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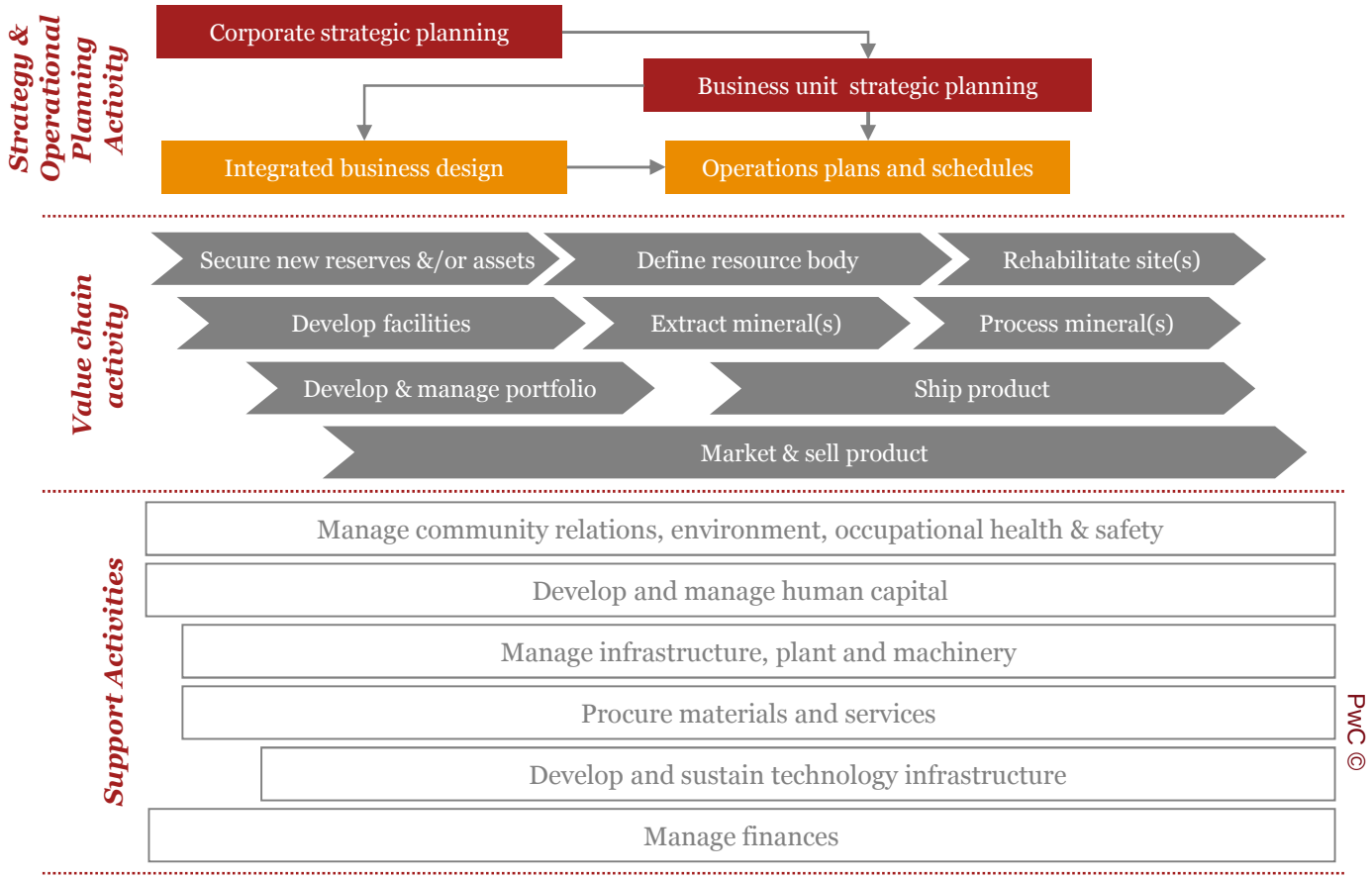
Mining Digital 101

Bas Mutsaers,

Global Account Director Mining
PwC Australia

The role of digital in PwC Mining Value Chain



The role of digital in mining

Our agenda today allows to discuss some of the dimensions of the multi discipline challenges

Autonomous Mining

Mine Planning

UAV's

Gaming Technology

Maintenance and IT/OT

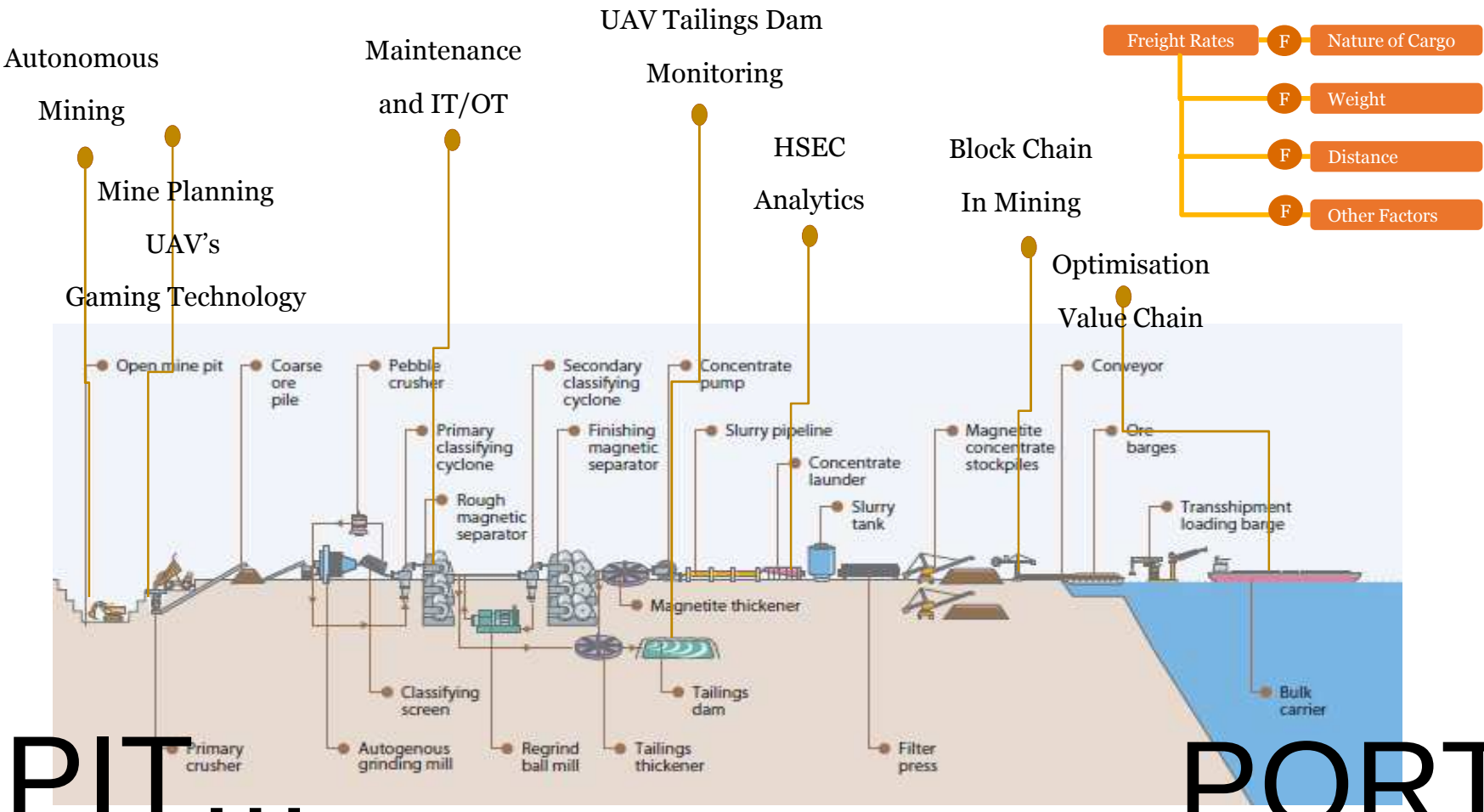
UAV Tailings Dam Monitoring

HSEC Analytics

Block Chain In Mining

Optimisation

Value Chain

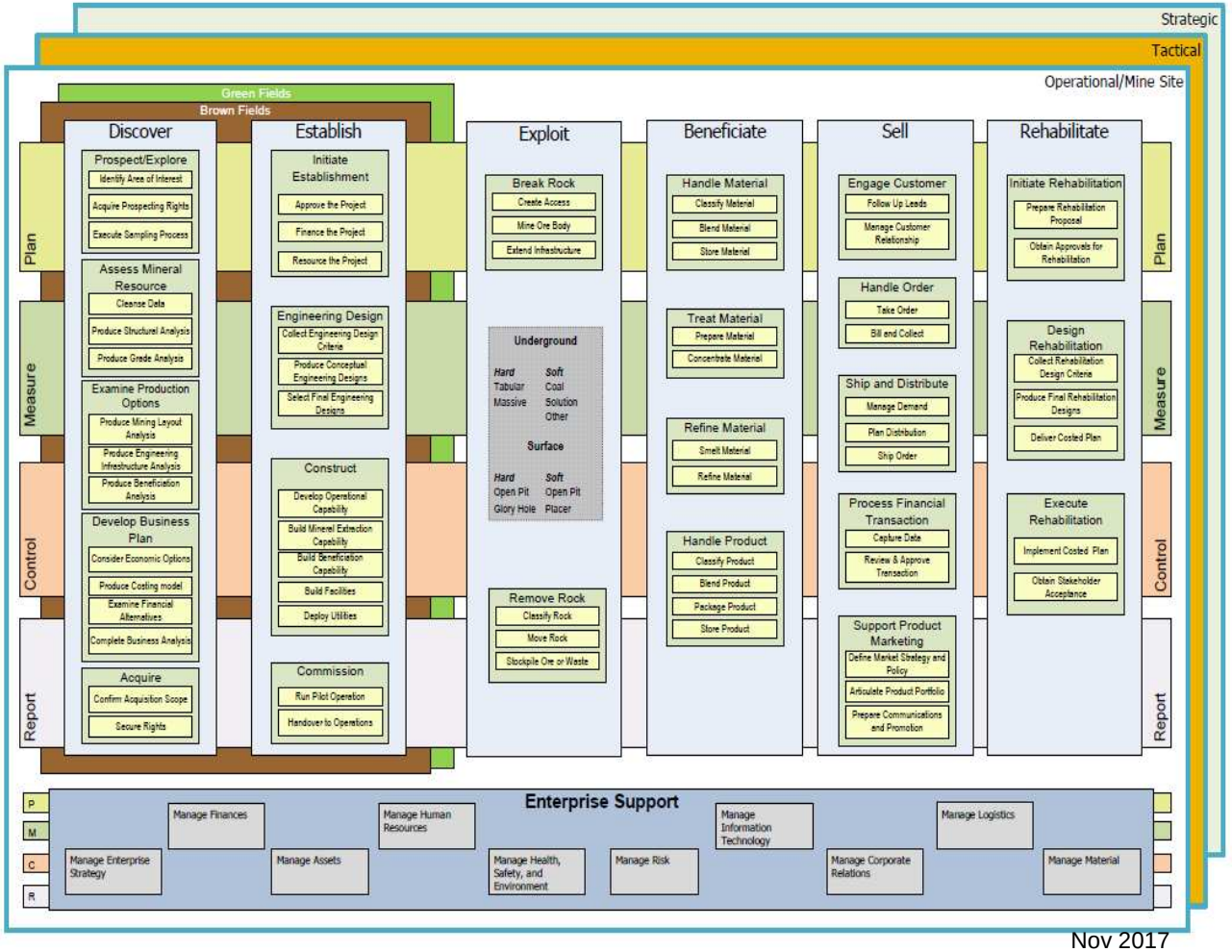


PIT…

…PORT

"The Open Group Mining Model" (Also known for TOGAF)

- Discover
- Establish
- Mine / Exploit
- Beneficiate
- Sell
- Rehabilitate
- Enterprise Support



In future no longer Diesel underground equipment

Mining Journal

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NEWSLETTERS 30 DAY TRIAL

SERVICES

Home > Engineering > Atlas Copco switches off diesel

Atlas Copco switches off diesel

Sweden's Atlas Copco, one of the world's biggest manufacturers and suppliers of underground mining and construction equipment, is accelerating its development of zero-emission and battery-driven machinery, the company said this week. "Our customers' future is electric," senior executive Andreas Nordbrandt said.

Staff reporter | 13 Oct 2017 | 12:30 | Feature

- Impact health of workers
- Less cost ventilation
- Green Mining energy sources compatible etc.

Future of efficient mining (Digital Mining GE)

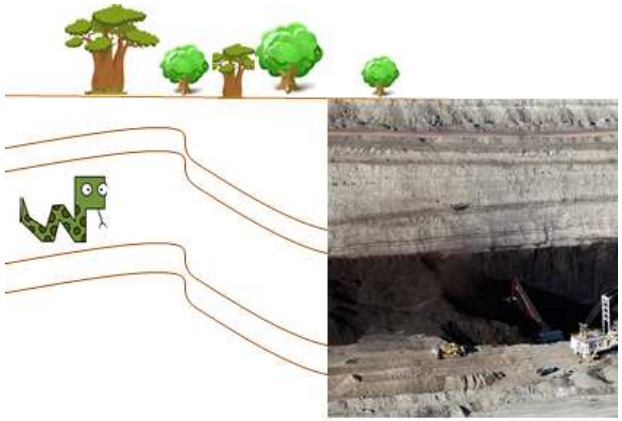
GE MINING

Mine the Gap: This Strange Metal Snake Shreds and Slithers through Narrow Underground Coal Seams

Feb 12, 2014 by Tomas Kellner

https://www.ge.com/reports/post/75691617815/mine-the-gap/

Meet the GE Fairchild F330 continuous miner, one of the strangest devices made by GE. The machine weighs as much as a fighter jet, stretches the length of a bus, and crawls through cracks no taller than a one year old. It can mine narrow coal seams sandwiched between soft sedimentary rock, and extract coal miners used to leave behind.



What if this is combined with

Knowing exactly where to dig connected

with Mine Planning and Scheduling

Processing underground – minimal disruption

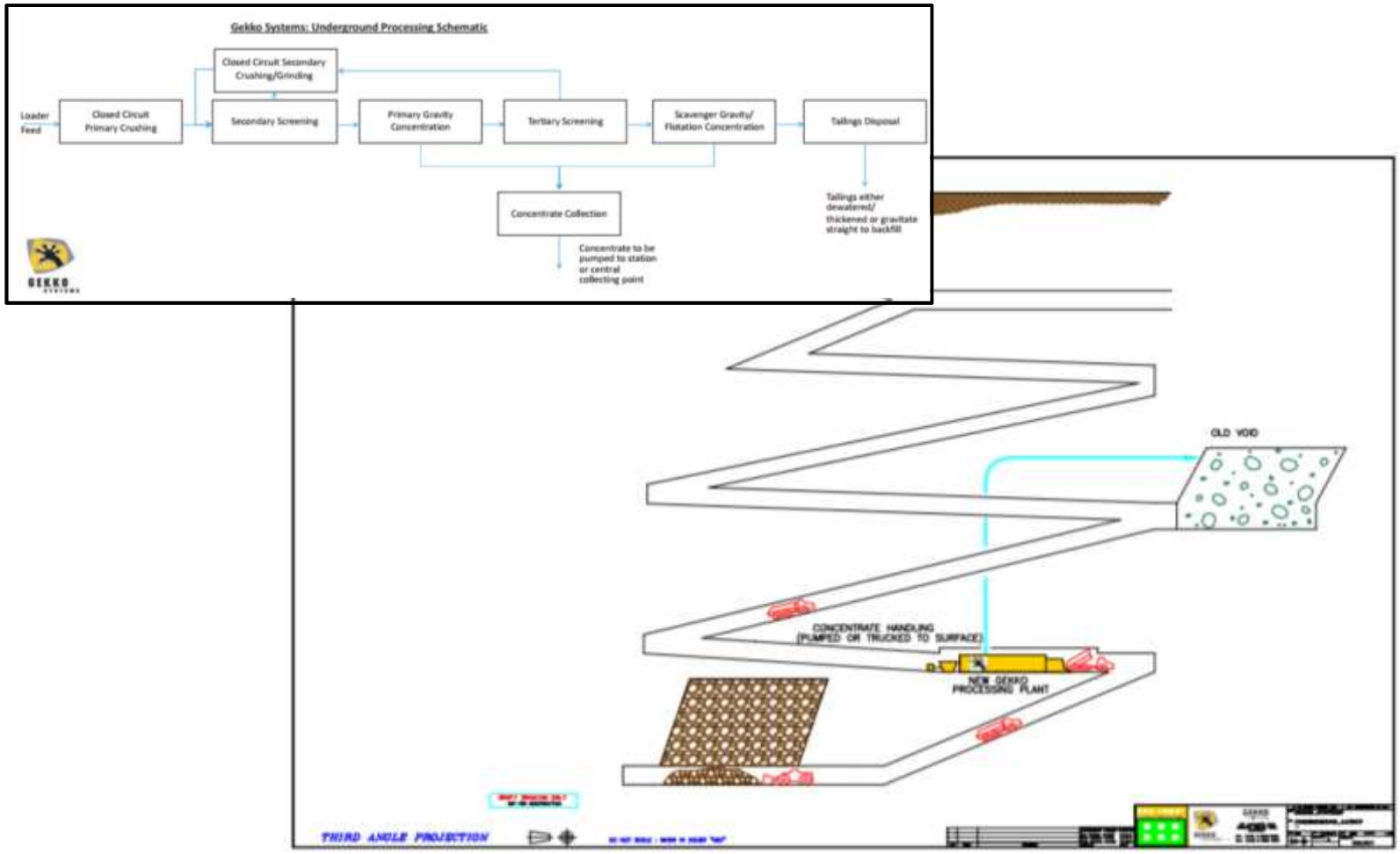


FIG 1 - Schematic of the Python installed in a mine.

Leave "Your Share" in Situ

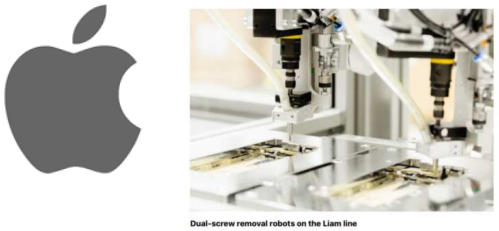
About $27 billion of gold changes hands every day in over-the-counter markets where settlements can sometimes take days, leaving price risk for buyers and sellers. Using blockchain promises more transparency, security and speedier deals. It also could attract new participants at a time when investors are souring on gold-backed exchange traded-funds, a key source of growth in physical demand over the past decade.

With digital and good sampling / GIS technologies we know more and more what is actually underground without previous risks.

With Sustainability Challenges there might be a case to keep the value FOR INVESTERS underground.

Future of efficient mining (Barrick Gold)

After a productive meeting, they called her back and told her they had gone in a different direction, they now wanted "Stop Mining the Earth Altogether".

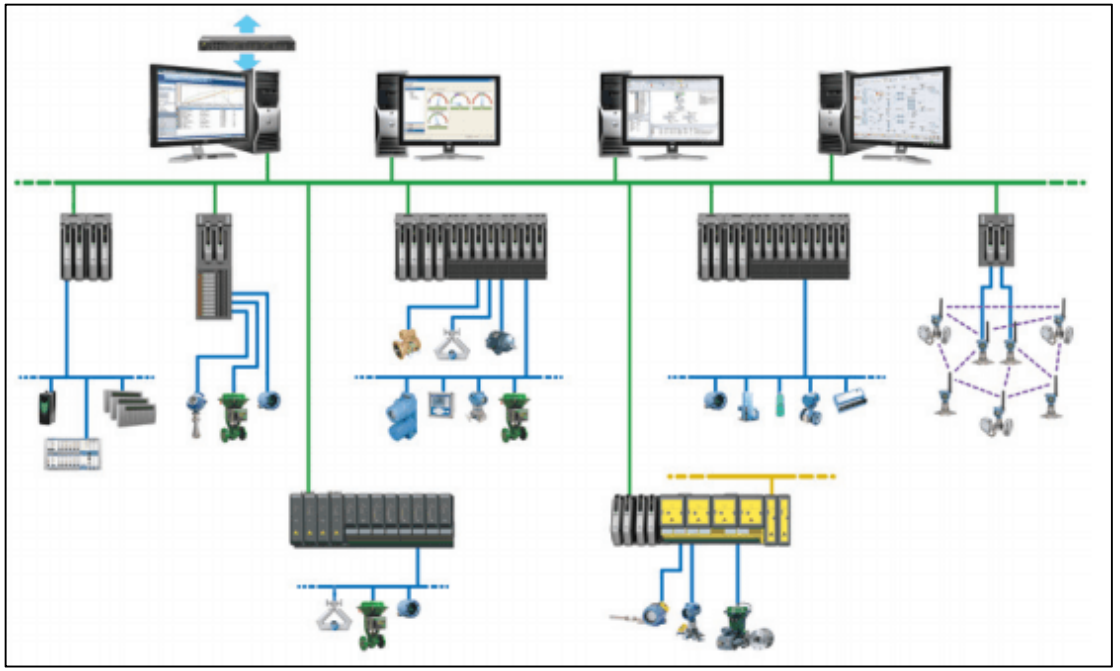


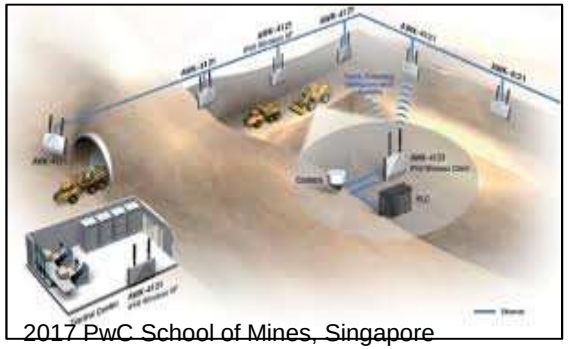
Apple have developed a robot that can dismantle and recycle an old iPhone in 19 seconds. Extracting the gold, copper, cobalt and other precious minerals to be reused in a new phone.

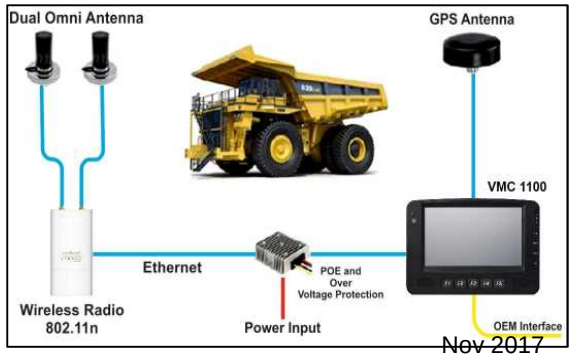
Can we process our minerals in the ground rather than taking it to the processing plant? Significantly reducing environmental impact and lowering the cost.

Or what if we use block chain? Instantaneous purchase orders, taking out all the middle men.

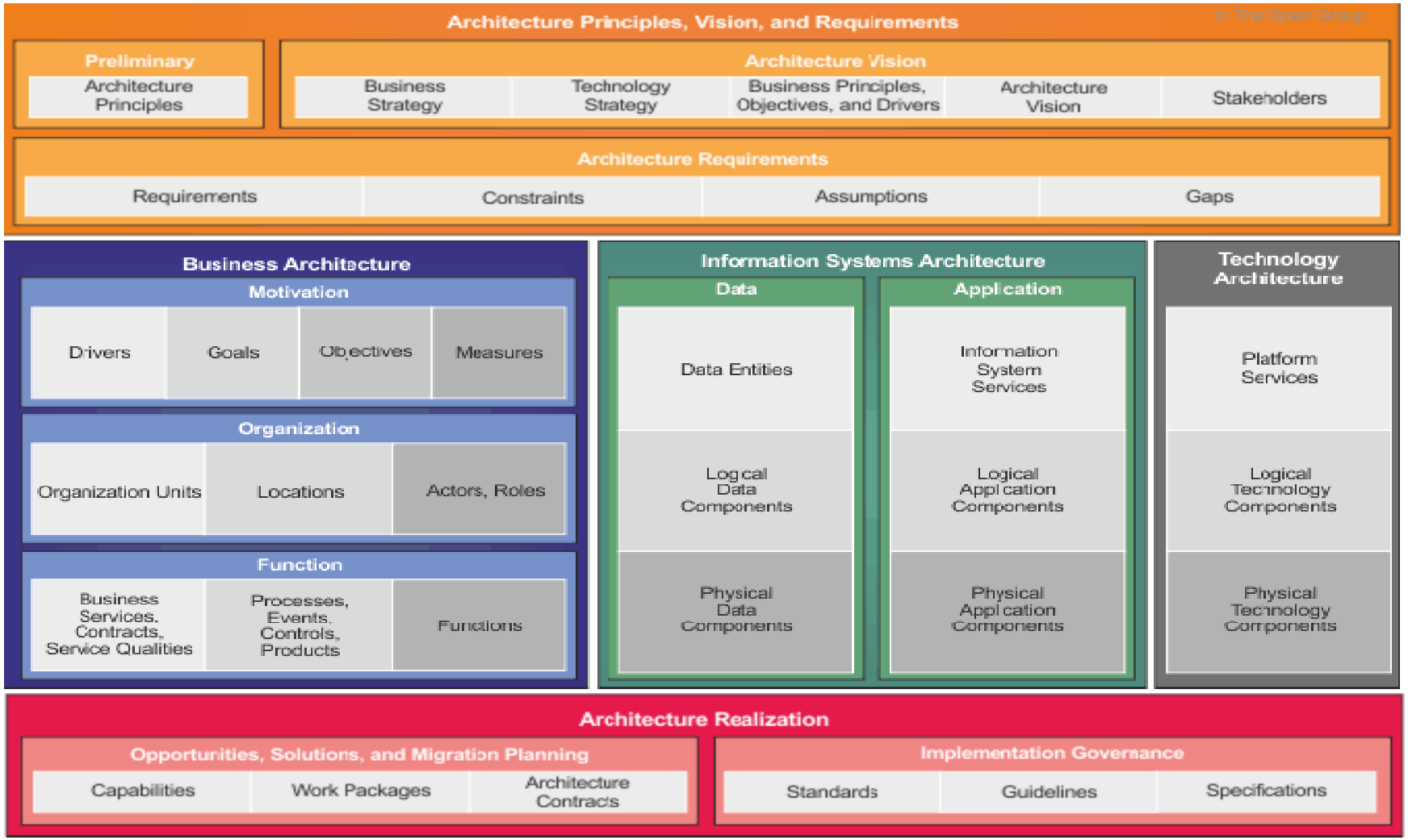
OT View






Dual Omni Antenna
GPS Antenna
VMC 1100
Ethernet
POE and
Over
Voltage Protection
Wireless Radio
802.11n
Power Input
OEM Interface

IT View


Architecture Principles, Vision, and Requirements
© The Open Group
Preliminary
Architecture Principles
Architecture Vision
Business Strategy
Technology Strategy
Business Principles, Objectives, and Drivers
Architecture Vision
Stakeholders
Architecture Requirements
Requirements
Constraints
Assumptions
Gaps
Business Architecture
Motivation
Drivers
Goals
Objectives
Measures
Organization
Organization Units
Locations
Actors, Roles
Function
Business Services, Contracts, Service Qualities
Processes, Events, Controls, Products
Functions
Information Systems Architecture
Data
Application
Data Entities
Information System Services
Logical Data Components
Logical Application Components
Physical Data Components
Physical Application Components
Technology Architecture
Platform Services
Logical Technology Components
Physical Technology Components
Architecture Realization
Opportunities, Solutions, and Migration Planning
Capabilities
Work Packages
Architecture Contracts
Implementation Governance
Standards
Guidelines
Specifications

IT/OT View

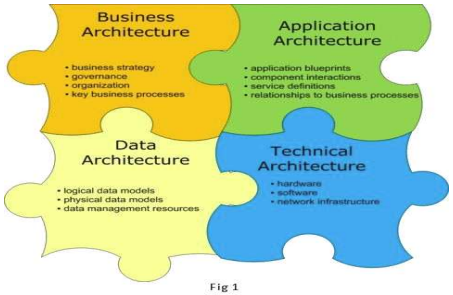
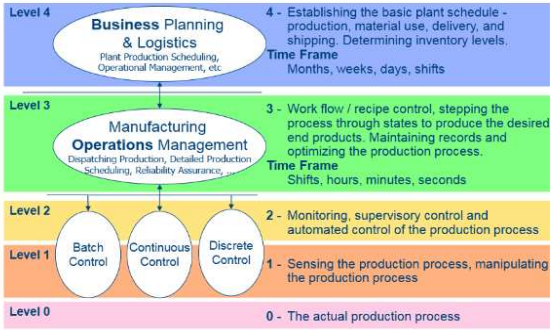
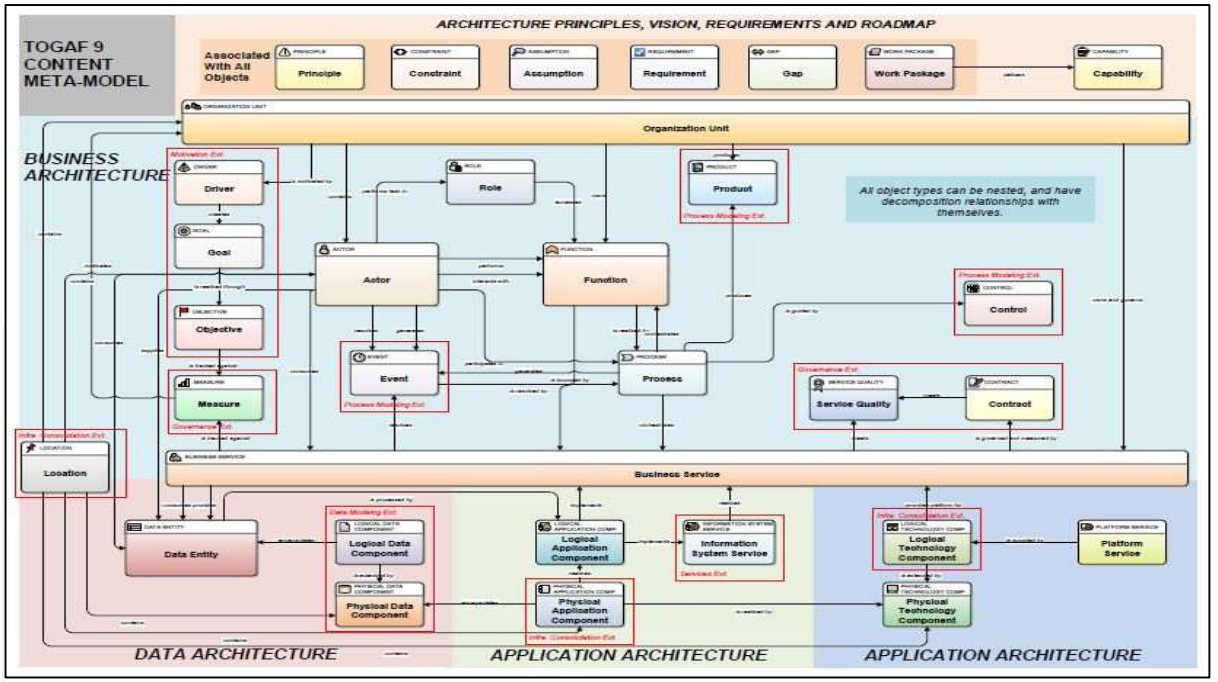
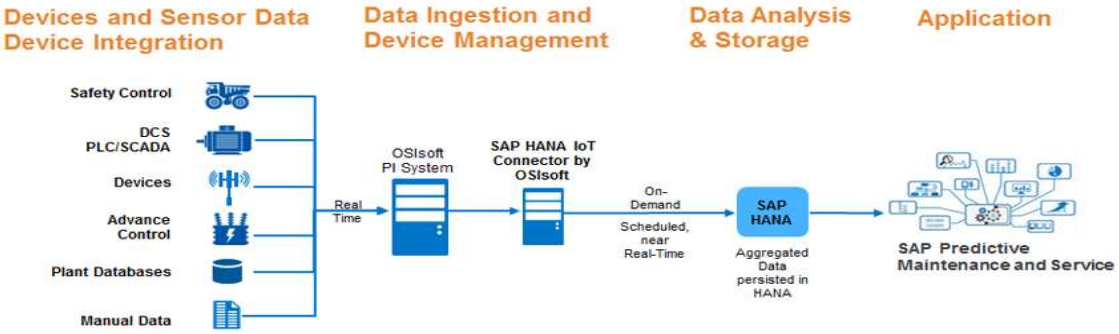


Fig 1

ISA 95 Levels – Distinct Sets of Activities







Process People Technology in control room

People considerations

Process considerations

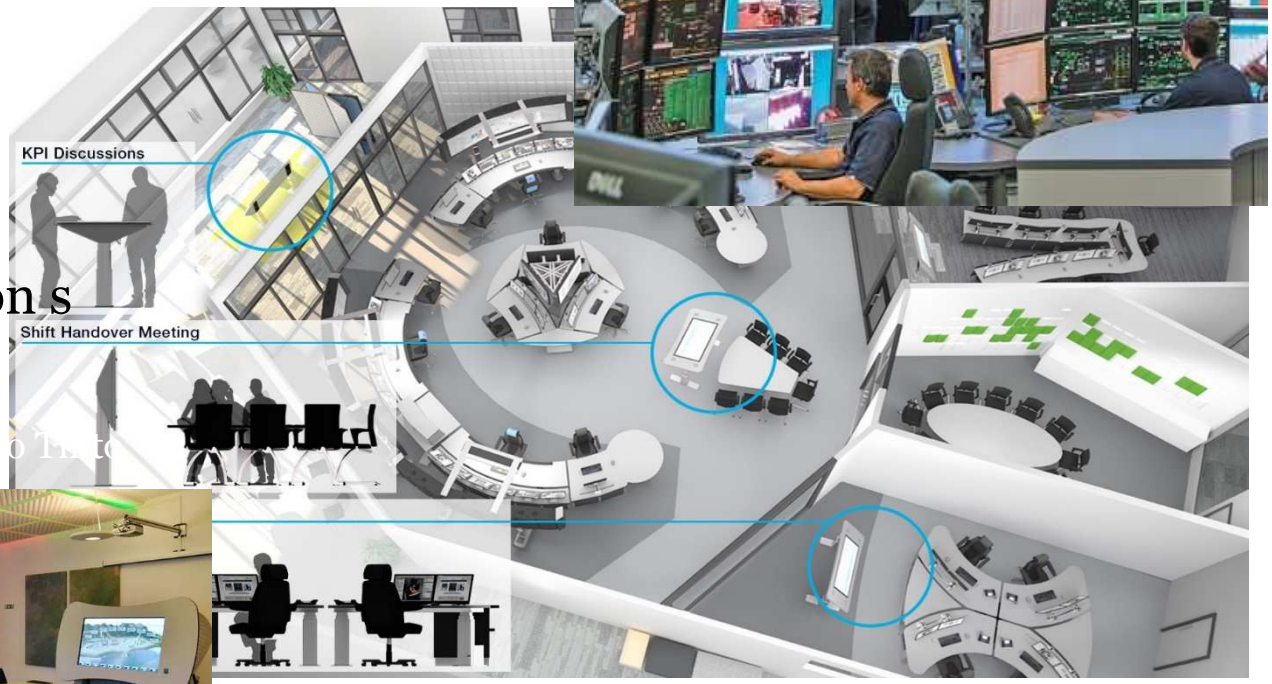
HSEC

Alarming

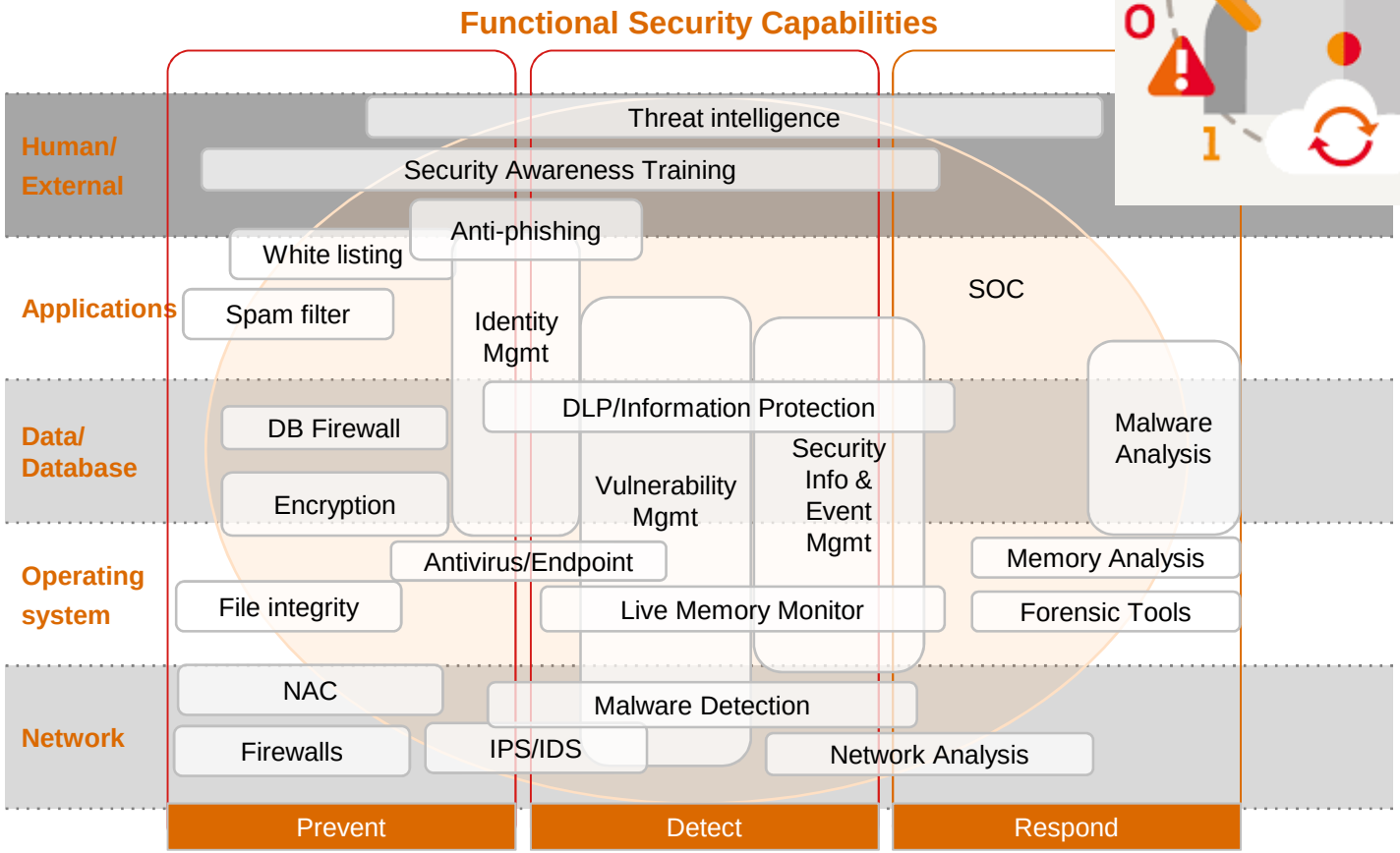
Infrastructure / Tech

Cyber considerations

Standards consideration s

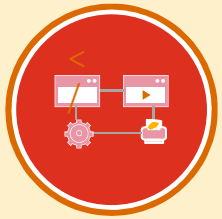


Cyber considerations



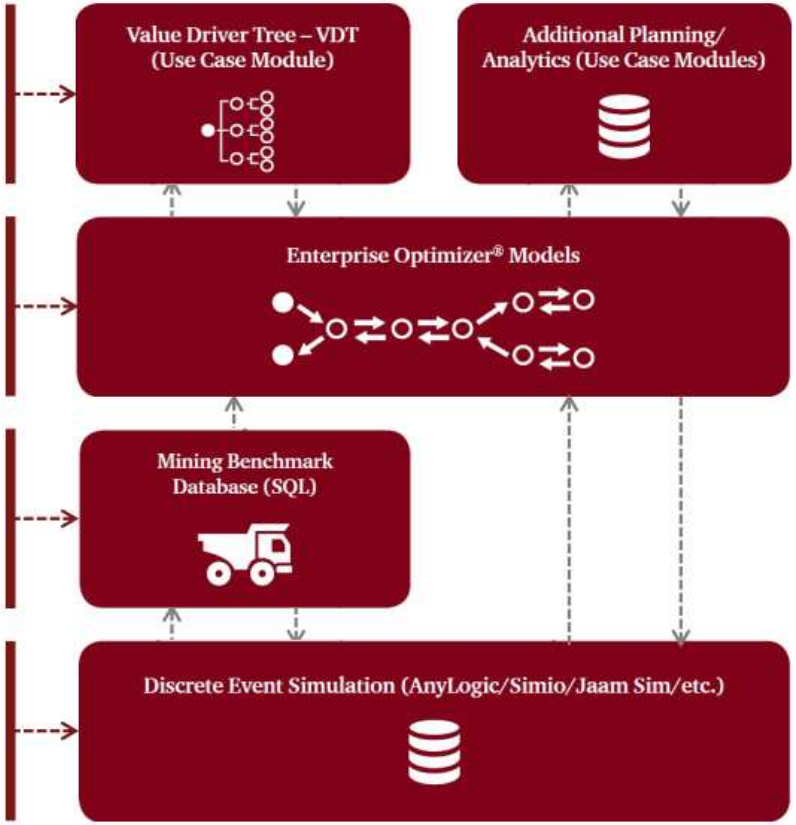
Big data analytics

Emerging trends in data, analytics, and visualization

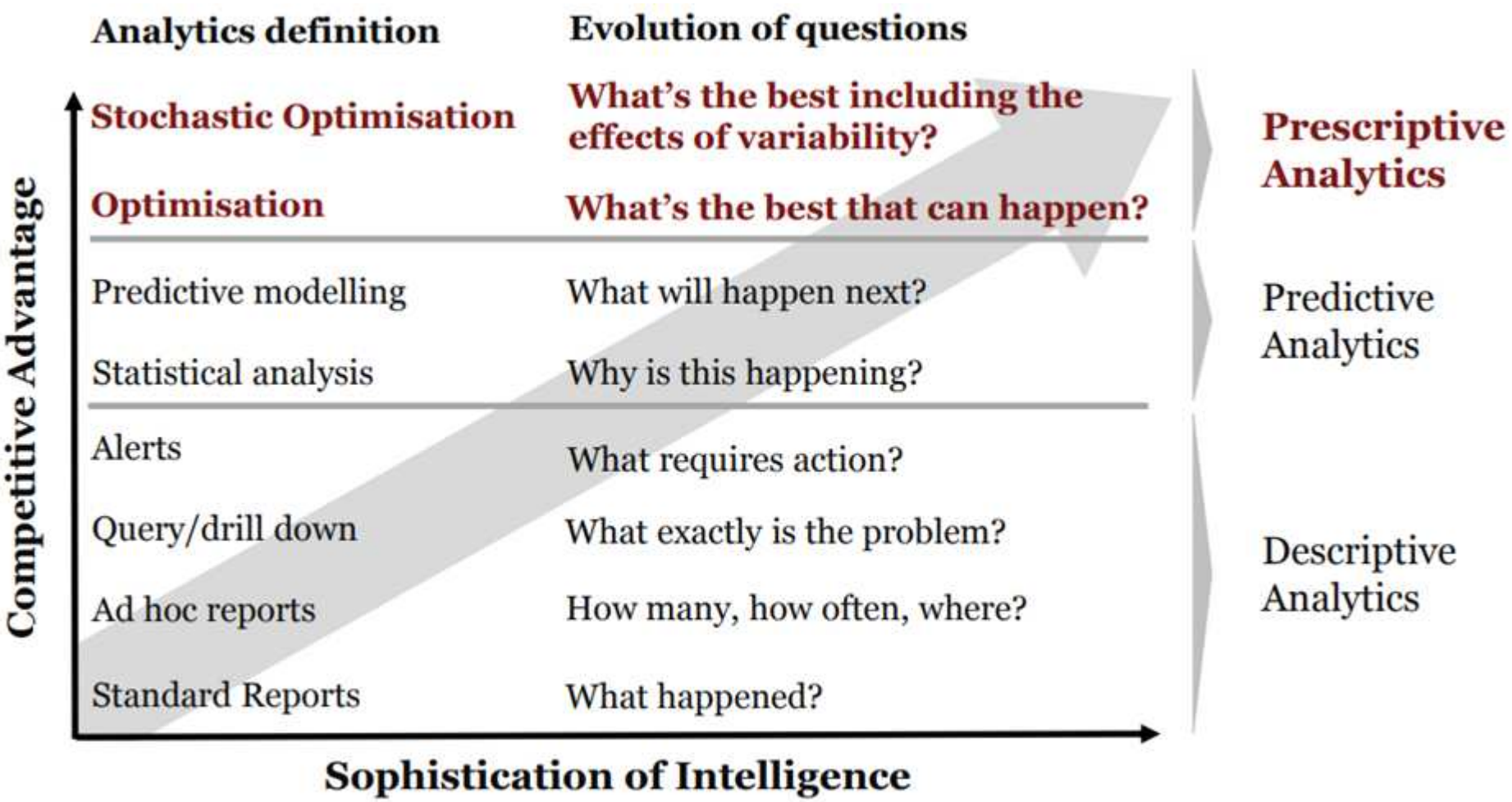
Big data	Nontraditional data	Information synthesis	Sophisticated analytics	Visual Insights & Tool Selection
The exponential growth of data and computing power is multiplying the number of opportunities to drive insights from information.	Telematics, satellites, sensors, voice/video-to-text, and other emerging technologies are creating data from previously non-quantifiable concepts.	Evolving data analysis and processing technologies are increasing our ability to draw insights from complex, messy, and unstructured data.	Advanced analytical techniques, such as simulation and optimization, are making it possible to pursue previously out-of-reach insights from data in (near) real time.	Presenting complex volumes of data in a simple and meaningful format begins with the correct tool selection and will ultimately accelerate decisions and results.
				

Digital is helping optimise the mining value chain

- How are the physical and financial drivers linked?
- What is mathematically optimal?
- What is possible in real world mining operations?
- Is this physically achievable?



The Evolution of Analytics Capability



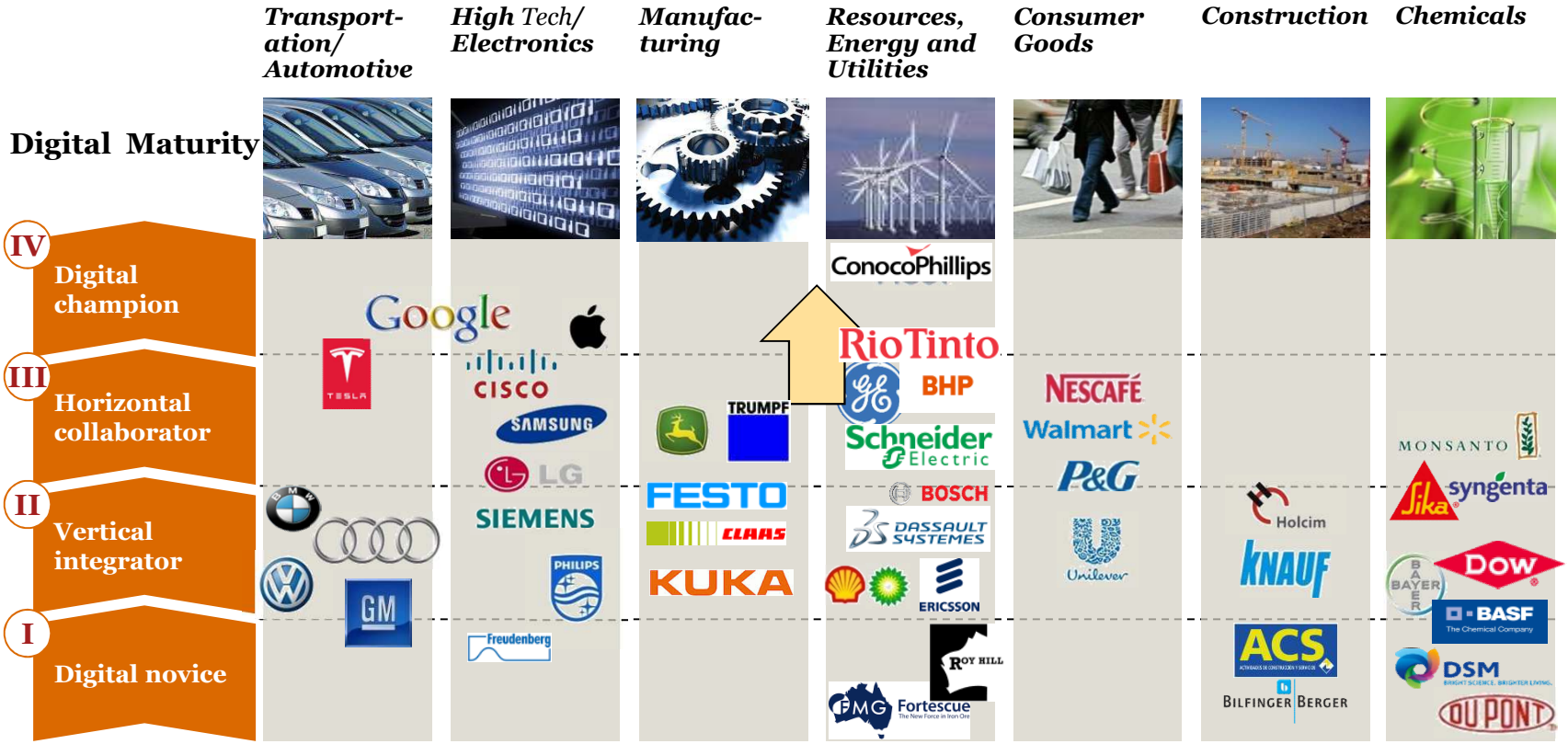
Source: Competing on Analytics: The New Science of Winning (Davenport / Harris)

Industry 4.0 Maturity Matrix:
Digital Enterprises develop across six dimensions and four stages

	I Digital novice	II Vertical integrator	III Horizontal collaborator	IV Digital champion
Business models, product & service portfolio	First digital solutions and isolated applications	**Digital product and service portfolio** with software, network (M2M) and data as key differentiator	**Integrated customer solutions** across supply chain boundaries, collaboration with external partners	Development **of new disruptive business models** with innovative product and service portfolio, lot size 1
Market & customer access	Online presence is separated from offline channels, product focus instead of customer focus	Multi channel distribution with **integrated use of online and offline channels**; Data analytics deployed, e. g. for personalization	**Individualized customer approach** and interaction together with value chain partners	**Integrated Customer Journey Management** across all digital marketing and sales channels with customer empathy and CRM
Value chains, processes	Digitized and automated sub processes	Vertical digitization and **integration of process and data flows within the company;**	Horizontal integration of **processes and data flows with customers and external partners**, intensive data use	Fully integrated partner ecosystem with self-optimized, **virtualized processes** decentralized **autonomy**
IT Architecture	Fragmented IT architecture inhouse	**Homogeneous IT** architecture inhouse	**Common IT architect-tures** in partner network	**Partner service bus, secure data exchange**
Compliance, legal, risk, security & tax	Traditional structures, digitization not in focus	**Digital challenges recognized** but not comprehensively addressed	**Legal risk consistently addressed** with collaboration partners,	**Optimizing the value chain network** for legal, compliance, security and tax
Organization & culture	Functional focus in „silos“	**Cross functional collaboration** but not structured and consistently performed	**Collaboration across company boundaries**, culture and encouragement of sharing	**Collaboration as a key value driver**

Companies need to decide how they want to develop their digital maturity

Industry Players Digital Maturity



Sources: PwC, Strategy& analysis – modified by Bas Mutsaers (just highlighting some areas for education purpose of Singapore Mines and not a position in the market)

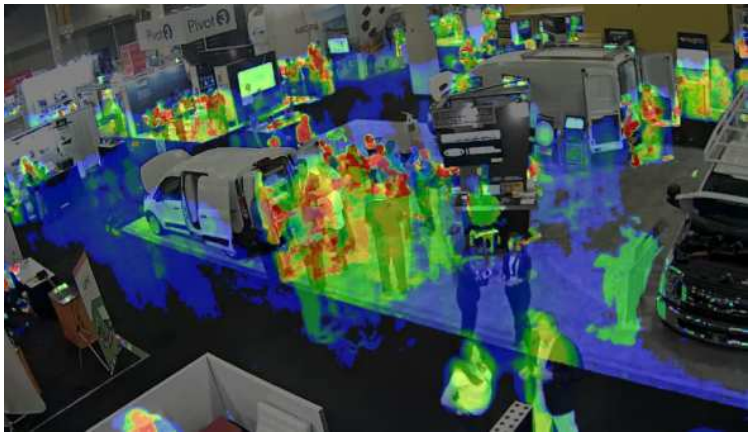
FMG and Roy Hill being new to the model has good starting point through Greenfield opportunity and high Tech.
ConocoPhilips mature in central control room both Hor and Vert. Rio Tinto longest player digital. BHP following.

Several mega forces are reshaping the marketing, sales and service environment, both in B2C / B2B

Overview of Trends in Customer Behavior

	Trend	Description	Examples
1	**"Mobile First" is the Reality**	▪ App ecosystems as a **central online location** across all mobile devices ▪ More and more **app ecosystems evolve across industries** ▪ Apps decisive for **online success** of companies	Comprehensive Mobile proposition
2	**Targeting & Analytics**	▪ Customers are more likely to respond to **relevant communication** at the right point in time – thus **targeting becomes key** ▪ Better targeting requires significantly better **analytics capabilities** ▪ Increase of sharing Data with Horizontal Value Chain Partners	Personalized ads and shopping
3	**Dynamic User Experience**	▪ Self-service is standard for digitally–affine target groups, as it enables more **independent, faster and convenient interaction** ▪ **Interaction with face-to-face channels** important ▪ Usage and migration forced by coupons, discounts and self-service	Self-service prior to the journey
4	**Unbounded Collaboration**	▪ Social Media is and will remain an important **information channel** ▪ As a service channel social media is gaining importance ▪ Forms **a bridge between self-service and face-to-face channels**	Social Media in Customer Service
5	**Cross-channel Distribution**	▪ Customers increasingly expect a **seamless journey** across all touch-points ▪ This requires to address the many, historically grown break-point and data silos between the offline & online world and own vs. 3rd party distribution	Cross-channel experience world

Other interesting developments



Source Hitachi – people tracking

Detect or even interoperate with other Fleet or People

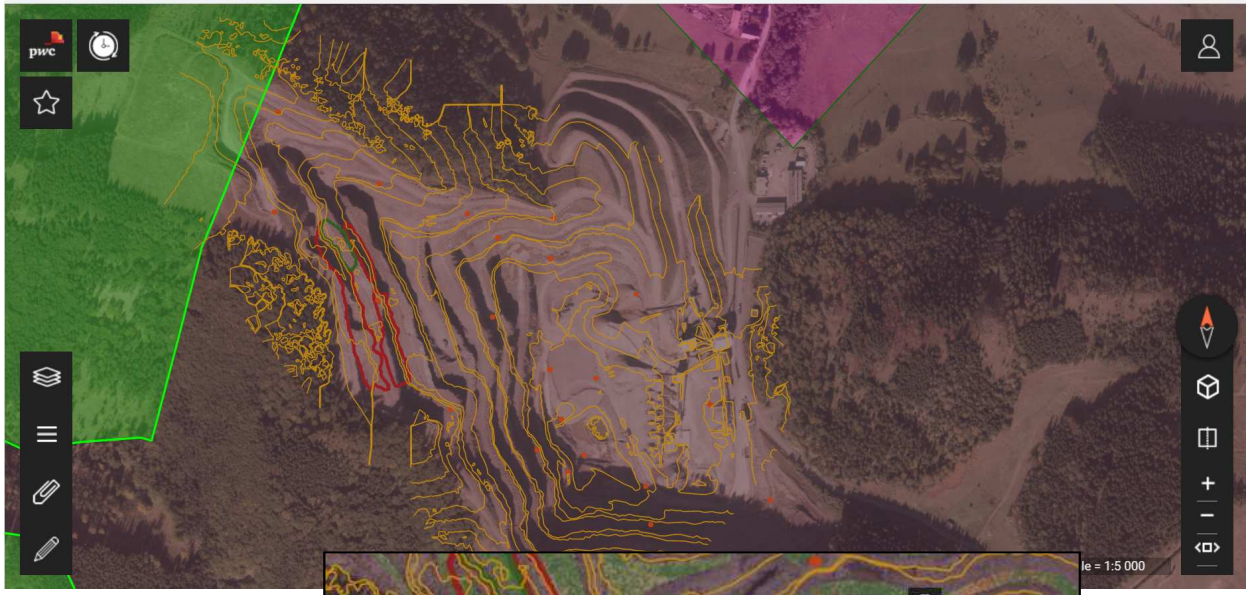
https://www.cat.com/en_US/by-industry/mining/surface-mining/surface-technology/detect.html

Before we cover our recent progress in some of these areas: What are <u>you</u> working on that is ahead of the curve?

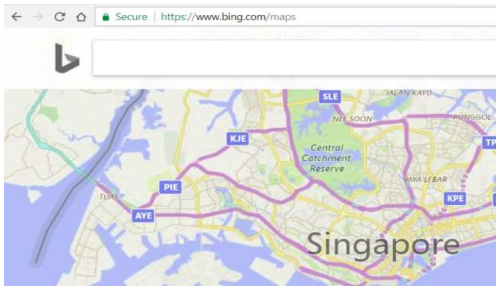
Live Demo – Power of Digital

PwC Web Server Combines
-GIS data
-UAV data
-AI (Artificial Intelligence)

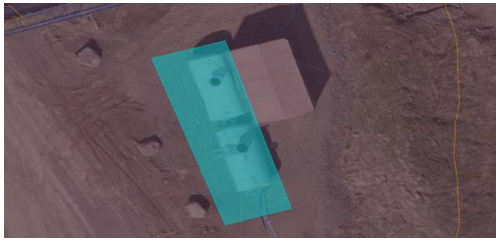
Maps Google + UAV gives greater detail Also various layers like height or additions for work process



GIS Layers

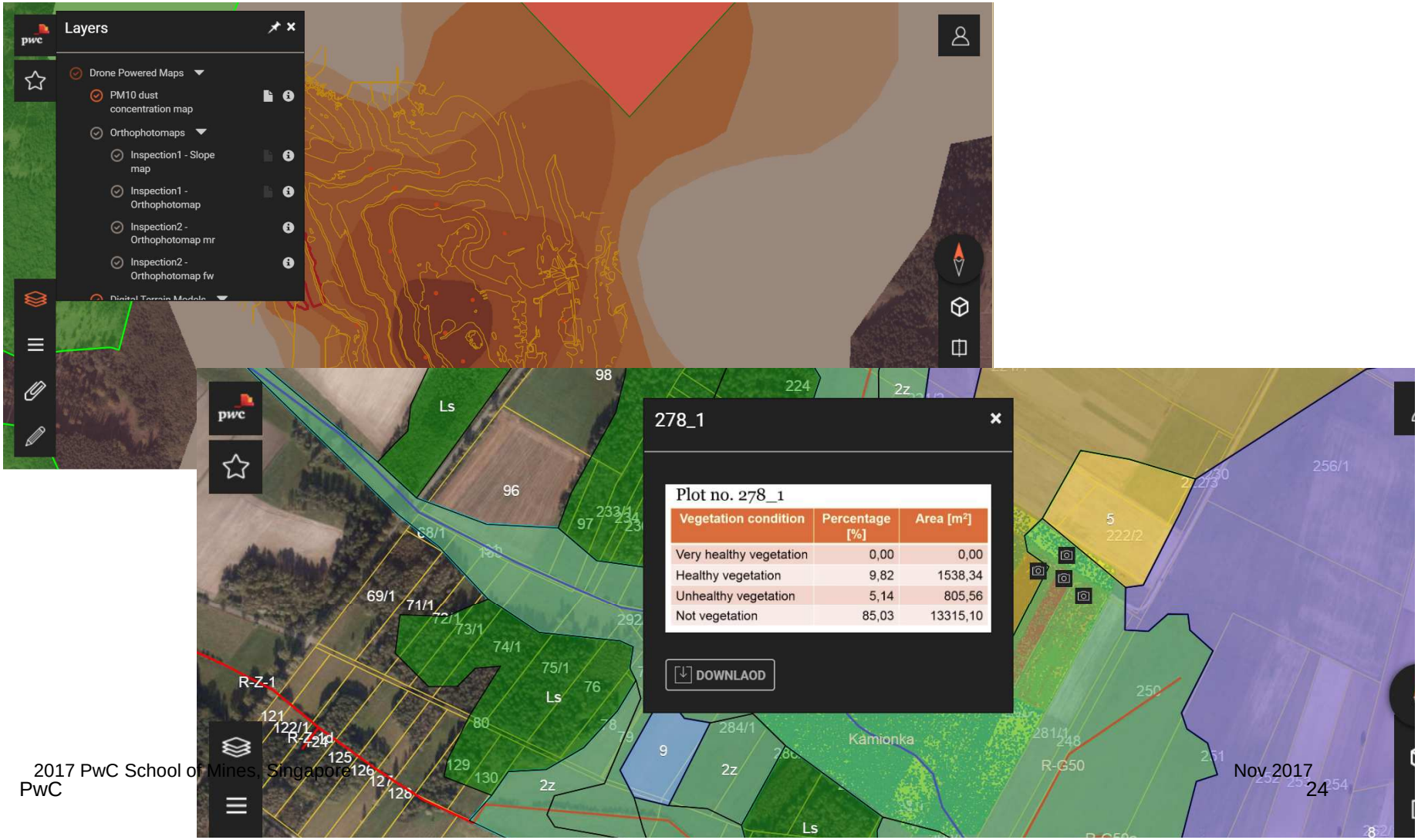


Bing MAPS combined with UAV data)

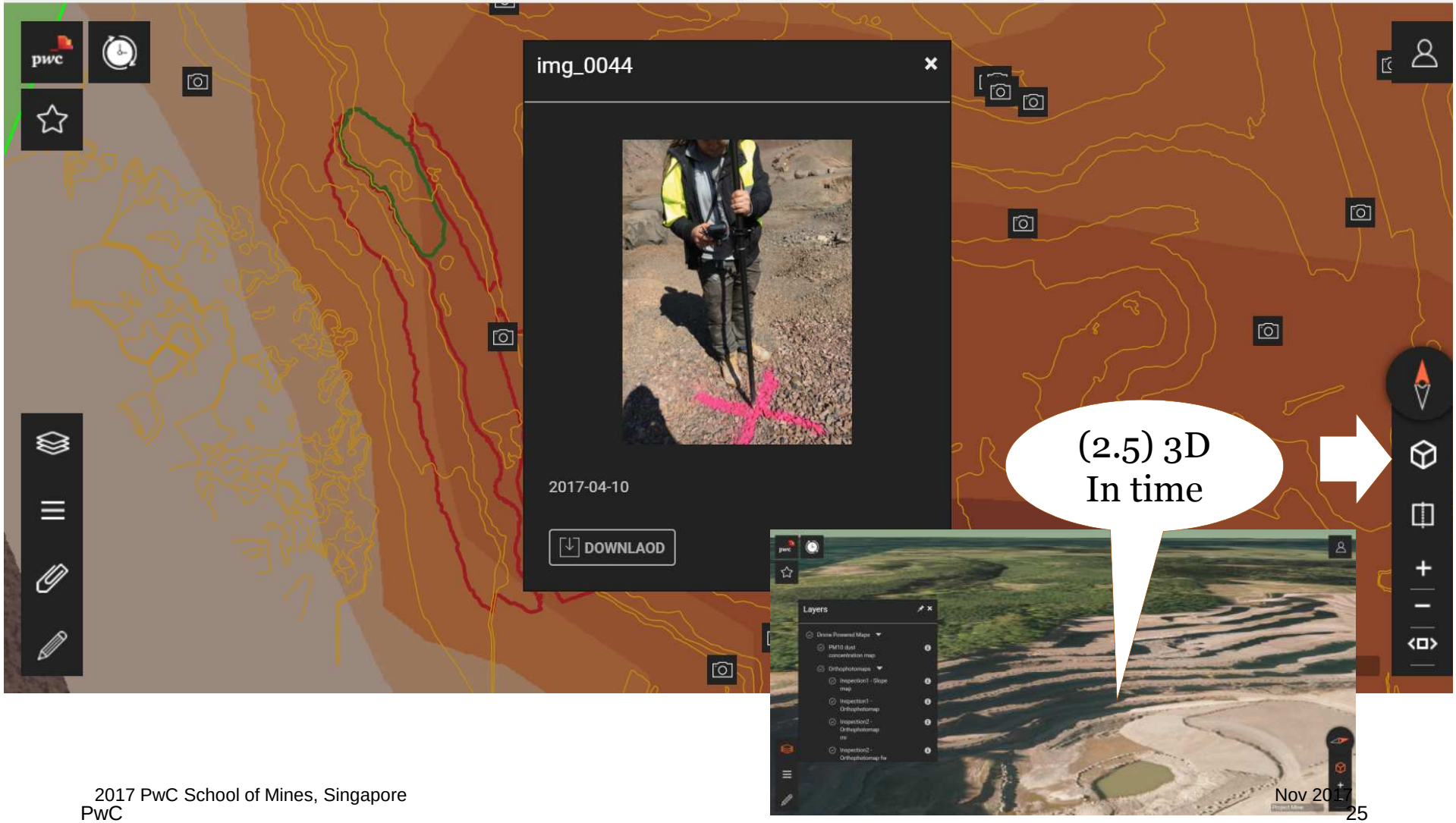


Make notes “Get rid of these tanks”

Adding for example dust measurements or health of vegetation

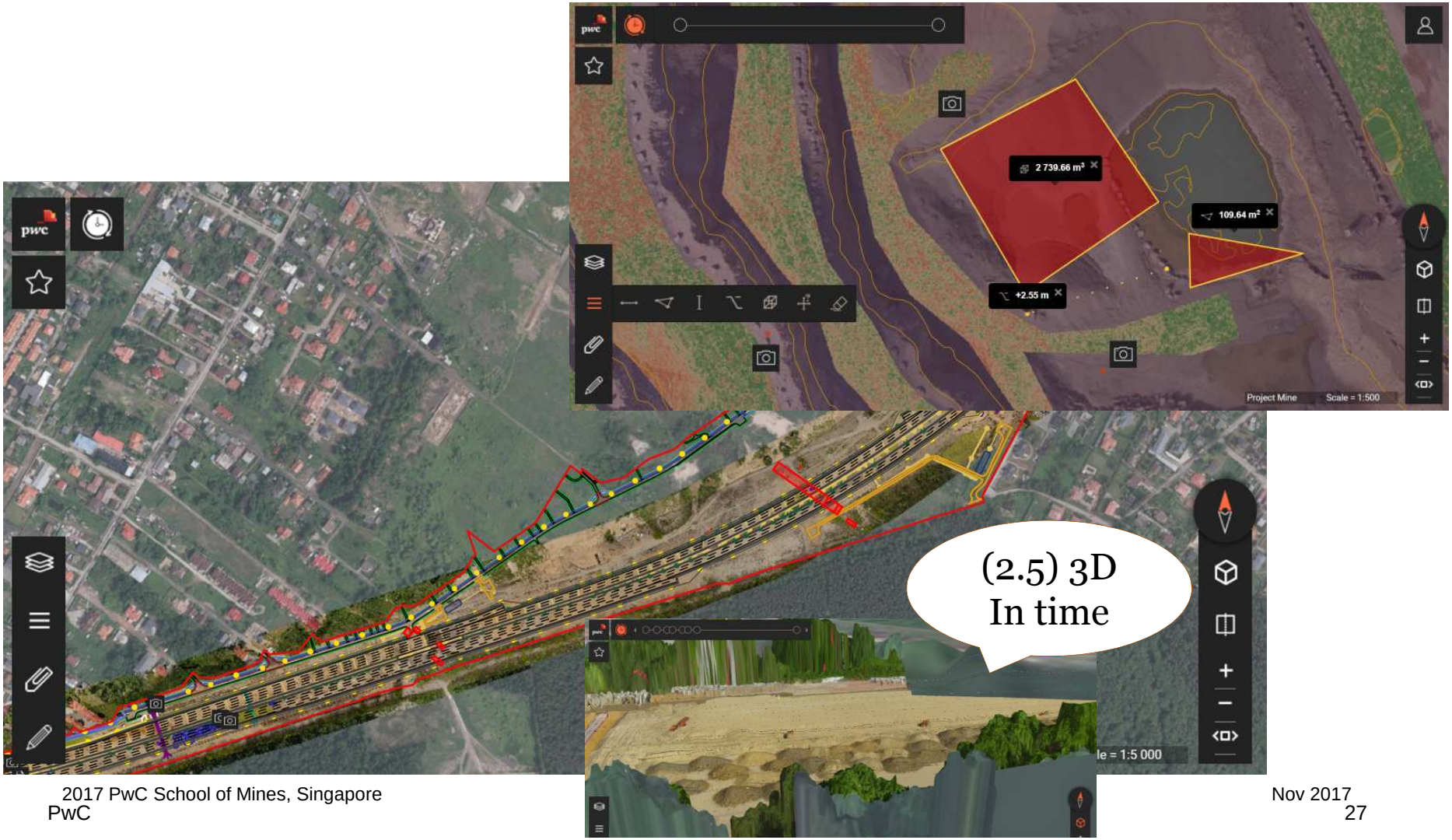


"Boots on ground" during exploration or for surveying. Coordinates on the map with links.

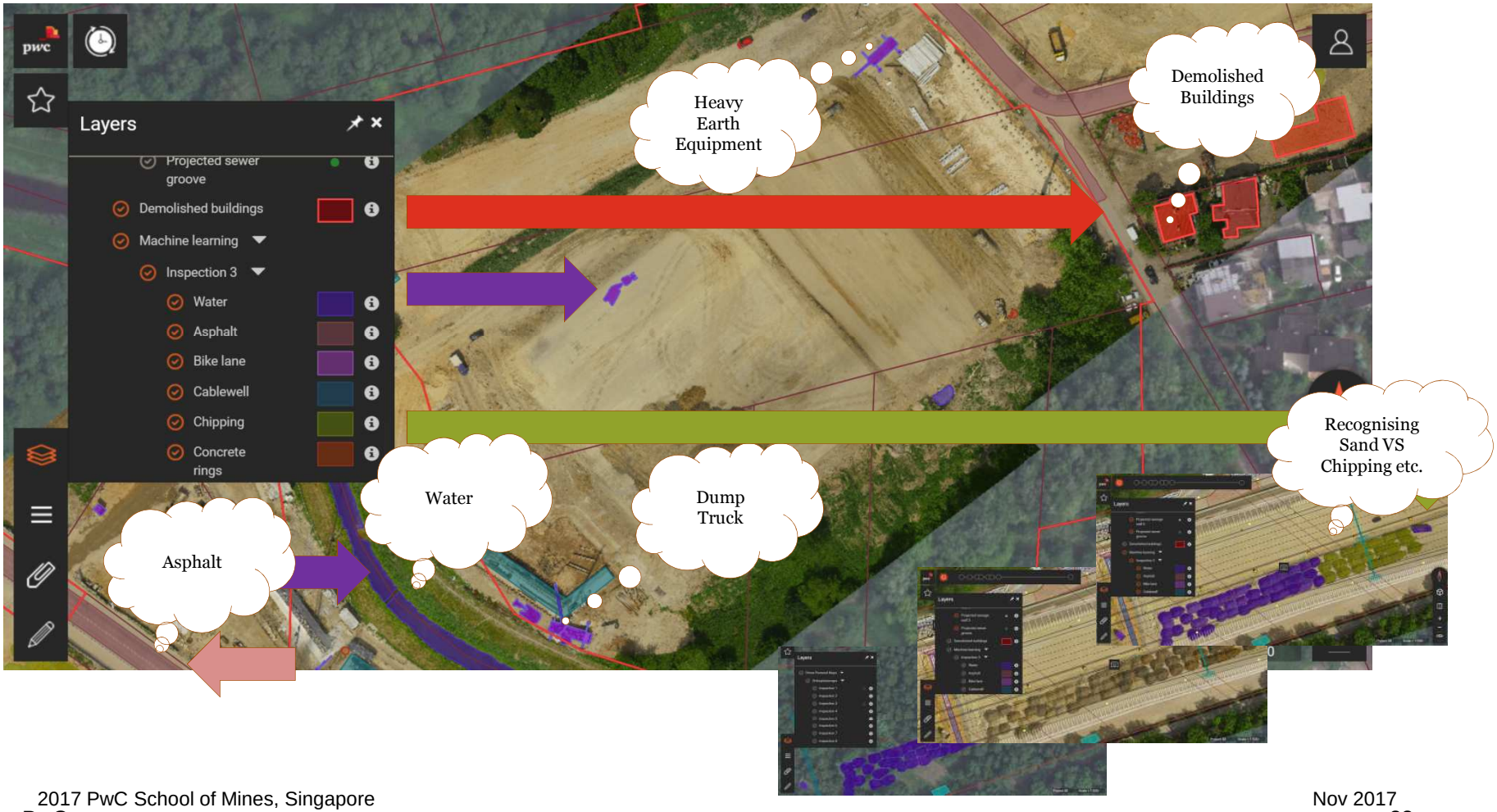


Compare progress - Differences in Time for operations or compliance

Distance – Height – Volume on the fly. Or maintenance constraints….



Analytics foundation is there - not have to do this tagging manually.



Thank you

For joining "School of Mines"

Any questions?

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