



Trinity College Dublin

Coláiste na Tríonóide, Baile Átha Cliath

The University of Dublin

Professionals for a Resource Efficient, Environmentally Friendly and Socially Integrated World

EGU-INTERMIN Short Course: The Future of Education and Skills in the Raw Materials Sector

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Implementation of Raw Materials activities

Sustainability

Important factors for a successful implementation of any raw-materials related project:

- Resource Efficient
- Environment-Friendly
- Socially Integrated

The professionals formed from now onwards face a world where paradigms are changing.

Consider National and Global Targets: 2050+



Reading the Trends

Minerals and Metals as Key Enabler Materials

There is no doubt about the role of raw materials in **society's development** up to now

- For example, the use of copper since the onset of electrification

There is no doubt about the role of raw materials in supporting the energy transition, mobility transition and **achieving Climate-related targets**.

- Green technologies require a wide range of RM

There is no doubt about the role of raw materials in supporting **communications and connectivity**:

- Global village
- Increased mobility

Reading the Trends

New Inputs in 2020

Covid-19 Pandemic halted mobility and triggered actions globally, tending to facilitate:

- Remote work
- Remote education
- Automated work where possible

Resulting in a demand for high technology related metals and minerals, many of them already included in the European list of Critical Raw Materials.

Resulting also in a refreshed discussion in society about connectivity and its relation to flexible working modalities, **new education models** and city planning.

Reading the Trends

Multiple Stakeholders Voice

There is a sustained increasing participation of more stakeholders in the definition of projects (mining, manufacturing, recycling), but also addressing the projects interactions with the natural sphere and different social settings.

	INTERNATIONAL BODIES	GOVERNMENTAL BODIES	ASSOCIATIONS	INDUSTRY	RESEARCH INSTITUTES	ACADEMIA	NGOs	CIVIL SOCIETY
GLOBAL								
CONTINENTAL								
NATIONAL								
REGIONAL								
LOCAL								

Trends of areas of impact, from global to local geographies, for stakeholders of the raw materials sector.

Stakeholders Categories and their Roles

Civil Society— Each, Everyone

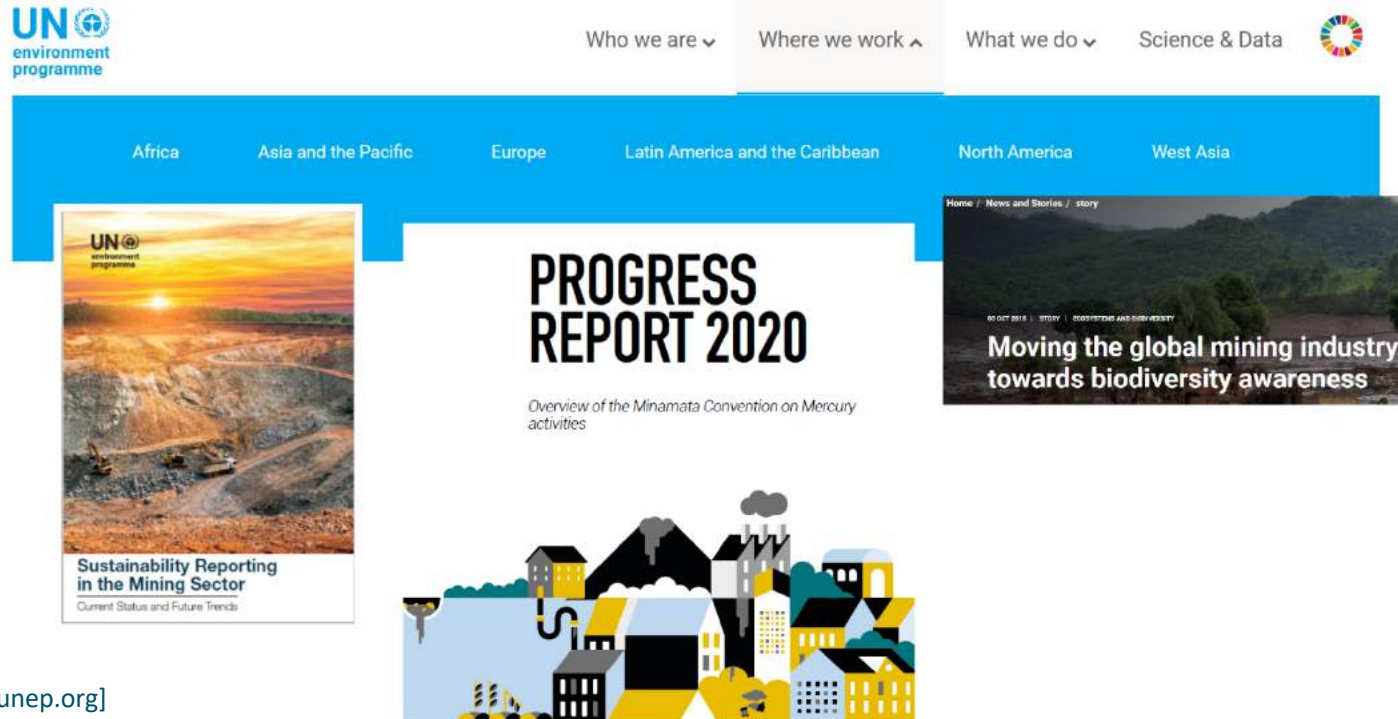


[Sources: www.reuters.com, www.time.com]

Time magazine's person of the year 2019 cover. TIME

Stakeholders Categories and their Roles

International Bodies — United Nations Environment Programme, UNEP



[Source: www.unep.org]

Stakeholders Categories and their Roles

Associations— EUROMINES



The Euromines Guidelines for Sustainable Development

European association for mining industries, metal ores and industrial minerals



European Association of Mining Industries, Metal Ores & Industrial Minerals

Position on Resource Efficiency



[Source: www.euromines.org]

1.1

Primary supply of EU raw materials for sustainable value chains



Expected achievements by 2050

Minerals and metals

By 2050, larger mines have reached deeper-seated operations, achieved low-emission, fossil-free production and the target of 'zero-impact' mining, as well as full automation and real-time control with driverless drill rigs and vehicles in surface and underground mines and quarries. Larger mines have introduced robots to conduct flexible tasks. The full exploitation process is automated from extraction to processing and is managed in real time and by one central hub, while smaller mines have achieved a certain degree of automation. There are no longer people in underground production areas or in quarries. The environmental footprint of mining is negligible. In marine mining, environmentally sound and sustainable extraction of identified sea deposits is a reality. The sector has achieved the target of 'zero-impact' mining and quarrying. In deep mining, mines and quarries across Europe have zero-impact on water and climate change. Dedicated technologies for facilitating space mining have been proposed and tested. The European self-supply of minerals and metals has increased substantially.



Stakeholders Categories and their Roles

Research Bodies— ICRAAG



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RESOURCES FOR A SUSTAINABLE SOCIETY

Our mission is to transform Irish geoscience by driving research and discovery, delivering economic and societal benefit, and advancing public understanding.

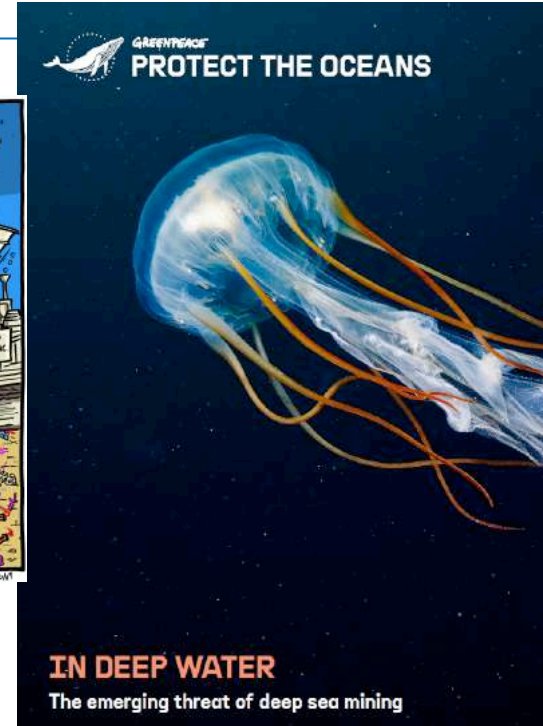
 [Read More >](#)



[Source: www.icrag-centre.org]

Stakeholders Categories and their Roles

NGOs— GREENPEACE



[Source: www.greenpeace.org]

Green Economy links with Responsible Sourcing

Good Practices in Europe — Primary Raw Materials



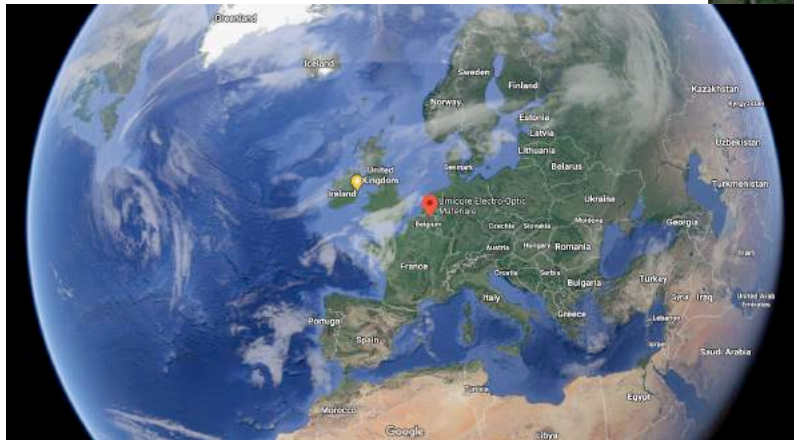
Co-existence despite overlapping priorities

[Source: maps.google.com]



Green Economy links with Responsible Sourcing

Good Practices in Europe — Secondary Raw Materials



Co-existence despite overlapping priorities

[Source: maps.google.com]



Reading the Trends

Minerals and Metals as Key Enabler Materials

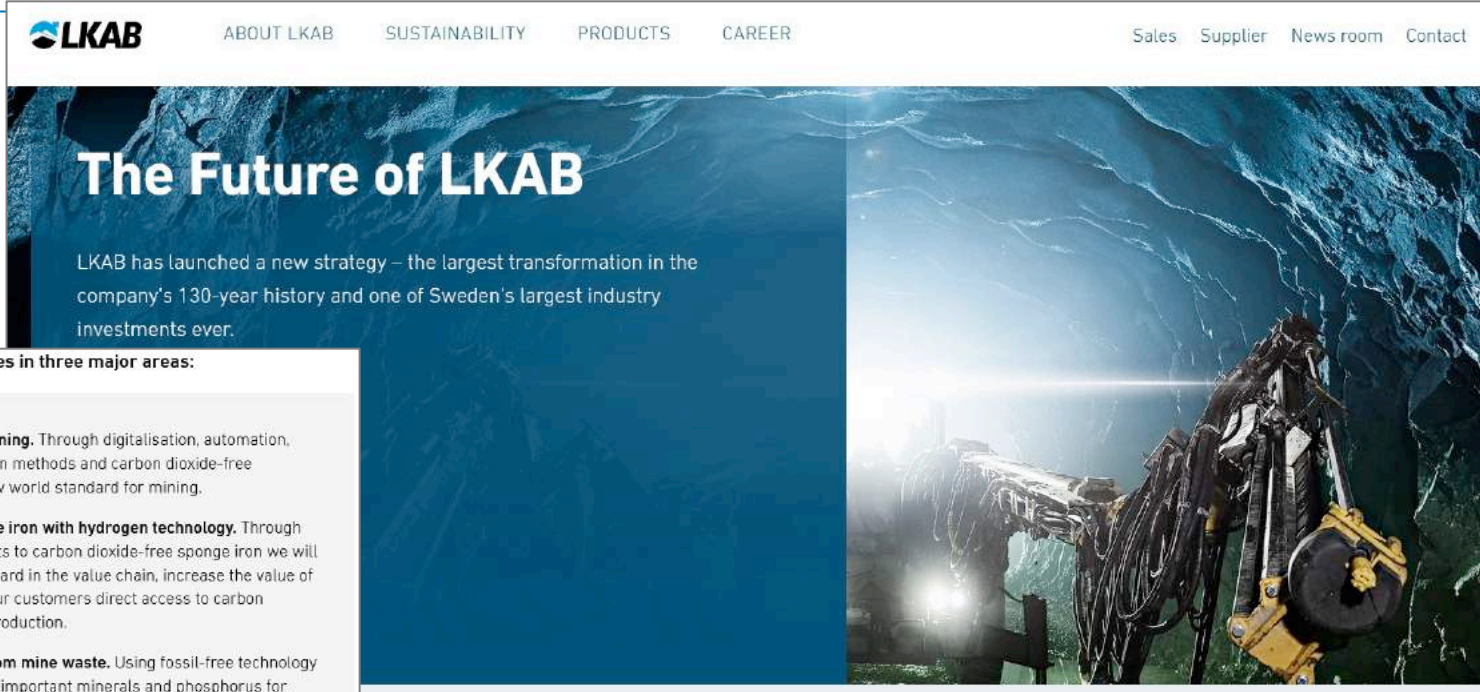
How to read the fast, high impact of new stakeholders voice?

Complex systems are Non-Linear and can develop/evolve differently than expected according to more traditional (linear) approaches.

This can lead to a very slow or very fast implementation of solutions/innovations to a pressing situation where multiple stakeholders are involved.

Stakeholders Categories and their Roles

Industry (Large) — LKAB



The screenshot shows the LKAB website header with a navigation menu: ABOUT LKAB, SUSTAINABILITY, PRODUCTS, CAREER, Sales, Supplier, News room, Contact. The main banner features the title "The Future of LKAB" and a sub-headline: "LKAB has launched a new strategy – the largest transformation in the company's 130-year history and one of Sweden's largest industry investments ever." The background image depicts a large yellow mining excavator in a dark, cavernous underground setting.

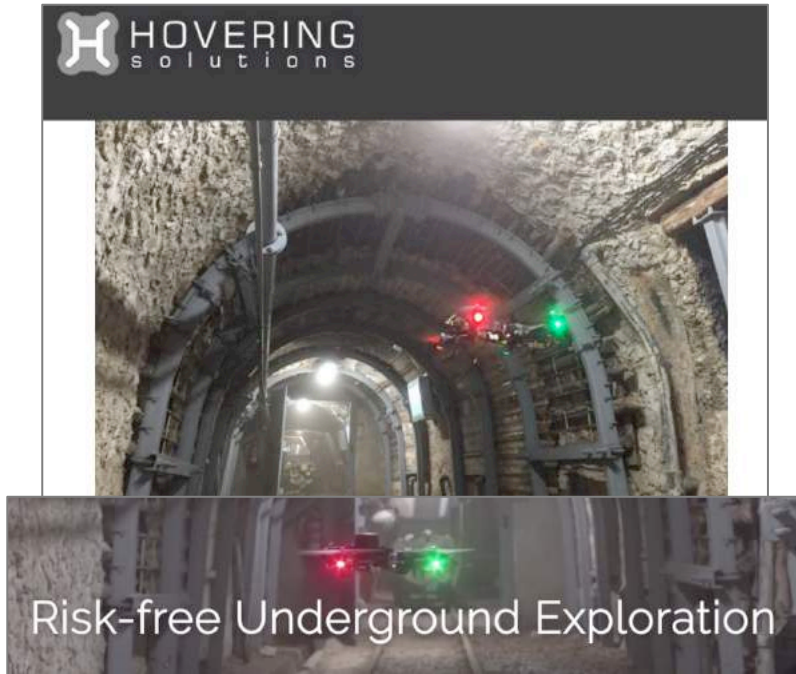
Our strategy consists of changes in three major areas:

- **New world standard for mining.** Through digitalisation, automation, electrification, new operation methods and carbon dioxide-free production we will set a new world standard for mining.
- **Carbon dioxide-free sponge iron with hydrogen technology.** Through the shift from iron ore pellets to carbon dioxide-free sponge iron we will take an important step forward in the value chain, increase the value of our products while giving our customers direct access to carbon dioxide-free iron for steel production.
- **Extract critical minerals from mine waste.** Using fossil-free technology we will extract strategically important minerals and phosphorus for mineral fertilizers from today's mine waste.

[Source: <https://www.lkab.com/en/about-lkab/lkab-in-brief/strategy-and-goals/>]

Stakeholders Categories and their Roles

Industry (SMEs) — Hovering Solutions, CyanoGuard



The image shows the Hovering Solutions logo at the top left, featuring a stylized 'H' in a square followed by the text 'HOVERING solutions'. Below the logo is a photograph of an underground tunnel with a small drone flying in the center. The drone has red and green lights. The tunnel walls are rocky and supported by metal beams. At the bottom of the image, the text 'Risk-free Underground Exploration' is written in white.

[Source: www.hoveringsolutions.com]



The image is a screenshot of the CyanoGuard website. At the top left is the CyanoGuard logo, consisting of two interlocking circles. To the right of the logo are navigation menus for 'Mining', 'Applications', and 'Solutions'. The main heading is 'Next-Generation Cyanide Monitoring' in large white text. Below the heading is the text 'The fastest and most reliable cyanide monitoring solution for gold mining, food safety, and medical applications.' On the right side, there is an image of a smartphone displaying a cyanide monitoring app interface with a circular gauge showing '3.38 PPM' and '25.100 PPM'. Below the smartphone is an image of three stacked orange rugged cases.

[Source: www.cyanoguard.com]

What does Industry say?

Leading companies will aim above and beyond

- Due diligence (occupational Health & Safety, Ethical Supply Chains)
- Inclusion / Diversity (even facilitated by new digital technologies)
- Gas, Liquid and Solid residues (management and monitoring)
- Communication with Community (local to global)

Role of our Professionals

Shaping the present to secure sustainable future

Important skills will make them **enablers of projects** that are:

- Resource Efficient
- Environment-Friendly
- Socially Integrated

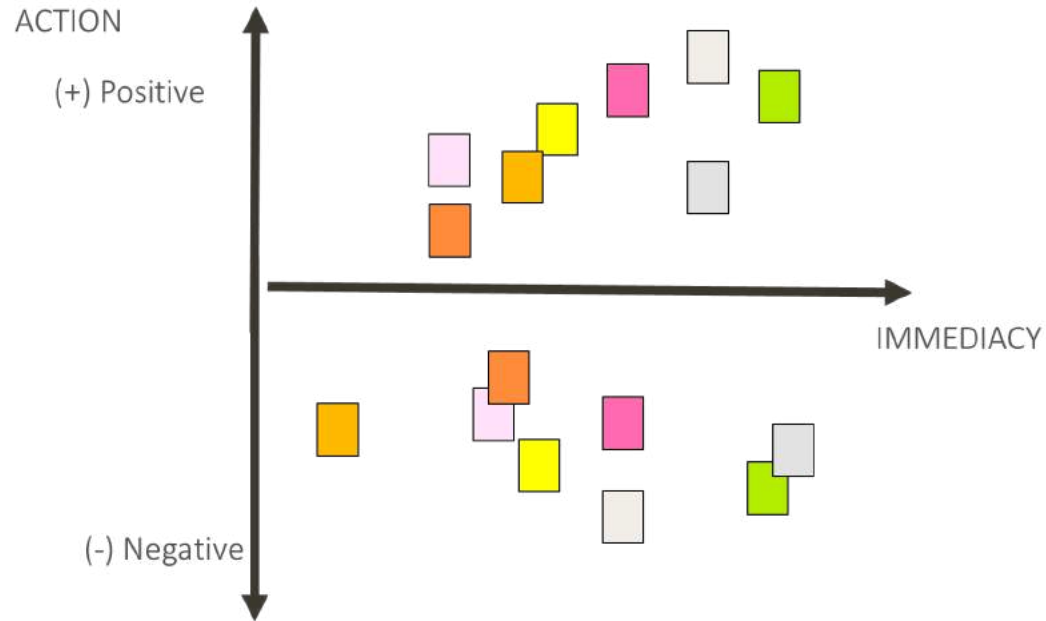
The professionals formed from now onwards face a world where paradigms are changing.



Managing the Impact of RM-related projects

Co-design with multistakeholders participation

Intensity of Stakeholders Impact: "Voice"



Stakeholders Categories and their Roles

Trends Identification: Flow and Bottlenecks

The perspectives of individuals as consumers purchasing high-tech goods and services that contain or require metals. The larger proportion of challenges identified in this case were related to societal challenges and problem definition (53%), followed by the socio-technical area, mostly in climate change and less on lack of resources (25%). The purely technical challenges remain in similar proportion to the other groups and represent the least difficult area (12%).

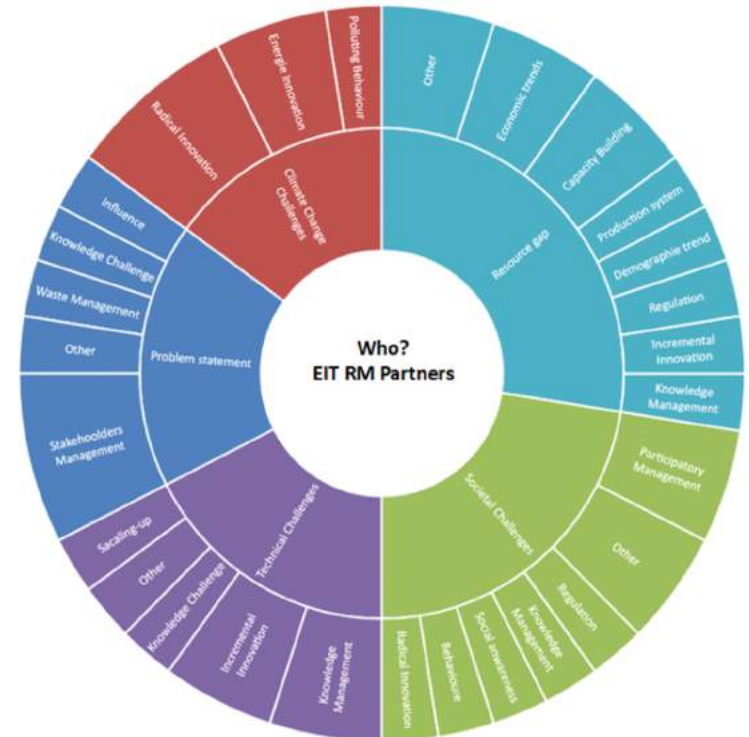


[Source: EU-LA RM Stakeholders Workshop “Socio-Technical Transitions & Sustainability – A System approach for practitioners of Raw Materials Value Chain”. Austria, 2016]

Stakeholders Categories and their Roles

Trends Identification: Flow and Bottlenecks

The perspectives of individuals who see themselves as part of an innovation community to produce raw materials sustainably. The larger proportion of challenges identified in this case were related to lack of resources and societal challenges (50%), followed by socio-technical areas in definition of the problem and climate change (33%). Purely technical challenges represent the least difficult area (17%).



[Source: EU-LA RM Stakeholders Workshop “Socio-Technical Transitions & Sustainability – A System approach for practitioners of Raw Materials Value Chain”. Austria, 2016]



Participatory methods produce sets of practical useful information sooner than other traditional methodologies, and maintain stakeholders engaged throughout the process.



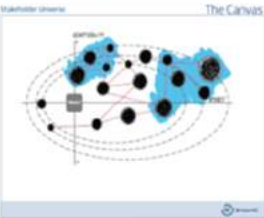
The Socio-Technical Analysis uses visual participatory methods as key tools.

[Source: EIT-funded project WinSmart “Win-Win Situations for the Mobility Transition” Johannesburg, South Africa, 2019.]


Generating useful information

Dashboard poster for reporting
Example of application of Visual tools for co-creation of bottom-up indicators
Transitions Hub- Climate KIC

Example of stakeholder analysis tool




Example of system analysis tool



Analysis & Codification

Example of reporting approach and infographics



Stakeholder ranking by attributes

Stakeholder clusters by attributes

Key socio-economic drivers and factors

Reference:
De Vicente, J., & Granel, R. (2016). Visual tools for system innovation: A method based on the construction of maps, analysis and further operational transitions. ISBN 978-0-85201-8-3. Available at: <https://www.transitionshub.eu/>

Conversations are spaces where knowledge is built.

Knowledge remains registered in these visual tools.

The results are codified and analysed to build indicators (bottom-up), useful for decision-making and to put plans into concrete actions.

[Source: work developed by Matti, Cristian ; Granel, Rafael and DeVicente, Javier – Transitions Hub – Climate KIC, 2016]

How is Academia responding?

Preparing graduates to interact with multiple stakeholders

A process involving systemic innovation is not necessarily linear, but in general terms the process includes the sequence: stakeholders' analysis, integration of multilevel perspectives, visioning & back-casting, and niche management.

1. Stakeholders Mapping
2. Determination of sets of challenges
3. Determination of sets of needs
4. Visioning designed outcomes for specific time lines
5. Building flexible roadmaps

Interact, Integrate, Create Solutions, Innovate (tech & non-tech)

How is Academia responding?

Preparing graduates to interact with multiple stakeholders

Multi-stakeholders co-design, via participatory processes enable a wider vision, reading and understanding complex systems, facilitate shared responsibility by all actors and ultimately enable TRUSTED SYSTEMS, by:

- Generating useful information where qualitative information is translated into semi-quantitative and qualitative data.
- Producing co-owned monitoring indicators.
 - Easy to monitor, control, evaluate and reassign as they progress.

Interact, Integrate, Create Solutions, Innovate (tech & non-tech)

How is Academia responding?

Preparing graduates to interact with multiple stakeholders

Global projects such as INTERMIN have a large potential to jointly develop curricula that will enable students to learn and apply participatory methodologies.

Interact, Integrate, Create Solutions, Innovate (tech & non-tech)



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