

# Our journey into Semantics

How to contextualize the meaning of Semantics for your organization

Ivo Willems

Global Director IT R&D / KM

10th - 13th of September 2018 in Vienna

**FLUOR**

**SEMANTICS**

Where Machine Learning Meets Semantics

# Agenda

- ◆ Corporate Overview
- ◆ A peek into an Engineering Project
- ◆ Challenges and Goals
- ◆ A Pivotal Concept: The Knowledge Assembly
- ◆ Three Proof Of Concepts
- ◆ Future Plans

# Agenda

- ◆ Corporate Overview
- ◆ A peek into an Engineering Project
- ◆ Challenges and Goals
- ◆ A Pivotal Concept: The Knowledge Assembly
- ◆ Three Proof Of Concepts
- ◆ Future Plans

# 2018 CORPORATE OVERVIEW



**FLUOR**<sup>®</sup>

© 2018 Fluor Corporation – All Rights Reserved

# Differentiators

- ◆ **Executing work in challenging locations**
- ◆ Optimizing returns on Clients' capital investments
- ◆ **Developing innovative and cost-effective technical solutions**
- ◆ Meeting compressed schedules
- ◆ **Linking global engineering resources**
- ◆ Sourcing material globally
- ◆ Mobilizing diverse workforces
- ◆ Managing joint ventures and alliances worldwide
- ◆ **Providing global fabrication capabilities**
- ◆ Utilizing modular construction techniques
- ◆ **Optimizing assets' life cycle**



# Worldwide Office Locations

More than 100 Offices in 36 Countries on 6 Continents

## Americas

Aliso Viejo, California, U.S.  
 Anchorage, Alaska, U.S.  
 Arlington, Virginia, U.S.  
 Baytown, Texas, U.S.  
 Bogotá, Colombia (2)  
 Buenos Aires, Argentina  
**Calgary, Alberta, Canada (3)**  
 Corvallis, Oregon, U.S.  
**Dallas, Texas, U.S. (2)**  
 Deer Park, Texas, U.S.  
 Edmonton, Alberta, Canada  
**Greenville, South Carolina, U.S. (3)**  
**Houston, Texas, U.S. (4)**  
 Idaho Falls, Idaho, U.S.  
 Ithaca, New York, U.S.  
 Kingston, Jamaica  
 Lima, Peru (2)

Long Beach, California, U.S.  
 Mexico City, Mexico (3)  
 Neiva, Colombia  
 North Charleston, South Carolina, U.S.  
 Pasadena, Texas, U.S.  
 Port of Spain, Trinidad and Tobago  
 Portland, Oregon, U.S.  
 Richland, Washington, U.S. (3)  
 Rockville, Maryland, U.S.  
 Salt Lake City, Utah, U.S.  
 San Francisco, California, U.S.  
 San Juan, Puerto Rico  
**Santiago, Chile**  
 Tampico, Mexico  
 Texas City, Texas, U.S.  
**Vancouver, B.C., Canada**  
 Washington, D.C., U.S.

## Europe/Africa/Middle East

Aberdeen, Scotland (2)  
 Abu Dhabi, U.A.E. (2)  
 Al Ahmadi, Kuwait  
 Al Khobar, Saudi Arabia  
**Amsterdam, The Netherlands**  
 Antwerp, Belgium  
 Asturias, Spain  
 Bergen-op-Zoom, The Netherlands  
 Birmingham, England  
 Doha, Qatar  
 Dubai, U.A.E.  
 Dublin, Ireland  
 Durban, South Africa (2)  
**Farnborough, England**  
 Gaborone, Botswana  
**Gliwice, Poland**

Hengelo, The Netherlands  
**Johannesburg, South Africa (2)**  
 London, England (3)  
 Madrid, Spain (2)  
 Maputo, Mozambique  
 Moscow, Russia  
 Ritthem, The Netherlands  
 Rotterdam, The Netherlands (3)  
 Sakhalin Island, Russia  
 Secunda, South Africa  
 Sneek, The Netherlands  
 Tarragona, Spain  
**Utrecht, The Netherlands**

## Asia/Australia

Atyrau, Kazakhstan  
 Bangkok, Thailand  
**Beijing, China**  
 Brisbane, Australia  
**Cebu, Philippines**  
 Jakarta, Indonesia  
 Kuala Lumpur, Malaysia  
**Manila, Philippines**  
**Melbourne, Australia**  
**New Delhi, India (2)**  
**Perth, Australia**  
 Seoul, South Korea  
**Shanghai, China**  
 Singapore (2)  
 Sydney, Australia (2)  
 Tokyo, Japan  
 Zhuhai, China

### Fluor Years of Experience in Region

North America	South America	Europe	Africa	Middle East	Asia	Australia
106	81	70	58	71	67	68

# Agenda

- ◆ Corporate Overview
- ◆ A peek into an Engineering Project
- ◆ Challenges and Goals
- ◆ A Pivotal Concept: The Knowledge Assembly
- ◆ Three Proof Of Concepts
- ◆ Future Plans

# Detailed Engineering – Information (Docs & Data)



- ◆ Process Engineering
- ◆ Mechanical Engineering
- ◆ CSA Engineering
- ◆ Electrical Engineering
- ◆ Control Systems Engineering
- ◆ Piping Engineering & Design
  
- ◆ Project Management & Controls
- ◆ Procurement & Subcontracting
- ◆ Logistics
  
- ◆ Construction



# Agenda

- ◆ Corporate Overview
- ◆ A peek into an Engineering Project
- ◆ **Challenges and Goals**
- ◆ A Pivotal Concept: The Knowledge Assembly
- ◆ Three Proof Of Concepts
- ◆ Future Plans

# CHALLENGES

- ◆ **Data Integration** -- Aggregation of dispersed (silo-ed) data
- ◆ **Data Completeness** -- incomplete data sets & changing data set
- ◆ **Disperse Data landscape** -- changing source
- ◆ **Data Volatility** -- heavy reliance on document exchange with implicit data ownership definitions
- ◆ **Data Consistency** -- focus on (silo-ed) work process related data
- ◆ **Data Linking** -- Inability to link related knowledge assets at a cross-discipline level
- ◆ **Data ReUse** – Inability to leverage what other engineers have done
- ◆ **Data Accessibility/Analytics** -- Not possible to answer the question "Which discipline knows about x?"

# GOALS

## Organizational Aspects

- ◆ Project Execution organization
- ◆ Information Technology organization
- ◆ Knowledge Management organization

## Technical Aspects

- ◆ Aggregation of dispersed data sets
- ◆ Integration in support of optimized work flows
- ◆ Enterprise Search
- ◆ Analytics (Descriptive, Diagnostics, Predictive and Prescriptive)
- ◆ Data definition/manipulation flexibility
- ◆ Utilizing unstructured data
- ◆ Cognitive capabilities

# Agenda

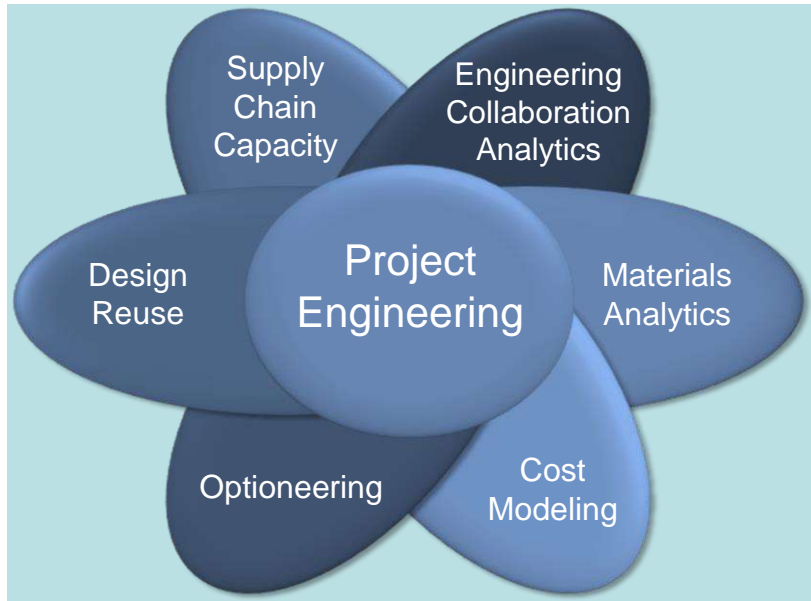
- ◆ Corporate Overview
- ◆ A peek into an Engineering Project
- ◆ Challenges and Goals
- ◆ A Pivotal Concept: The Knowledge Assembly
- ◆ Three Proof Of Concepts
- ◆ Future Plans

# What is a Knowledge Assembly?



“Knowledge Assets” (petals of the flower) are combined based on the user and what they are working on (who, what, where) and are combined into “Knowledge Assemblies”.

# Illustrative Project Engineering Knowledge Assembly



## Supply Chain Capacity

- Using analytics, determine supply chain capacity for various components needed in the construction and assembly of the cad/cam design being done.



## Engineering Collaboration Analytics

- Using Text Analytics, searching through engineering discussion threads for latest leading practices.



## Materials Analytics

- Using analytics, determine material options and costs to various parts.



## Cost Modeling

- Utilizing costing models to run through various costing and pricing options with various supplier products.



## Optioneering

- Running through a series of different design decisions and options



## Design Reuse

- Access to “similar” assembly, sub-assembly, and pre-defined “leading” practice designs

# Illustrative Project Planning Knowledge Assembly



## Project Planning

- Predictive Project Controls, Supply Chain Analytics, HSEC, Historical Project Plans and Look Backs, Legal / Regulatory, Economic Forecast, What-If planning, Human Capital Planning, Budget Forecast, Best Practices



## Predictive Project Controls

- Using analytics, determine historical similar projects and actual costs associated, pre-determine Predicted costs of projects based on historical trends and current econometric conditions.



## Supply Chain Analytics

- Optimized Supply Strategies based on Predicted/Actual project needs.



## H.S.E.C

- Health, Safety, Environment and Community. Pulls relevant and latest data surrounding project being worked based on geographic conditions and local social context



## Historical Project Plans and Look Backs

- Risk Reports, Project Plans, Look Backs and all other relevant project data from historical similar projects.



## Legal/Regulatory Info

- Compliance and all other pertinent legal issues pertaining to a project



## Economic Forecast

- Materials, Labor, and Environmental forecasts meant to predict future costs to better plan for projects.

# Agenda

- ◆ Corporate Overview
- ◆ A peek into an Engineering Project
- ◆ Challenges and Goals
- ◆ A Pivotal Concept: The Knowledge Assembly
- ◆ **Three Proof Of Concepts**
- ◆ Future Plans



# SEMANTIC SEARCH PROOF OF CONCEPT (PoC)

## How can we create an Enterprise Search function (which works with Knowledge Assemblies)?

- Want to use RDF to be able to express relationships in a contextual manner
- Will use Virtuoso as our triple store
- Focus on one application first : IBM Connections (Fluor's social and knowledge environment)

## The Big Picture: A Journey towards easier access of information

- Regular Search
- Semantic Search
- Persistent Search
- (Federated) Enterprise Search
- Cognitive Information Presentation

# SEMANTIC SEARCH PROOF OF CONCEPT (PoC)

## Current IT environment

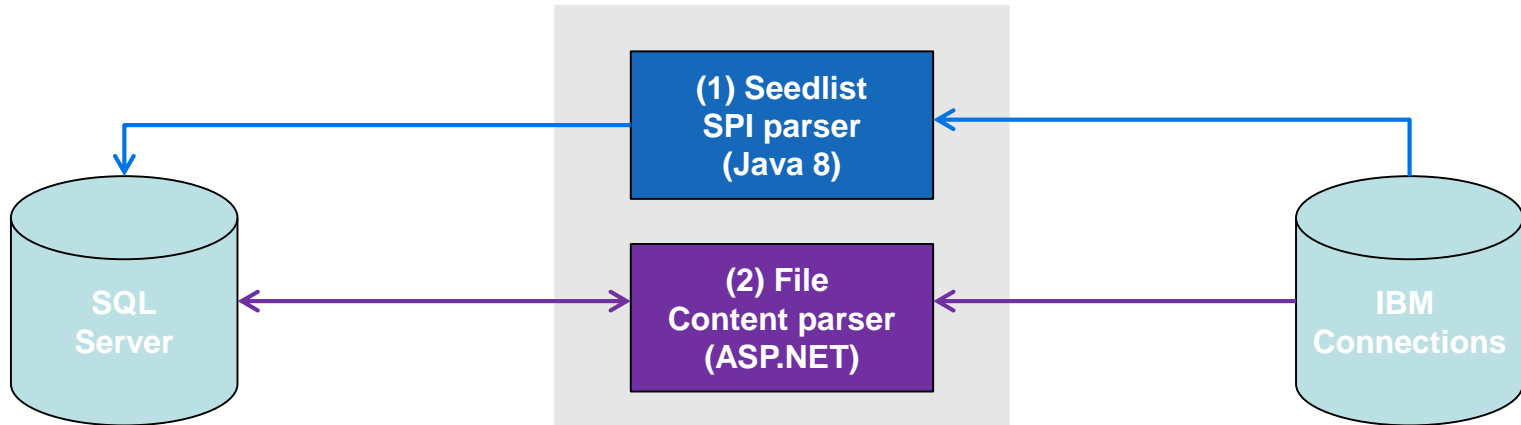
- traditional structured data requirements (relational world + lots of spreadsheets/docs)
- additional security requirements → quad store
- IT Governance requirements → IBM Websphere vs Apache Tomcat

## 3-step Approach

- Content retrieval
- Content indexing
- Content search & presentation

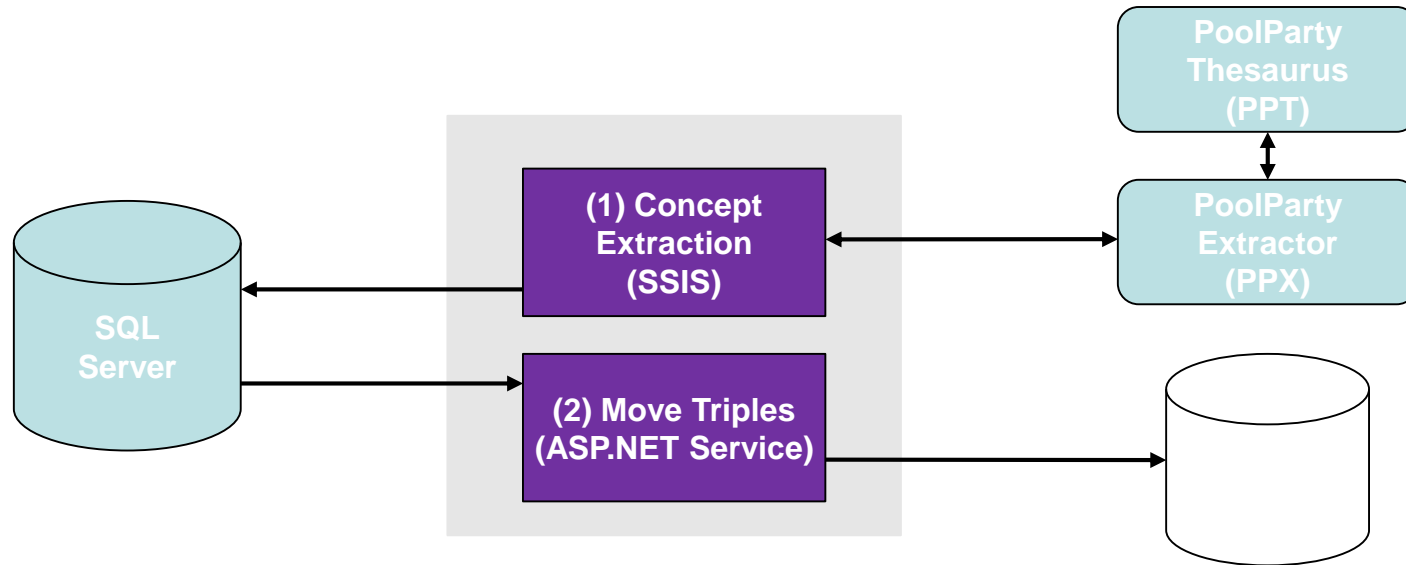
# Components: Content retrieval

- ◆ Parse Connections Seedlist SPI and Connections community memberships, and store in SQL (can process deltas)
- ◆ Retrieve file content and store back to SQL



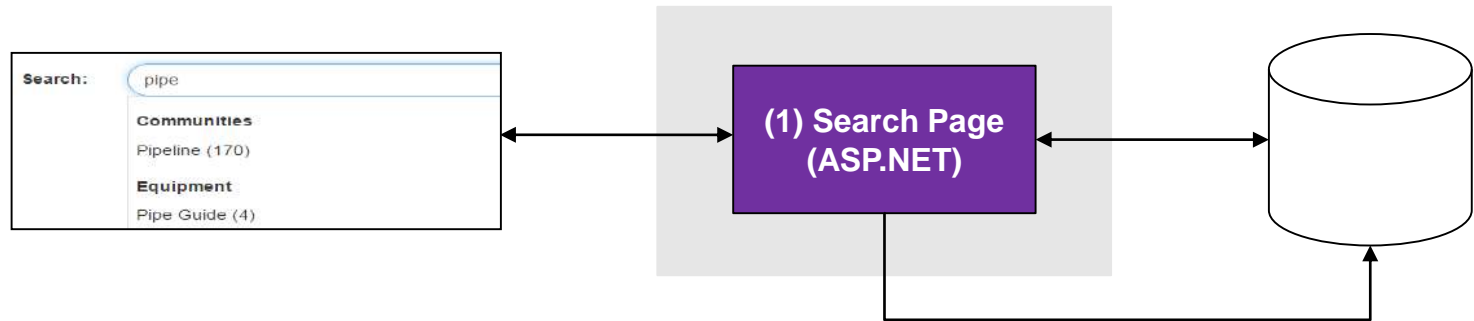
# Components: Content indexing

- ◆ Process data with PoolParty to identify matching concepts from the Thesaurus, create Triples, store back in SQL
- ◆ Move Triples to Virtuoso



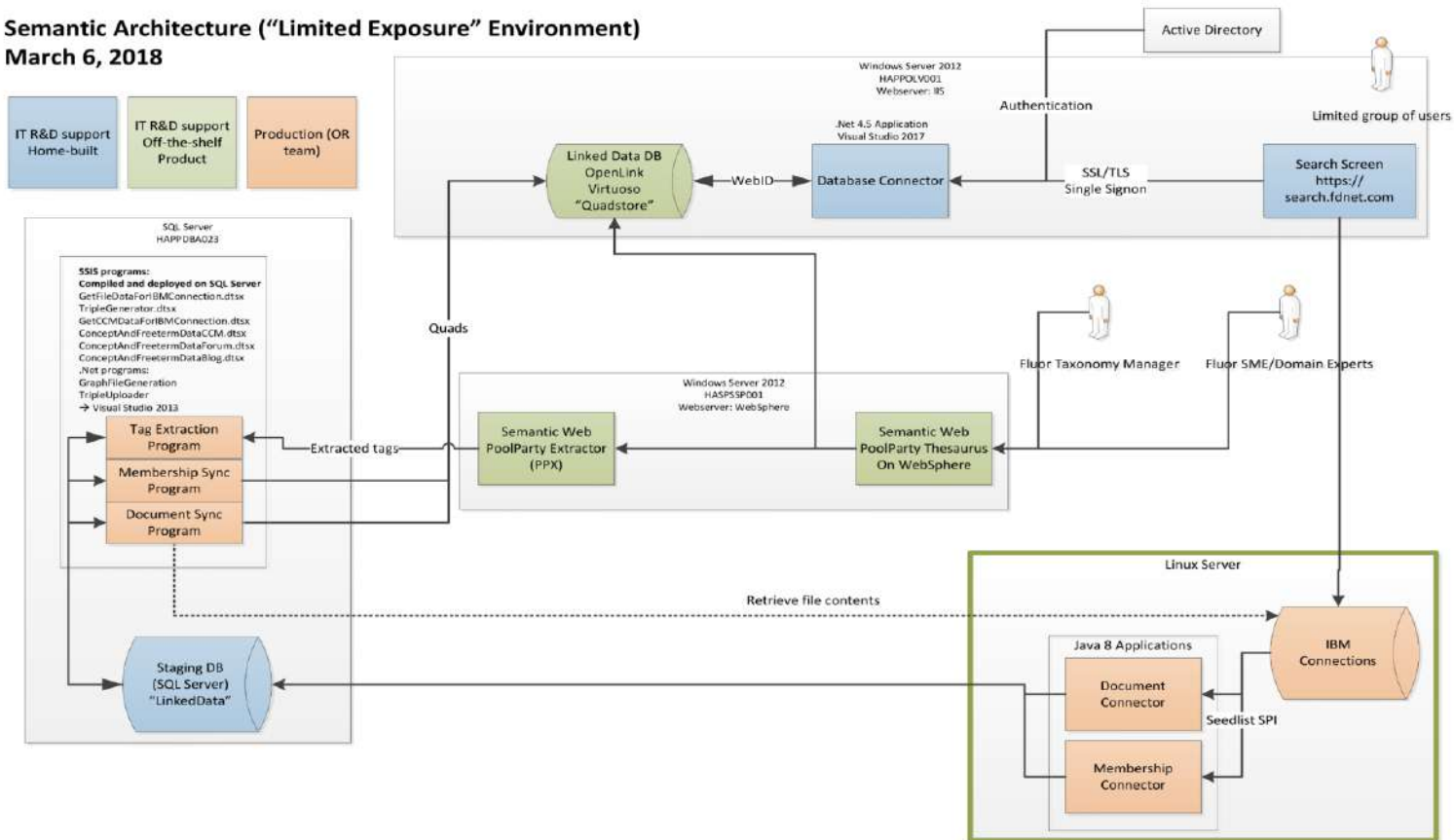
# Components: Content search & Presentation

- ◆ User single sign on to Search page using Windows credentials
- ◆ Search page builds SPARQL, queries Virtuoso on behalf of user and returns results
- ◆ Search query logged in Virtuoso



# Semantic Search Architecture

## Semantic Architecture ("Limited Exposure" Environment) March 6, 2018



# Semantic Search



**FLUOR**

flow |

**Concepts**

- flow Diagram (57)
- flow Rate (53)
- Process flow Diagram (50)
- Load flow (16)
- Volume flow Primary Element - Positive Displacement (8)

**Numbered Documents**

- 000.490.3820 Identification of Material Requirements from Plot Plan and flow Diagrams.zip (1)
- 000.490.0000 RWP-MM Integrated Work Process - Material Planning Work flow Diagram.pdf (1)
- 000.400.2001 Negotiation Work flow Diagram.pdf (1)
- Metso's Neles® flow control products receive SIL certifications .html (1)
- 000.270.2930 flow Diagrams.pdf (1)

# Semantic Search



## Refine Your Search

› Authors

› Communities

› Concepts

- Environment (4)
- Stable (4)
- Mass Flow Rate (4)
- Duration (4)
- Process Data Sheet (3)

› Numbered Documents

Enter search text

flow meters ×

219 results found.

### [000.225.1131 Hydraulic Design - Single Phase Flow - Gas.pdf](#)

Community: *DEV Test Community 1* Author: Laura Cowser

**flow** GAS PURPOSE This document establishes fundamental guidelines for the Process Engineer to use when performing single phase gas flow<...ameters associated with gas flow are provided in Fluor Manual 225-002 Piping Hydraulics and Specification. An accurate calculation of the par.....

### [000.265.1005 Power System Study.docx](#)

Community: *Electrical: Secure* Author: Rob Koene

**flow** The Electrical Power System Studies are being executed in all phases of a Project. Categories of Study Power System studies can be catego...ameters, (e.g. what models are used as a basis) Manufacturers equipment ratings and tolerances As-Tested requirements regarding Shop Tests Clie.....

### [000.265.1005 Power System Study.pdf](#)

Community: *Knowledge OnLine: Electrical* Author: Steve DeVita

**flow** The Electrical Power System Studies are being executed in all phases of a Project. Categories of Study Power System studies can be cat...ameters, (e.g. what models are used as a basis) Manufacturers equipment ratings and tolerances As-Tested requirements regarding Shop Tests.....



# Semantic Search

https://search.fdnnet.com/#3

File Edit View Favorites Tools Help

## FLUOR

Refine Your Search

- Authors
  - Darryl Wing (2)
  - Andrzej Czechowski (1)
  - Surajit Banerjee (1)
- Communities
- Concepts
  - Flow Rate (4)
  - Mass Flow Rate (4)
  - Standard (3)
  - Rating (3)
  - In-line (2)

Enter search text

flow meters × Mass Flow Rate ×

4 results found.

**In-line thermal dispersion flow measurement possible for flue gas??**.pdf  
*Community: Knowledge OnLine: Control Systems* Author: Andrzej Czechowski  
**flow meters** BY John G. Olin, Ph.D CEO, Founder Sierra Instruments, Inc. October 15, 2008 FOREWORD T..... **Mass Flow Rate** of a fluid, primarily gases, flowing through closed conduits. The operation of thermal dispersion mass flowmeters is attrib...

**RE: Wedge Flow Meter**.pdf  
*Community: Knowledge OnLine: Control Systems* Author: Surajit Banerjee  
**flow meters** Insensitive to wear & eliminates fouling Fit and forget installation Reduced cost of ownership instrumentation flow pressure tempe..... **Mass Flow Rates** can be attained using the multi- variable technology offered with todays Differential Pressure transmitters Erosive, Stands up...

**Technical Presentation : Flow Instrument (Part-1)**.ppt  
*Community: Knowledge OnLine: Control Systems* Author: Darryl Wing  
**flow meters** are used mainly in liquids, slurries, gases or vapours. Unaffected by changes in fluid temperature, pressure, density, and viscosi..... **Mass Flow Rate**. The operation of a Coriolis Flow Meter is based upon the measurement of Coriolis acceleration forces. Coriolis flow meters measure...

© 2016-2018 Fluor Corporation. All Rights Reserved.

125%

# Search Assist – Curated Answers

**Challenges** in Fluor Knowledge Base (KOL):

- 1) 99% of Q&A not recorded → can't be leveraged by others
- 2) Users complain about Search in KOL
- 3) Our systems perceived as 'not clever' compared with personal phone search capabilities, etc
- 4) 20K monthly searches are being conducted, on a limited domain
- 5) Data is stored in silos → users need to be 'location aware'

# Search Assist – Curated Answers

Potential **support** to make Search easier in Fluor Knowledge Base (KOL):

- 1) A single place to search for information → ‘location agnostic’
- 2) Quality results that are highly relevant to role and activity
- 3) Quickly determine trust-worthiness of search results
- 4) Obtain the ‘answer’ instead of ‘search results’
- 5) Confidence that if a question is asked, an answer will appear soon.

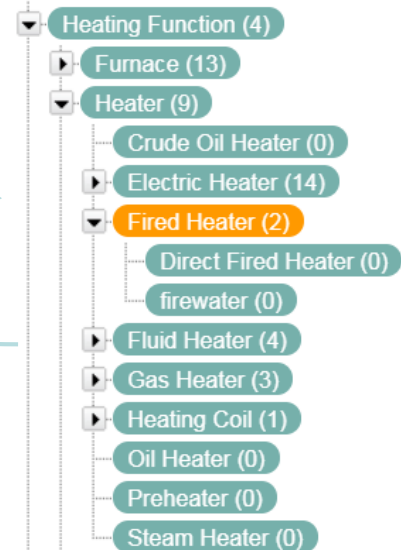
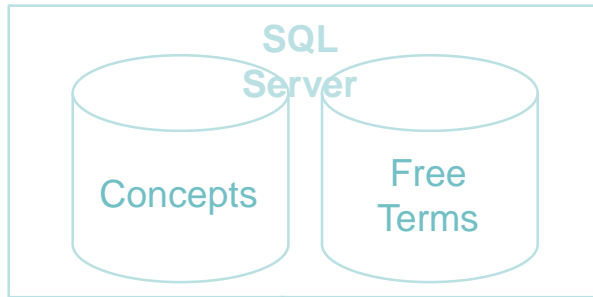
# Search Assist – Curated Answers

Where can I ask for help on fired heater?



## KNOWLEDGE ONLINE

Extract Concepts and Free Terms from 17 years worth (20k) of questions and answers



### Where can I ask for help on fired heater?

We recommend you ask your question in one of the following Knowledge OnLine forums:

- [Downstream](#) in the Process Technology community
- [Heat Transfer Equipment](#) in the Mechanical community
- [Utilities, Offsites and Tankage](#) in the Process Technology community

SPEL

- ① Where can I ask for help on SPEL? in Knowledge OnLine
- ① How can EHT design be integrated with SPEL? in Search Assist
- ① Is SPEL compatible with Windows 10? in Search Assist
- 👤 SmartPlant Electrical ( SPEL ) Help in other Connections communities
- 📎 000.265.4104 ETAP to SPEL Interface.pdf in Electrical
- 📎 000.265.8711 Activity Based Flow Diagram Electrical Eng SPEL Install & Setup Workfl in Electrical
- 📎 000.265.1060 SmartPlant Electrical Project Implementation - SUPERSEDED.doc in Electrical
- 📎 000.265.1060 SmartPlant Electrical Project Implementation - SUPERSEDED.pdf in Electrical
- 📎 000.265.1063 Smartplant Electrical Drawings Guideline - SUPERSEDED.docx in Electrical



Did this answer your question?

Yes

No

Where can I ask for help on SPEL?



### Where can I ask for help on spel?

We recommend you ask your question in one of the following Knowledge OnLine forums:

- [2D Engineering & Design - SmartPlant - Electrical](#) in the Systems Support community
- [Software and Deliverables](#) in the Electrical community
- [Project Execution](#) in the Systems Support community

If you prefer to ask your question directly to a Knowledge Manager click  above.

Did this answer your question?

Yes

No

How can EHT design be integrated with SPEL?



### [How can EHT design be integrated with SPEL?](#)

Submitted on 21 Jun 2018 by Susan Skinner (inactive)

Click on the link above to access a presentation that compares a conventional EHT design work process against a more data-centric EHT workflow. It also contains a demonstration of this new work process highlighting SPEL's functionality within this data-centric concept.

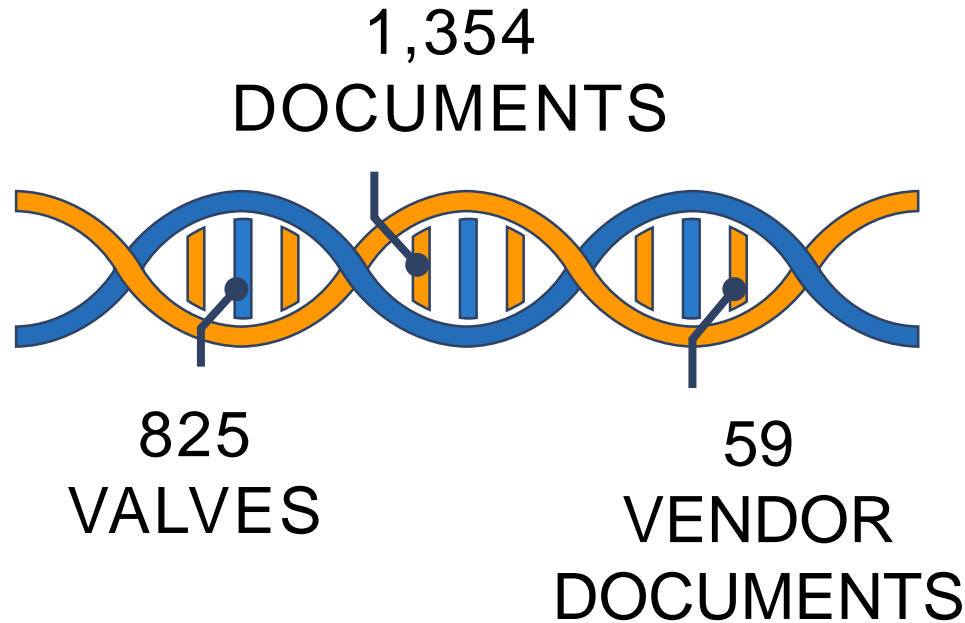
Did this answer your question?

Yes

No

# Requisition Packages – Current State

What's in a Requisition Package?



Requisition Package Traits:

- Numerous File Types and Access Protocols
- Hundreds or thousands of revisions
- Bundled in a ZIP file for delivery
- Minimal content re-use, if any at all.

# Requisition Packages – Future State

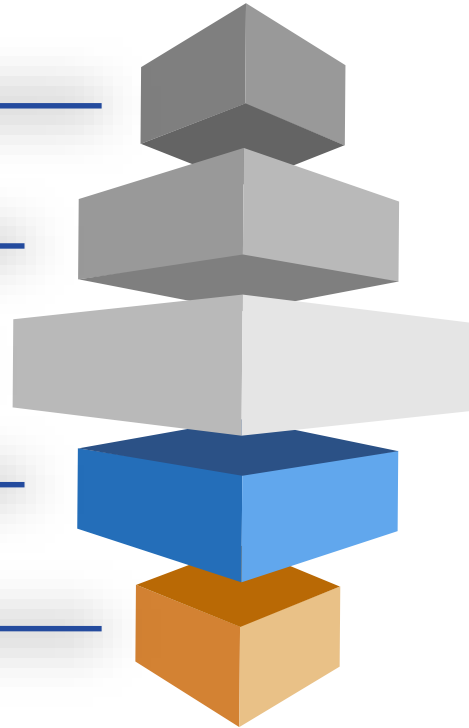
Engineering  
Knowledge Graph

Intelligent data  
structures

Rule Driven  
Modeling

Seamless  
Collaboration

Re-use;  
Not re-invent



# Agenda

- ◆ Corporate Overview
- ◆ A peek into an Engineering Project
- ◆ Challenges and Goals
- ◆ A Pivotal Concept: The Knowledge Assembly
- ◆ Three Proof Of Concepts
- ◆ Future Plans



# Where we want to go

## ▶ Utilize semantics to

- Provide the right information to the right role at the right time
- Establish (flexible) integration between dispersed systems
- Combine structured and unstructured data in intelligent class objects
- Create bots → rules-based engineering
- ‘Reversed Push/Pull’ → cognitive behavior
- Utilize better query mechanisms for information gathering (‘KM on steroids’)

# Where we want to go

- ▶ End of presentation