Applied Data Science, Big Data and The PI System

Teaching the Next Generation of Engineers the Skills of Today

Presented by **Pratt Rogers, PhD**
University of Utah

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Presentation Outline

- Introduction
- Digital and data intellectual divide
- Role of academia in bridging the digital divide

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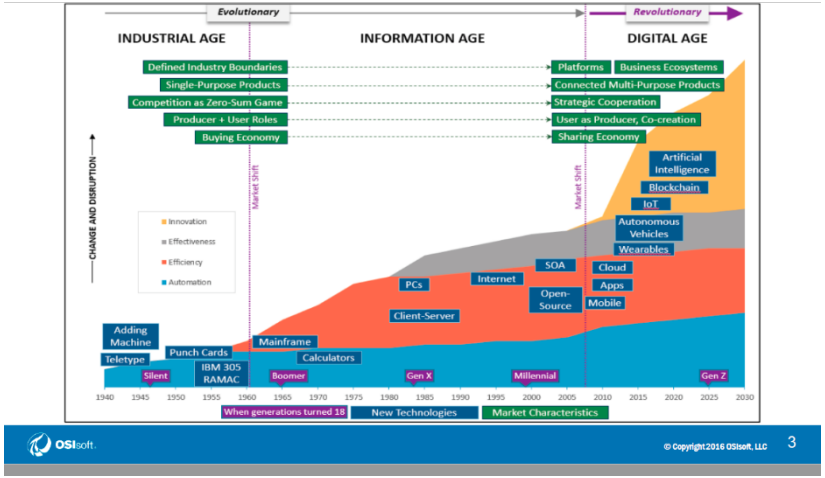
Starting thought….

*"The key to good **decision making is not knowledge. It is understanding**. We are swimming in the former. We are desperately lacking in the latter…*

*…I have sensed the enormous frustration with the unexpected **costs of knowing too much**, of being inundated with information. We have come to **confuse information with understanding**"*

"Blink"
Malcom Gladwell



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THE UNIVERSITY OF UTAH

College of Mines and Earth Sciences

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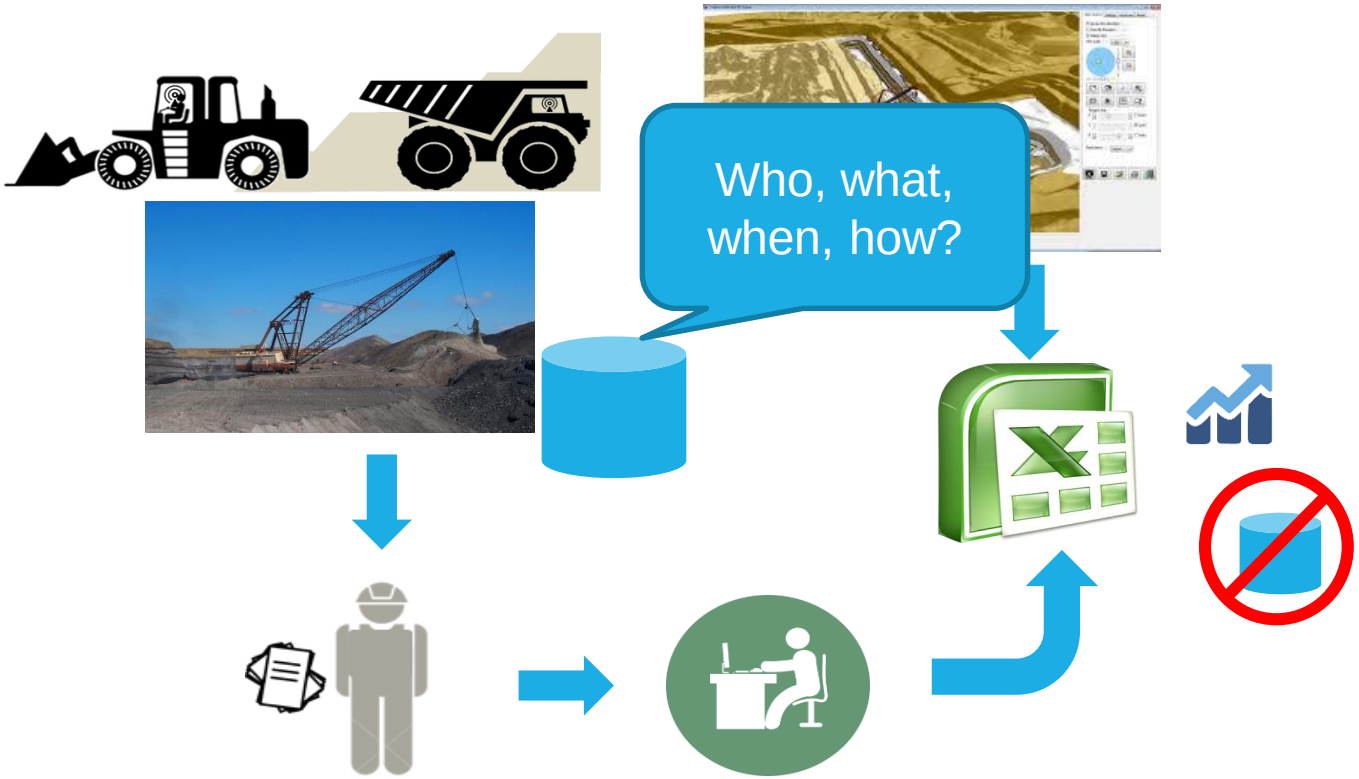
Atmospheric Sciences

Geology & Geophysics

Metallurgical Engineering

Mining Engineering

First job out of school



New hire engineer…

Performance management initiative

Glorified data clerk!

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Graduate school and MISOM Technologies: how to make data more effective…

Areas of work
Data Warehouses
Digital Audits
Continuous Improvement consulting
PI AF modeling and event frames

Commodity	Type
Coal	Surface, Underground
Metals	Surface, UG, Mill
Industrial (salt, aggregates)	Greenfield Surface, surface, UG,

… like any asset, it should create value

Data → Action

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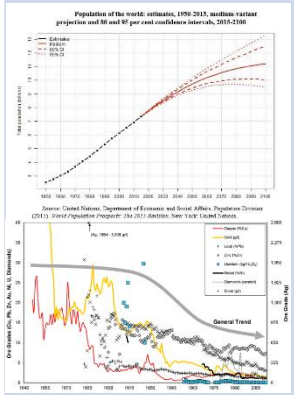
Why? – Sustainable development

Macroeconomics: Population growth & Ore Grades



Natural Capital: Water & Energy

Financial Capital: Operational costs - $per

Human Capital: Safety & Health Automation

Permitting: Social license

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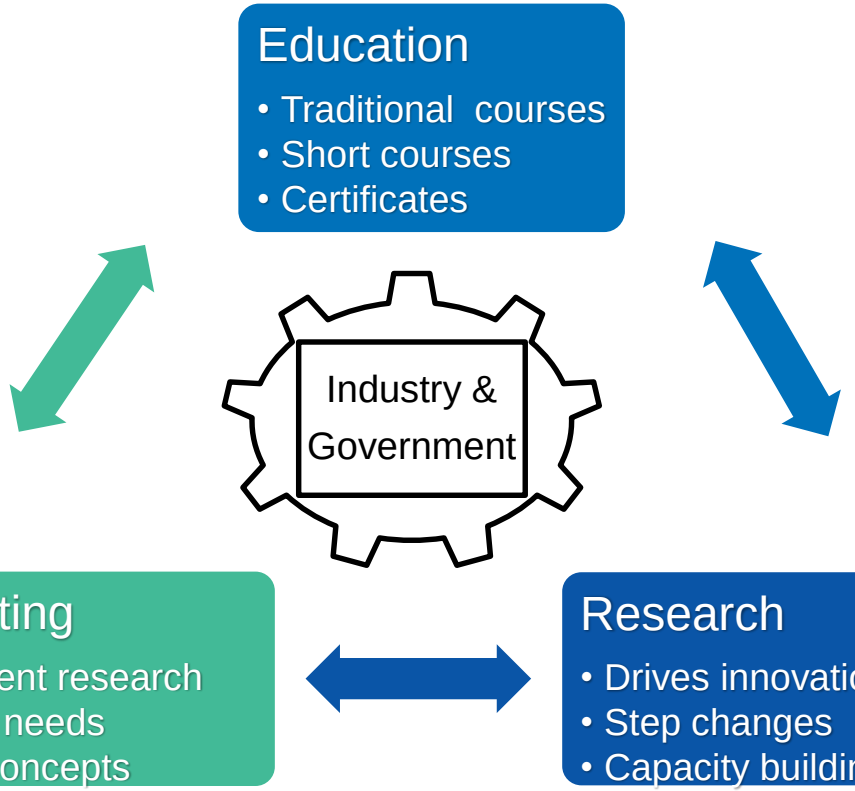
Successful academic approach



Not just monetary support -

In kind
Data
Modules
Content

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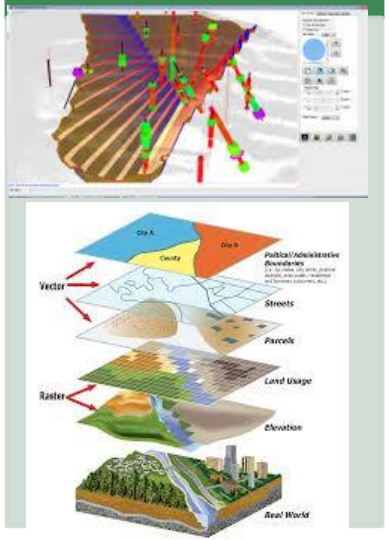
Common data at mine sites

Time series

Relational

Unstructured

Spatial



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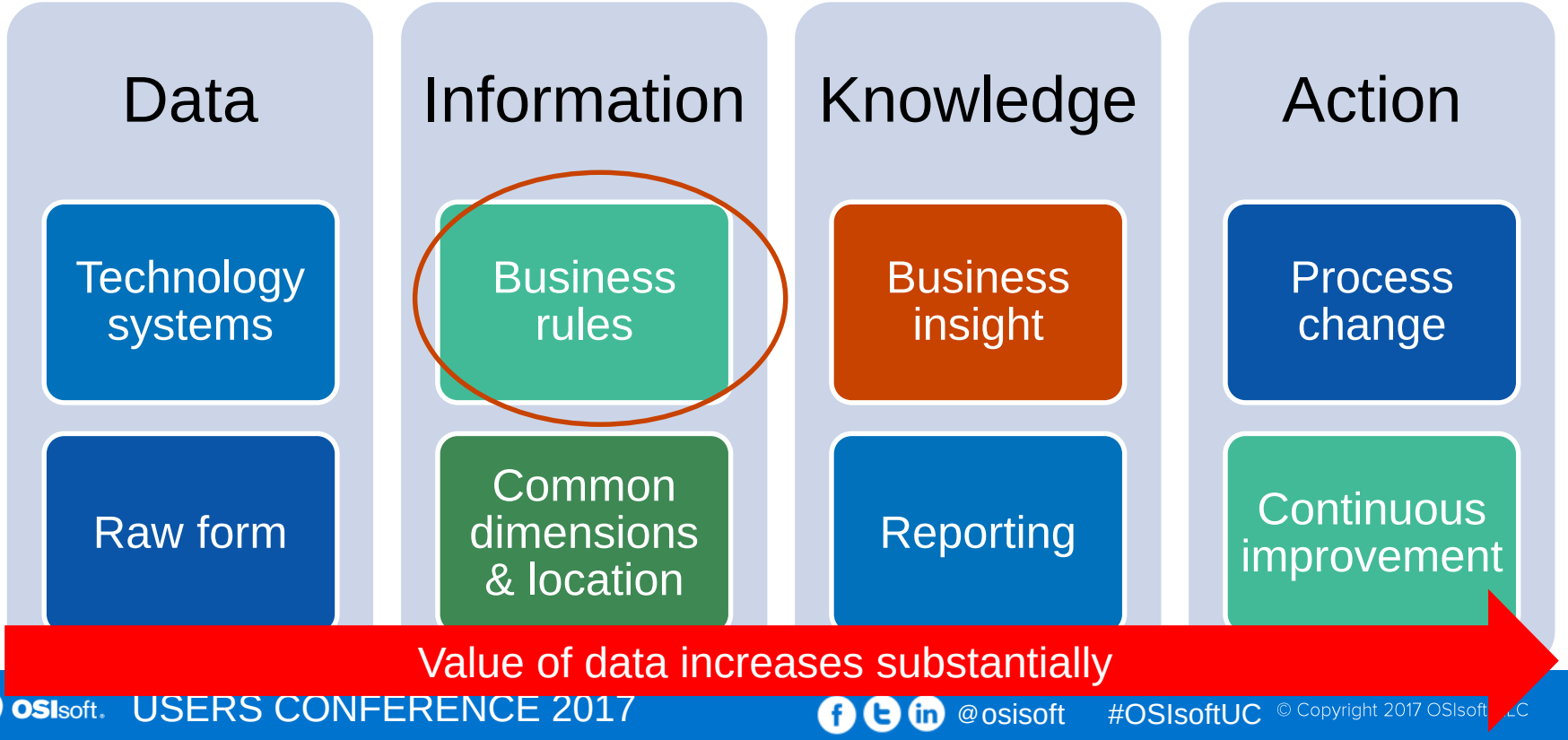
Business intelligence process approach



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Common data problem statement: Low levels of data utilization and value - Ph.D. DUVI

Asset Optimization

Root Cause Analysis

Predictive Maintenance

Performance Management

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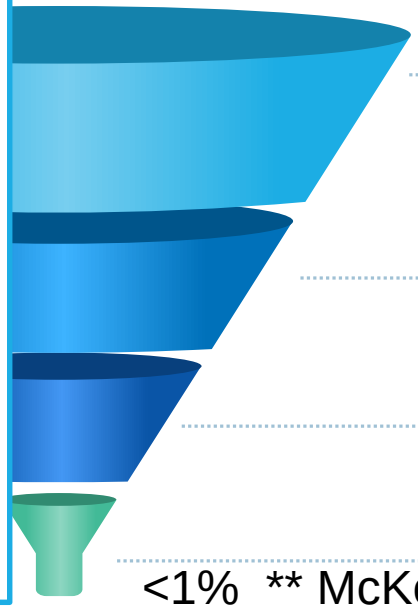
Lost Digital Opportunities



utilization

<1% ** McKenzie
~$370 billion/year

Operational data sets
Data is paper based, data not stored, data not captured, dispersion, connectivity,

Operational information
Data lacks context, data is not relevant, technology is hard to use,

Operational understanding
Data not analyzed, cognitive overload, data latency,

Operational action
Latency, granularity, no frontline feedback,

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Exploring the digital divide

Mining Perspective

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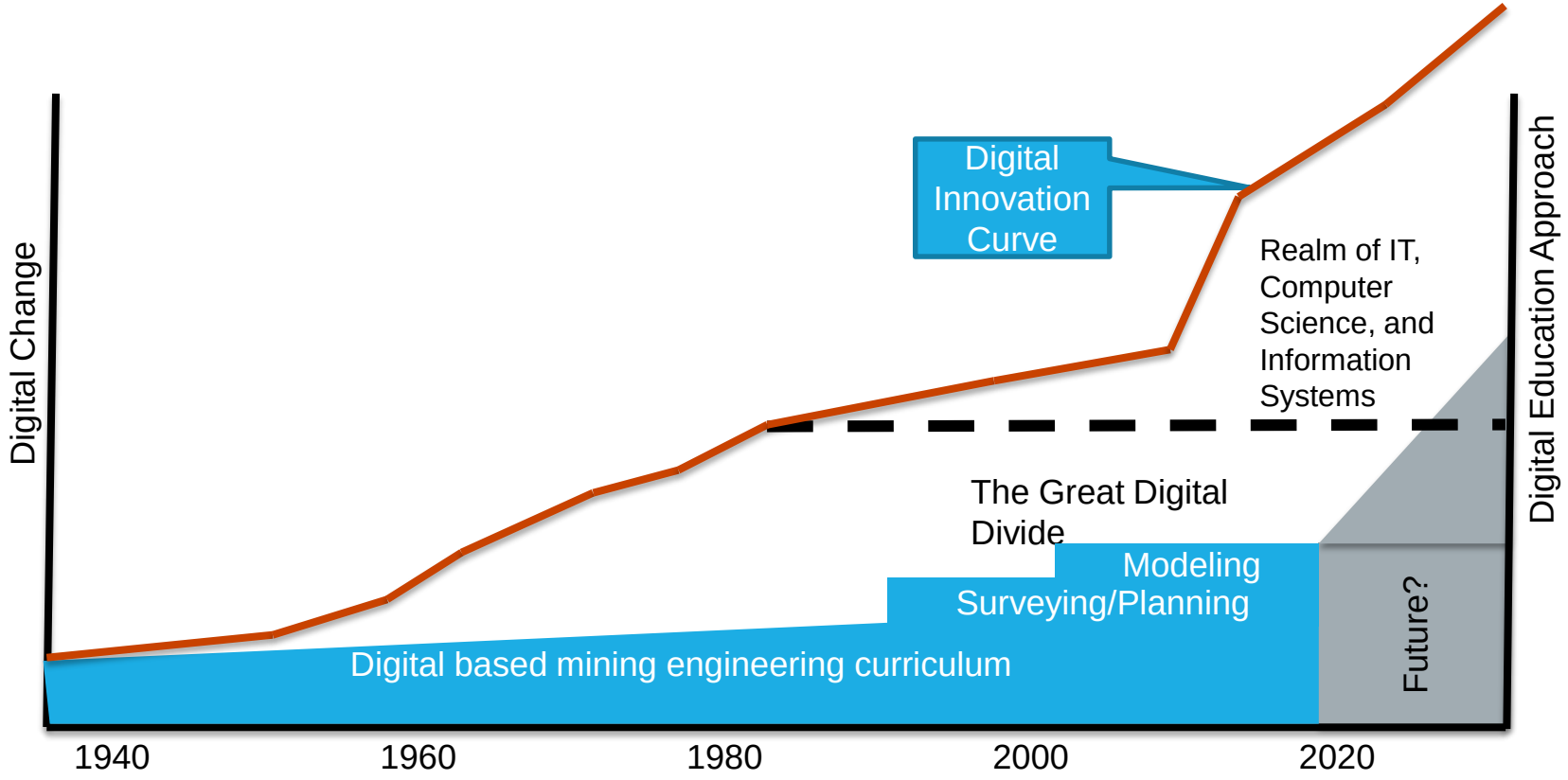
Why the lost digital opportunity?



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Implications of “digital divide”

Technology implementation confusion

- Installation ≠ Implementation
- Site capabilities

Lack of strategic plan

- Corporate or site driven
- Process changes

Collaboration pains

- Context
- **Business rules & operational standards**

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What can be done?

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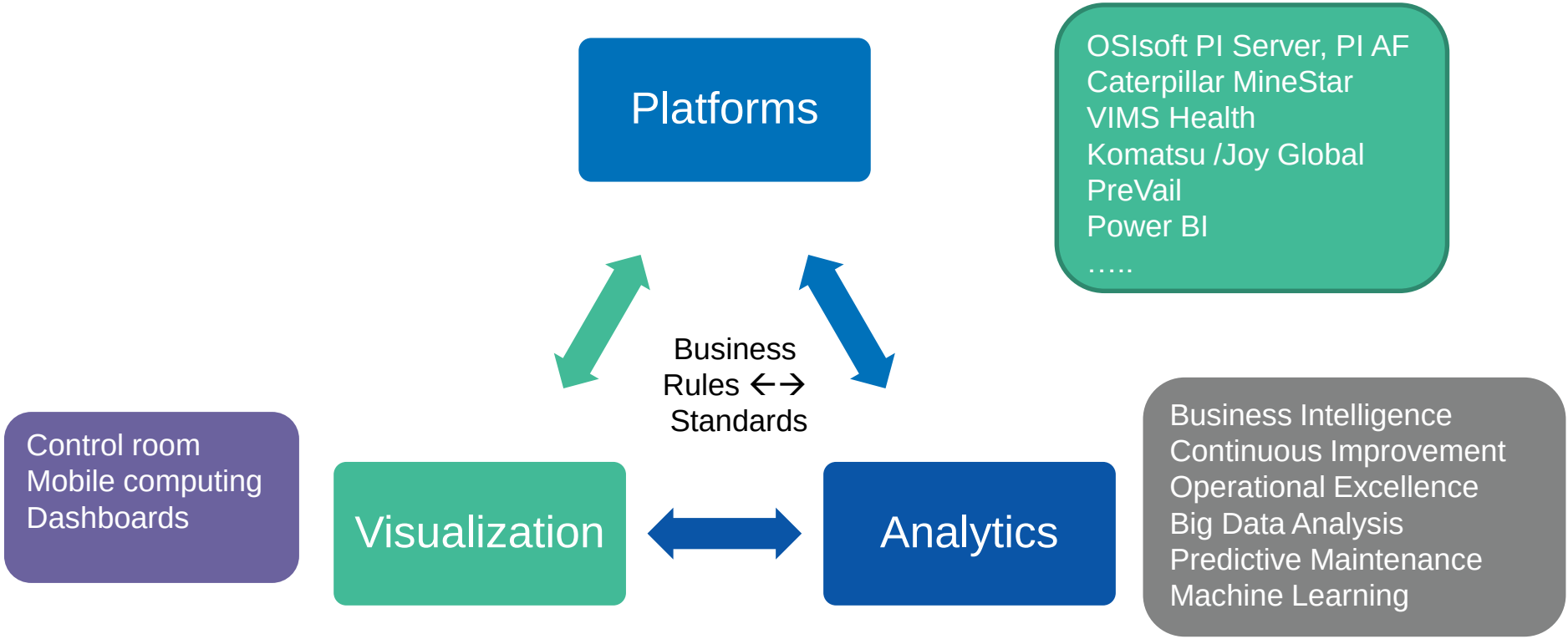
Utah's Digital Minescape: mining IS/OT research lab



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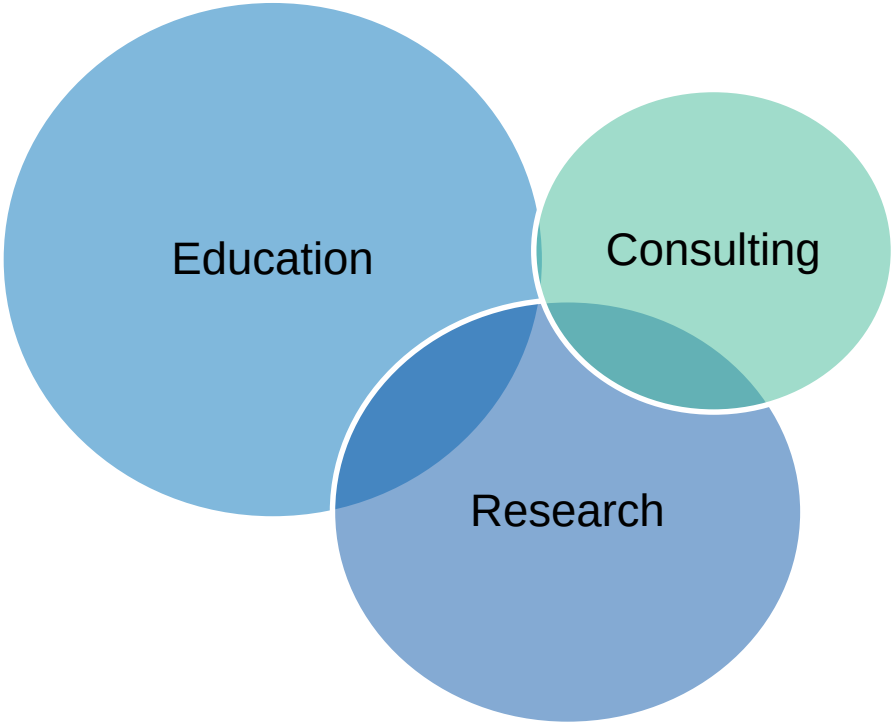
Enact change in following areas



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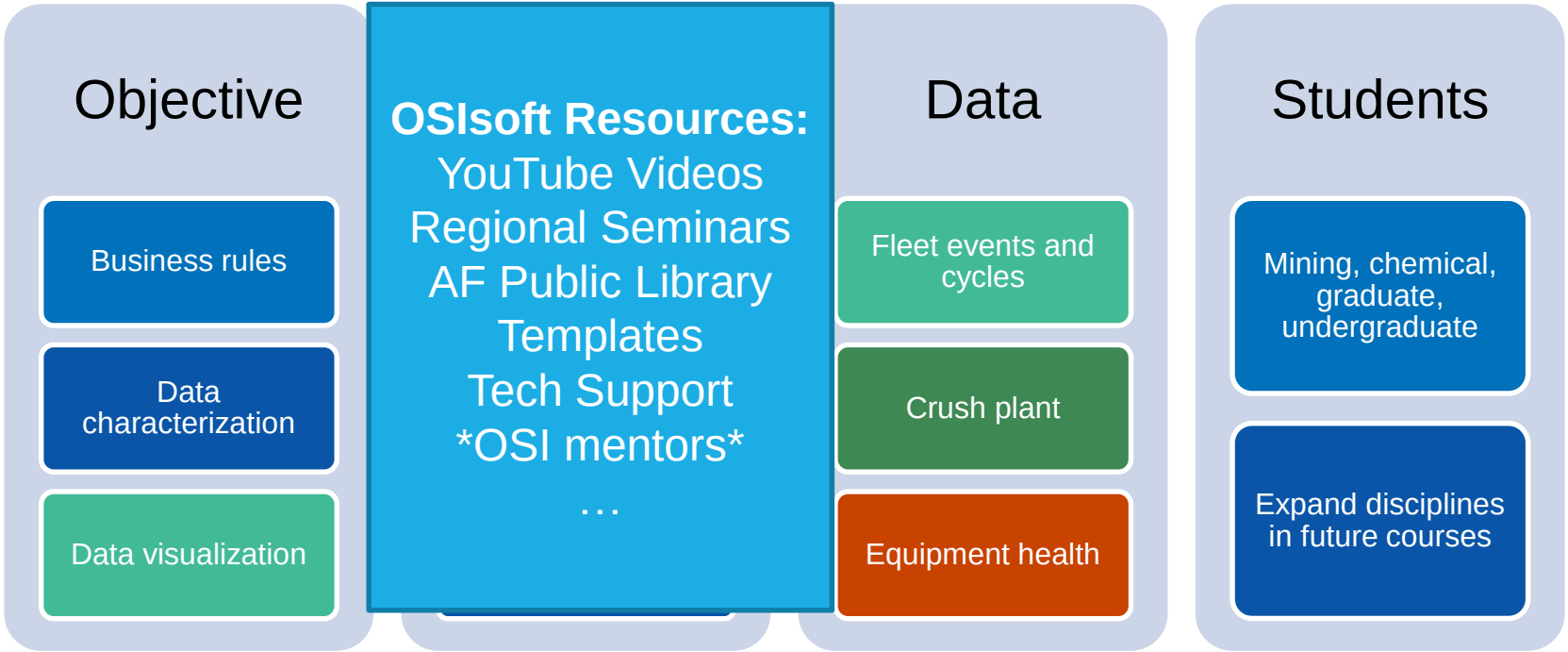
Engineering applications of big data – Fall 2016



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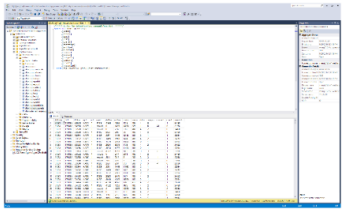
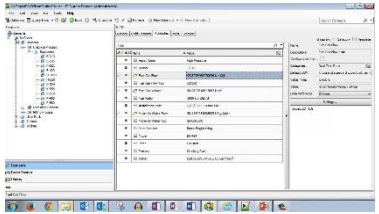
Connecting engineering and operational standards to business rules

Excel tables & pivot



SQL tables & views

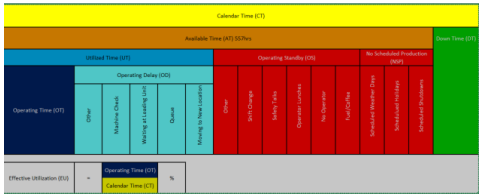


PI AF / Event Frames

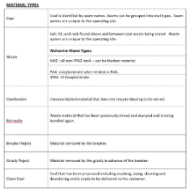
Business rules to engineering standards

Business rules to engineering standards

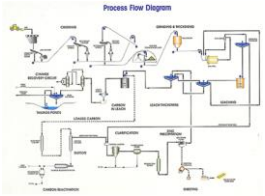
Business rules to engineering & operational standards



Time Usage Model



Material Hierarchy



Process Flow Diagram

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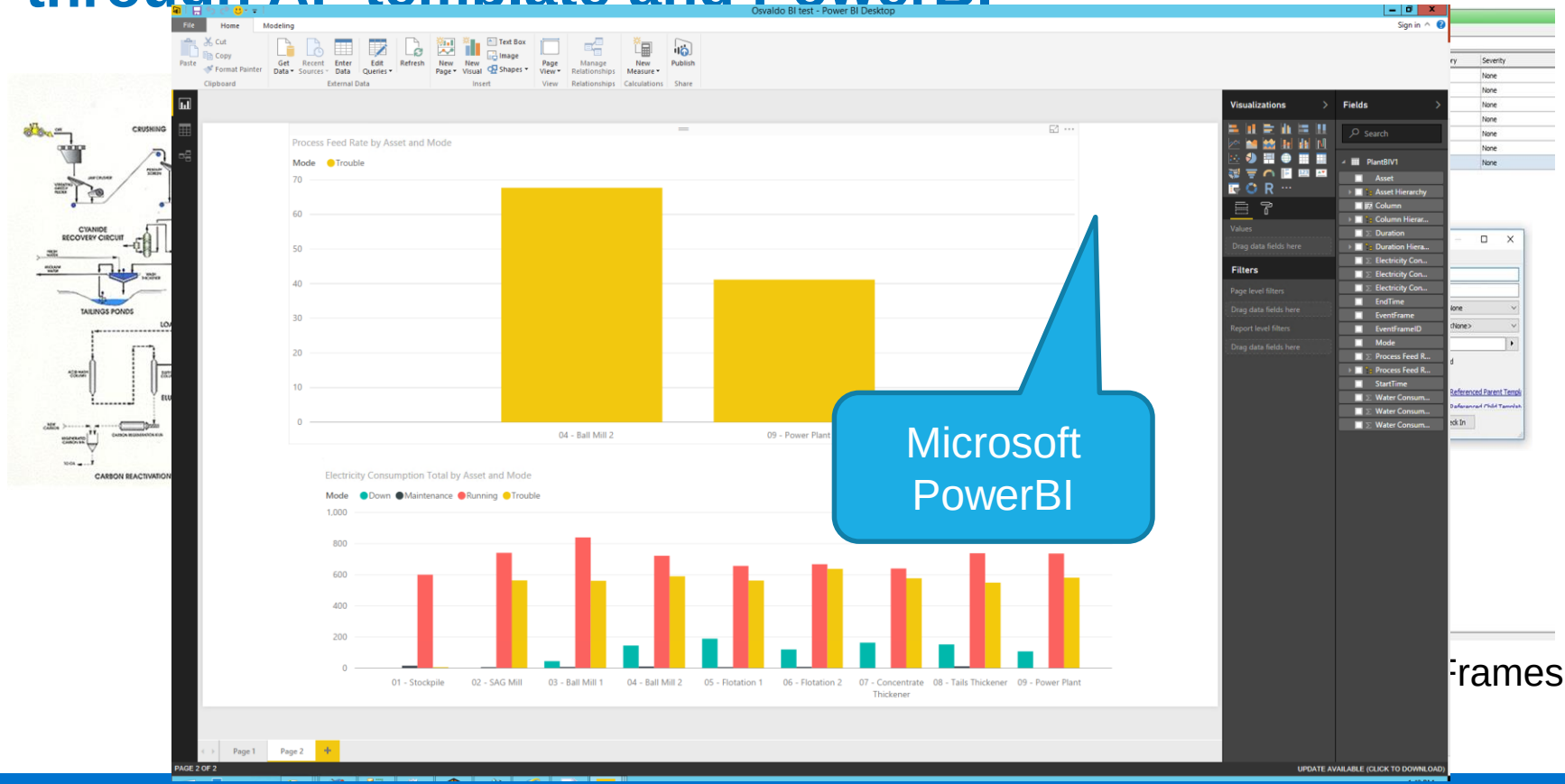
Contextualizing process flow diagram to AF model through AF template and PowerBI



-rames

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Initial lessons learned

- Introduce concepts gradually
  - I do, we do, you do approach
- Infrastructure always a challenge
- Business rules first, visualization second
  - Visualizations important business rules foundational
- Students are enjoying it!

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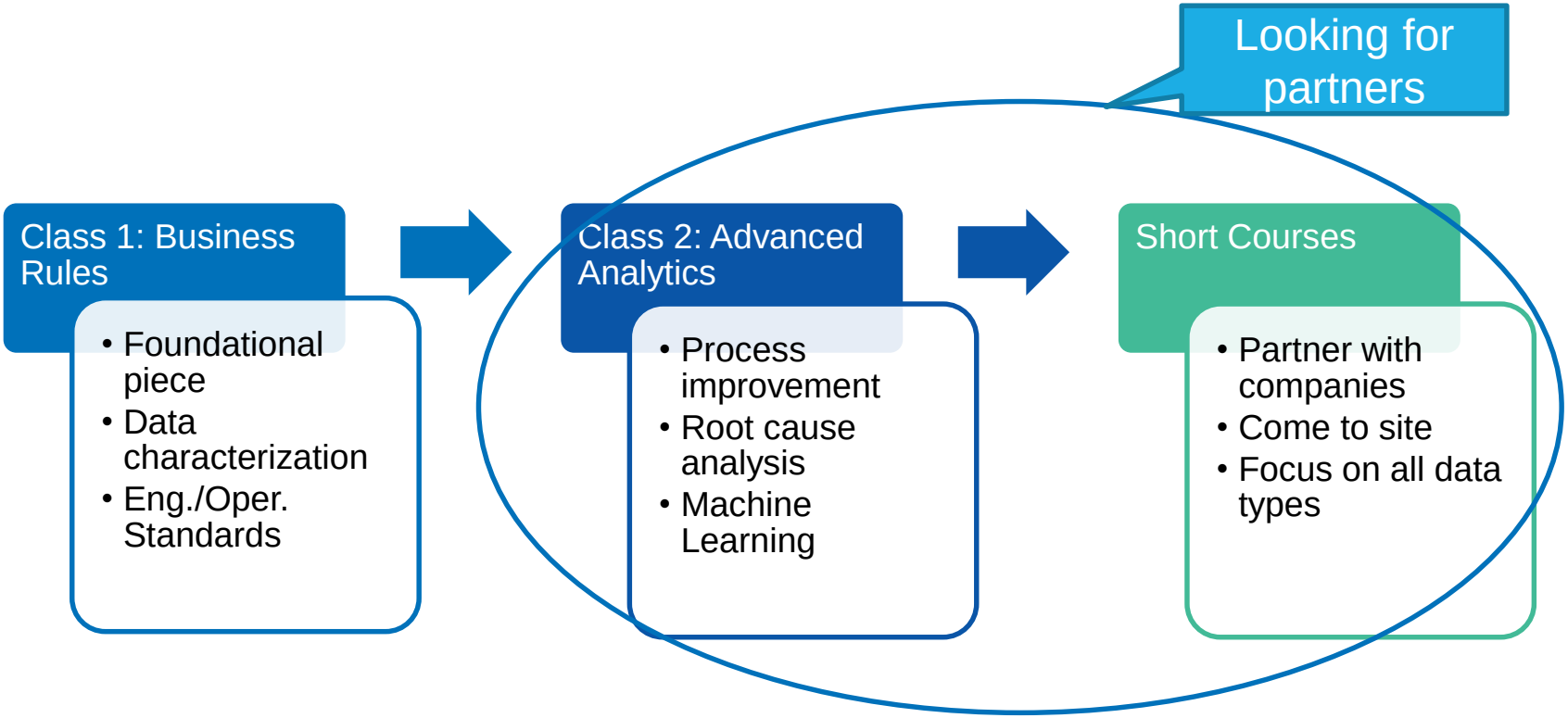
Class Progression



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Conclusions

- Large opportunity to expand mining curriculum - People
  - Short courses, certificates, etc.

- Technology collaboration is key - Process
  - Break “silos” – data, process, roles, etc.
  - Working with other disciplines

- Looking for support: data, content, modules, etc.
  - Start small and expand
  - Leads to funded research

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감사합니다

谢谢

Danke

Gracias

Merci

Thank You

ありがとう

Спасибо

Obrigado

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Contact Information

Pratt Rogers
Pratt.rogers@Utah.edu
Assistant Professor
University of

Osvaldo Bascur
OsvaldoB@osisoft.com
Industry Principal
OSIsoft

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