=true&keywords=41-D&selections=null&textsearch=G... - 7KB - 2015-12-30 - Request Removal

JSC Digital Image Collection [Relevance Score: 10 of 10]
on aft bay (41851); Spacecraft 012 looking toward -Y axis during installation of heat shield. Note **uprighting system** compressor in aft bay, at right, and Reaction Control **System** (RCS) valve module panel, center of photo (41852); Crew compartment heat shield being prepared for installation (41853). Subject Terms:**APOLLO** 1
images.jsc.nasa.gov/luceneweb/caption.jsp?searchpage=true&to_day=31&from_year=1900&from_month=1&to_y... - 7KB - 2016-01-07 - Request Removal

Goldfire

Dashboard | Researcher | My Queries & Alerts | My Data | Search History

Save, Alerts

Welcome to IHS Goldfire, Meza, David (JSC-NA141) | Help | Log Off

Select where to search: IHS Content | Articles | Patents | Corporate

Repository Specific

Apollo <AND> uprighting system

Advanced

Set Query Alert | Manage Queries & Alerts

SYNONYMS & ONTOLOGY

FILTER RESULTS BY

Facet Filter

Content Classes

Corporate 530 >

Distribution by knowledge bases...

Modification Date

2002 2015

In Between

2002 - 2015

Site or Domain

< This field is missing > 458

www.jsc.nasa.gov 69

spaceflight.nasa.gov 3

File Extension

pdf 458

< This field is missing > 72

530 results

1. APO B-074-34 CHRON F2 ND LOW.pdf
KNOWLEDGE BASE: JSCHistory

Kraft and Kleinknecht have informed me that the **Apollo uprighting system** is not working.

Save Summary KB Info

2. APO B-065-36 CHRON F1 APR-29-65 APR-30-65.pdf
KNOWLEDGE BASE: JSCHistory

Test requirements were completed for **uprighting system** and stability tests on **Apollo** Boilerplate 1101.

Save Summary KB Info

3. 04146-ASTP B-1300 FR F8 AUG-75.pdf
KNOWLEDGE BASE: JSCHistory

The command module went to the stable II attitude after landing and was righted in 4 minutes and 24 seconds by the **uprighting system**. The **Apollo** crew opened the hatch after flotation collar installation to get more fresh air into the...

Save Summary KB Info 4 Similar Documents

4. J. Milton Heflin Oral History
KNOWLEDGE BASE: JSCHistory

And in fact, for the **Apollo** landings on the water, if my memory serves me correct, just... The **uprighting system**, which was a system to inflate bags on top of the command module, and if it's under water, as these bags inflate, then the center of buoyancy gets changed, and it just basically flips it right side up.

Save Summary KB Info 2 Similar Documents

5. HSI-139423.pdf
KNOWLEDGE BASE: JSCHistory

With the boilerplate in the Stable II attitude, the three test subjects upright the boilerplate by activating the **uprighting system** as per **Apollo** Block II crew postlanding procedures.

Save Summary KB Info

Clustering

All Results

Focused information on: uprighting system

General Facts | Parts and Functions | Parameters | Causes and Effects | People & Roles | Consumer Sentiment | Corporate Categories

Made Up Of

compressor-inflated bag	(5)
air bag	(1)
gas filled bag	(1)
uprighting bag	(1)
inflatable bag st	(1)

Part Of

recovery aids	(7)
ai'ds Recovery aids	(1)
recovery subsystem	(1)

Objects Acted Upon

recovery aids	(3)
system test	(2)
longeron	(2)
system performance	(2)
system canister	(2)

More

Functions (Action + Object)

uprighting of spacecraft	(5)
return of spacecraft	(4)
return	(3)
inflation of bag	(2)
return of command module	(2)

More

Acting Subjects

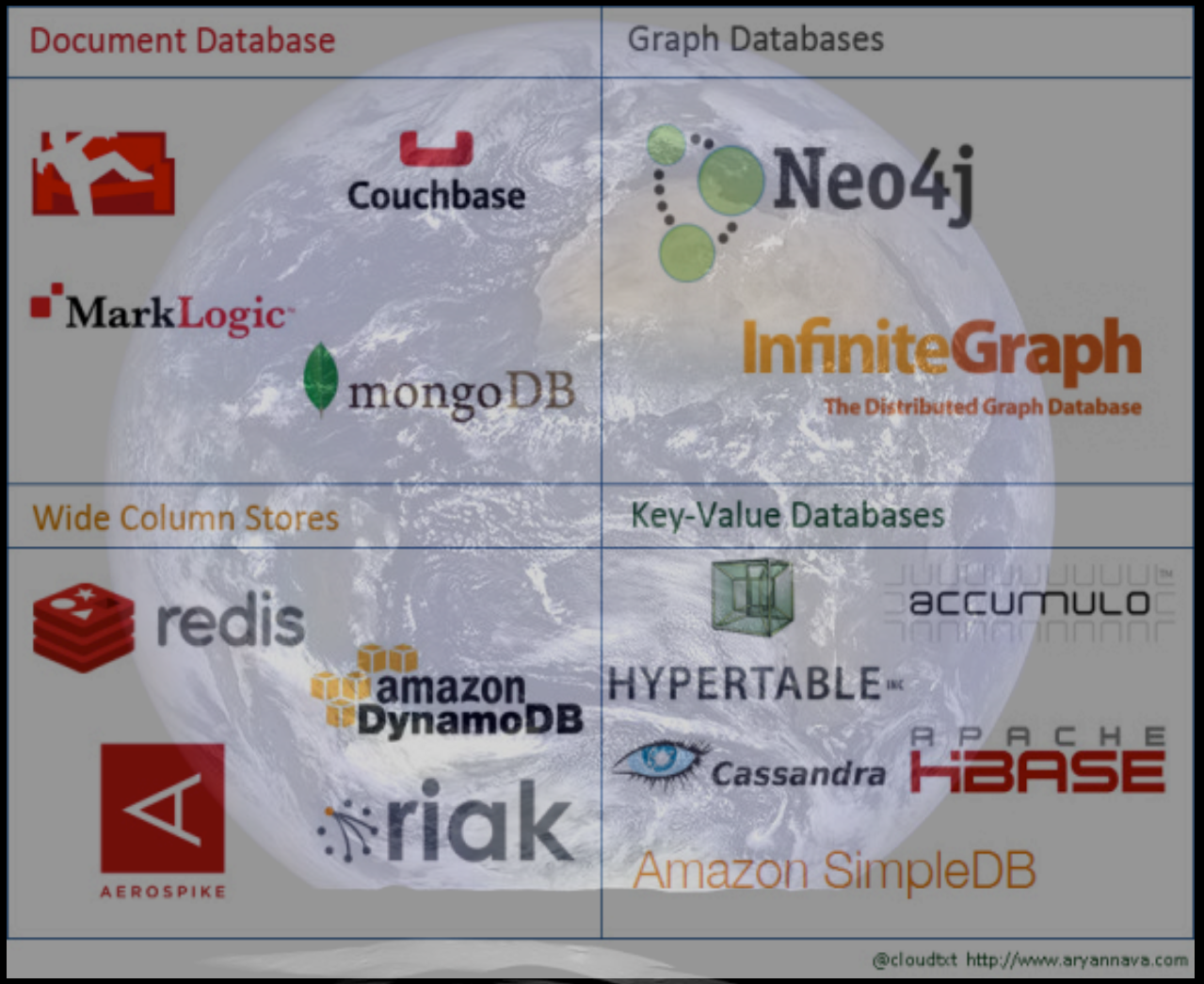
air	(1)
ANTENNA	(1)
arid post landing operation hatched by d...	(1)

Interactions

uprighting system returns spacecraft	(4)
uprighting system uprights spacecraft	(4)
uprighting system returns command mod...	(2)
uprighting system rights command module	(2)
crew activates uprighting system	(2)

More

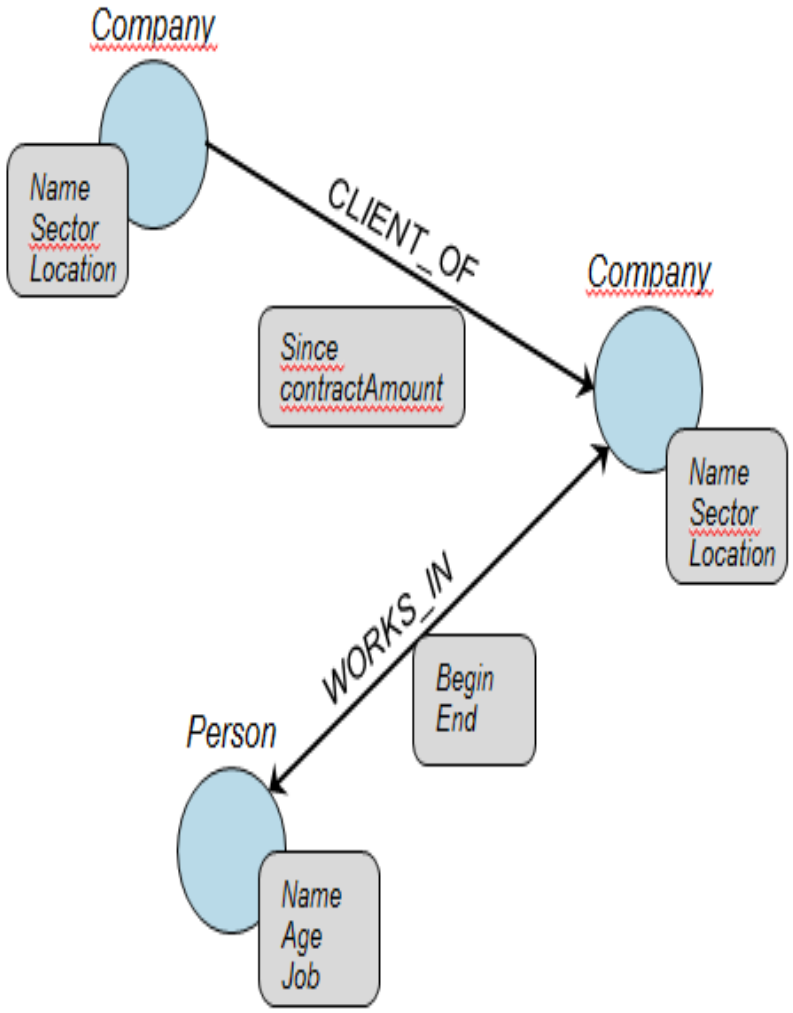
Opportunity 2: Storage and Access



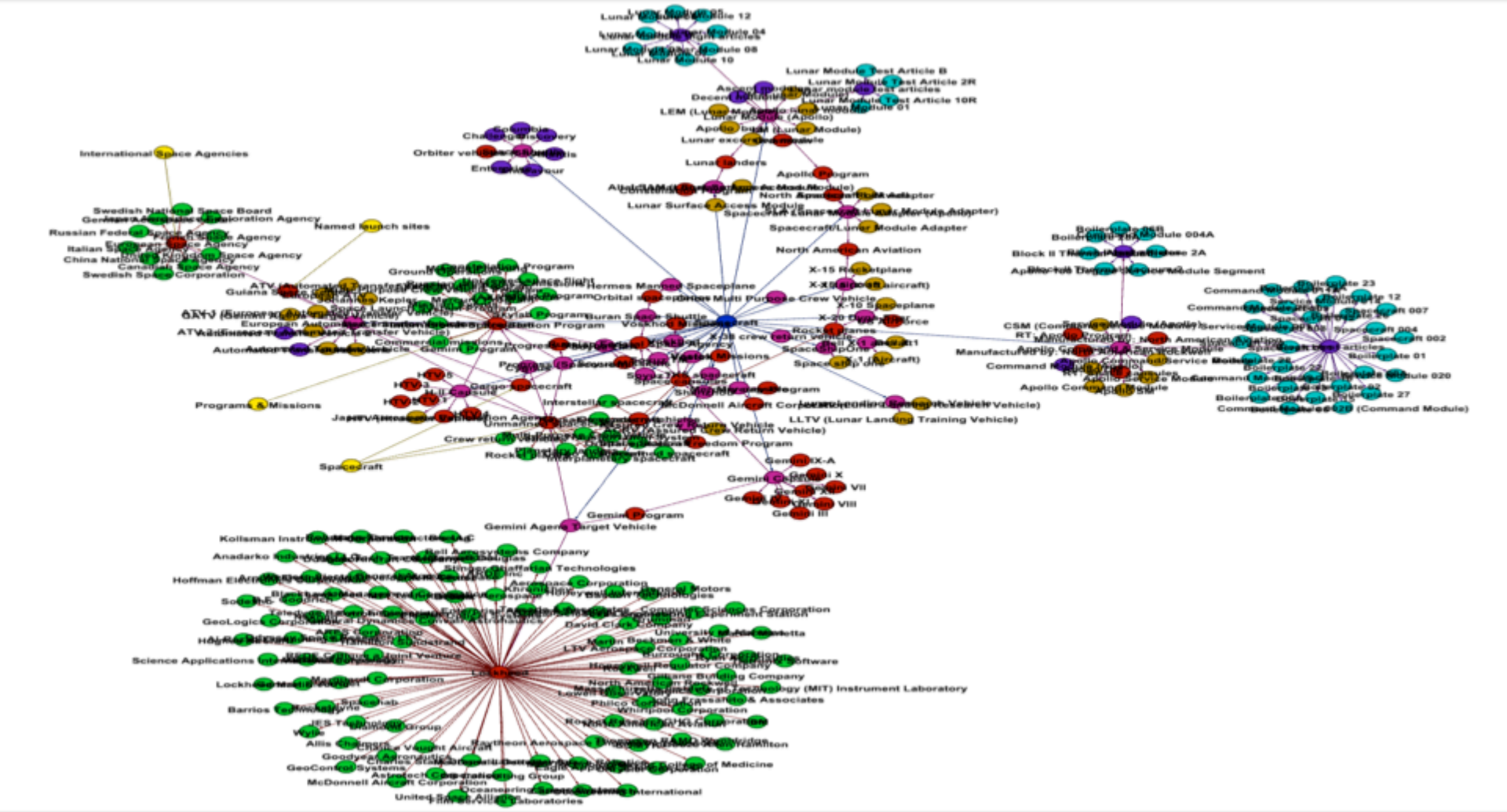
Document to Graph

Document Oriented Database

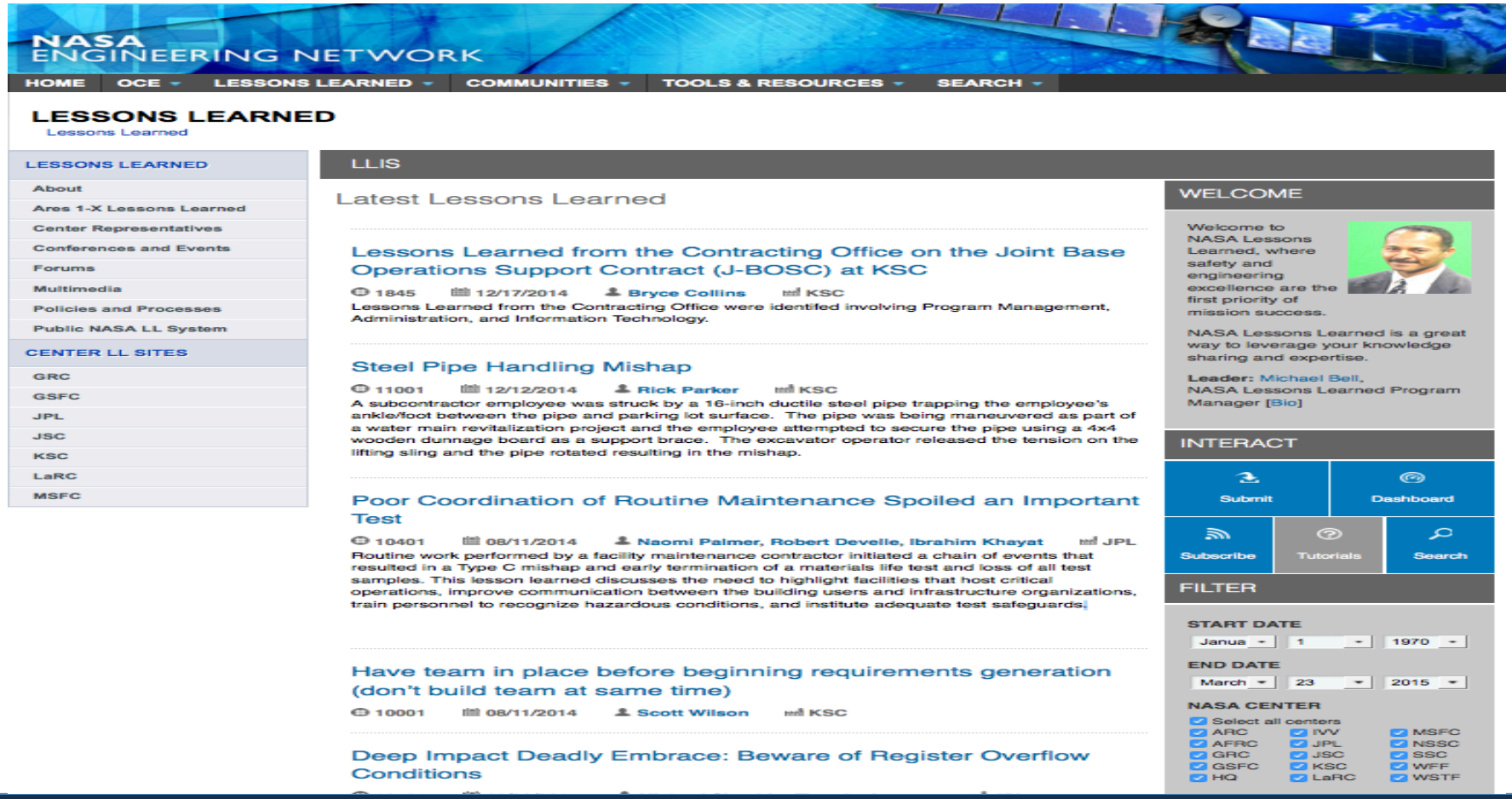
```
{
   "_id" : 1,
   "name" : { "first" : "John", "last" : "Backus" },
   "contribs" : [ "Fortran", "ALGOL", "FP" ],
   "awards" : [
        { "award" : "W.W. McDowell Award",
          "year" : 1967,
          "by" : "IEEE Computer Society" },
        { "award" : "Draper Prize",
          "year" : 1993,
          "by" : "National Academy of Engineering" }
   ]
}
```



PATTERNS EMERGE



LESSON LEARNED DATABASE



2031 lessons submitted across NASA. Filter by date and Center only.
Useful information stored in database.

TOPIC MODELING

Topics

gene	0.04
dna	0.02
genetic	0.01
...	

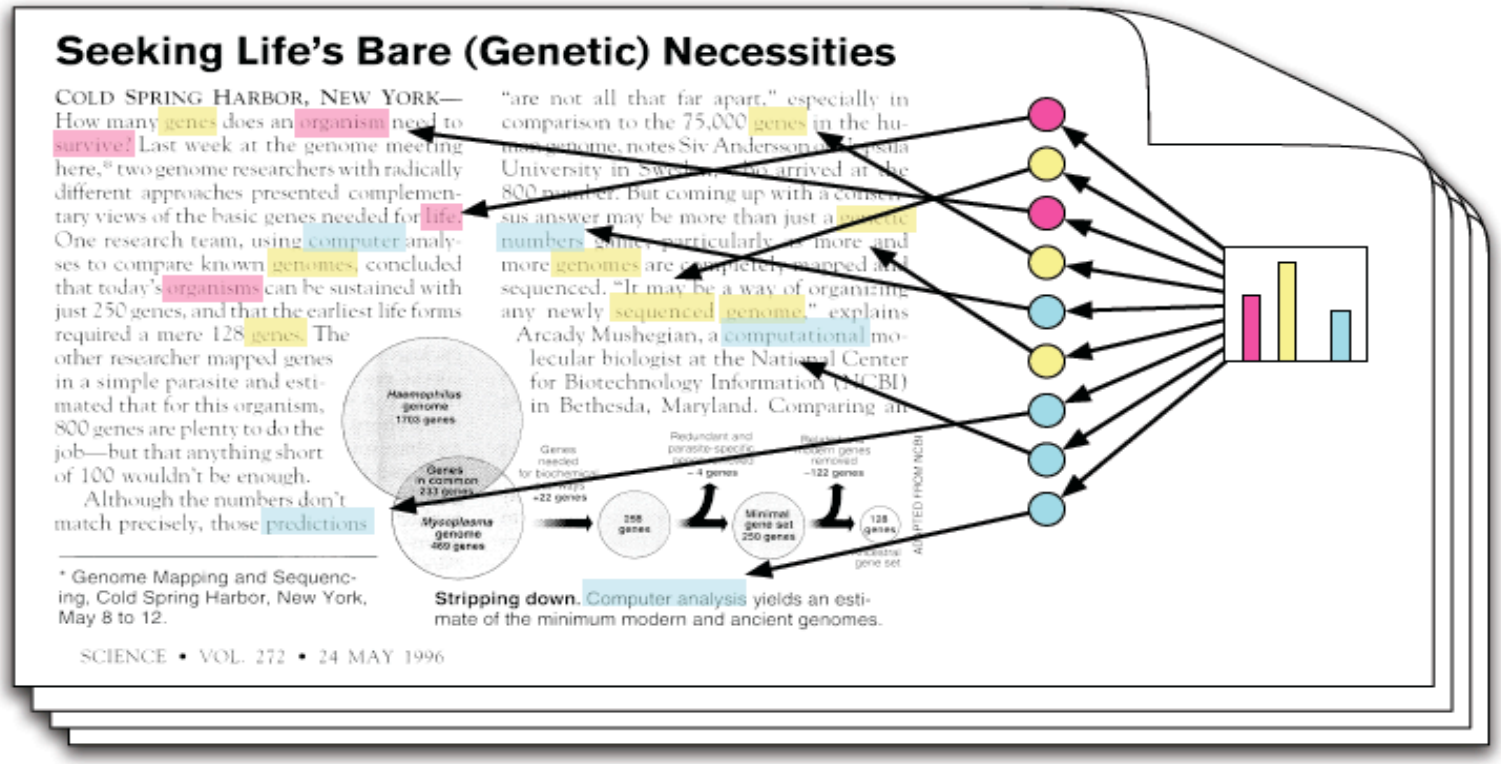
life	0.02
evolve	0.01
organism	0.01
...	

brain	0.04
neuron	0.02
nerve	0.01
...	

data	0.02
number	0.02
computer	0.01
...	

Documents

Topic proportions and assignments



Seeking Life's Bare (Genetic) Necessities

COLD SPRING HARBOR, NEW YORK— How many genes does an organism need to survive? Last week at the genome meeting here,* two genome researchers with radically different approaches presented complementary views of the basic genes needed for life. One research team, using computer analyses to compare known genomes, concluded that today's organisms can be sustained with just 250 genes, and that the earliest life forms required a mere 128 genes. The other researcher mapped genes in a simple parasite and estimated that for this organism, 800 genes are plenty to do the job—but that anything short of 100 wouldn't be enough.

Although the numbers don't match precisely, those predictions "are not all that far apart," especially in comparison to the 75,000 genes in the human genome, notes Siv Andersson of Uppsala University in Sweden, who arrived at the 800 number. But coming up with a consensus answer may be more than just a genetic numbers game, particularly as more and more genomes are completely mapped and sequenced. "It may be a way of organizing any newly sequenced genome," explains Arcady Mushegian, a computational molecular biologist at the National Center for Biotechnology Information (NCBI) in Bethesda, Maryland. Comparing an

* Genome Mapping and Sequencing, Cold Spring Harbor, New York, May 8 to 12.

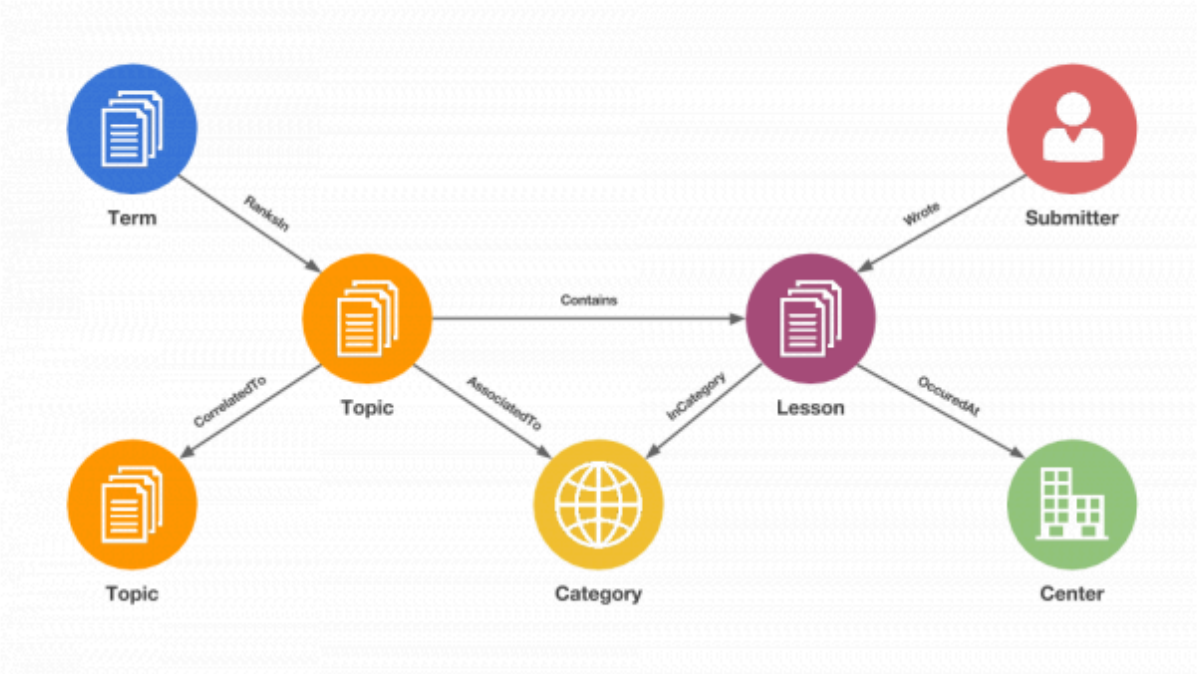
Stripping down. Computer analysis yields an estimate of the minimum modern and ancient genomes.

SCIENCE • VOL. 272 • 24 MAY 1996

Topic models are based upon the idea that documents are mixtures of topics, where a topic is a probability distribution over words.

Blei, David M. 2011. "Introduction to Probabilistic Topic Models." *Communications of the ACM*. David Blei homepage - http://www.cs.columbia.edu/~blei/topicmodeling.html

GRAPH MODEL OF LESSON LEARNED DATABASE

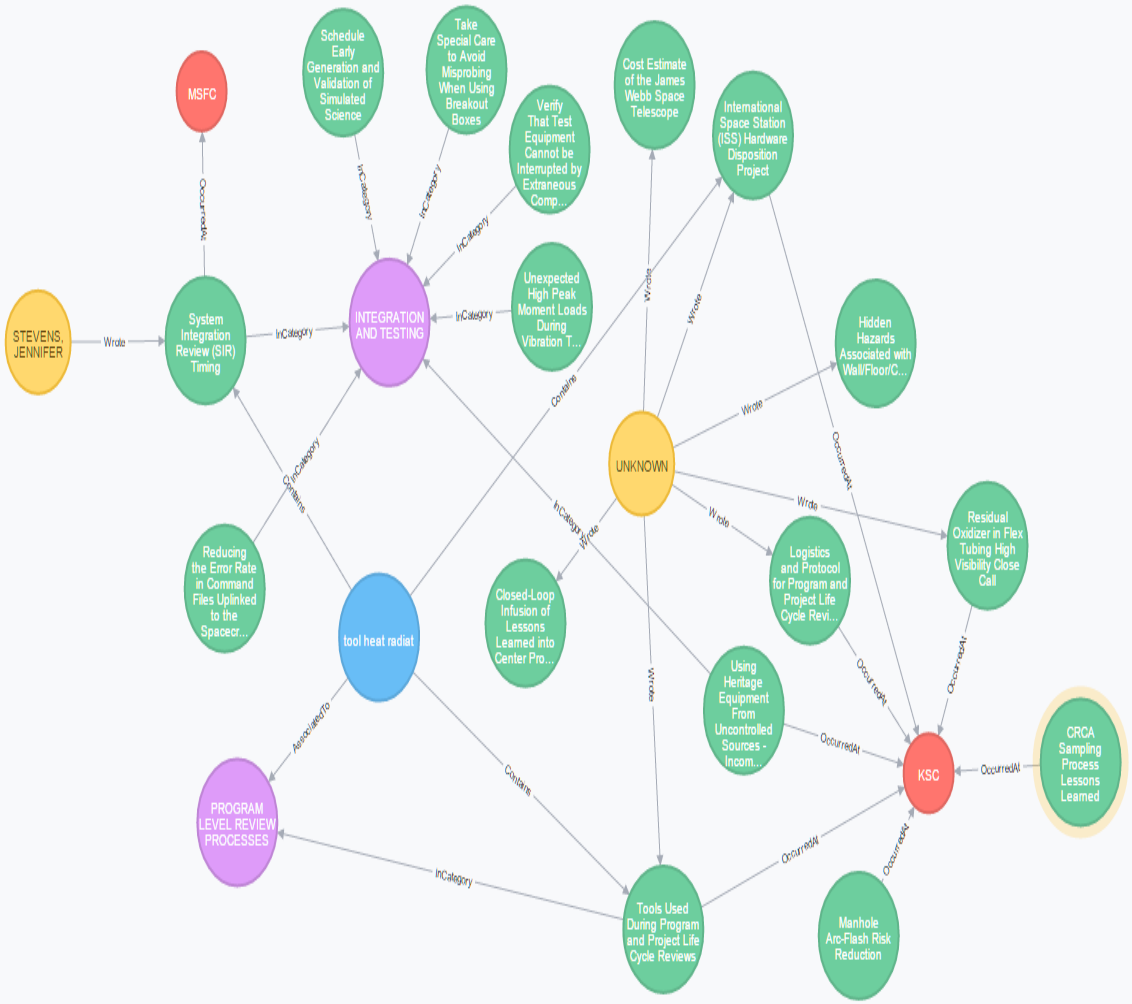


NASA's knowledge management graph model.

$ MATCH (n:Lesson) RETURN n LIMIT 25

*(32) Category(2) Center(2) Lesson(25) Submitter(2) Topic(1)

*(28) AssociatedTo(1) Contains(3) InCategory(8) OccurredAt(8) Wrote(8)



Lesson **url:** https://nen.nasa.gov/web/11/viewall/-/viewall/8018 **org:** Human Exploration and Operations, **title:** CRCA Sampling Process Lessons Learned

abstract:

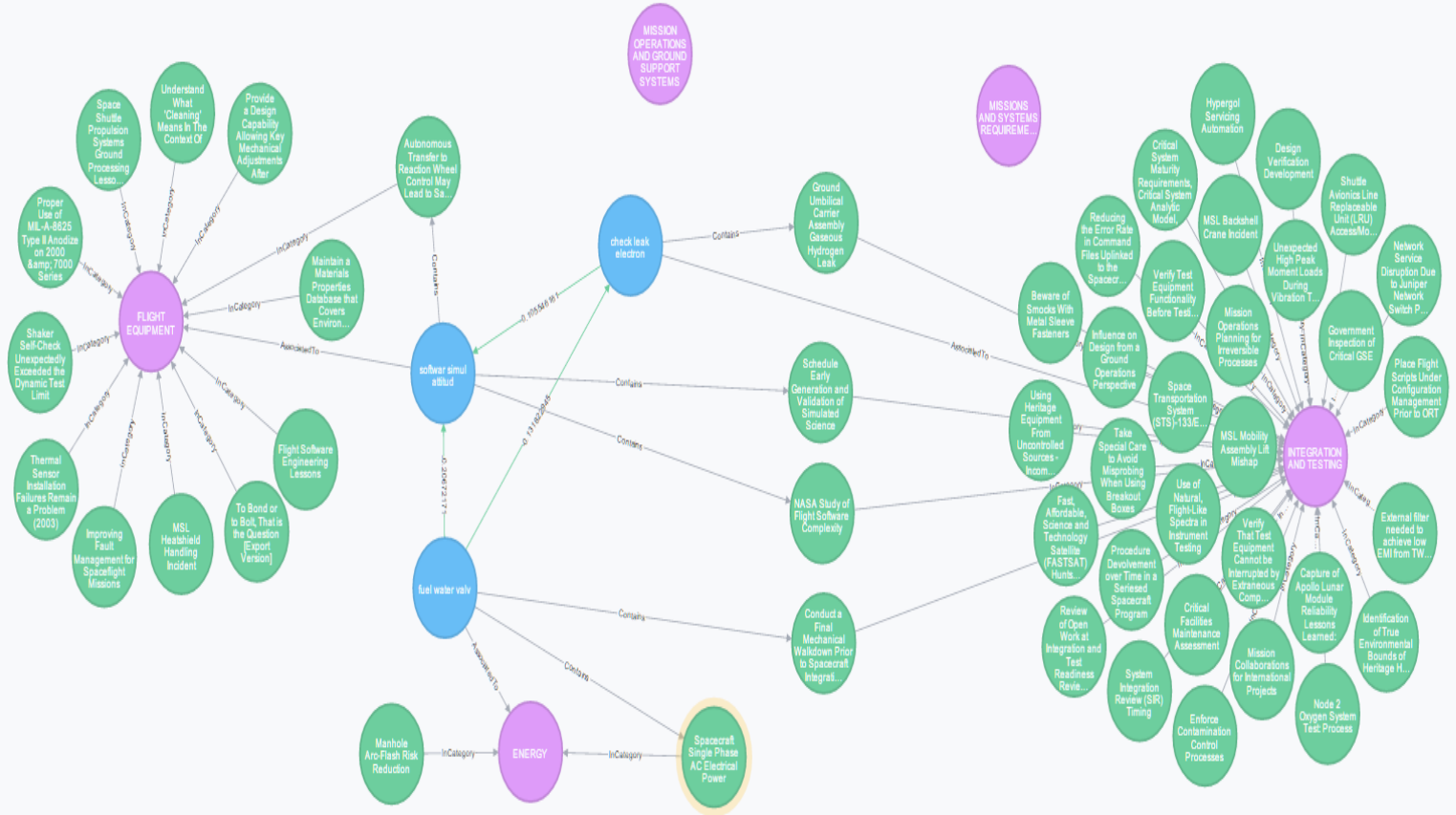
The sampling and analysis processes, used to verify cleanliness of gases and liquids loaded into payloads and related Ground Support Equipment (GSE), were introducing an unacceptable level of process induced contamination. The process induced contamination often necessitated multiple resampling and extensive analyses to develop confidence of clean commodity.

lesson: The particle contamination monitoring was insufficient to provide meaningful feedback to ensure operating protocols were successful in maintaining cleanliness levels.🔒 **safety:** FALSE **name:** 8018 **year:** 2014 **month:** 3 **day:** 11

$ MATCH (n:Category) WHERE n.name <> 'NA' RETURN n LIMIT 5

*(57) Category(5) Lesson(49) Topic(3)

*(61) AssociatedTo(3) Contains(6) CorrelatedTo(3) InCategory(49)



Lesson **safety:** FALSE **url:** https://nen.nasa.gov/web/11/viewall/-/viewall/4057 **title:** Spacecraft Single Phase AC Electrical Power

abstract:

When single-phase power is pulled from a 3-phase supply (e.g., for Orbiter lighting) that is feeding critical 3-phase motors, there is a resulting phase imbalance (especially neutral leg current) that can disrupt instrumentation that is monitoring the health of other equipment. This instrumentation monitors the current draw of the motor (or an associated load such as a fluid pump) to sense motor loading that may indicate when a bearing is wearing out, a pump is stalling, or there are short or open circuits. Whenever possible, dedicated 3-phase power should be provided to critical rotary equipment to alleviate this problem.

lesson:

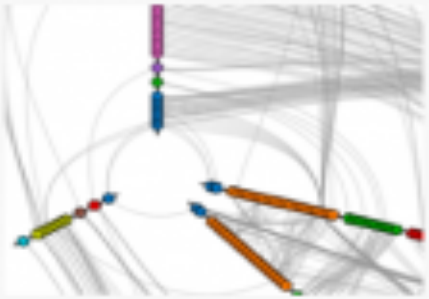
Having a sensitive sensor that relies on obtaining 3-phase current phase imbalances to provide insight into the status of a given piece of equipment can give false indications when the 3-phase current affects other equipment being operated.
<IMG WIDTH="474" SRC="/llis_lib/images/1034441main_spacecraftsinglephase.jpg" HEIGHT="350" BORDER="0" />
Shuttle Orbiter Fuel Cell Powerplant

org: Science, Exploration Systems, Space Operations, **name:** 4057 **year:** 2010 **month:** 9 **day:** 16

OPPORTUNITY 3: DATA DRIVEN VISUALIZATION

Fisheye Distortion

Hive Plot

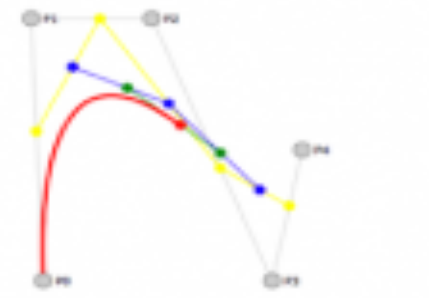


Co-occurrence Matrix

Motion Chart

Chord Diagram

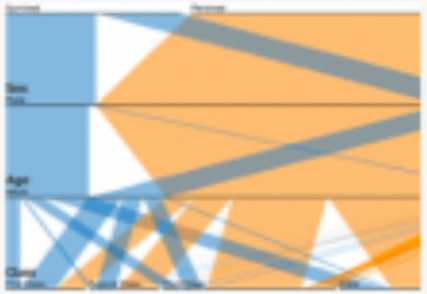
Animated Béziers



Zoomable Sunburst

Collatz Graph

Parallel Sets



Word Cloud

Obama's Budget Proposal

Facebook IPO

Menu Find Edit data ON OFF

1 SELECTED NODES

• Fuel and Oxidizer Storage Tank Relief Valves. #11384

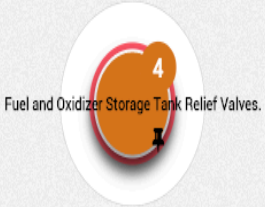
pinned Lesson

Select... Deselect Hide Expand...

PROPERTIES

Find a property...

day	2
lesson	Lack of relief valve isolation has resulted in excessive toxic vapor releases to the environment.
month	10
name	146
safety	FALSE
title	Fuel and Oxidizer Storage Tank Relief Valves.
url	https://nen.nasa.gov/web/11/viewall/-/viewall/146
year	92



LINKURIOUS
VISUALIZE GRAPH DATA EASILY

Menu Find Edit data ON OFF

1 SELECTED NODES

• Topic - fuel water valv #11797

pinned Topic

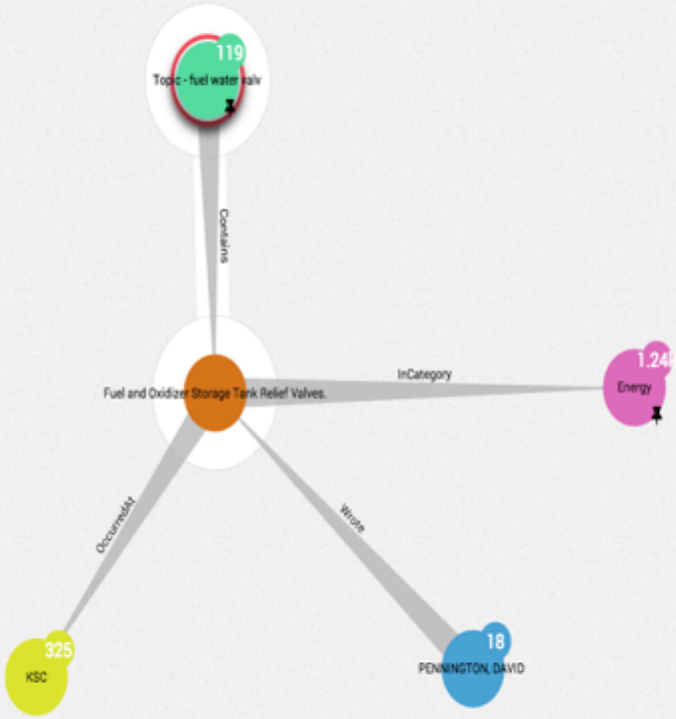
Select... Deselect Hide Expand...

PROPERTIES

Find a property...

label	fuel water valv
name	2

1 EDGES / 120 IN DATABASE



LINKURIOUS
VISUALIZE GRAPH DATA EASILY

Menu | Find | Edit data ON OFF

Nodes | Edges | Paths | Patterns

Type to search nodes...

1 SELECTED NODES

- Fuel and Oxidizer Storage Tank Relief Valves. #11384

pinned | Lesson ×

Select... | Deselect | Hide | Collapse

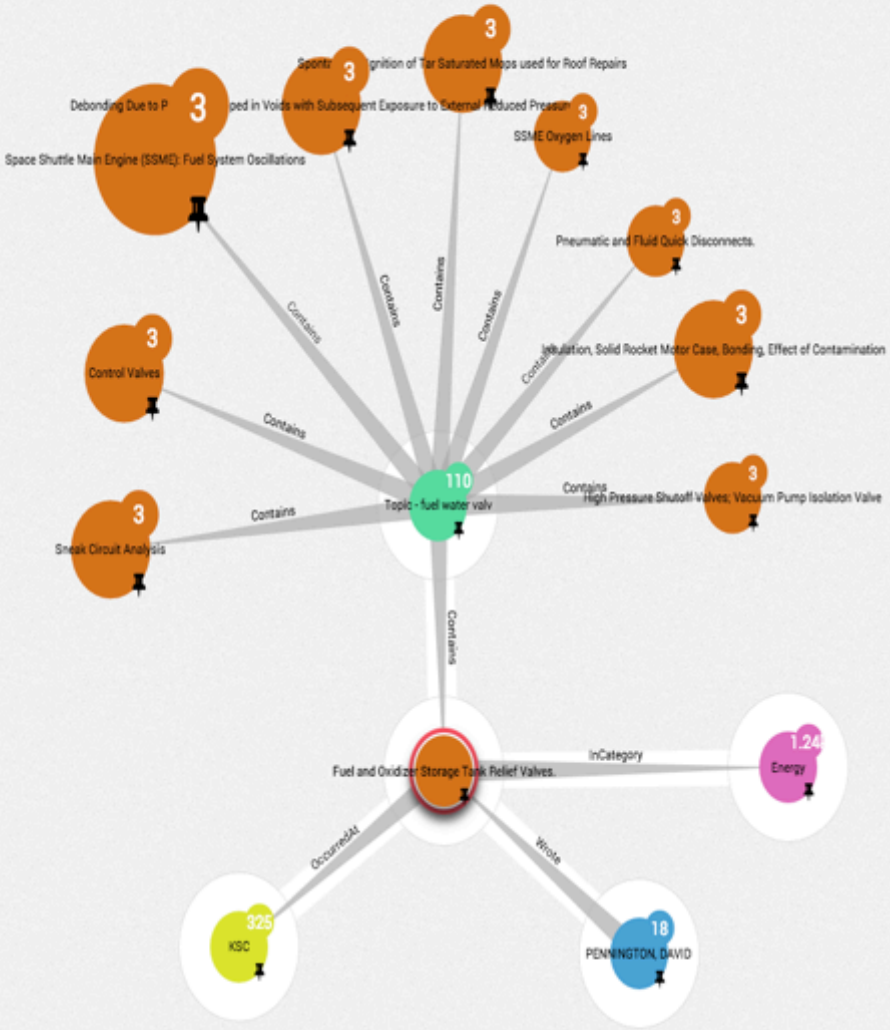
PROPERTIES

Find a property...

day	2
lesson	Lack of relief valve isolation has resulted in excessive toxic vapor releases to the environment.
month	10
name	146
safety	FALSE
title	Fuel and Oxidizer Storage Tank Relief Valves.
url	https://nen.nasa.gov/web/11/viewall/-/viewall/146
year	92

+ Add property

4 EDGES / 4 IN DATABASE



LINKURIOUS
VISUALIZE GRAPH DATA EASILY

Menu | Find | Edit data | Geo map

Nodes | Edges | Paths | Patterns

```
1 Enter a cypher query that returns nodes and edges only...
```

PREVIEW RESULTS

What is cypher

1 SELECTED NODES

• Use of Propellant Grade Commodities for Fuel Cell Powerplants #288

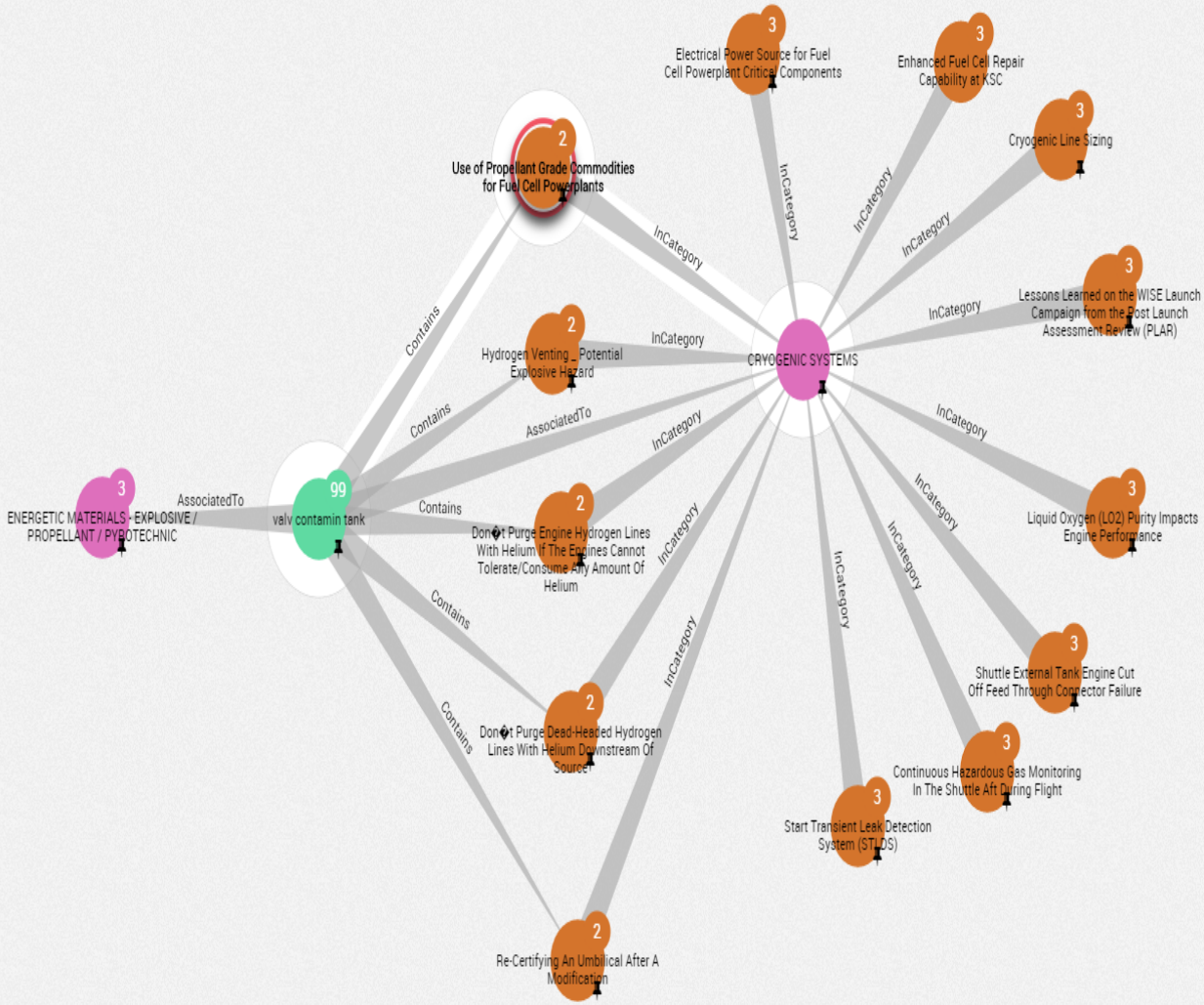
pinned Lesson

Select... | Deselect | Hide | Expand...

PROPERTIES

Find a property...

abstract Space Shuttle Alkaline Fuel Cell Powerplants (F
O2 and H2 as reactants. These FCPs require hig
LH2 and LO2 (99.99% and 99.989% purity levels,
respectively) than Space Shuttle Main Engines (
and 99.2% LO2). Proton Exchange Membrane (P
have been developed that can use propellant gra
reactants. This means that a common liquid oxy
liquid hydrogen system could potentially be des
both propulsion and electrical power generation
requirements as well as for Environmental Contr
Support System (ECLSS). This would simplify cr
loading operations by getting rid of extra pad cle
load operations for the FCP Power Reactant Sto
Distribution (PRSD) system and potentially cons
into one "cryo load." In addition, if propellant gra
reactants were used for Lunar or Mars surface l



LINKURIOUS
VISUALIZE GRAPH DATA EASILY

Menu | Find | Edit data ON OFF

Nodes | Edges | Paths | Patterns

```
1 MATCH (n:Topic)-[r:CorrelatedTo]->(m:Topic)
2 WHERE r.corr > 0.40
3 RETURN n, m, r,
4 n.name AS from,
5 m.name AS to,
6 (r.corr) AS value
```

PREVIEW RESULTS

1 SELECTED NODES

- valv contamin tank #2384

pinned Topic

Select... | Deselect | Hide | Expand...

PROPERTIES

Find a property...

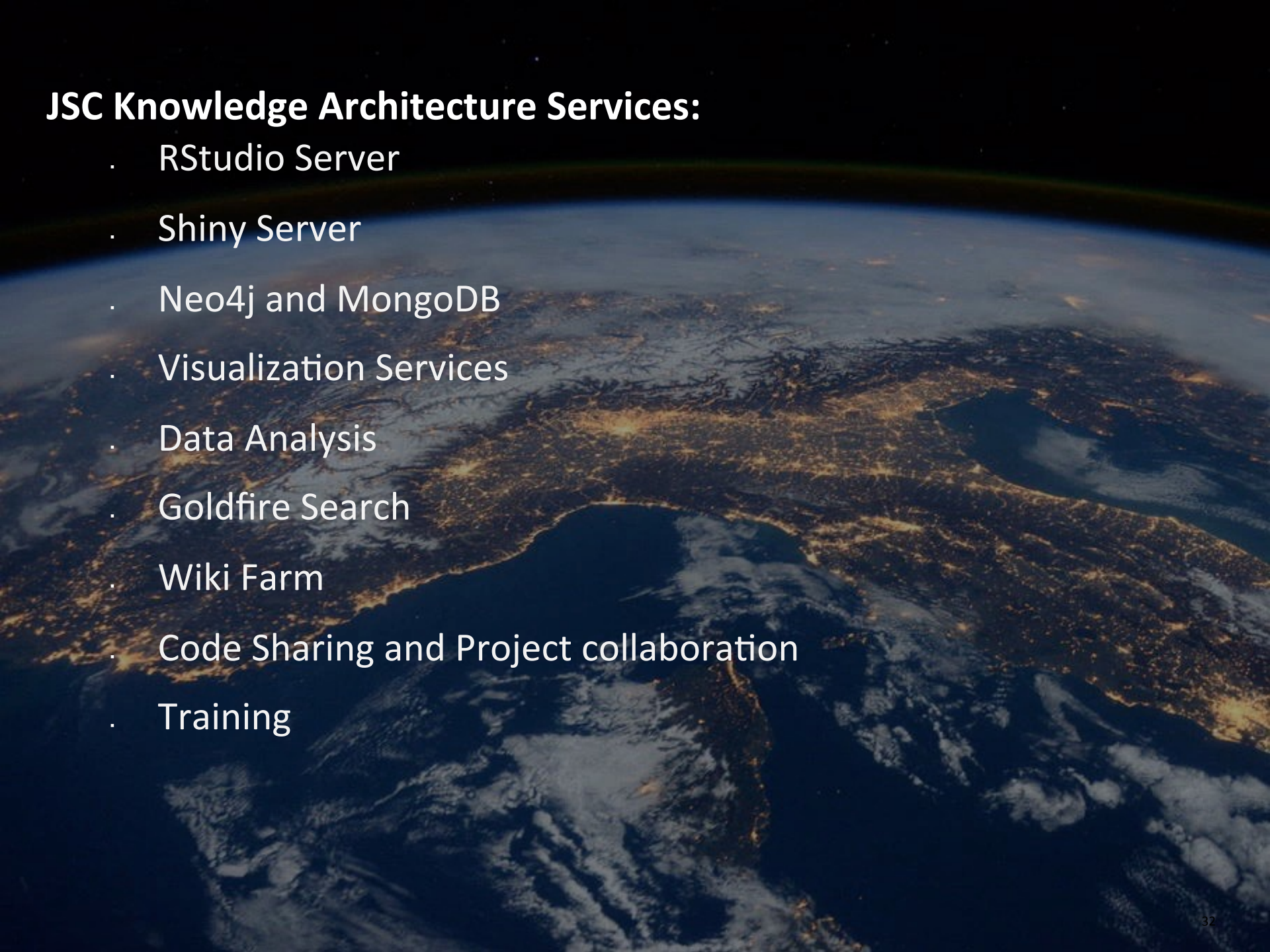
label	valv contamin tank
name	27

1 EDGES / 106 IN DATABASE

LINKURIOUS
VISUALIZE GRAPH DATA EASILY

WHAT COULD YOU ACCOMPLISH IF YOU COULD:

- Empower faster and more informed decision-making
- Leverage lessons of the past to minimize waste, rework, re-invention and redundancy
- Reduce the learning curve for new employees
- Enhance and extend existing content and document management systems



JSC Knowledge Architecture Services:

- RStudio Server
- Shiny Server
- Neo4j and MongoDB
- Visualization Services
- Data Analysis
- Goldfire Search
- Wiki Farm
- Code Sharing and Project collaboration
- Training

Contact Information

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QUESTIONS?