



Teaching Risk Management

Hidden Information Pathways

Vale Brumadinho – January 2019

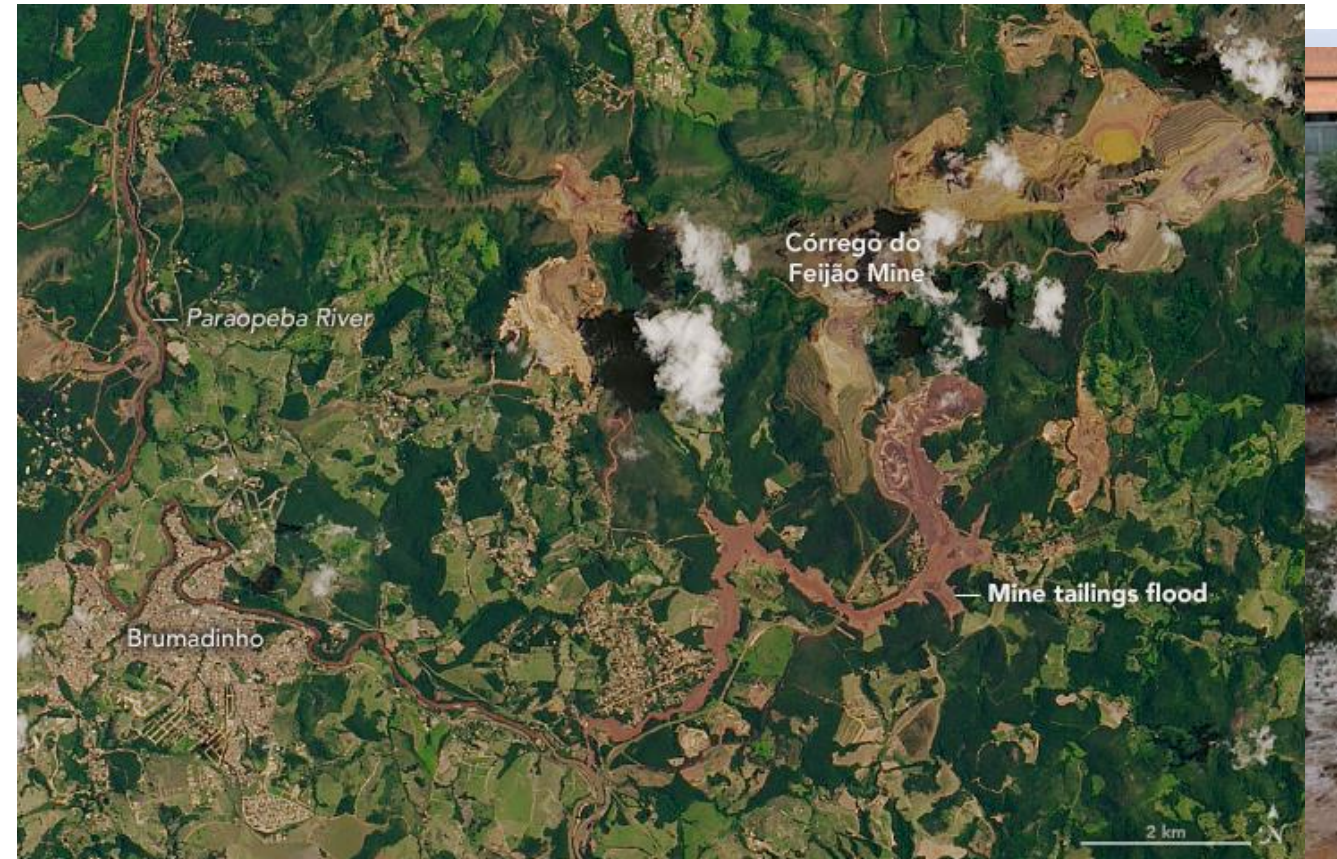
248 dead, 22 remain missing¹

Brazilian senate has called for murder charges against Vale's CEO and CFO¹

Recommended indictment of stability auditor, certifying dam despite data¹

Internal risk assessments by Vale showed risk had exceeded tolerable²

Vale claimed 'no mention of imminent failure appeared in reports.'³



1. "Brazilian mining company to pay out £86m for disaster that killed almost 300 people", The Guardian, 2019, <https://www.theguardian.com/world/2019/jul/16/vale-brazil-mining-dam-collapse-brumadinho>
 2. "Vale 'knew collapsed dam was at risk', says report", BBC UK, 2019, <https://www.bbc.com/news/business-47209265>
 3. "Why the Brumadinho dam collapse wasn't surprising", Geographical, 2019, <https://geographical.co.uk/people/development/item/3123-tailings-dam-collapse>
- Video: "Brazil: shocking video captures moment of deadly dam collapse", The Guardian, 2019, <https://www.theguardian.com/world/2019/feb/01/brazil-mining-dam-video-captures-moment-collapse>

Learning – the unstoppable entropy



Humans learn from every experience



Outcomes can be unexpected

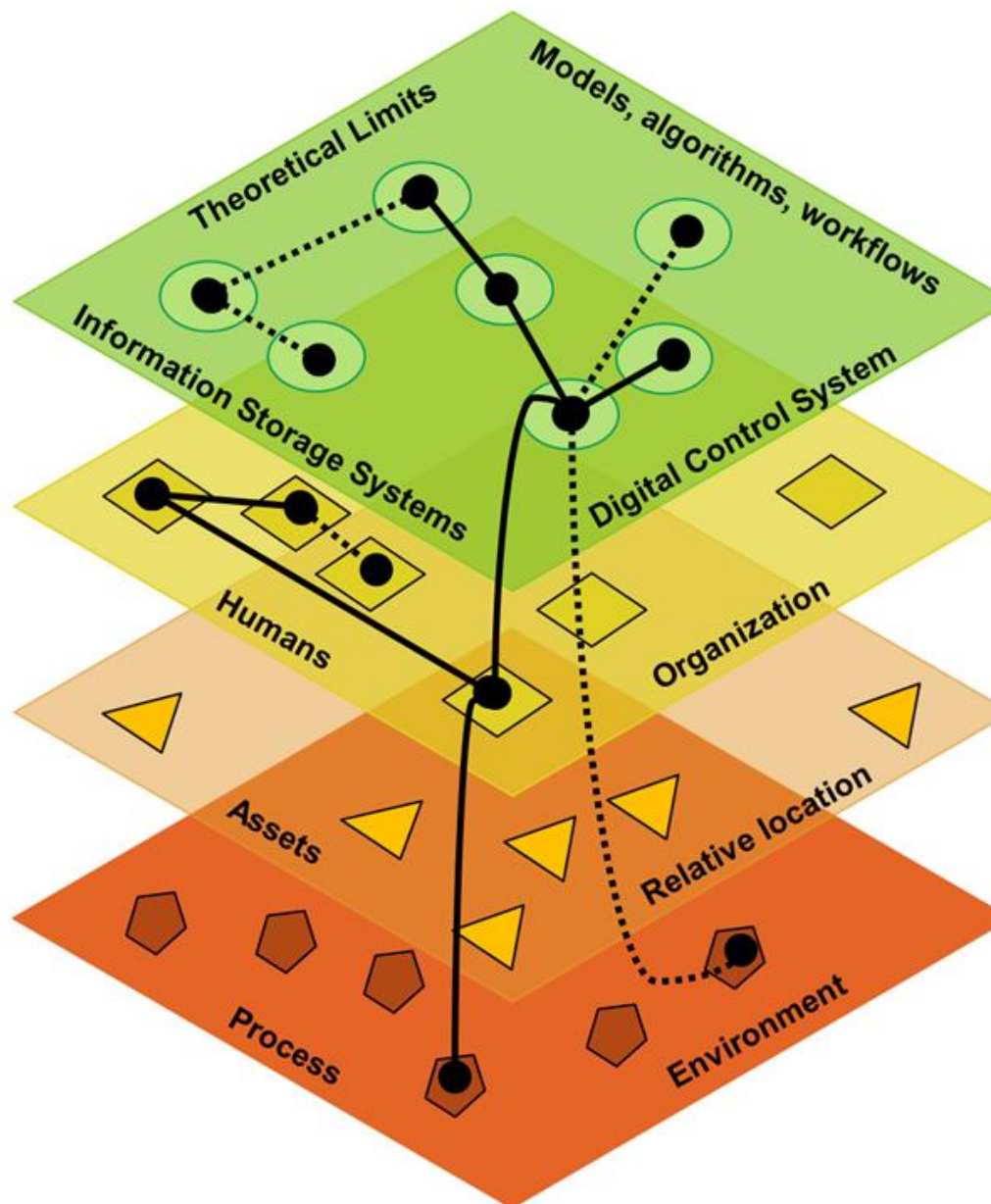
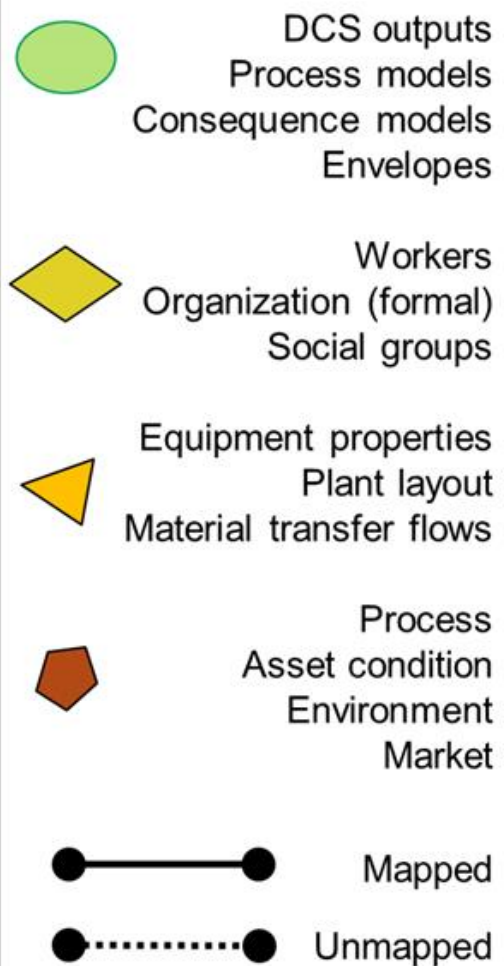


“Normalization of deviance” - humans adapt



Structures affect information flows

Information Flows (existing schema)



“human activity is still a major driving force in managing abnormal events such as diagnosing faults and determining root-cause events”

(Gonzales, Huang, Lau, 2015)

The Project – Site based information model

Qualitative Research

Collaborative
Critical context
Engagement
Training

Machine learning and analytics

Incident data
DCS
Asset
management

Information model

Facility-designed
Maintainable
Minimal
complexity

ShookIoT

 Microsoft Azure



Project Outline

Phase 1
8 months



Phase 2
8 months



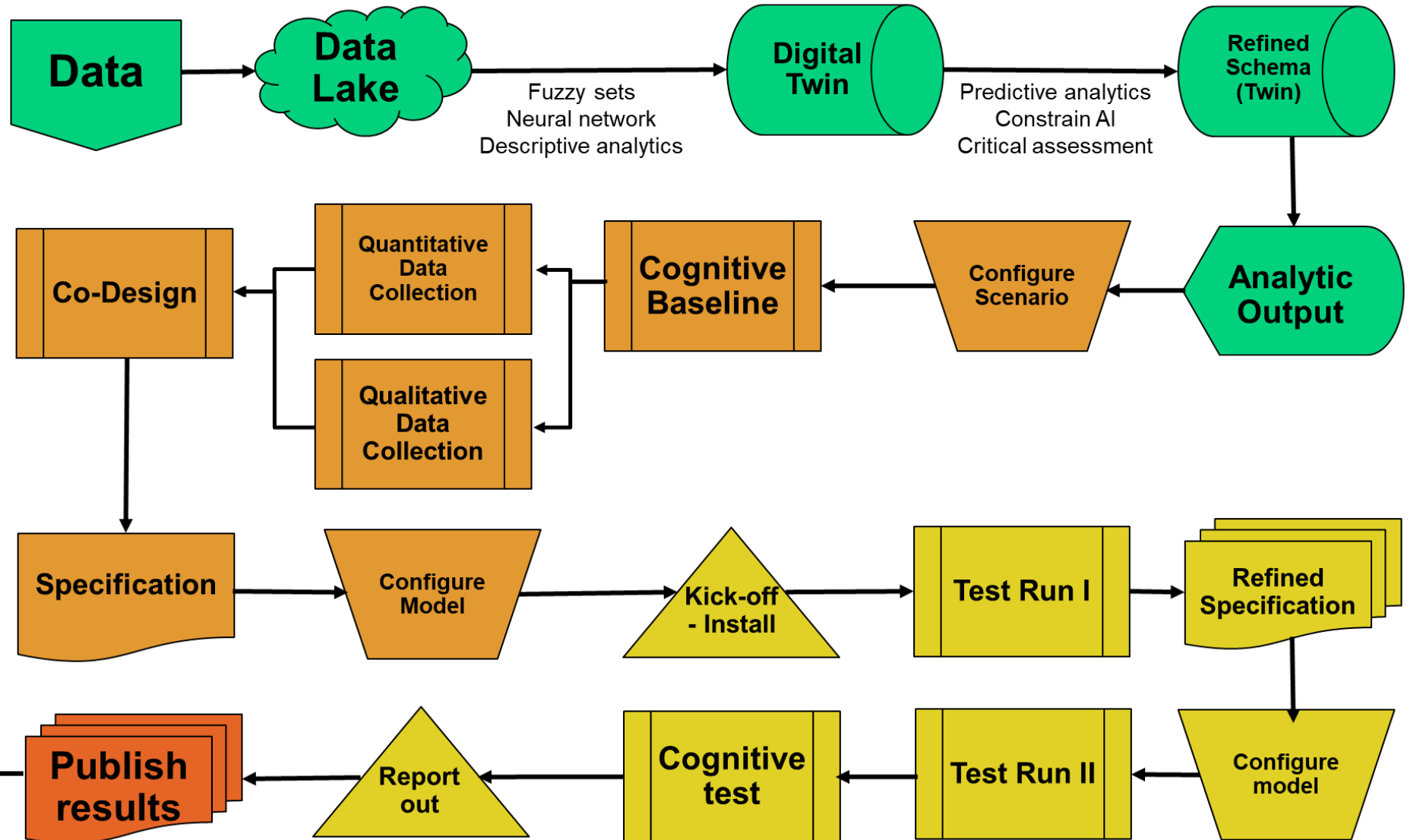
Phase 3
8 months



Phase 4
15 months



*Estimated durations, based
on May 2020 start*



If this is how we teach each other...

Don't touch that
We don't use that one
Don't worry about that one
We always use this code
Just do it this way
That's someone else's job
You just need to...

What will a robot learn?

“[...] there was "often a considerable reluctance to learn" about the possibility of serious accidents. Pointing out that such events happen rarely, managers decided "their time [was] best spent on other important issues.”

[Moore, 2017]

Optimize your workforce, embrace digitalization, seize a sustainable future



Please ask questions at the break!

Michelle Naef, P. Eng
Lianne Lefsrud, PhD., P. Eng