



**SUOMI
FINLAND**

MINING FINLAND

Kaivosvesiverkoston loppuseminaari

Kuopio 4.12.2017

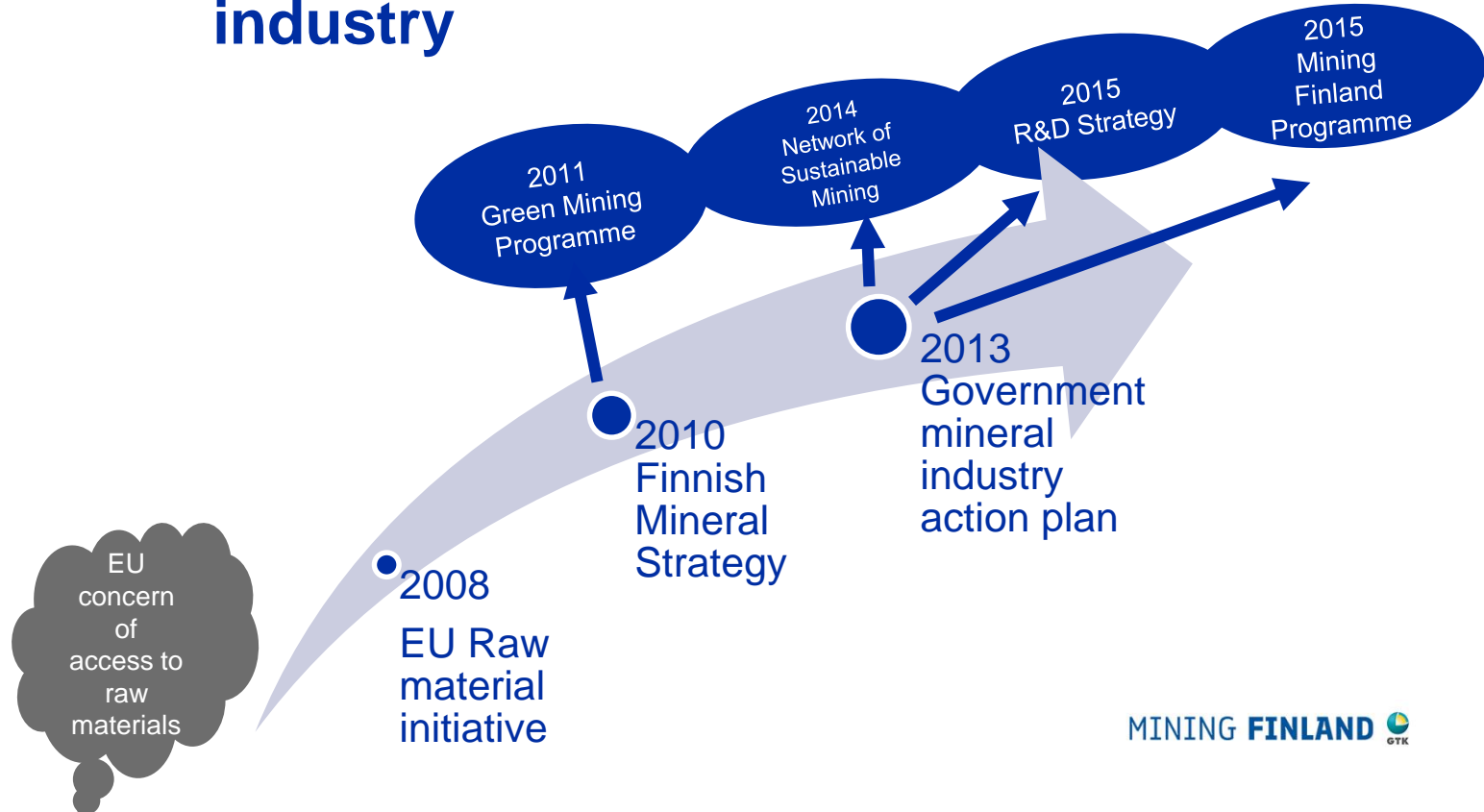
Harry Sandström





Finland is strongly committed to systematic development of mining industry

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MINING FINLAND is one of Team Finland growth programmes

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Innovative bioproducts

Agrotechnology from Finland



Beautiful Beijing

CONNECTIVITY
FROM FINLAND



Education Export Finland

Team Finland Health



DIGITAL
HOSPITALS FINLAND



FinlandCare

Maritime and Offshore from Finland

Mobility as a Service - Intelligent Vehicle and Traffic Growth Program (MaaS)

Developing Markets Growth Program



TWO AIMS OF THE MINING FINLAND PROGRAMME

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Promote mining and exploration investments to Finland



Promote export and international networking of Finnish mining technology and service companies

Hosted by GTK and implemented jointly with Finpro.

Main activities

- Visibility of Finnish mining cluster in international forums
- Expert seminars
- Training
- International and networking
- Marketing in selected focus countries
- **National networking -> from products to solutions and larger offering**



FINLAND IS A **RECOGNIZED** ENGINEERING COUNTRY

Finnish engineering companies have developed major innovations, such as Flash Smelting of copper, advanced automatic pressure filters, process integration and optimization services, etc.

It has been estimated that Finland and Sweden provide approx. **80% of technology** used in underground mines worldwide



Over 200 technology and service providers across the mine value chain

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	Exploration & Development	Mining	Mineral Processing	Rehabilitation / Closure
Contracting				

	Exploration & Development	Mining	Mineral Processing	Rehabilitation / Closure
Supplies & Consumables				



SELECTED HIGHLIGHTS OF FINNISH MINING TECHNOLOGY OFFERING ACROSS VALUE CHAIN

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Exploration



Mining



Processing



Environment and water management





EXPLORATION

Data and knowledge based mineral potential and resource assessment

- Geological interpretation and modelling
- Mineral investment targeting
- Exploration, field work and logging
- Geophysical and geotechnical measurements and interpretation
- Drilling and drilling equipment
- Material characterization and on-site measurements
- Pilot tests

TIME TO MINE! 30-40% shorter development time:

- Proper investment targeting
- Geological interpretation and modelling
- Integrated exploration and measurement techniques
- Mineralogical characterization and beneficiation tests
- Environmental and geotechnical information simultaneously

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Mining

Productivity by optimization of mining processes

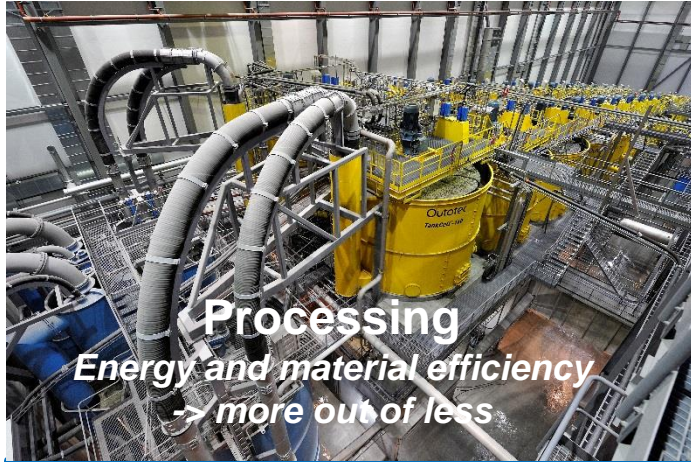
Mine and engineering planning
 Tunneling an construction
 Mining machinery and accessories
 Drilling, drilling equipment and rock splitting
 Fleet management
 Power compensation solutions

IMPROVED PRODUCTIVITY! 25-40% increase in production:

- Digitalized drilling and blasting planning
- Classification of ore and side rock based on continuous on site analysis
- Decreased down time and fuel consumption by digitalized and fleet management and smart transport systems
- Improved mine planning based on novel real time geotechnical measurements

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- Engineering and planning
- Piping construction and solutions
- Granulation
- Mixing solutions
- Flotation and processing solutions
- On-line measurements
- Power compensation solutions
- Maintenance and installations
- Hydraulic systems
- Logistic and packaging solutions

**10-25% IMPROVED RECOVERY AND
10% MORE MACHINERY CAPACITY :**

- On-line measurement based process control from comminution to concentration
- Novel conditioning techniques before flotation
- Effective mixing solutions
- Novel power supply compensation

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Water process planning and infrastructure
Water and waste water treatment
Tailing pond construction and maintenance
Process water management
Water processing solutions and recycling
Metal recovery from waters and tailings
On-site environmental monitoring solutions

IMPROVED WATER AND ENVIRONMENT MANAGEMENT

- 95% water recovery by closed water circulation
- 24/7 on line and real time heavy metal monitoring system
- 50% more dredging capacity by novel water area construction machinery
- 3D tubing and pumping planning for tailing areas

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ouluwateralliance



Watermaster

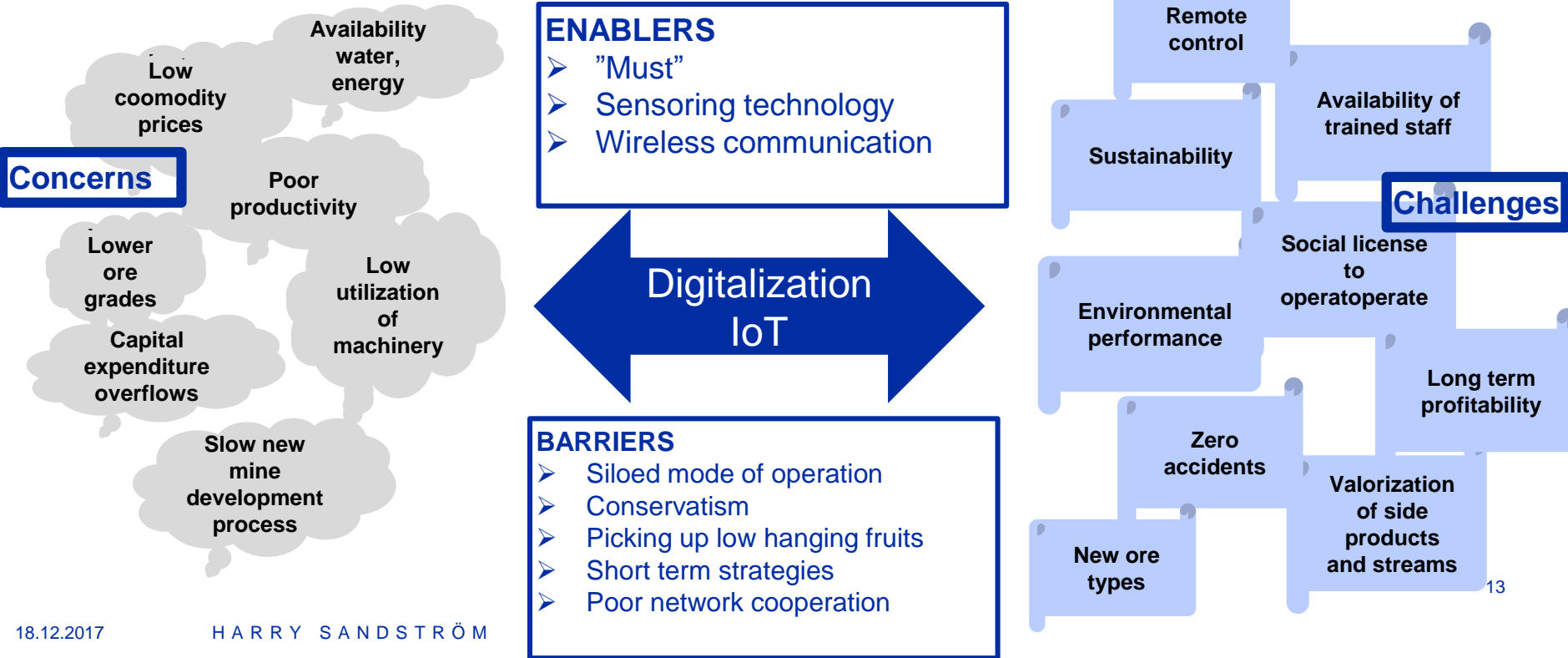


Outotec



+ Digitalization/loT is one development theme in corporate cooperation in Mining Finland

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Promoting digitalization by cross corporate cooperation in Mining Finland

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Our approach and aim:

Digitalization and IoT must be easily adoptable, cover the whole value chain and should provide real and measureable added value

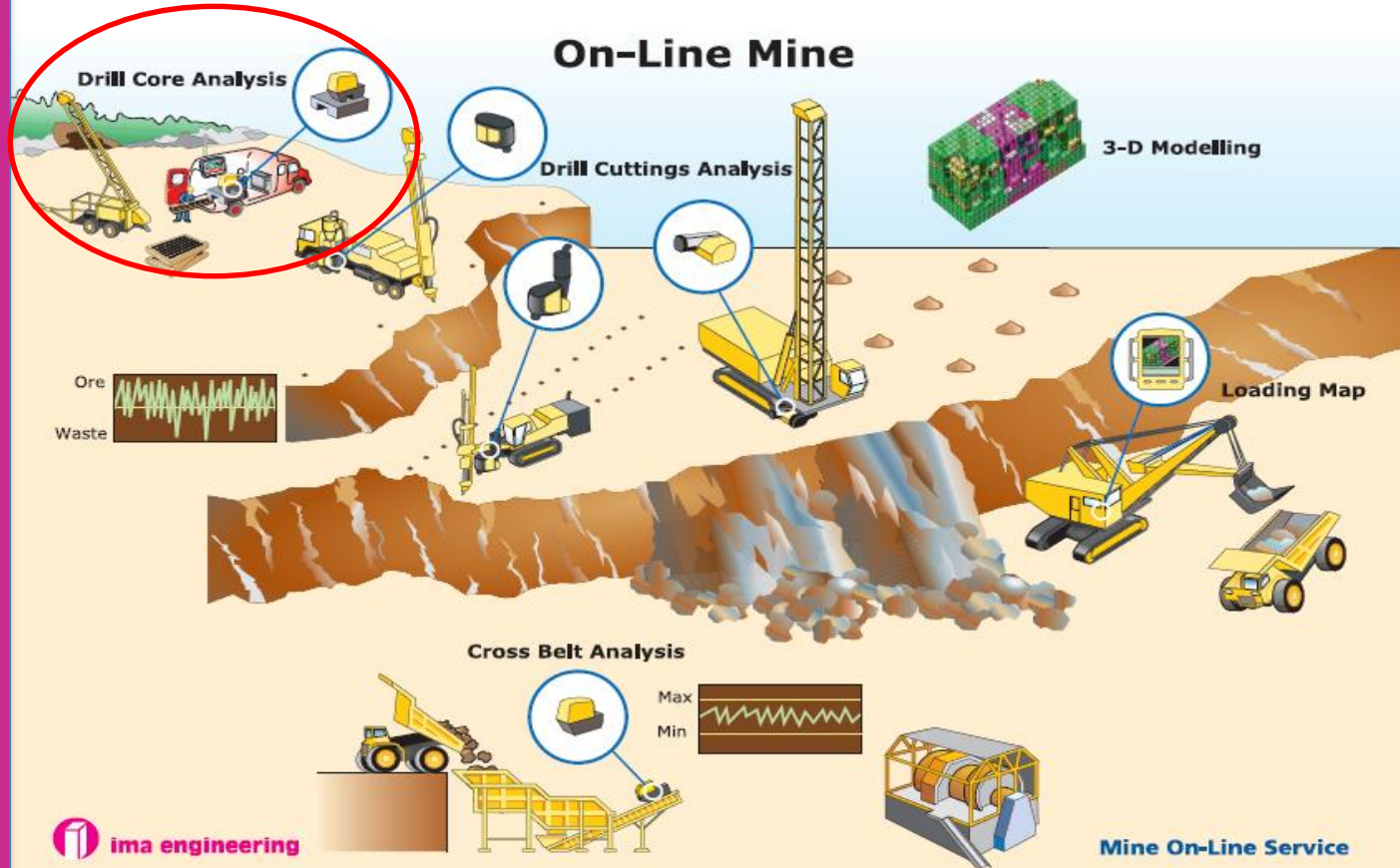
Example of IMA Engineering, Mine On-Line Services and Millisecond:

- *Real time update of 3d model of ore body*
- *Improved blast planning and drilling*
- *Real time material characterization prior concentration*
- *Improved fleet utilization*



On-Line Mine Applications

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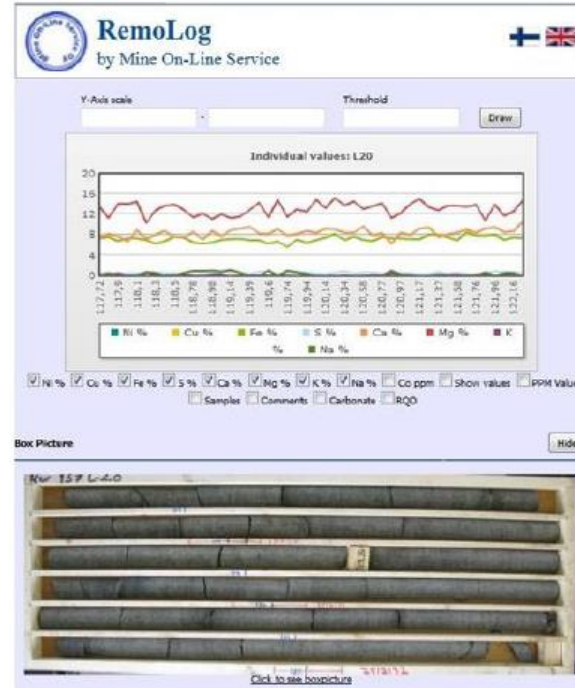


Increasing Productivity by IoT- Exploration

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Remolog™ - Remote reporting and logging tool

- Remolog(TM) is a fast and easy reporting platform for Scanmobile analysis results
- **Can be used as a remote logging tool**
- Web based service provides easy and safe access from anywhere with internet connection



Mine On-Line Service



Enabling next phase of Intelligent Mining by IoT



Drilling & blasting

- Drilling data transfer automation, also for legacy machinery
- Mine grade control via drilling and blasting optimization
- Geometallurgical data 3D modelling on blasting benches

Loading

- Selective loading based on ore grade and location
- Loading optimization
- Load guidance, alerts

Hauling

- Load tracking with ore tonnage and grade data
- Driver guidance & alerts
- Run of Mine ore and wasterock pile grade, with tonnage and location tracking

Crushing and analysis

- Tracking load origin with expected grade composition
- Destination control
- Driver behaviour, control
- Alerts

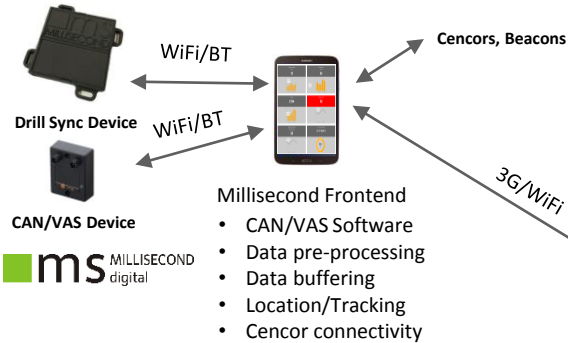
Control

- Real time monitoring & alerts for geologist, shift management
- Ore grade monitoring
- Preventive Alerts
- Analytics, statistics for efficiency, behaviour, machinery health

In co-operation with the Mining Finland digital technology cluster

Connecting machines, people and surroundings

Data collectors



Enriched data from intelligent drilling add on equipment such as



Data integration platform

Customer/3rd party Integrations

- Production monitoring systems
- Planning systems
- Reporting systems
- Maintenance systems



Millisecond Cloud Service)

- Data modelling
- Data processing
- Data analytics
- Reports creation
- Dashboards creation
- Data syncing

Enriched real time data for

- Blasting planning
- Safety
- **Blasting follow-up**
- **Blasting analytics**
- **Optimization**

Customer



Production control room

- **Real time production data**
- Dashboards
- Reports
- Alarms
- Events



Production planning

- Realtime data for the planning
- **Drilling plans**
- **Blasting plans**
- Dashboards
- Reports
- Events



Maintenance planning

- **Realtime data for the maintenance**
- Alarms
- Dashboards
- Reports
- Events



Mining Finland painotukset 2018

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- Fokusoitut markkinointitoimet kohdemarkkinoilla
- Ostaja- ja mediavierailut Suomeen
- Viestintä- ja mediavaikuttaminen Suomen kaivosteknologiasektorin brändin vahvistamiseksi
- Kansainvälisten investorien segmentointi ja kontaktointi
- Kansallisen yhteistyön edistäminen ja kaivosteknologiaverkoston toiminnan vakiinnuttaminen
- Kaivosteknologiakoulutusviennin edistäminen



Minig Finland international activities 2018

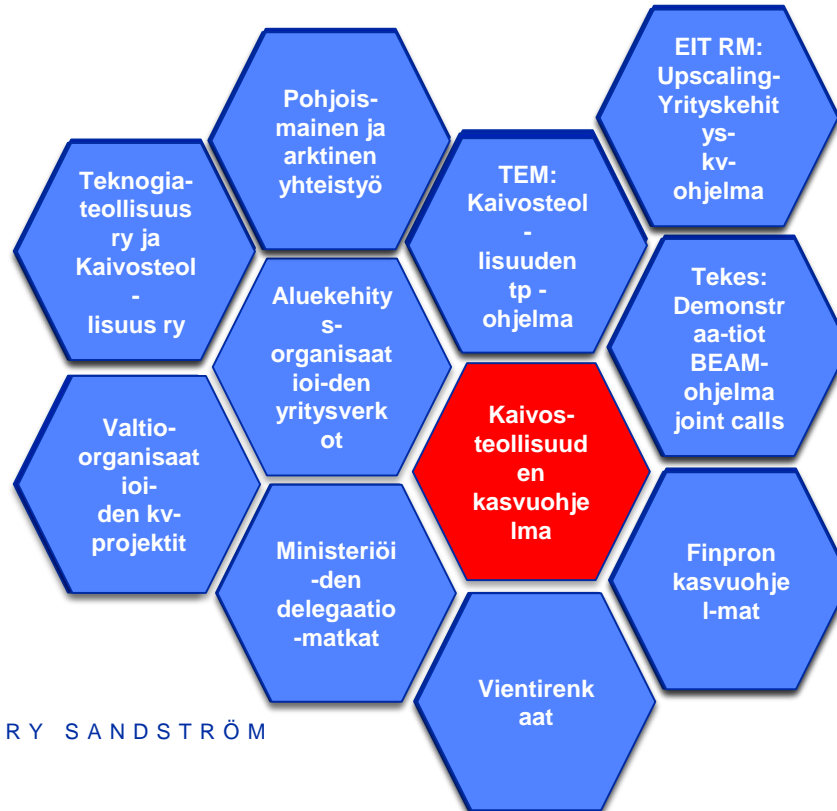
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		Jan18	Feb18	Mar18	Apr18	May18	June18	July18	Aug18	Sept18	Oct18	Nov18	Dec18
Trade shows and congresses													
Vancouver Resource Investment Conference	Vancouver	21-22											
Mineral Exploration Roundup	Vancouver	22-25											
Mining Indaba	Cape Town		5-8										
PDAC2018	Toronto			4-7									
Mines and Money	Hong Kong				4-6								
EU-Latin America Mining Exploration Convention	Madrid				10-12								
Invest in mining in Nordics	Helsinki				17								
CIM convention	Vancouver					6-9							
Mining Week	Sydney					14-18							
Mines and Technology	Helsinki					27-30							
Expomina Peru 2018	Peru									12-14			
Mines and Money/Technology	London												TBC
Road shows/delegation visits													
Copper Belt	Zambia		TBC										
Road show	Peru/Chile			TBC									
Road show	Australia					TBC							
Road show	Canada										TBC		
Peruvian delegation visit	Finland				TBC								



Mining Finland in cooperation with national actors and programmes

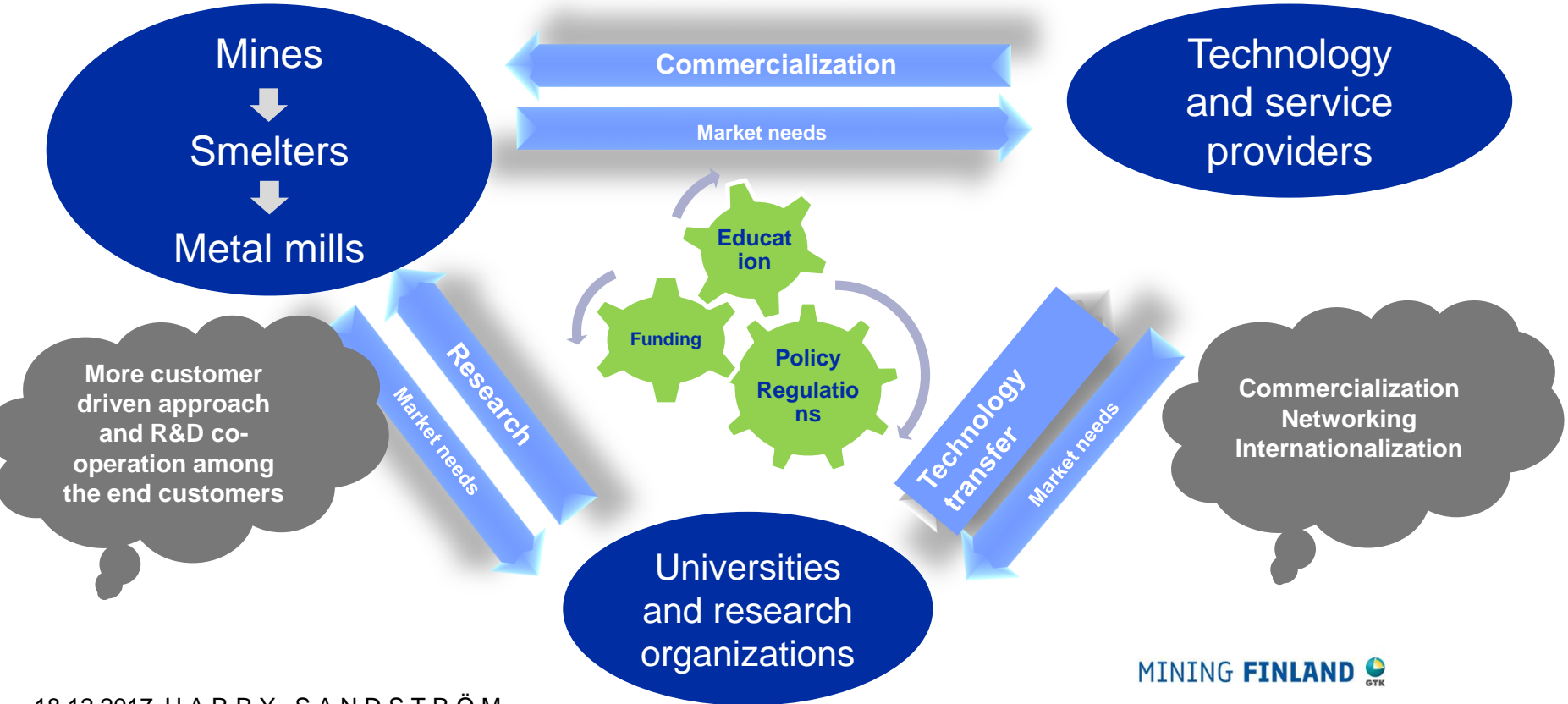
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Finland has today strong mining ecosystem

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Benefits for companies to be a member of MINING FINLAND

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- Market studies
- Information on business opportunities, customers and partners in selected focus markets
- Information on global investor markets for member companies
- Buyer and investor visits to Finland and match-making events in focus countries
- Assistance in creating a larger offering and marketing synergies among members
- Training and match-making events
- Business delegation visits to focus countries



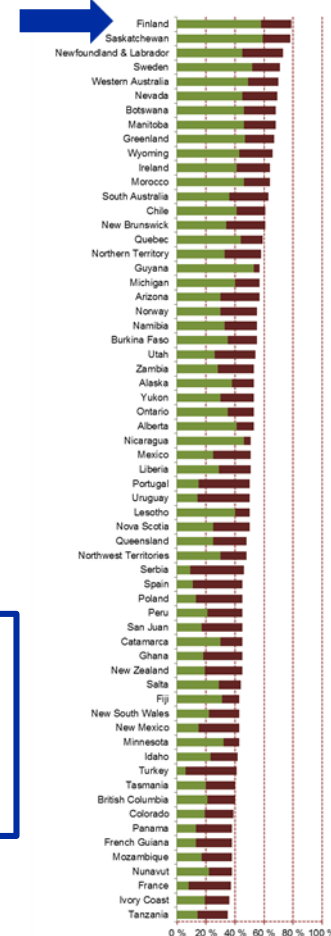
WHY TO EXPLORE IN FINLAND?

- Significant potential for new discoveries
- Excellent geodata and infrastructure
- Long mining tradition, know-how and services
- Strict but clear mining and environmental legislation
- Low corporate tax (20%)
- Downstream industry and proximity to major markets

Fraser Institute ranks Finland **1st in Europe and 5th globally**, for Investment Attractiveness 2016. Finland has been ranked **consistently in the top 10 since 2010**.

Strengths: World's best geodata, Attractive environment, Security

Fraser 2014





EXPLORATION POTENTIAL

Undiscovered resources

- GTK has undertaken statistical estimation of undiscovered, and potentially recoverable metal resources in Finland since 2008
 - **PGM, Ni, Cu, Zn, Au, Cr** for 10 different deposit types
 - **V, Fe, P, REE, Li** will be assessed in the coming years
- USGS three-part quantitative assessment method:
 1. evaluation and selection of descriptive and grade-tonnage models of the deposit types
 2. delineation of permissive tracts
 3. estimation of the number of undiscovered deposits within each tract
 - the estimated number of deposits is combined with the grade and tonnage distributions from the deposit models to assess the total undiscovered metal endowment

The results of the assessment should not be confused with formal industrial standard resource or reserve estimates

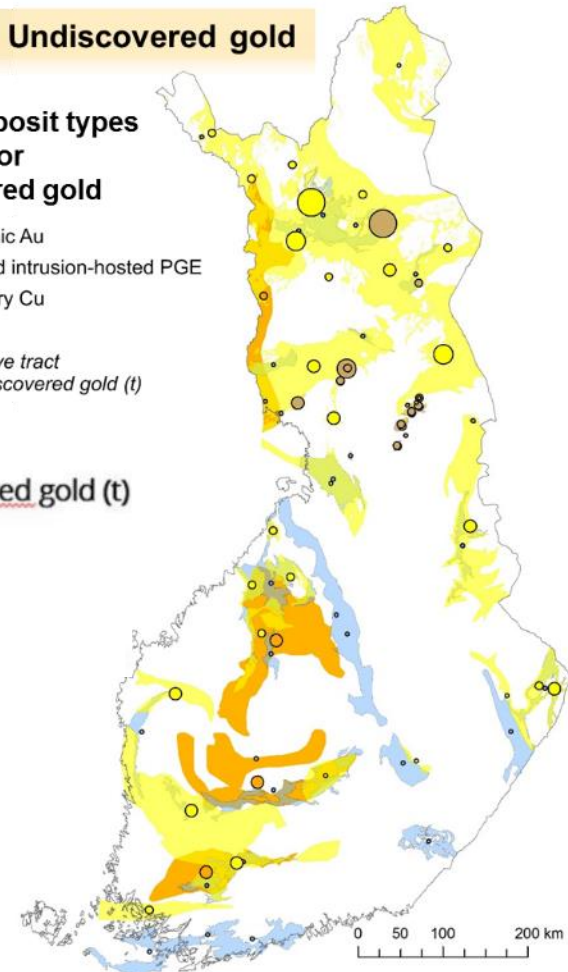
Undiscovered gold

Mineral deposit types assessed for undiscovered gold

- Orogenic Au
 - Layered intrusion-hosted PGE
 - Porphyry Cu
 - VMS
- ↑ ↕ Permissive tract
Amount of undiscovered gold (t)

Median undiscovered gold (t)

- < 5
- 5 - 30
- 30 - 60
- 60 - 90
- > 90



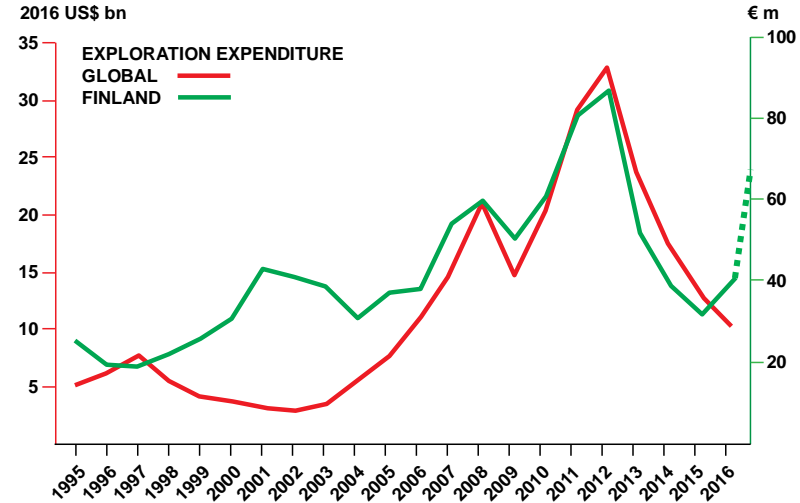


EXPLORATION ACTIVITY

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	2017	2016	2015	2014	2013	2012
Exploration expenditures (M€)	+59% 65.2*	+19% 41.0	-12% 34.5	-26% 39.1	-39% 52.8	86.8
Exploration permit applications	+36% 133**	+40% 98	-42% 70	-4% 120	-50% 125	250
Drilling (km)		+37% 178	-9% 130	-21% 142	-51% 179	366
• Grassroot		20	23	26	32	36
• Greenfield		57	51	46	51	103
• Brownfield		101	56	70	95	227

*Estimate, **By October 2017 Source: Finnish Mining Authority (TUKES)



- Exploration activity in Finland started to rise in 2016



Thank you for your attention!

For more information, please contact



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