



A SUSTAINABLE ECOSYSTEM FOR THE INNOVATIVE RESOURCE RECOVERY AND COMPLEX ORE EXTRACTION

D9.1 Market Shaping, Open Fair Repository, Scale- up Business Models and Socio-Economic Impact v1

Editor(s)	Christiana Themistocleous (ACCELI), Polyxeni Chrysostomides (ACCELI) Joana Guedes (UNP), Bruno Almeida (UNP)
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Contributor(s)	
Reviewer(s)	TUC – Antonia Papadaki, George Arampatzis TUBAF – Sabrina Hedrich, Claudia Kallmeier
Abstract	This report presents the market analysis for the XTRACT results, as well as their competitive market positioning to ensure large-scale deployment and adoption. It further details the XTRACT Intellectual Property Rights (IPR) claims and initial exploitation intentions as well as the relevant legal framework. This deliverable further reports the work carried out for the preparation of the XTRACT Knowledge repository within XTRACT platform.
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Executive Summary

This deliverable presents the outcomes of T9.1 "Market analysis and strategy definition", T9.2 "Socio-economical sustainability analysis and XTRACT ecosystem business models and uptake roadmap" and T9.3 "XTRACT Knowledge repository". These tasks are led by ACCELI (T9.1 and T9.2) and UNP (T9.3) and run from Month 10 (M10) to M36. This deliverable specifically outlines the progress and results achieved for these three tasks up to M18.

This deliverable provides an initial market analysis for XTRACT solutions, along with the consortium's preliminary plans for exploiting these technologies and solutions following the project's conclusion. To achieve this, the report includes a detailed analysis of the exploitable assets, along with an overview of their key competitors. Additionally, it provides an overview of the business model which will be used for the XTRACT exploitable assets, laying the foundation for a more comprehensive evaluation in the next phase.

Lastly, this deliverable provides an overview of the XTRACT Knowledge repository which was set up under T9.2, its structure, its integration with XTRACT website and methodology followed.

The deliverable concludes with an overview of the above-mentioned work and next steps for the purposes of preparing the second version of this deliverable in M36.

Table of Contents

1.	Introduction.....	12
2.	XTRACT Taxonomy of Exploitable Assets/Results and IPR Claims.....	14
2.1.	Taxonomy and Table Mapping of Exploitable Assets.....	14
2.2.	Preliminary IPR Management–Contributions, Background AND FOREGROUND	21
2.3.	Partner Exploitation Pathways and Intentions.....	23
2.4.	IPR Protection and Exploitation	25
3.	Market Analysis and Impact Assessment	27
3.1.	Determining Potential Customers.....	27
3.1.1.	Target Customer.....	27
3.1.2.	Wider Sector.....	28
3.1.3.	Benefits for the Customers	29
3.2.	Identification of Existing Market.....	31
3.2.1.	Existing Market.....	31
4.	SWOT Analysis	34
5.	Policy Plans and Regulatory Framework	37
5.1.1.	XTRACT Reconfigurable UAV System	37
5.1.2.	Electrodialysis and Processability Index.....	37
5.1.3.	Muon technology for detecting internal density distributions in mining-related waste rock stockpiles	37
5.1.4.	In situ Bioleaching, Phytomining – Phytoremediation solution.....	38
5.1.5.	LCA & SLCA Guidelines on the Mining Sector	38
5.1.6.	Other	38
6.	Business Models	39
6.1.	Business Model Canvas	39
6.2.	Value Proposition Canvas.....	40
7.	Socio-Economic Indicators	41
8.	Knowledge Repository.....	42
8.1.	XTRACT@IoT-Catalogue	44
8.2.	Knowledge Repository Structure	46
8.2.1.	Technologies.....	46
8.2.2.	Use Cases.....	48
8.2.3.	Training Material	54
8.3.	Integration with XTRACT Website	62
	Content Development	65

D9.1 - Market Shaping, Open Fair Repository, Scale-up Business Models and Socio-Economic Impact	v1
8.3.1. Methodology	65
8.3.2. Technologies.....	65
8.4. Future Work	75
9. Conclusions and Next Steps	76
Annex 1 – Exploitable Assets List Template	77
Definitions and Classifications of Exploitable Assets/Results	78
Table of Exploitable Assets	78
Description of Exploitable Assets/Technologies	81
Intellectual Property Rights Management, Contributions, Backgrounds & foreground Claims	83
Partner Exploitation Pathways and Intentions.....	84
SWOT Analysis	87
Regulatory Framework	89
Annex 2 – Competitors and Stakeholders Survey Template	90
Determining of the Target Customer	92
Identification of Existing Market	94

List of Figures

Figure 1 - Bar Chart Analysis of Asset Categorisation	21
Figure 2 - IPR Management Analysis	23
Figure 3 - Analysis of partner's input on exploitation pathways and intentions	255
Figure 4 -Target customer	288
Figure 5 - Wider Sector.....	29
Figure 6 - Benefits for the customers.....	300
Figure 7 - Types of broader customers envisioned by XTRACT partners	300
Figure 8 - Description of the current market	311
Figure 9 - Market size	322
Figure 10 - Wider competition	322
Figure 11 - The frequency of finding alternative options in the market.....	333
Figure 12 - Business model canvas template	39
Figure 13 - Value Proposition Canvas.....	400
Figure 14 - Knowledge Repository Banner	422
Figure 15 - IoT-Catalogue Technologies	444
Figure 16 - IoT-Catalogue Validations	444
Figure 17 - XTRACT Workspace	455
Figure 18 - XTRACT Components Section	466
Figure 19 - Component Description Section	477
Figure 20 - Component Used On Section	488
Figure 21 - Component Media Gallery Section	488
Figure 22 - XTRACT Project Use Case Section.....	49
Figure 23 - Use Case Description Section	500
Figure 24 - Use Case Summary Section	51
Figure 25 - Use Case Place Section	511
Figure 26 - Use Case Team Section	52
Figure 27 - Use Case Characterisation Section	522
Figure 28 - Use Case Solutions Section.....	53
Figure 29 - Use Case Media Gallery Section	533
Figure 30 - XTRACT Training Material Section.....	56
Figure 31 – Training Material Start Section.....	56
Figure 32 - Training Material Chapters Section	566
Figure 33 - Training Material Team Section	57
Figure 34 - Training Material Used On Section	57

Figure 35 - Home Course View	58
Figure 36 - Chapter Page	60
Figure 37 - XTRACT Communication Channels	622
Figure 38 - Knowledge Repository Page.....	643
Figure 39 - Methodology Steps	654

List of Tables

Table 1: Description of Exploitable Assets	14
Table 2: Mapping and Categorisation of Exploitable assets	19
Table 3 - IPR Management-Contributions (C), Foreground (F) and Background (B) Claims	22
Table 4 - Partners' exploitation pathways and intentions	24
Table 5 - SWOT analysis.....	344
Table 6 - Training Material (Intentions)	54
Table 7 - Adaptation of Quantum Magnetometer to Drone-Mounted Sensors Approach	654
Table 8 - BIM Search API	665
Table 9 - Biomining.....	665
Table 10 – Drone Magnetometer.....	666
Table 11 - Electrodialysis	676
Table 12 - Ground Penetrating Radar	676
Table 13 - Hyperspectral Drone Inspection.....	687
Table 14 - InSAR.....	687
Table 15 - Knowledge Repository.....	698
Table 16 – LCA & SLCA Guidelines on the Mining Sector	698
Table 17 - LiDAR Drone.....	68
Table 18 - Measuring-While-Drilling	69
Table 19 - Membrane Filtration	69
Table 20 - Muon Detection System	710
Table 21 - Muon Imaging Software	710
Table 22 – Near Real-Time Rock Quality Assessment from Drill Monitoring.....	721
Table 23 - Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals.....	721
Table 24 - Optimised Drill Performance	732
Table 25 - Phytoremediation/ Phytomining Solution Using Trees	732
Table 26 - SLAM-LiDAR	732
Table 27 - X-Ray Fluorescence.....	743
Table 28 – XTRACT Geospatial Platform.....	743
Table 29 – XTRACT Reconfigurable UAV System.....	754

Terms and Abbreviations

API	Application Programming Interface
BIM	Building-Information-Modelling
BMC	Business Model Canvas
CO ₂	Carbon Dioxide Emissions
EASA	European Aviation Safety Agency
GDPR	General Data Protection Regulation
IoT	Internet of Things
IPR	Intellectual Property Rights
ISO	International Organisation for Standardisation
KER	Key Exploitable Results
LCA	Life Cycle Assessment
M	Month
ML	Machine Learning
MWD	Measure-While-Drilling
NGOs	Non-governmental organisations
R&D	Research and Development
SDGs	Sustainable Development Goals
SLCA	Social Life Cycle Assessment
SWOT	Strengths-Weaknesses-Opportunities-Threats
T	Task
TRL	Technology Readiness Levels
UAS	Unmanned Aircraft Systems

VPC	Value Proposition Canvas
WP	Work Package
XRF	X-ray fluorescence

1. INTRODUCTION

In alignment with the Sustainable Development Goals (SDGs), XTRACT is spearheading the Zero Waste Mining initiative. This initiative aims to minimise environmental impacts by reducing waste production and material disturbance.

By addressing critical emission-intensive stages of the mining value chain, XTRACT focuses on sustainable and efficient resource extraction. A key priority is to utilise waste stocks to alleviate resource pressure while advancing the EU's climate neutrality objectives.

Over its three-year duration, the XTRACT project will develop and refine a range of advanced technologies, which will be validated at four pilot sites across the EU. The project will adopt a holistic design ecosystem, realised as an integrated, multi-stakeholder solution with a compositional architecture incorporating sensors and UAV technologies. Additionally, XTRACT will implement low-Technology Readiness Levels (TRL) green technologies aimed at not only remediating mine waste but also enabling the extraction and recovery of valuable metals.

More specifically, XTRACT leverages state-of-the-art remote sensing systems and real-time monitoring technologies to optimise resource assessment, waste management and safety, thereby reducing emissions and improving productivity. New tools such as Measure-While-Drilling (MWD) automation are being developed to minimise ore losses and waste, reducing the emission intensity per unit of ore mined.

In addition, XTRACT is pioneering innovative mining technologies for low-grade, remote and previously uneconomic deposits. These include optimised in-situ bioleaching processes to maximise metal recovery, combined with advanced membrane treatments for valuable metals from wastewater.

XTRACT's innovative solutions will be further validated at four pilot sites, Germany, Sweden, Portugal, and Greece. Detailed information about the concept, pilots, and technologies can be found in *D3.1 Live doc understanding the Stage of Raw Material Extraction and Resource Recovery*, *D4.1 XTRACT Technological Solutions for Strategic Metal Extraction and Waste Assessment Processes* and *D6.1 Live documents, XTRACT Digital Technological Solutions for Optimized Conventional Mining Processes and Digital Infrastructure*.

This report includes an outline of the Market Analysis of each exploitable technology that is developed or derived from XTRACT project. It encompasses a taxonomy, IPR management, contributions, background and foreground claims. It also details partner exploitation pathways and intentions, a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis, and sets out the relevant regulatory framework. Finally, the deliverable provides an overview of the Business Model Canvas (BMC) and Value Proposition Canvas (VPC), outlining the strategic roadmap for sustainable impact.

More specifically, the deliverable draws on input from all consortium partners to identify exploitable assets, map partner intentions, and assess each result's regulatory and competitive context.

Further this deliverable provides details of the XTRACT Knowledge Repository, including details of the methodology followed, its structure and contents.

As the project's key exploitable results (KERs) continue to evolve and mature, a second version of this deliverable, D10.1, will be prepared and submitted in M36. In contrast to D9.1 which focuses on the individual exploitable results, the upcoming deliverable will prioritise the KERs and will provide a comprehensive market analysis of the integrated XTRACT unified solution. Furthermore, it will include a detailed business plan outlining the proposed exploitation strategies and operational activities to ensure the successful commercialisation and sustainability of the XTRACT project.

Further, the second version of this deliverable will list the pilot indications for socio-economic sustainability of the XTRACT results and shall provide the differences and similarities between different projects. These are prepared under WP8 and will be analysed from the scope of exploitation in the second version of this deliverable.

2. XTRACT TAXONOMY OF EXPLOITABLE ASSETS/RESULTS AND IPR CLAIMS

For the purposes of this deliverable, ACCELI collaborated with the consortium partners in order to gather their contributions in XTRACT. The goal was to identify the assets, determine the responsible partner for each one, and collect their respective contributions, IPR claims and exploitation vision.

For these purposes the following forms were prepared and distributed to the consortium partners:

- A. Exploitable Assets List, a template of which is presented in **ANNEX I**; and
- B. Competitors and Stakeholders Survey, a template of which is presented in **ANNEX II**.

As this is a public deliverable and to safeguard the partners' IPR, the completed forms are not included in this deliverable. Instead, only an analysis of the input collected is presented.

It is important to note that this report presents an initial draft of the market analysis and potential business models for XTRACT. As the project progresses and the key exploitable results are further identified, a second version of this deliverable, D10.1 (M36), will be submitted.

2.1. TAXONOMY AND TABLE MAPPING OF EXPLOITABLE ASSETS

In the following table, the full name of each asset/technology/result is provided with a short description. Also, related technologies associated with these exploitable components are presented. From the information provided by the consortium partners, a total of 17 exploitable assets is envisaged to be utilised in XTRACT.

Table 1: Description of Exploitable Assets

No.	Asset's Title	Short Description of the asset	Related to Technology
1	Ore grade assessment in real time through drill monitoring	Ore grade assessment will be performed through MWD-data analysis.	MWD technology Artificial Intelligence technology Machine Learning (ML) technology
2	XTRACT reconfigurable UAV system	The XTRACT reconfigurable UAV system is a versatile unmanned aerial vehicle designed for a range of missions in challenging mining environments. It can be equipped with various sensors, including multispectral, thermal, and RGB cameras, as well as LiDAR, to gather critical data for ore extraction, environmental monitoring, and waste management. The system is modular, allowing for easy payload swapping based on mission requirements, ensuring flexibility and efficiency in resource management operations. It provides real-time or near-real-time data processing capabilities, enhancing decision-making in remote and hard-to-reach mining locations.	The UAV system integrates advanced technologies including sensor fusion, modular payload design, and automated flight capabilities. It supports applications such as aerial surveying, 3D imaging, and environmental analysis, contributing to better resource extraction and reduced environmental impact in mining operations.

3	Optimised drill performance	The developed drill performance optimisation asset will be based on MWD technology. Drilling data will be obtained from sensors installed on the rig and will be used for optimisation processing including ore/waste conduct identification.	MWD technology Artificial Intelligence technology Machine Intelligence technology
4	Electrodialysis and processability index	The electrodialysis has the following strengths in a successful implementation: • Electrodialysis salt splitting using Green Energy • Integration of electrodialysis into in situ bioleaching processes • Using of metal sulfate solutions from in situ bioleaching for production of sulfuric acid and use in the bioleaching process.	The following aims are related: • Building a small-scale demonstration plant • Integration into the in-situ bioleaching experimental setup • Metal hydroxides can be used for neutralisation purposes in the bioleaching process. The technology supports active and passive mining to recover metals and recycle sulphuric acid.
5	Muon technology for detecting internal density distributions in mining-related waste rock stockpiles	A highly innovative, non-invasive solution utilising cosmic-ray muons to map internal density distributions within stockpiles. The technology provides accurate resource estimation, optimised recovery, and enhanced safety, contributing to more efficient and sustainable mining practices.	Muography-based borehole muon detectors and advanced data analysis/visualisation software tailored for density mapping in mining environments.
6	Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals	Bioleaching is a sustainable and eco-friendly technology that uses microorganisms naturally occurring in mining environment to catalyse the recovery of strategic and critical metals from low-grade primary and secondary resources for recovering metals from sulfidic ores, at lower environmental and economic costs than conventional pyro- and hydro-metallurgical mining processes. When performed in-situ, energy inputs to recover metals are even lowered, as excavating, transportation and crushing of the ore are not required.	Electrodialysis of bioleaching solution. Membrane filtration. Muon technology. Geophysical electromagnetic methods. In situ bioleaching technology benefits from optimised drilling performance and resource characterisation e.g. by MUON technology or X-ray fluorescence system. The technology can be coupled

		The in-situ bioleaching technology allows for sustainable and eco-friendly recovery of metals even from dilute and hard to access resources without harsh chemicals and production of toxic gases. The system uses indigenous microorganisms and operates at low cost.	with electrodialysis and membrane filtration unit.
7	Novel Membrane Filtration Technology for Higher Metal Recovery, Water and Waste-Water Treatment	Hybrid combination of microfiltration and nanofiltration technology for downstream processing allows an optimised separation of target elements. Technology will be transferred to different water and waste water problem cases.	Combined with in-situ bioleaching, the downstream processing can be implemented directly on-site. Combination with electrodialysis offers further possibilities for enhancing sustainability.
8	Phytomining – Phytoremediation solution	The proposed phytomining technique involves using trees to extract metals/metalloids from the soil. The harvested trees can then be processed to recover the metals.	Waste management/Remediation
9	Adaptation of quantum magnetometer to drone-mounted sensors approach	Quantum magnetometer can detect extremely subtle variations in magnetic fields, providing high-precision measurements of geological formations. By mounting these sensors on drones, mining operations can conduct rapid, non-invasive geophysical surveys over large areas, including difficult-to-access terrains.	Combination of magnetometer and aerial drone
10	UAV-Derived SLAM for in situ and fragmented material characterisation, analysis of blast fragmentation and calculation of rock fragmentation distribution	UAV-derived SLAM (Simultaneous Localisation and Mapping) technology enables drones to autonomously navigate in GNSS denied environments, creating detailed 3D maps of mining environments in real-time. In mining, it is used for in situ characterisation of fragmented materials, especially after blasting. By capturing high-resolution data and 3D models of the blasted rock, this technology allows for precise analysis of blast fragmentation and the calculation of rock size distribution. This improves operational efficiency by optimising blasting techniques, reducing costs in material handling and processing, and enhancing overall safety in the mine.	SLAM in indoor spaces and GNSS denied environments

11	X-ray fluorescence (XRF) system survey for high resolution geochemistry (drone based)	Enables the detection and distribution of geochemical composition of an area, based on XRF analyses. Provides a comprehensive overview of mining environments and mine wastes in terms of spatial geochemical composition XRF portable sensors can rapidly survey large areas, assessing ore grades or mapping pile wastes and ore deposits Use of remote sensors (drones) X-ray fluorescence system pretends to integrate the commercial sensor into a drone	Combination of aerial drones and hyperspectral sensors, as hyperspectral images can provide detection of specific mineralogical compositions. Can be related with quantum magnetometer data, as variations in magnetic proprieties are related with geological background Can also be related to density data gained using MUON technology Commercial X-Ray Fluorescence
12	Adaptation of hyperspectral sensor to UAV for ore characterisation	Hyperspectral imaging enables the detection of specific mineralogical compositions based on their unique spectral signatures. In mining, UAV-mounted hyperspectral sensors can rapidly survey large areas, identifying and mapping ore deposits with high precision by analysing the reflected light from the surface.	Integrate aerial drones and hyperspectral sensors
13	XTRACT Geospatial Platform	Geospatial platforms help improve efficiency by providing a comprehensive overview of the mining site, enhancing exploration efforts, optimising resource extraction, and ensuring regulatory compliance.	
14	Bioleaching of mine wastes	Using microorganisms to recover valuable metals and remove toxic elements from various mine wastes which cannot be treated with conventional technologies. Thereby allowing for a cost-effective and sustainable process.	Can be related to data gained using MUON technology, X-ray fluorescence system and processability index.
15	LCA & SLCA Guidelines on the mining sector	This framework offers comprehensive instructions for carrying out social life cycle assessment (SLCA) and life cycle assessment (LCA) that are especially suited for the mining sector. It will encompass methods for assessing the social and environmental implications along the mining value chain, emphasising important areas, such as waste management, resource extraction, processing and the	All pilot technologies

		socioeconomic effects of mining operations. By combining environmental, social, and economic goals, these guidelines will attempt to advance sustainable practices in the mining industry, thereby fostering more ethical sourcing and the circular economy.	
16	Knowledge Repository	Knowledge Repository intends to create a repository for mining the data, compliance with the UNFC and UNRMS standards	Internet of Things (IoT) Catalogue
17	Building-Information-Modelling (BIM) Search API	BIM Search Application Programming Interface (API) aims to interact with BIM models in a dynamic and programmatic way	

Table 2 below provides detailed information on the Work Packages and Tasks in which each exploitable asset is used, along with the partner(s) associated with it and related pilot. Following this, the categories of exploitable asset types are presented:

Categories:

F – Framework/Architecture/Blueprint/Guideline

M – Module/Platform element/Side Product

D - Dataset/Knowledgebase

P – Pilot/Use case/application

I – Intangible/Patent/Publication

Other

The third column of Table 2 presents information regarding the stage of the mining process where the exploitable assets are applied. There are four mining stages: *Exploration (EP)*, *Extraction (EX)*, *Processing (P)*, *Waste Management (W)*.

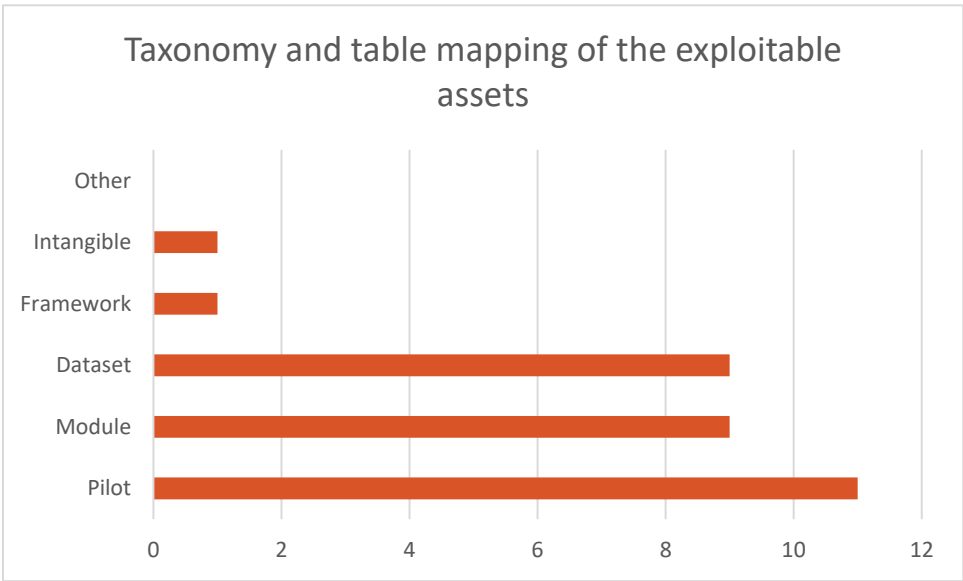
Table 2: Mapping and Categorisation of Exploitable assets

No.	Asset Title	Mining Value Chain	Source of Assets (WP/T)	Introduced by partner (name of partner)	Related to Pilot	Category
1	Ore grade assessment in real time through drill monitoring	EX	T6.1 / 7.1	LTU	P2-SWEDEN	D, P
2	XTRACT reconfigurable UAV system	EP	T6.3 / 7.3	ACCELI	P3-PORTUGAL P2-SWEDEN	M
3	Optimised drill performance	EX	T6.1 / 7.1	LTU	P2-SWEDEN	D, P
4	Electrodialysis and processability index	EX	T4.2 / 5.2	GEOS	P1-GERMANY P3-Portugal P4-GREECE	M, P
5	Muon technology for detecting internal density distributions in mining-related waste rock stockpiles	W	T4.5 / 5.5	MUON	P3-PORTUGAL	D
6	Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals	EX, W	T4.1 / 5.1	TUBAF BRGM	P1-GERMANY	M, P
7	Novel Membrane Filtration Technology for Higher Metal Recovery, Water and Waste-Water Treatment	EX, W	T4.3 / T5.3	TUBAF	P1-GERMANY	M, P
8	Phyto mining – Phytoremediation solution	EX, W	T4.4 / T5.4	LAMMC, TUC, NTUA, AMDC	P4-GREECE	D, P, I
9	Adaptation of quantum magnetometer to	EP, W	T6.2 / 7.2	USAL, ACCELI	P3-PORTUGAL	D, P

	drone-mounted sensors approach					
10	UAV-Derived SLAM for in situ and fragmented material characterisation, analysis of blast fragmentation and calculation of rock fragmentation distribution	EP	T6.2 / 7.2	USAL, ACCELI	P2-SWEDEN	D, P
11	X-ray fluorescence system survey for high resolution geochemistry (drone based)	EP	T6.3 / 7.3	UNP, LNEG	P3-PORTUGAL	D, P, M
12	Adaptation of hyperspectral sensor to UAV for ore characterisation	EP, EX, P, W	T6.2 / 7.2	USAL, ACCELI	P2-SWEDEN P3-PORTUGAL	D, P
13	XTRACT Geospatial Platform	EP, EX, P, W	T3.4	USAL	ALL PILOTS	M
14	Bioleaching of mine wastes	EX, W	T4.2 / 5.2	TUBAF	P3-Portugal	M, P
15	LCA & SLCA Guidelines on the mining sector	All	T8.4 / 8.5	TUC	All pilots	F
16	Knowledge Repository	Other	T6.5 / 7.5	UNP	All	M, D
17	BIM Search API	Other	T6.7 / 7.7	UNP	All	M

Figure 1 below illustrates the taxonomy and mapping of the exploitable assets. Out of 17 exploitable components, 11 are utilised in the project's pilots, making it the most frequently used category. Both "Dataset" and "Module" categories contain 9 exploitable assets in each. Notably, "LCA & SLCA Guidelines on the mining sector" is the only exploitable asset classified as a Framework, while "Phyto mining – Phytoremediation solution" is the only one categorised as Intangible. Lastly, none of the partners completed the "Other" category in its form.

Figure 1 - Bar Chart Analysis of Asset Categorisation



2.2. PRELIMINARY IPR MANAGEMENT—CONTRIBUTIONS, BACKGROUND AND FOREGROUND

In the initial stages of the XTRACT project, it was crucial to identify and further specify the relevant background knowledge, expertise, and data contributed by consortium partners. This process builds on the elements outlined in the Grant Agreement and Consortium Agreement, as well as the input provided by partners through shared questionnaires. Within this framework, the identified background can be associated with the project’s generated assets, enabling the determination of access rights, ownership, and IPR considerations.

The identification of projects assets has the goal of creating a comprehensive mapping of these assets to the XTRACT solution. To achieve this, all valuable IP assets within the project must be systematically documented.

In the following table (table 3), the categorisation of the assets as *Background*, *Foreground* and *Contributor* during the XTRACT project is presented. The partners provided information regarding prior background knowledge related to each asset, i.e., which existed before the project began.

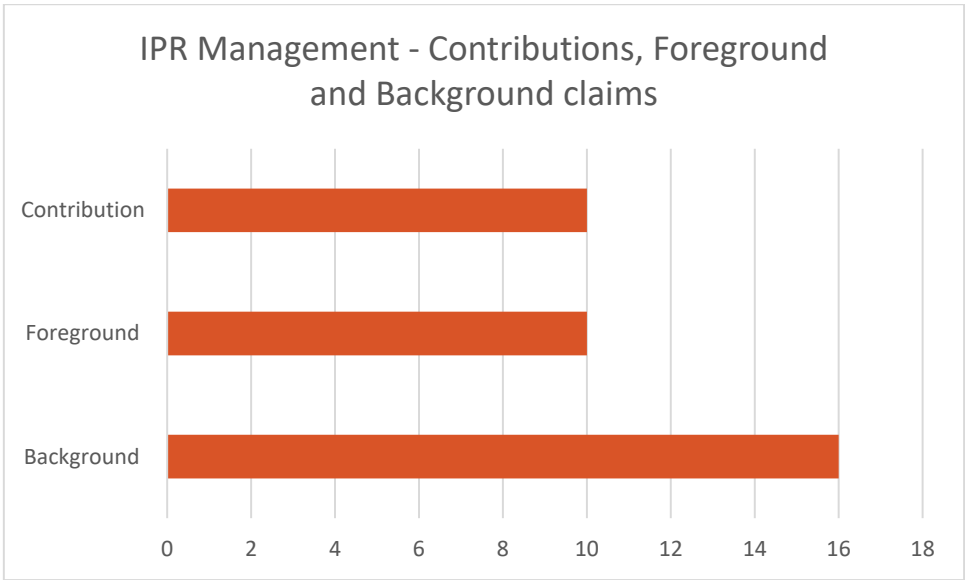
In the Foreground category, the partners assert that they have developed, or will develop, new Foreground knowledge while working on the asset, which they can or will be able to exploit. Lastly, each partner needed to claim having made, or what will make, a significant contribution to the development of the asset. Naturally, this implies that the partner is actively involved in the asset’s task with a meaningful amount of person hours.

Table 3 - IPR Management-Contributions (C), Foreground (F) and Background (B) Claims

No.	Asset's Title	Short partner's name	Category
1	Ore grade assessment in real time through drill monitoring	LTU	B, F
2	XTRACT reconfigurable UAV system	ACCELI	B, C, F
3	Optimised drill performance	LTU	B, F
4	Electrodialysis and processability index	GEOS	B, F
5	Muon technology for detecting internal density distributions in mining-related waste rock stockpiles	MUON	B, F
6	Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals	TUBAF, BRGM	C, B, F
7	Novel Membrane Filtration Technology for Higher Metal Recovery, Water and Waste-Water Treatment	TUBAF	B, C
8	Phytomining – Phytoremediation solution	LAMMC, TUC, NTUA, AMDC	C, B, F
9	Adaptation of quantum magnetometer to drone-mounted sensors approach	USAL, ACCELI	C, B
10	UAV-Derived SLAM for in situ and fragmented material characterisation, analysis of blast fragmentation and calculation of rock fragmentation distribution	USAL, ACCELI	C, B
11	X-ray fluorescence system survey for high resolution geochemistry	UNP, LNEG	C, B, F
12	Adaptation of hyperspectral sensor to UAV for ore characterisation	USAL, ACCELI	C, B
13	XTRACT Geospatial Platform	USAL	C, B
14	Bioleaching of mine wastes	TUBAF	B, C
15	LCA & SLCA Guidelines on the mining sector	TUC	B
16	Knowledge Repository	UNP	B, F
17	BIM Search API	UNP	F

Figure 2 below demonstrates the overall distribution of claims related to IPR Management. 16 out of 17 components are identified as having *Background* claims. The “BIM Search API2” is the only component with a *Foreground* claim. Also, consortium partners have claimed (or intend to claim) substantial *Contributor* support for ten components. Similarly, partners have developed (or intending to develop) new *Foreground* knowledge for ten assets listed in the exploitation list (Table 3).

Figure 2 - IPR Management Analysis



2.3. PARTNER EXPLOITATION PATHWAYS AND INTENTIONS

For every exploitable asset, a range of potential exploitation paths/intentions (which are not mutually exclusive) was identified for consideration. Based on input from partners, the following table outlines the intended paths for each individual exploitable asset.

It should be noted that the Table 4 reflects the partners' preliminary, non-binding intentions and outlines potential approaches they may pursue for exploitation. These paths include market sales, technical development, licensing, internal exploitation, further research activities, academic publications, dataset generation, other specialised services, and training programs as well as governmental engagement.

For these purposes the exploitation pathways and intentions for the assets have been categorised as follows:

Market (sales) (M) which involves a partner leveraging their existing sales channels to promote and sell the asset to potential customers, often through licensing agreements without owning the asset.

Technical Creation, Assembly, and Production (C) which reflects a partner’s intention to produce the asset, either for independent sales or distribution through third-party channels.

Licensing (L) which entails a partner licensing or assigning an asset or related knowledge to third parties for a fee, which is a common approach for universities or entities lacking dedicated sales teams.

Internal Use (I) which signifies plans for internal application, expansion, or replication of the asset, typically for pilots, demonstrators or integration into product lines.

Further Research (R) which focuses on plans for additional research, including publishing in journals, conferences, or other research activities.

Publication (P) which involves creating materials such as handbooks, best practices, multimedia, videos, or presentations related to the asset.

Dataset Utilisation (D) which refers to exploiting datasets through online marketplaces, research experiments, consulting services, or other purposes.

Training (T) which reflects a partner's intention to develop training materials or provide services like online tests, webinars, or printed resources related to the asset.

Services (S) which encompasses offering complementary services, such as consulting, technical integration, support, maintenance, and other value-added services connected to the asset.

Governmental Engagement (G) which includes leveraging connections to promote the asset to governmental bodies, contribute to policy recommendations, or engage with standardisation organisations and associations.

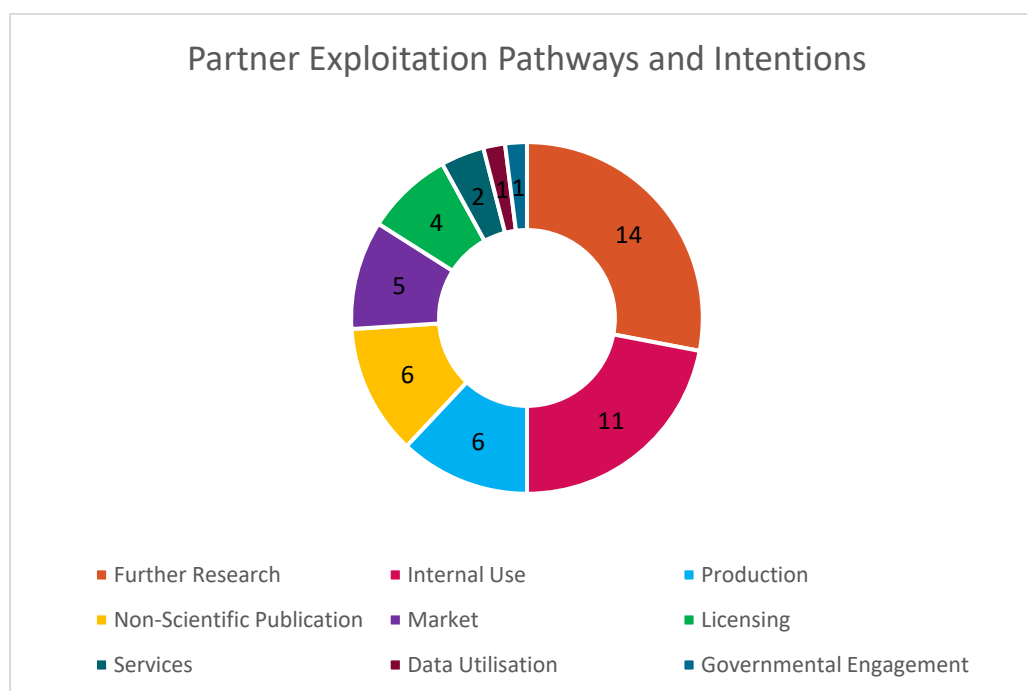
Table 4 - Partners' exploitation pathways and intentions

No.	Asset's Title	Short partner's name	Category
1	Ore grade assessment in real time through drill monitoring	LTU	I, R
2	XTRACT reconfigurable UAV system	ACCELI	M, I, C, R, S
3	Optimised drill performance	LTU	I, R
4	Electrodialysis and processability index	GEOS	I, R
5	Muon technology for detecting internal density distributions in mining-related waste rock stockpiles	MUON	C, I, R, P, T, S
6	Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals	TUBAF, BRGM	C, L, I, R
7	Novel Membrane Filtration Technology for Higher Metal Recovery, Water and Waste-Water Treatment	TUBAF	C, L, I, R
8	Phytomining – Phytoremediation solution	LAMMC, TUC, NTUA, AMDC	I, R, P, G
9	Adaptation of quantum magnetometer to drone-mounted sensors approach	USAL, ACCELI	I, R, P
10	UAV-Derived SLAM for in situ and fragmented material characterisation, analysis of blast	USAL, ACCELI	I, R, P

	fragmentation and calculation of rock fragmentation distribution		
11	X-ray fluorescence system survey	UNP, LNEG	I, R, P, D, M, C
12	Adaptation of hyperspectral sensor to UAV for ore characterisation	USAL, ACCELI	I, R, P
13	XTRACT Geospatial Platform	USAL	M, L
14	Bioleaching of mine wastes	TUBAF	C, L, R
15	LCA & SLCA Guidelines on the mining sector	TUC	R
16	Knowledge Repository	UNP	M, C
17	BIM Search API	UNP	M, C

Figure 3 demonstrates an analysis for the partner's exploitation pathways and intentions. The most common pathway is Further Research, with 14 out of 17 exploitable assets planned for this purpose. Over half of exploitable assets (11 out of 17) are intended for internal use, making it the second most prevalent pathway.

Figure 3 - Analysis of partner's input on exploitation pathways and intentions



2.4. IPR PROTECTION AND EXPLOITATION

An effective protection of the exploitable outcomes that developed or currently being developed in the XTRACT project and are being reflected in D1.2 XTRACT IPR Plan which has been submitted. This

protection approach is crucial for the potential commercial exploitation of XTRACT results. Protection should be sought when the project results can reasonably be expected to have commercial value. All consortium partners must consider both their individual interests and the broader goals of the consortium when discussing IP protection. A mechanism should be established to safeguard exploitable results, ensuring they are covered for a suitable period and within the relevant jurisdictions. This collective responsibility will help maximise the potential of the project's outcomes while aligning with the interests of all partners involved.

According to IPR ownership guidelines the results are considered jointly owned if they are created collaboratively by two or more participants, and it is not possible to clearly identify each participant's individual contribution or to separate the results for the purpose of applying for, obtaining, or maintaining protection. Joint ownership typically arises in specific situations, especially for technological results. The rules regarding joint ownership are currently addressed in the consortium agreement. However, since this agreement is established before the project's results are created, participants should also sign a separate joint ownership agreement during or close to the end of the project's implementation. This agreement should define how ownership is allocated and outline the terms for exercising that ownership.

In *Table 3*, the contributors for each exploitable asset are clearly provided. At this stage, only the contributors and lead developer of each component are given. In a later stage (M19-36), there is a plan to include the lead developer and contributors in the KERs. In other words, it will be showed the individual and joint exploitation intentions regarding the IPR ownership.

In *Table 4* and at this early stage of the project the partners have provided their intentions of individual exploitation pathways in section 2.3 above. These intentions will not necessarily be followed or remained unchanged until the end of the project.

Therefore, the individual exploitation plans of each partner will further be considered during the second iteration of this deliverable which is due in M36.

During the second phase of this project the intention is for the consortium partners to generate a document which will describe in detail the intellectual property rights of the project results and clear IPR distribution based on the % ownership of each development. The aim of this exercise will be to generate, discuss, align, validate and agree on the distribution of the intellectual property ownership of each asset developed throughout the project. The outcome of this exercise may later be reused as part of a wider joint exploitation agreement to support the generation of the compensation to be distributed to each partner.

3. MARKET ANALYSIS AND IMPACT ASSESSMENT

This section presents an overview of the market landscape and evaluates the potential impact of the project's outcomes based on input from consortium partners. To present the market analysis and impact assessment, the “Competitors and Stakeholders” survey was distributed to the consortium partners to gather all the necessary input. The main goal of the survey was to identify the partner’s vision for exploitation ideas and, consequently, understand the practical applications that the project may pursue after its completion.

The partners were required to address questions regarding the target customers for their exploitable assets and the benefits these customers would gain from using these technologies. Additionally, they were asked to provide information about the broader sector and the existing market to which these exploitable assets along.

All the inputs were consolidated, and conclusions were showed regarding the above topics. These conclusions will mainly be presented using graphs in the following subsections. It is repeated that this market analysis describes the current status of exploitable assets individually. In the next steps, the analysis will consider the key exploitable results of the project.

3.1. DETERMINING POTENTIAL CUSTOMERS

3.1.1. Target Customer

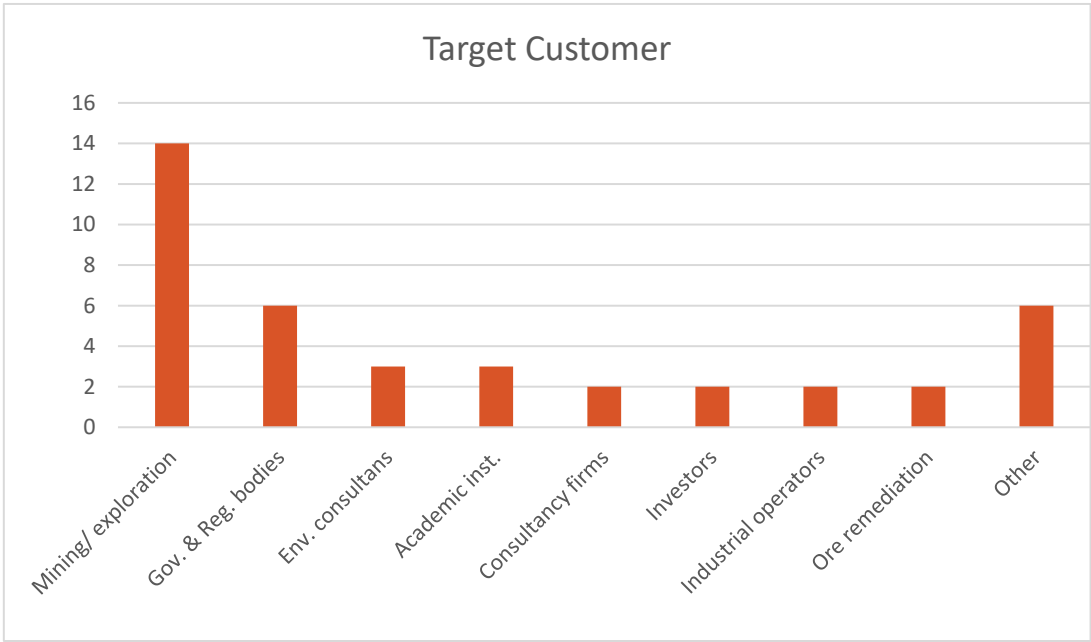
Through the “Competitors and Stakeholders” questionnaire, partners were asked to answer questions regarding the target customer group of their exploitable asset or the exploitable assets they contribute to.

The bar chart illustrates the eight most predominant target customers for the exploitable assets of the XTRACT project. The leading category, as expected, is “Mining and exploration companies” with fourteen answers, confirming that the primary market for these assets is within the mining sector.

The second most predominant category is the “Government and regulatory bodies” with six answers, followed, by “Environmental consultants” and “Academic institutions” with three responses. The rest categories, “Consultancy firms”, “Investors”, “Industrial operators”, “Ore remediation companies” has two responses. Finally, the category “Other” is included the negligible choice like raw material management, non-governmental organisations (NGOs), site owners, Research & Development (R&D) organisations, service providers, logistics and supply chain companies.

In conclusion, the mining sector dominates the target customer base, with other categories playing supplementary roles. These findings are expected to align with results concerning the joint exploitable assets in subsequent project phases.

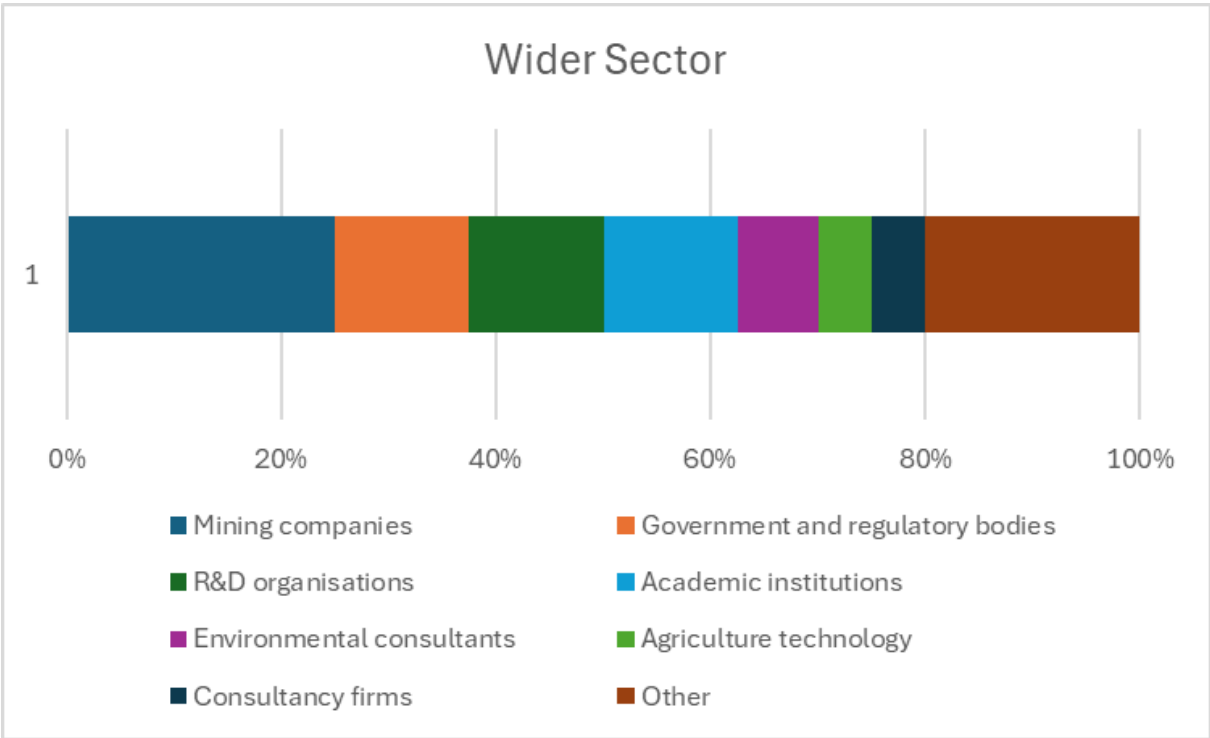
Figure 4 -Target customer



3.1.2. Wider Sector

The following chart demonstrates the wider sectors identified by consortium partners, providing an overview of the market landscape for exploitable assets. The data indicates that the mining industry is the dominant sector, with more than 20% of the responses attributing exploitable assets to this field. This reflects the significant applicability of the project outcomes within mining-related activities. The next most represented sectors are government and regulatory bodies, R&D organisations, and Academic institutions with 12.5% each. The “Government and Regulatory Bodies” category is demonstrating the importance of engaging public institutions and regulatory bodies for the successful deployment of the project technologies. Similarly, both R&D organisations and academic institutions highlight the relevance of the project outcomes to research and educational sectors.

Figure 5 - Wider Sector



3.1.3. Benefits for the Customers

The benefits of using these exploitable assets are illustrated in Figure 6 below. Among the predominant benefits, cost efficiency stands out as the most significant. This indicates that customers who utilise the XTRACT exploitable assets achieve greater productivity while reducing costs. Additionally, six of the exploitable assets contribute to environmental sustainability. Furthermore, three exploitable assets enhance data collection accuracy and/or are environmentally friendly in their use. Lastly, the XTRACT exploitable assets also promote operational efficiency and support regulatory compliance and social responsibility.

Figure 6 - Benefits for the customers

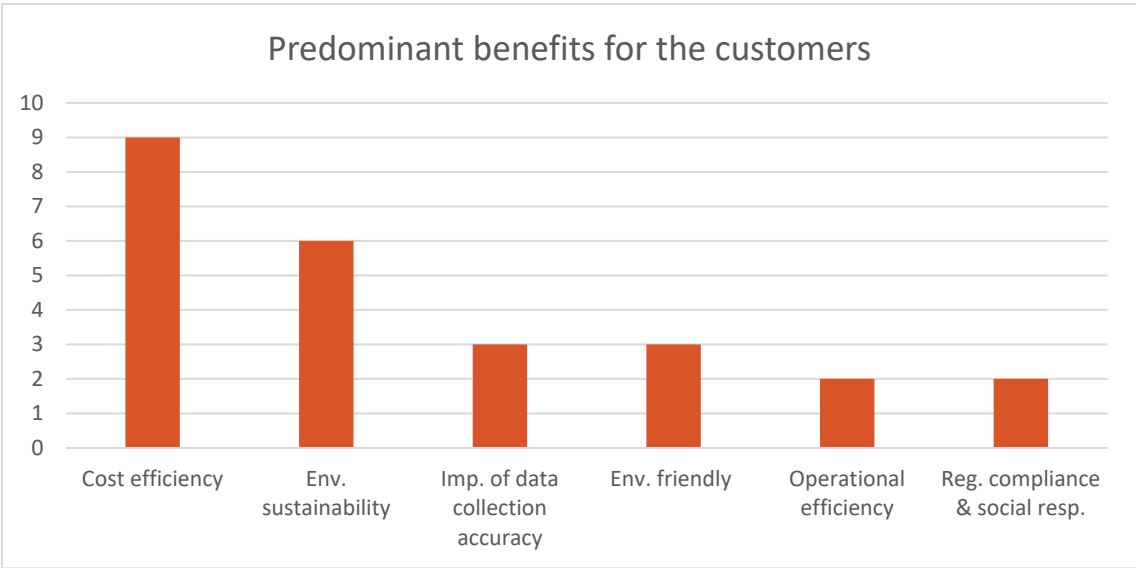
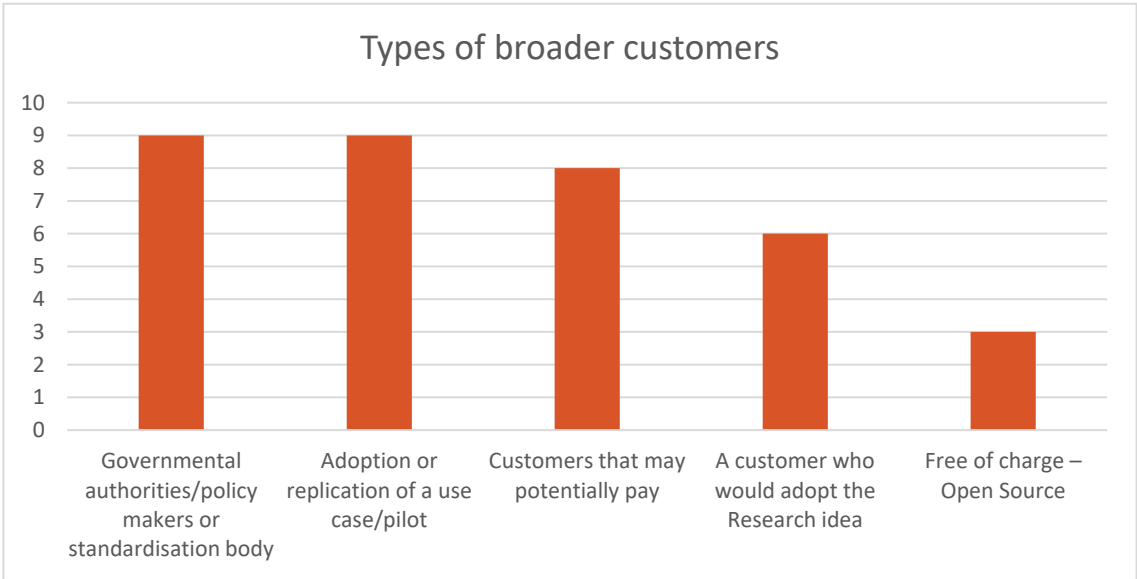


Figure 7 illustrates the types of broader customers envisioned by consortium partners for the project solution. The most prominent customer categories are governmental authorities, policy makers, or standardisation bodies, as well as entities involved in the adoption or replication of a use case or pilot, both receiving the highest emphasis. This highlights a strategic focus on engaging influential institutions and driving real-world application of the project outcomes. Other envisioned customer types include those potentially willing to pay for the solution, customers who would adopt the research idea for further development, and, to a lesser extent, users interested in a free-of-charge or open-source approach.

Figure 7 - Types of broader customers envisioned by XTRACT partners



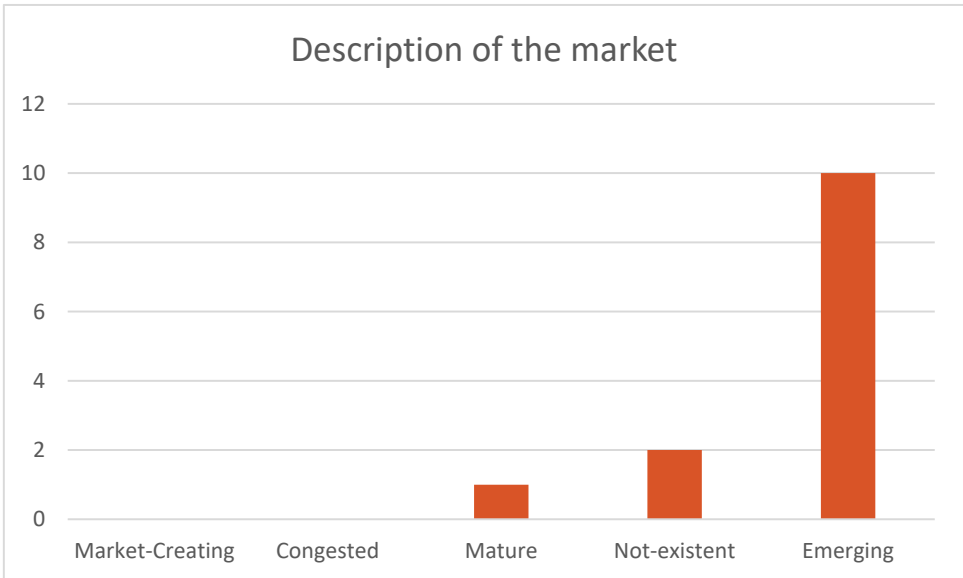
3.2. IDENTIFICATION OF EXISTING MARKET

3.2.1. Existing Market

By completing the second part of the "Competitors and Stakeholders" survey, consortium partners had the opportunity to identify the existing market for their exploitable asset. The questions addressed the potential existence and size of the market, the availability of similar options, and the customer's accessibility to them. They also explored whether customers could find alternative options in the market and what those alternatives were. Below, the overall picture of the existing markets for the assets is presented.

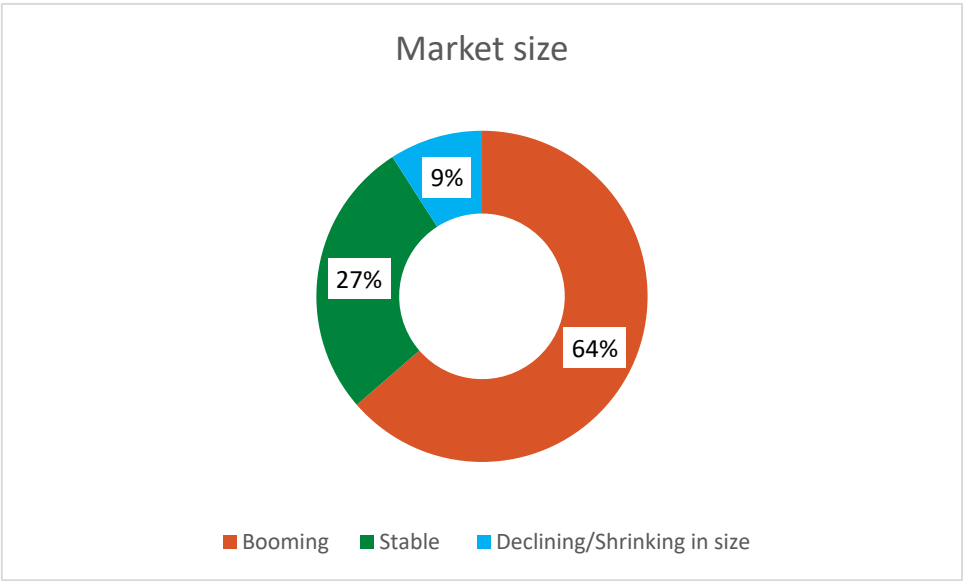
Figure 8 illustrates the distribution of the markets, across the stages of development, that each exploitable asset exists. Most of the markets, with a count of 10, are emerging with the potentials for growth and development. Two markets are classified as not- existent, indicating that these markets have yet to be established. Also, one market was characterised as mature, demonstrating its development and stable nature. No markets are currently creating or congested.

Figure 8 - Description of the current market



Among the existing markets, more than 50% are booming. Nearly one-third of the markets are stable, while one is declining. These results lead to the conclusion that the joint exploitation results will also be established in booming markets (see Figure 9 below).

Figure 9 - Market size



With input from partners, a picture of the competitors in the markets, relative to XTRACT exploitation assets, has been developed. Figure 10 below shows the results. The most popular responses are “Potential collaborators, who we could approach to explore partnerships” and “Comparable research initiatives, projects, or clusters”, each with nine selections. These are followed by “Direct competitors in the market” and “Alternatives that utilise different technologies or ideas instead of our solutions”. Finally, with three selections, “Substitutes that don't offer similar solutions but solve the same problems through more basic or less advanced methods”, is the least chosen category.

Figure 10 - Wider competition

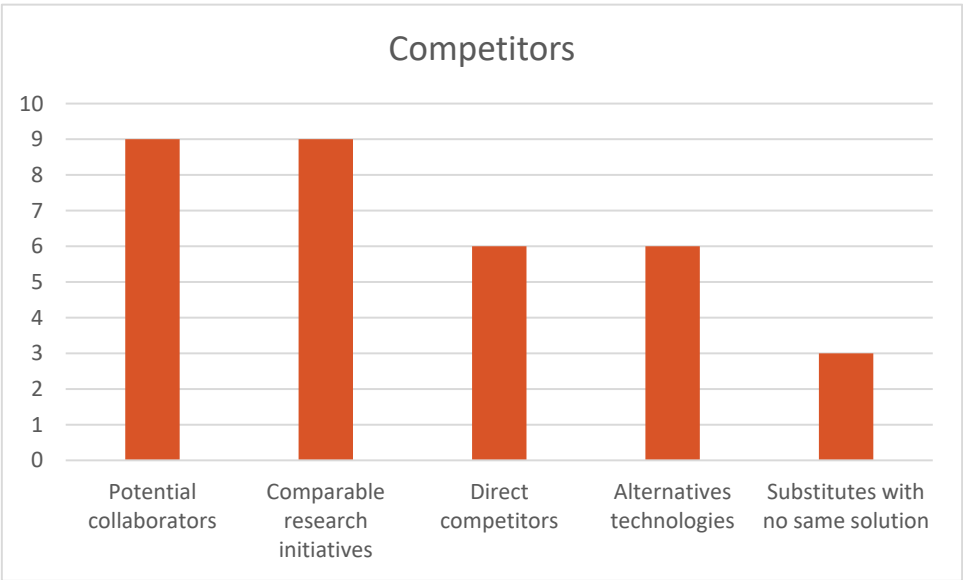
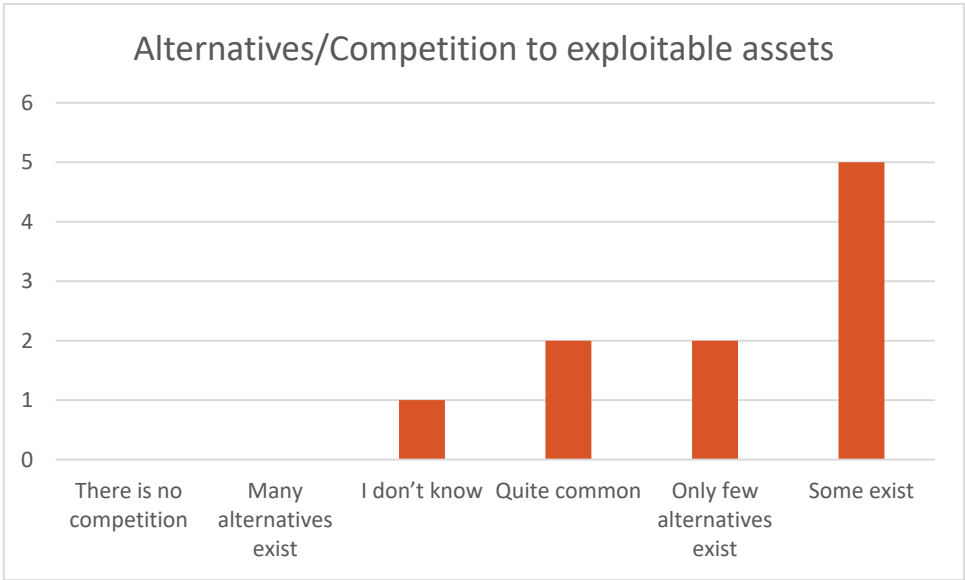


Figure 11 relates to the frequency of finding alternative options in the market compared to the exploitable assets identified. All exploitable assets used in XTRACT project have competitors or alternative options, except for one that is currently unknown. Two exploitable assets have quite common alternatives, while two others have only a few. For five exploitable technologies, there are some alternatives available. However, none of the exploitable assets have a large number of alternatives options.

Figure 11 - The frequency of finding alternative options in the market



4. SWOT ANALYSIS

A SWOT analysis is a strategic tool used to assess the Strengths, Weaknesses, Opportunities, and Threats associated with a project or business initiative. This method involves defining clear objectives and identifying both internal and external factors that could impact their success. By regularly reviewing the operating environment, organisations can stay ahead of evolving trends and incorporate them into their decision-making processes. In today's highly competitive landscape, it is essential for both the project and the long-term strategies of all stakeholders to understand how these factors could influence their efforts. A SWOT analysis enables organisations to evaluate their competitive position and identify elements that could either support or undermine their goals.

We have collected the input of the partners regarding their individual solutions/exploitable assets a summary of which is provided in the SWOT table below. This is merely overview of some project's internal and external factor, that can impact its success. By considering these factors, the project's strengths addressed its weaknesses, takes advantage of opportunities, and mitigates potential threats.

The collected information from each exploitable asset has been compiled into Table 5. It is important to note that some inputs for the exploitable assets are missing due to the early stages of the XTRACT project. The majority of these assets consist of datasets, general intangible assets, and elements of the pilots and/or platforms. For this reason, a more complete version of the SWOT analysis will be provided in the project's second iteration.

Table 5 - SWOT analysis

	Favourable Factors	Adverse Factors
Internal Factors	Strengths The strengths of the UAVs used include flexible payload configurations and ability to process real-time data using advanced sensors, which enhance operational efficiency in resource management. A deep understanding of geology, geochemistry, and mineralogy of ore deposits enables significant waste reduction, contributing to improved resource exploitation. The exploitable technologies also offer high accuracy and easy deployment in diverse environments, making them versatile and accessible. Moreover, their user-friendly design enhances interpretation, improving usability for mining operators. The integration of social and environmental sustainability helps address key challenges in mining, while portable, adaptable, and cost-	Weaknesses High initial development and integration costs are required in the early stages. The performance of exploitable assets such as UAV, is dependent on weather conditions and environmental factors. The use of these exploitable assets increases the energy consumption of pilots. Portable exploitable assets sometimes require sufficient power to operate, which can limit the duration of pilots. Also, the sensors on UAVs need to be lightweight so as not to overburden the drones. In general, they are relatively new technologies on the market with a lack of commercialization expertise, limited sales and marketing channels.

	effective systems save time and simplify operations. Centralised data processing mitigates risks, further strengthening the value of these exploitable assets.	Standards change frequently to reflect ever-evolving mining technologies. Insufficient resources to enable extensive training and implementation. Require continuous updates and maintenance for accuracy. Possible learning curve for new users who are not familiar with the repository. Complexity in implementation.
External Factors	Opportunities Continued growing demand for environmental monitoring and sustainable resource extraction. Potential for scale-up work for wider commercial and industrial applications. Technological developments to enhance capabilities. New potential applications in the rehabilitation of mining sites. Growing demand for sustainable and non-invasive mining solutions driven by global environmental regulations and green initiatives. Increased focus on reprocessing historical stocks and waste for critical raw materials essential for the green and digital transition. Availability of public funding and support for innovative sustainable technologies, particularly in the EU. Use may be extended to other sectors such as energy and manufacturing for similar applications. Could them be a potential commercialisation as a subscription-based knowledge management tool. Supporting the circular economy in mining, enabling the reuse and recycling of extracted materials, reducing waste and supporting sustainable natural resources.	Threats Competitive pressure from larger manufacturers with greater financial and technological resources. Regulatory barriers in various regions that limit licenses and the use of exploitable assets in certain locations. Rapid technological developments may require continuous system upgrades to remain competitive. Stability factors are required for exploitable assets to be consistent. Security conditions must be addressed, especially in residential areas. Other SMEs piloting similar applications, creating potential direct competition in the emerging market. Economic downturns or budget cuts in the mining industry could limit adoption rates. Dependence on partner collaboration for consistent data exchange.

	Additionally, exploitable assets are highly sought after by end users for decision-making and problem-solving. Finally, there are not many competitors in the market due to the complexity and expertise required.	
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5. POLICY PLANS AND REGULATORY FRAMEWORK

For the XTRACT project, it is important to consider the applicable legal and regulatory framework that may influence the developed technological innovations. These laws generally address aspects like technical standards, limitations on the use and application of the technology, and any required registration or licensing procedures. Effectively navigating these regulations is essential to ensure compliance and facilitate the seamless implementation of the innovations within the defined legal parameters.

A summary of the legal frameworks governing the use and deployment of the exploitable assets has been identified. A more detailed analysis is under T9.6, titled “Standardisation and empowering European mining”.

5.1.1. XTRACT Reconfigurable UAV System

The legal frameworks governing the use of drones in the European Union include EU Regulation (EU) 2019/945 and (EU) 2019/947, which set safety and operational standards for Unmanned Aircraft Systems (UAS) to ensure secure and innovative drone operations across the EU. These regulations categorise UAS into three operational levels: Open, Specific, and Certified, with varying levels of authorisation requirements based on risk assessments. The European Aviation Safety Agency (EASA) enforces regulations for drones in the Open Category A1/A3, focusing on low-risk operations and safety. The standards also align with International Organisation for Standardisation (ISO) /TC 20/SC for aircraft and space vehicle safety. Furthermore, drone surveillance activities must comply with the General Data Protection Regulation (GDPR) when personal data is involved, with certain exemptions based on the nature of the activity.

5.1.2. Electrodialysis and Processability Index

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy.

All EU Member States are obliged to bring all waters into a 'good ecological' and 'good chemical status' by 2015 and, in exceptional cases, by 2027. For groundwater, a 'good quantitative' and 'good chemical status' must be achieved.

5.1.3. Muon technology for detecting internal density distributions in mining-related waste rock stockpiles

The implementation and deployment of MUON technology must adhere to various national and EU regulations, as well as international standards, ensuring compliance with safety, environmental, and data protection laws. Key EU directives, such as the Directive on the management of waste from extractive industries (2006/21/EC), the ATEX Directive (2014/34/EU), and the GDPR (2016/679), influence the operation of MUON's technology by requiring proper waste management, equipment safety in explosive environments, and secure data handling. Additionally, specific national laws, such as Germany's Federal Mining Act and Finland's Mining and Occupational Safety Acts, impose additional compliance requirements for operations in these countries. MUON technology also aligns with global standards like ISO 14001 for environmental management. The technology's passive nature, minimal power consumption, and safe design ensure that it meets regulatory standards, supporting the goal of environmentally responsible and safe mining operations. To ensure smooth deployment, MUON will proactively navigate these regulations by establishing protocols for compliance, without significant obstacles to the use of its technology.

5.1.4. In situ Bioleaching, Phytomining – Phytoremediation solution

Directive 2006/21/EC of the European Parliament and the Council, adopted on 15 March 2006, establishes measures for managing waste from extractive industries to minimise its adverse effects on the environment and human health. It outlines procedures to prevent harm to water, air, soil, fauna, flora, and landscapes, ensuring proper waste management practices. This directive requires the implementation of best practices and risk mitigation strategies to address the environmental impact of extractive waste. Technologies like bioleaching, phytomining and phytoremediation must adhere to these guidelines, ensuring that their on-site applications follow the directive's standards to minimise negative environmental outcomes.

5.1.5. LCA & SLCA Guidelines on the Mining Sector

Regulation (EU) No 2020/852 establishes a framework to promote sustainable investment by setting criteria to determine whether an economic activity, such as mining, is environmentally sustainable. The regulation aims to support the EU's sustainability objectives and encourages businesses to adopt sustainable practices by providing clear guidelines for assessing environmental impacts. In line with this regulation, the LCA and SLCA guidelines offer tools for evaluating the environmental and social effects of mining activities, helping companies demonstrate compliance with EU sustainability standards, which can enhance investment opportunities and support from the EU.

5.1.6. Other

It is important to note that some inputs for exploitable assets are missing due to the early stages of the XTRACT project. These assets primarily include datasets, intangible assets, and components of pilots and/or platforms. An updated version of this section will be provided in the project's second iteration. Some of these exploitable assets, such as datasets, do not fall under any specific policy or regulation.

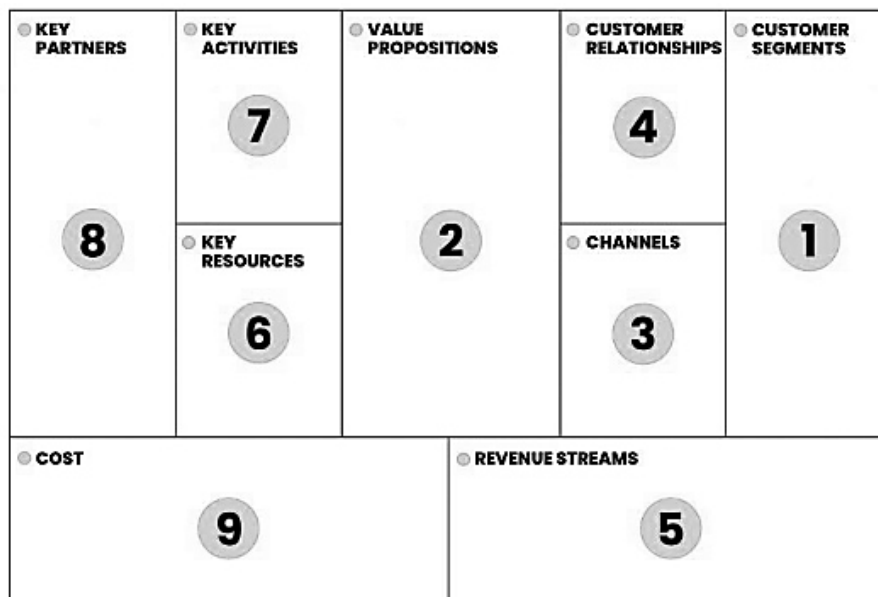
6. BUSINESS MODELS

In Section 6, an overview of the business models will be provided to enhance the market analysis for the deliverable. The first stage will include a brief description of the two business models that will be analysed. The final analysis, focusing on the business perspective of the project, will be presented in the second version of this deliverable, D10.1 which is due for submission on M36.

6.1. BUSINESS MODEL CANVAS

The BMC is a strategic tool designed to indicate the key activities, resources, goals and structure of XTRACT solution. Including nine interconnecting building blocks, the BMC provides a view of critical business components, including customer relationships, infrastructure, offerings, and financial viability. To ensure the smooth implementation and operation of the XTRACT project, subsequent stages will include further process on specific sub-sections of the BMC. Figure 12 will be utilized and presented in a second stage by collecting input from partners.

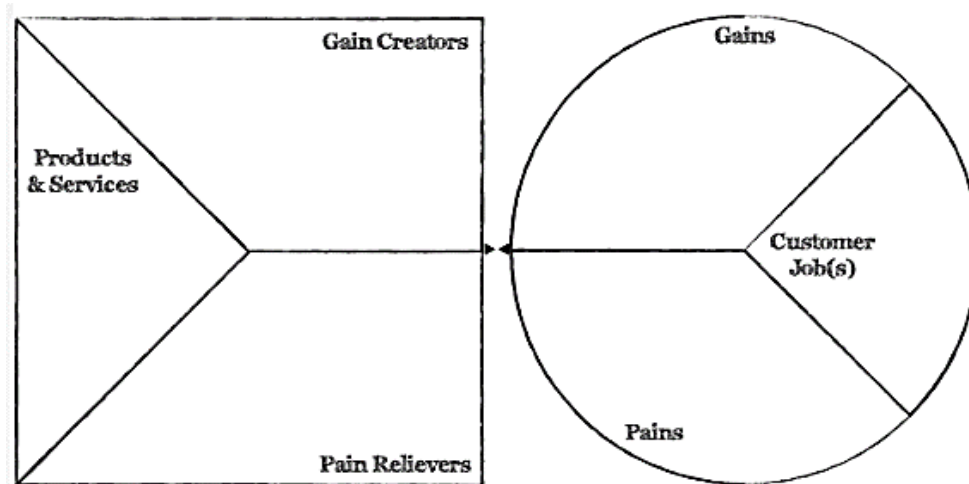
Figure 12 - Business model canvas template



6.2. VALUE PROPOSITION CANVAS

The VPC is also a strategic tool that helps businesses effectively develop and position their products, services, solutions and technologies by aligning them with market needs. It acts as a bridge between the product and the market, enabling organisations to find and meet customer expectations and needs. Derived from BMC, the VPC is divided into two main sections: the Value Proposition and the Customer Profile, each with three subcategories. This template below, provides an analytical view of how a business's offerings address customer problems, fulfil needs, and deliver benefits.

Figure 13 - Value Proposition Canvas



7. SOCIO-ECONOMIC INDICATORS

All Pilot Sites should define the indicators for the socio-economic and environmental sustainability of the XTRACT results, highlighting the importance of balancing social, economic, policy, and environmental objectives and assessing the impact of the XTRACT adoption and scaling-up initiatives.

This exercise will be carried out under WP8 and more specifically T8.4 Environmental and social sustainability of XTRACT technological solutions (M14-M34). The indicators and templates that will be used and completed for this exercise will be presented in the second version of this deliverable and will be analysed for the purposes of T 9.2 Socio-economical sustainability analysis and XTRACT ecosystem business models and uptake roadmap.

8. KNOWLEDGE REPOSITORY

The section 8 provides an overview of the XTRACT Knowledge Repository, a central hub designed to collect, organize, and share key project outcomes, including technologies, use cases, and training materials. The Repository plays a crucial role in supporting knowledge transfer, promoting reuse, and enabling broader adoption of XTRACT results. The following subsections describe its structure, technological development, content creation methodology, and the next steps for its continued enhancement.

Figure 14 - Knowledge Repository Banner



As the Figure 14 shows, the Knowledge Repository is on xtract.iot-catalogue.com, which is a workspace inside the IoT-Catalogue. Both IoT-Catalogue and workspace will be fully present in the next section of this deliverable.

Developed simultaneously in Task T6.5 and T9.3, the XTRACT Knowledge Repository is a key component of the XTRACT Platform, designed to support raw material management across different stages of excavation, extraction, and reaction. It follows the FAIR principles – Findable, Accessible, Interoperable, and Reusable –, ensuring that all knowledge, tools, and solutions generated by the XTRACT project are widely available and usable by different stakeholders.

As a centralized digital hub, the Knowledge Repository stores and provides access to digital solutions, methodologies, and tools developed by the XTRACT consortium, allowing external contributors to add new components and functionalities.

In this regard, the two main target groups of the Knowledge Repository are:

- **Mining Industry Stakeholders:** One of the objectives of the Knowledge Repository is for similar mines with identical problems to use XTRACT solutions. This means that Mining Industry Stakeholders can use the Knowledge Repository to search for their mining problem and find the tools and processes that were used to solve similar problems in the XTRACT context.
- **Technology Developers and Start-ups:** Another objective of the Knowledge Repository is to promote the development of XTRACT similar technologies for the same mining problems. In this case, Technology Developers and Start-ups will use the Knowledge Repository to have a better notion of the actual mining problems and the development solutions trend to help them develop their own tools and processes.

Beyond that, the Knowledge Repository shows the organizations that developed the solutions, their experience and offers the possibility to contact these same organizations.

The potential users of the Knowledge Repository can be environmental and remediation organizations, government and regulatory bodies, research and academia, training and education providers, broader public and communities

Being more than just a storage platform, the Knowledge Repository can enhance the XTRACT business model by offering access to premium tools and solutions, encouraging third-party contributions,

increasing innovation and platform relevance, and continuously adapting to industry changes to ensure the long-term sustainability of the XTRACT project.

The main focus of T9.3 is that the Knowledge Repository ensures long-term sustainability by enabling continuous updates and the inclusion of new technologies for raw material management. These updates will be made through IoT-Catalogue.com, with the XTRACT website being the gateway, which guarantees its existence beyond the end of the project.

In this sense, the Knowledge Repository gathers four key features:

- **Open and Modular Structure:** Designed to be expandable with new functionalities over time.
- **Interoperability:** Ensures seamless integration with various systems and external tools.
- **Accessibility:** Provides a user-friendly interface for different stakeholders, including researchers, industry professionals, and policymakers.
- **Scalability:** Allows for continuous growth by enabling new solutions to be added as the sector evolves.

8.1. XTRACT@IOT-CATALOGUE

[IoT-Catalogue.com](https://www.iot-catalogue.com) is a web-based catalogue for Internet-of-Things (IoT) solutions. With its established way of structuring content, already used in 18+ EU projects, it brings IoT users and technology providers together, from the domain needs to IoT solutions (and back) via validated solutions with components, assembly guides, and more. Figure 15 and Figure 16 present the main pillars (Technology, and Validation) of the IoT-Catalogue.

Figure 15 - IoT-Catalogue Technologies

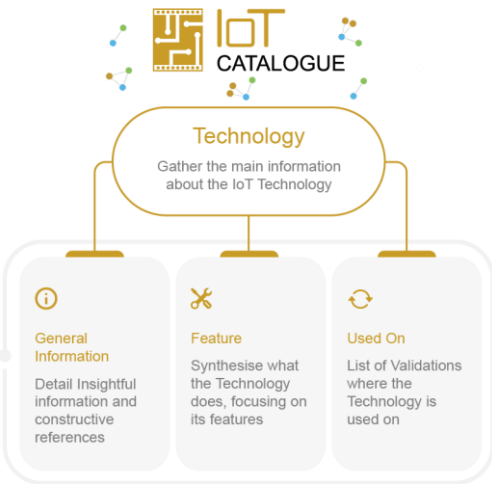
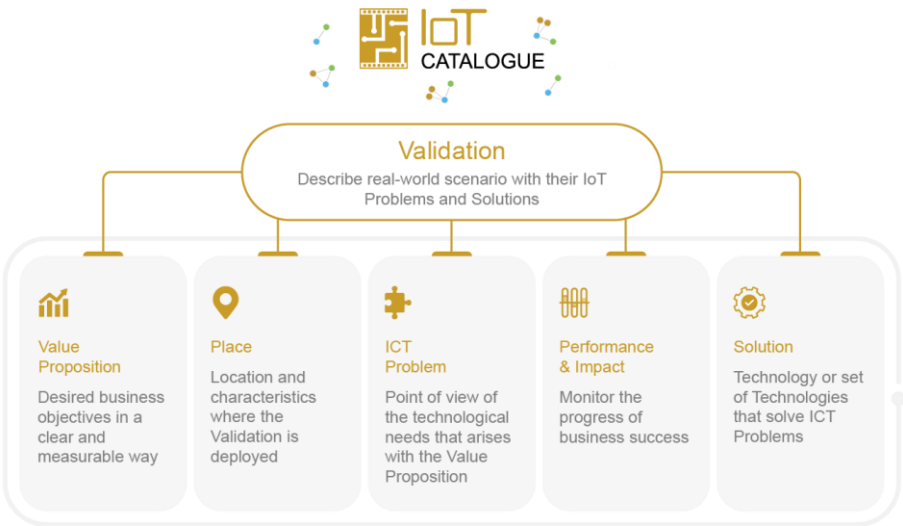


Figure 16 - IoT-Catalogue Validations



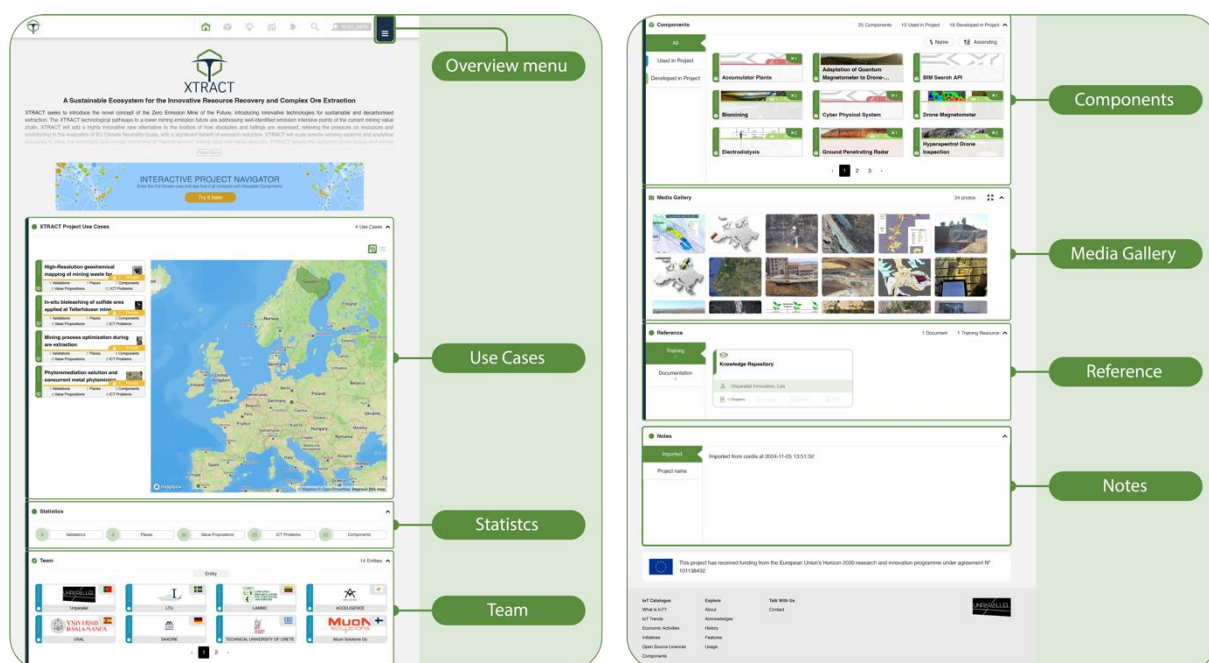
Being developed and maintained by UNPARALLEL Innovation, IoT-Catalogue.com provides a solid, flexible solution as the support the proposed Knowledge Repository, that can integrate new features in line with the project's requirements.

A Workspace is a page in IoT-Catalogue.com that exists only for a specific project. In the case of the XTRACT project, this Workspace is xtract.iot-catalogue.com.

The information from projects will be imported from Cordis¹ to the IoT-Catalogue.com, with the description (motivation and objectives), and the participating entities.

The Figure 17 shows the XTRACT Workspace. The project title, logo and description are displayed at the top of the page. The project content will be distributed across the rest of the page, including its use cases (with the location on the map), statistics, team (project consortium), components (the technological assets developed and/or used in the solutions), media gallery, references (with the training and documentation available) and notes.

Figure 17 - XTRACT Workspace



¹ <https://cordis.europa.eu>

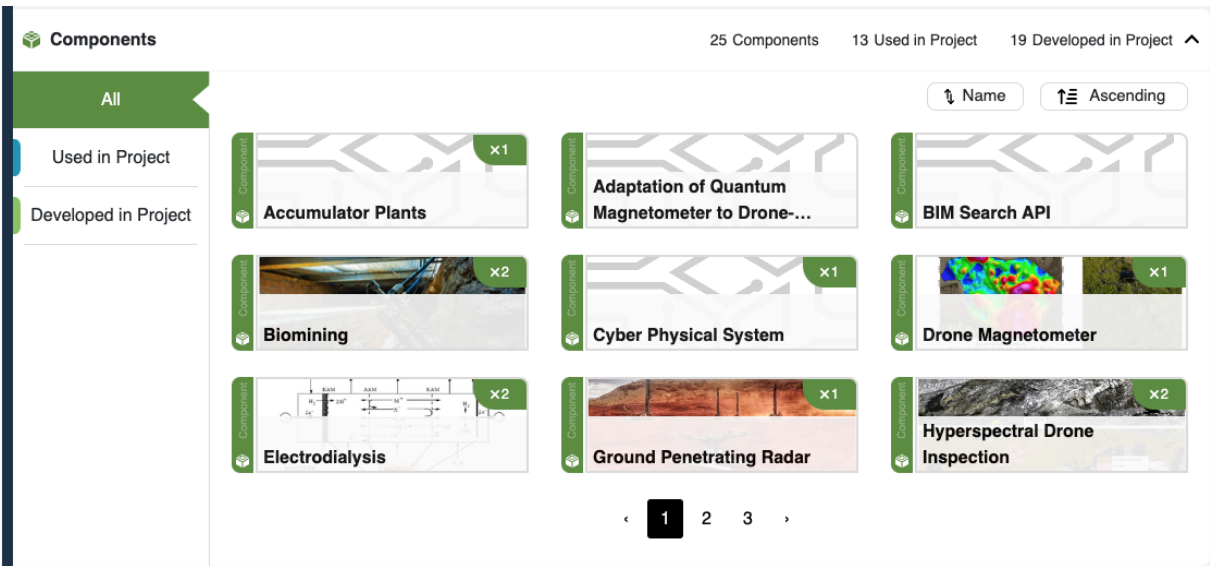
8.2. KNOWLEDGE REPOSITORY STRUCTURE

In terms of content, the Knowledge Repository will be composed of: Technologies, Use Cases and Training Material. This section is dedicated to explaining the segments that make up each of these contents of the Knowledge Repository Page.

8.2.1. Technologies

The component section presents an overview of all the technologies utilized in XTRACT, both developed and used in the project. Furthermore, users can filter them by those used in the project and those developed within it. For each technology, users can view how many times it has been applied to the project through the tag presented in the top right corner (Figure 18).

Figure 18 - XTRACT Components Section



Component Description

The Component Description section shows the tags that categorise and specifies the component. These tags are linked to other components that use the same tags.

Below, the description addresses how this technology works and how it contributes to achieving the objectives and overcoming the challenges (Figure 19).

This approach allows the collection of detailed information about the technologies developed and used in the project—including their purpose, functionality, usage methods, and application contexts—and makes this information accessible to external users.

Figure 19 - Component Description Section





xtract







Component
Biomining

● **Characterization**

Developer

TU BAF

Developed in Project

XTRACT

Keywords

Microorganisms

Catalyse

Bioleaching

Define

Metal Concentrates

Mining

Recover Metal Process

Recover

Metals

● **Description**

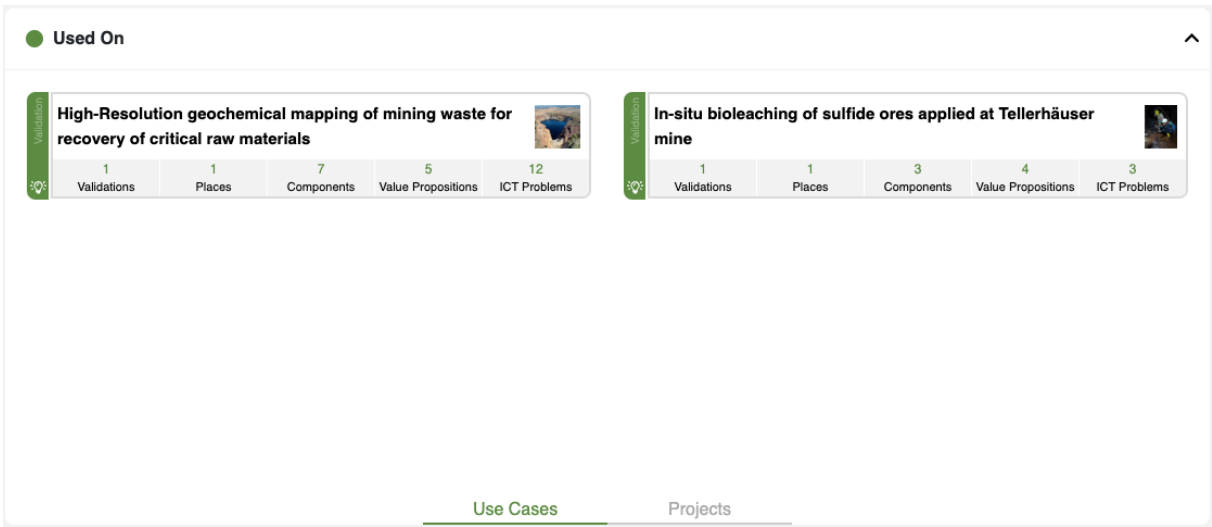
Biomining has the potential to recover critical metals from primary and secondary ores, as well as waste materials, where conventional technologies are neither economically nor environmentally viable. Through bioleaching, microorganisms facilitate the extraction of valuable metals while also removing toxic elements from various mining residues that cannot be effectively treated using traditional methods. This technology offers a significantly improved eco-balance compared to conventional pyro- and hydrometallurgical processes, ensuring safer working conditions, operation at ambient pressure and temperature, reduced chemical and energy consumption, lower CO2 emissions, and lower initial investment costs.

Component Used On

The Used On section provides information about the contexts in which technology is also used (Figure 20):

- Use Cases: This separator displays if the technology has been deployed in other Use Cases.
- Projects: This separator displays if the technology has been implemented in other projects within the IoT Catalogue.

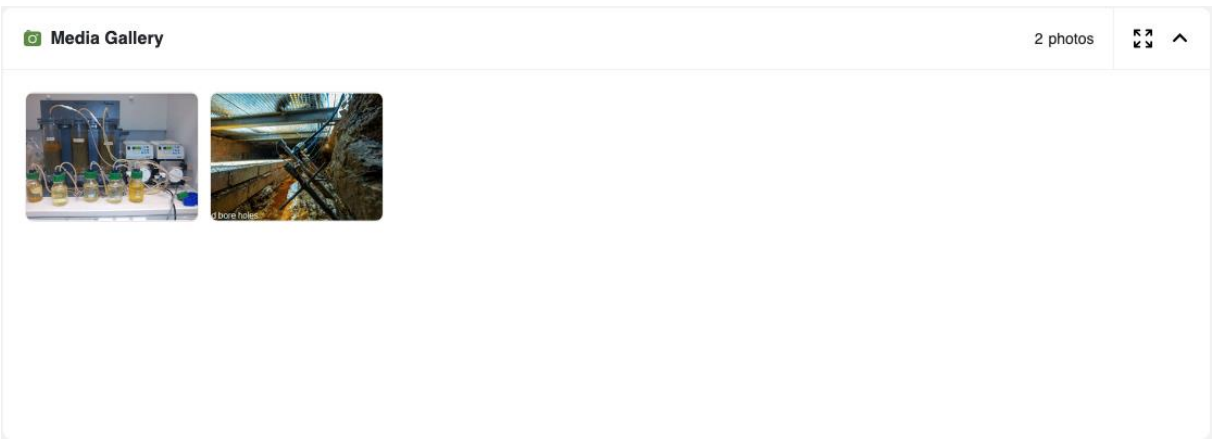
Figure 20 - Component Used On Section



Component Media Gallery

The Component Media Gallery section contains images of the component, such as photos, images and videos, in case the component includes this type of content (Figure 21).

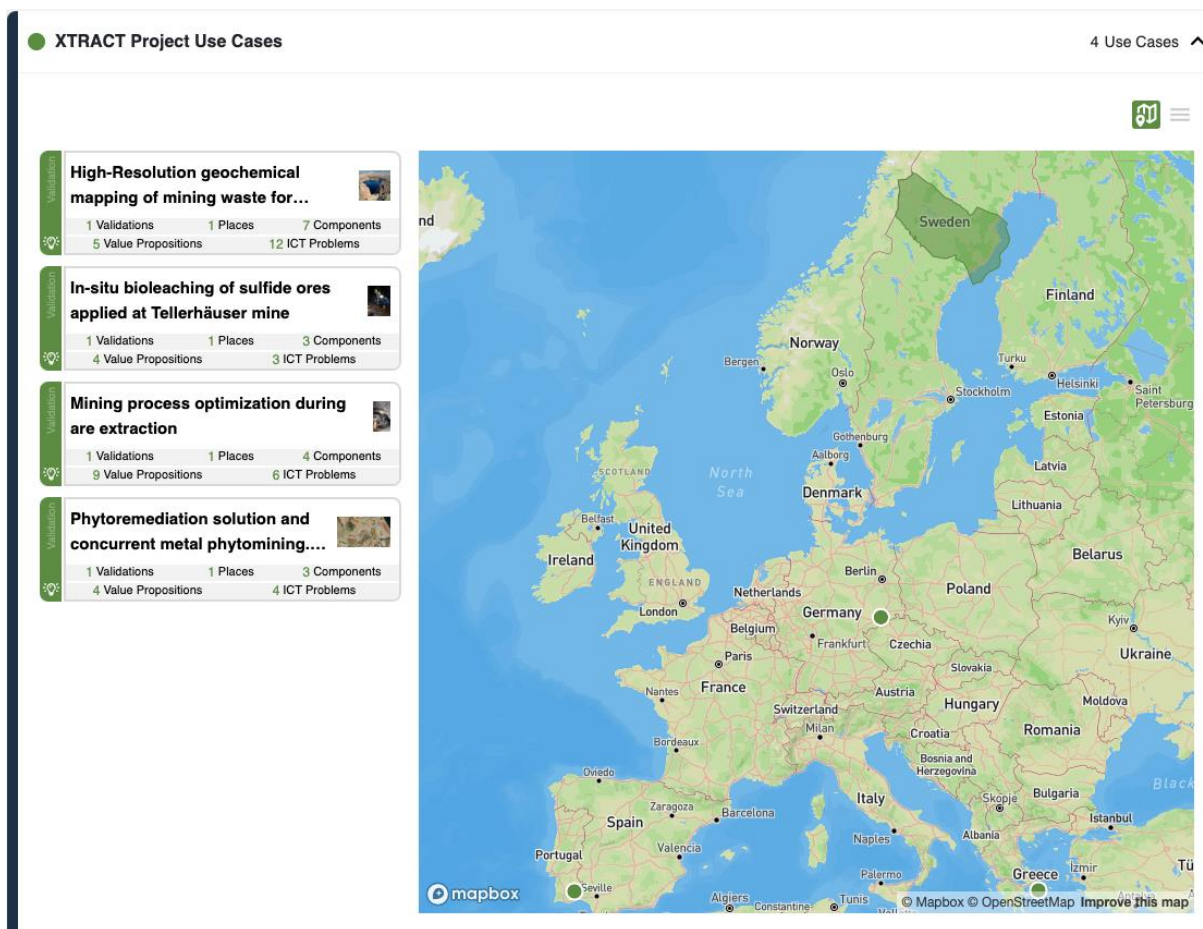
Figure 21 - Component Media Gallery Section



8.2.2. Use Cases

A Use Case consists of specific situations where an environmental or technological problem was identified, and the technologies and strategies of XTRACT were applied to overcome the challenges and achieve the project’s objectives. Each Use Case is shown by topic, featuring its title and a map highlighting the locations where the technologies were deployed (Figure 22).

Figure 22 - XTRACT Project Use Case Section



The Use Case page provides an in-depth look at a specific Use Case, approaching the main aspects and demonstrating how these technologies were used to overcome this environmental challenge. Each Use Case describes situations where the project has had a positive impact, showcasing the concrete benefits achieved in terms of sustainability, productivity and saving resources. This section focuses on how the project's innovative solutions contribute to solving the identified problems.

Use Case Description

The Use Case Description is an overview of the strategies used to achieve the main proposal, and the benefits being realized through the implementation of the technologies.

As an example, Figure 23 shows the description of the Use Case "High-Resolution geochemical mapping of mining waste for recovery of critical raw materials", the respective image, and also the main characterisations via tags.

Figure 23 - Use Case Description Section

Use Case: High-Resolution geochemical mapping of mining waste for recovery of critical raw materials

The Iberian Pyrite Belt (IPB) extends from southern Portuguese Alentejo province along Spanish Andalucía close to Seville. It constitutes one of the most important metallogenic provinces for Volcanogenic Massive Sulphide deposits worldwide, including worldclass deposits as well as medium size deposits like the S. Domingos Mine.

An irregular tract of superficial iron-staining and gossan extends southeast from the orebody, partly lying along the slopes of a shallow to moderately incised valley. This drains southeast wards from a point about 500m away from the mine. The volcanic rock sequence in the mine is not well exposed and the structure is tectonically complex. The upper volcanic levels are covered by a thick turbiditic sequence (Flysch Group) and the allochthonous Phyllite Quartzite (PQ) group caps the volcanic pile. The outcropping area was formed by a unique vertical mass of cupriferous pyrite associated with zinc and lead sulphides, elongated in an E-W direction. This orebody was exploited to a depth of 120m below the topographic surface as an open pit mine and from this depth down to 420m. Mining accesses consisted of wells and galleries.

S. Domingos Mine has a long-time span history of mining exploitation. The first products were extracted by incineration processes, separated and the richest nodules were submitted to a fusion process. The leaching of the poor products was carried out in cementation tanks but this process was abandoned in 1868 due to technical difficulties and high costs. When copper prices dropped, the material was leached in a raw state making the recovery more efficient.



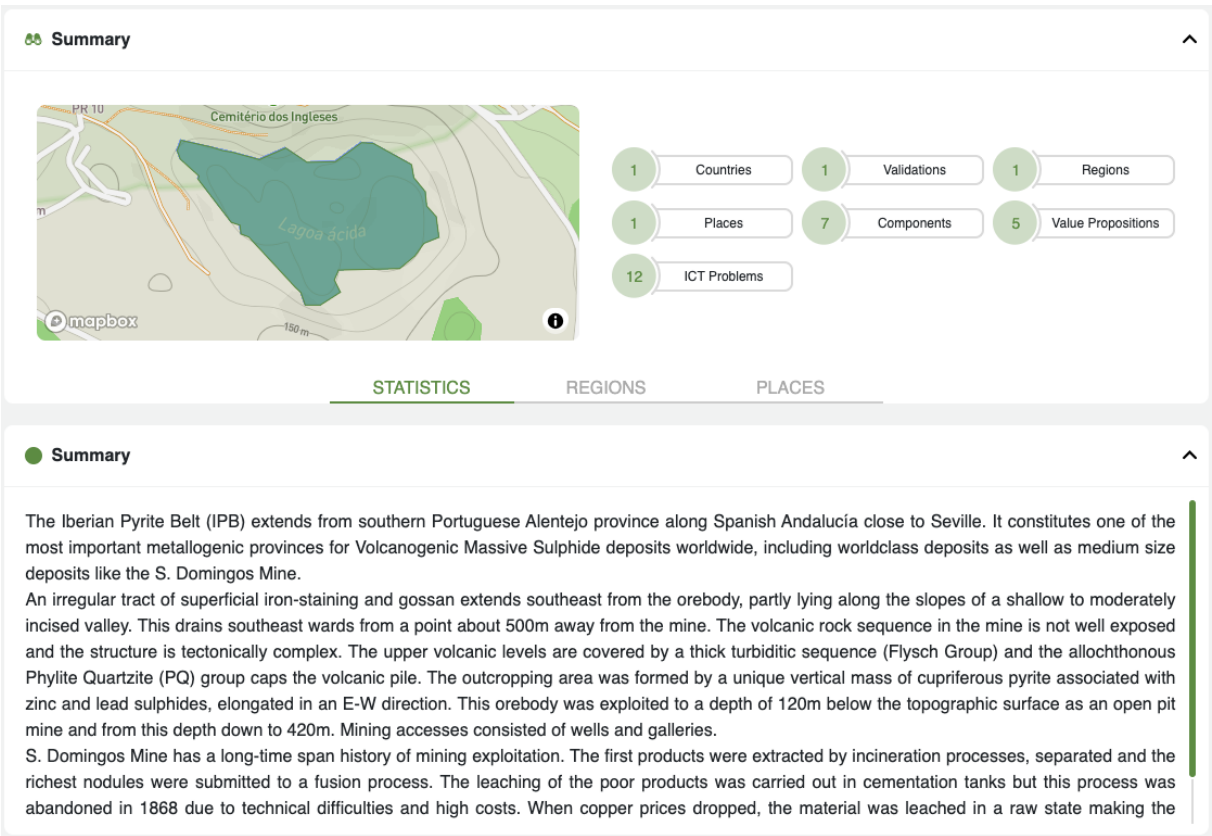
[Read Less](#)

EC Project XTRACT

Use Case Summary

The Summary shows a map with the regions where the Use Case occurred and provides information on the number of Countries, Validations, Regions, Places, Components, Value Propositions and ICT Problems that compose the Use Case. It also includes a summary of the Use Case (Figure 24).

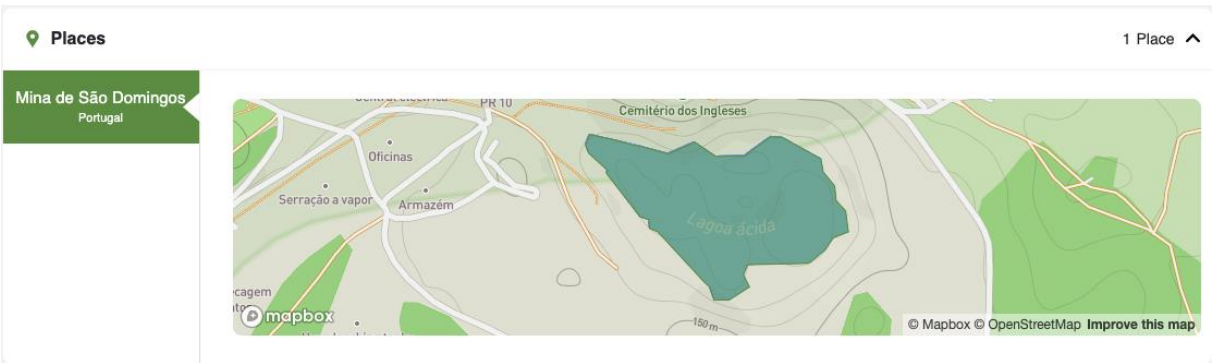
Figure 24 - Use Case Summary Section



Use Case Place

The Use Case Place provides information about the places where the Use Case take place, presenting them separately in the case there exists more than one place per Use Case (Figure 25).

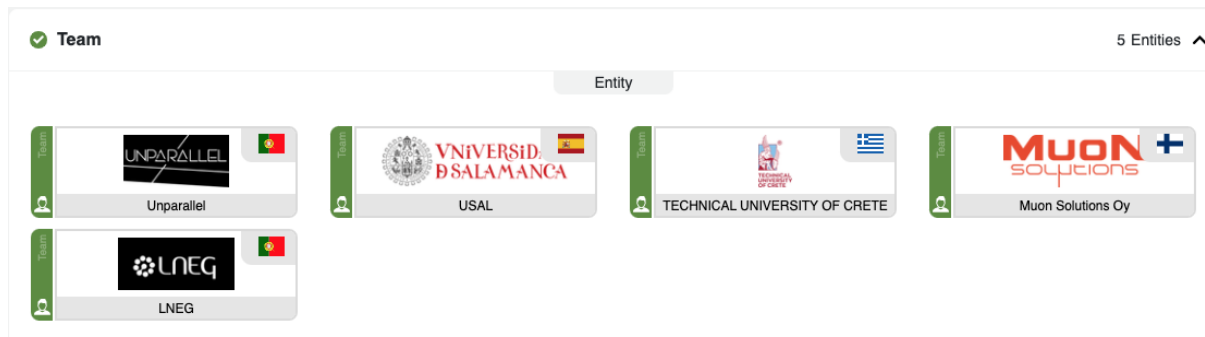
Figure 25 - Use Case Place Section



Use Case Team

The Use Case Team section presents all partners involved in the Use Case (Figure 26).

Figure 26 - Use Case Team Section



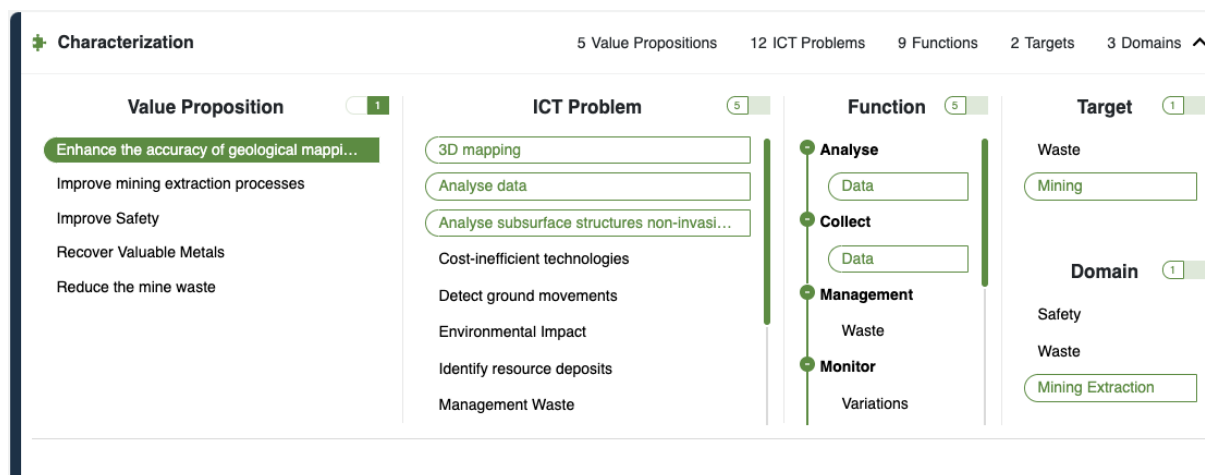
Use Case Characterisation

The Characterisation section presents a dashboard that links the Value Proposition, ICT Problem, Function, Target, and Domain. The purpose of this dashboard is to provide an intuitive visualisation of how these topics are interconnected.

- Value Proposition: The core proposal, the desired objective
 - o Domain: The activity area of the Value Proposition
- ICT Problem: The technological needs to achieve the Value Propositions
 - o Function: Functionality of the ICT Problem
 - o Target: Purpose of the functionality

As Figure 27 shows, specific connections can be visualised by pressing any topic, and each Value Proposition can have one or more ICT problems.

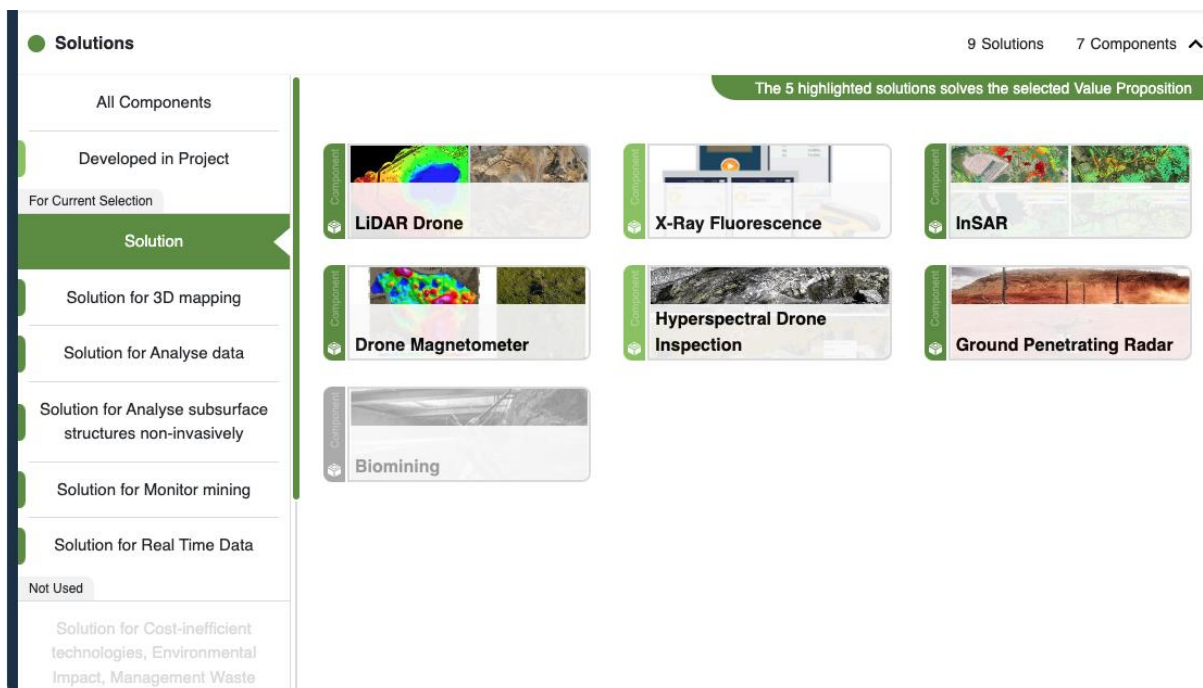
Figure 27 - Use Case Characterisation Section



Use Case Solutions

The Use Case Solutions section presents all the technologies used in the specific Use Case (Figure 28 - Use Case Solutions Section). Users can filter the solutions by those developed specifically for the project or those common across multiple Use Cases. Additionally, technologies can be filtered by their functions, providing an in-depth understanding of their roles.

Figure 28 - Use Case Solutions Section



Use Case Media Gallery

The Use Case Media Gallery section provides photos and videos (Figure 29), in case the Use Case includes this type of content.

Figure 29 - Use Case Media Gallery Section



8.2.3. Training Material

Training Materials are resources designed to help users understand and use the tools and technologies developed within the XTRACT project. These materials are tailored to different types of users and aim to make it easier to adopt and apply XTRACT solutions in real work environments. They may include Custom-Developed Training Materials, Third-Party, Educational Resources, Technical Documentation, Assessment Tools and Community Forums and Support.

As the Table 6 - Training Material (Intentions) shows, these materials would be developed by the developer tools partners of the XTRACT project; and their target group will be the users who will use XTRACT's tools.

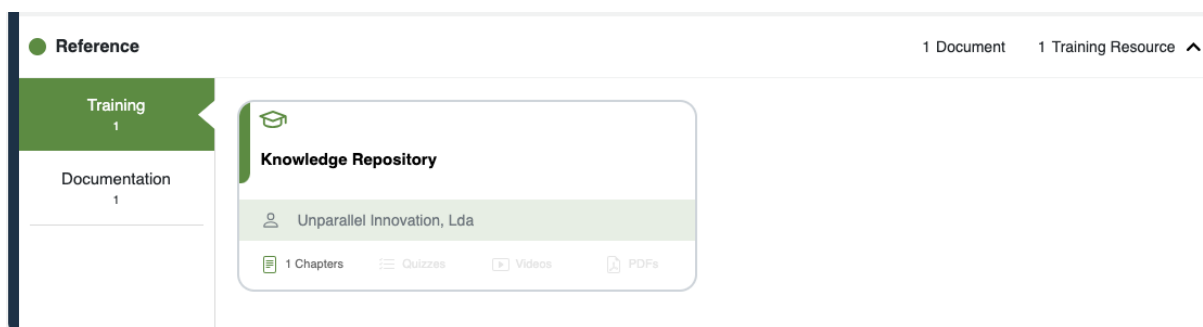
Table 6 - Training Material (Intentions)

Tool	Partner	Name	Type
XTRACT Reconfigurable UAV System	ACCELI	XTRACT Reconfigurable UAV System	User Manual or Training
Adaptation of Quantum Magnetometer to Drone-Mounted Sensors Approach	ACCELI USAL	Quantum Magnetometer on UAV	Training
Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals	TUBAF, BRGM	Recommendations application in biomining	for Paper, Process flow sheet
Electrodialysis	GEOS	Recommendations application in biomining	for Paper
Phytoremediation/Phytomining Solution Using Trees	LAMMC	Recommendations	Paper
Measuring-While-Drilling	LTU	To be Determined	Paper
Optimised Drill Performance	LTU	To be Determined	Paper
Muon Imaging Software	MUON	Geochemical and mineralogical assessment of reactivity in a full-scale heterogeneous waste-rock pile	Paper
Bioleaching of mine wastes	TUBAF	Recommendations application in biomining	for Paper, Process flow sheet

LCA & SLCA Guidelines on the Mining Sector	TUC	LCA & SLCA Guidelines on the Mining Sector	Guidelines
Knowledge Repository	UNP	Platform User Guidance	Training
Knowledge Repository	UNP	User Manual	User Manual
BIM Search API	UNP	API Description	Swagger
BIM Search API	UNP	BIM and IoT Together	White Paper
BIM Search API	UNP	BIM Search API	Software
X-Ray Fluorescence	UNP	Fluorescence Assembly Guide	User Manual
X-Ray Fluorescence	UNP	Fluorescence Drone Integration	Software
Adaptation of Quantum Magnetometer to Drone-Mounted Sensors Approach	USAL	To be Determined	Paper
Ground Penetrating Radar	USAL	To be Determined	Paper
InSAR	USAL	To be Determined	Paper
SLAM-LiDAR	USAL	To be Determined	Paper
XTRACT Geospatial Platform	USAL	XTRACT tool	Visual Presentation

As Figure 30 shows, the Training Material of XTRACT project appears in the Reference section. This section could include the Training Material, and the documentation related to the components of the project such as papers, user manuals, etc.

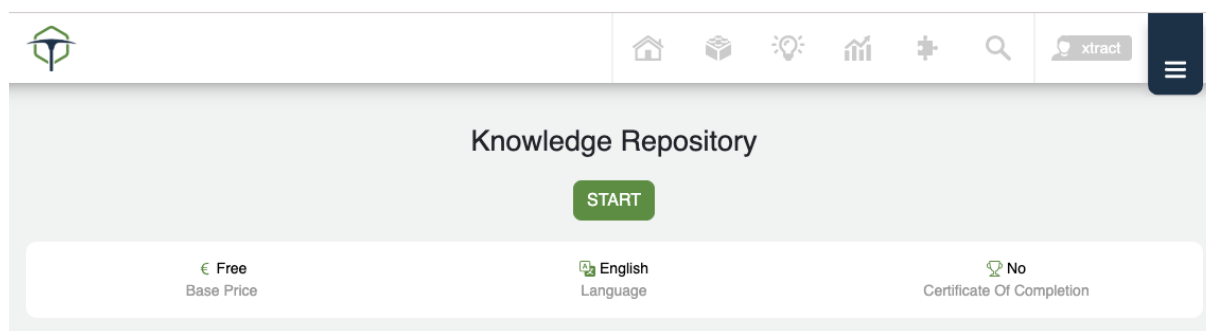
Figure 30 - XTRACT Training Material Section



Training Material Details

The Training Material Start section is where the user can start playing the training material selected. In this section there is also information about the cost, the available language and if the training material gives a certificate of completion or not (Figure 31).

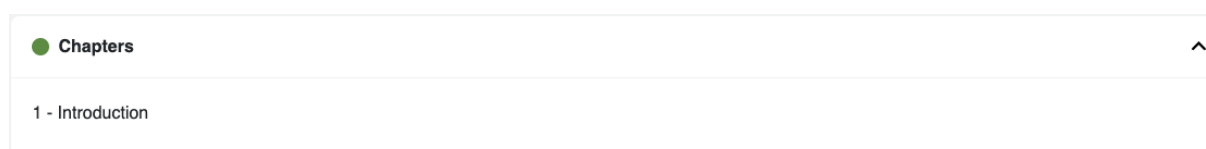
Figure 31 – Training Material Start Section



Training Material Chapters

The Training Material Chapters section includes the chapters of the training material selected (Figure 32).

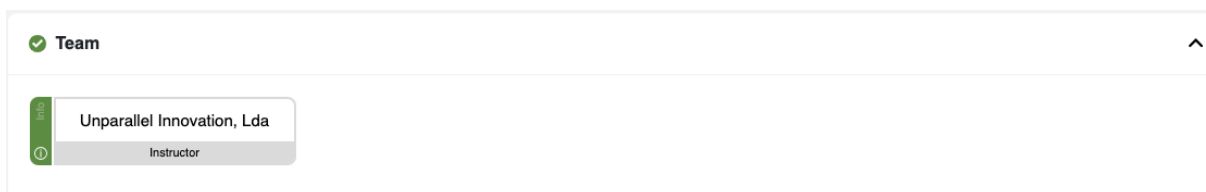
Figure 32 - Training Material Chapters Section



Training Material Team

The Training Material Team section presents all entities involved in the training material selected (Figure 33).

Figure 33 - Training Material Team Section

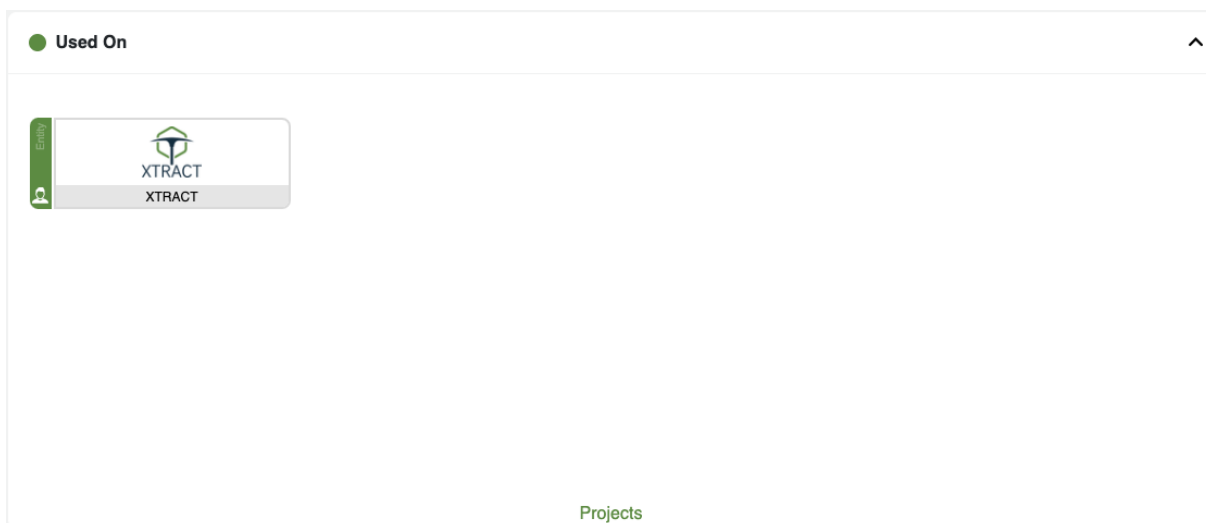


Training Material Used On

The Used On section provides information about the contexts in which project the training material is also used (Figure 34):

- Projects: This separator displays if the training material has been implemented in other projects within the IoT Catalogue.

Figure 34 - Training Material Used On Section



Training Player

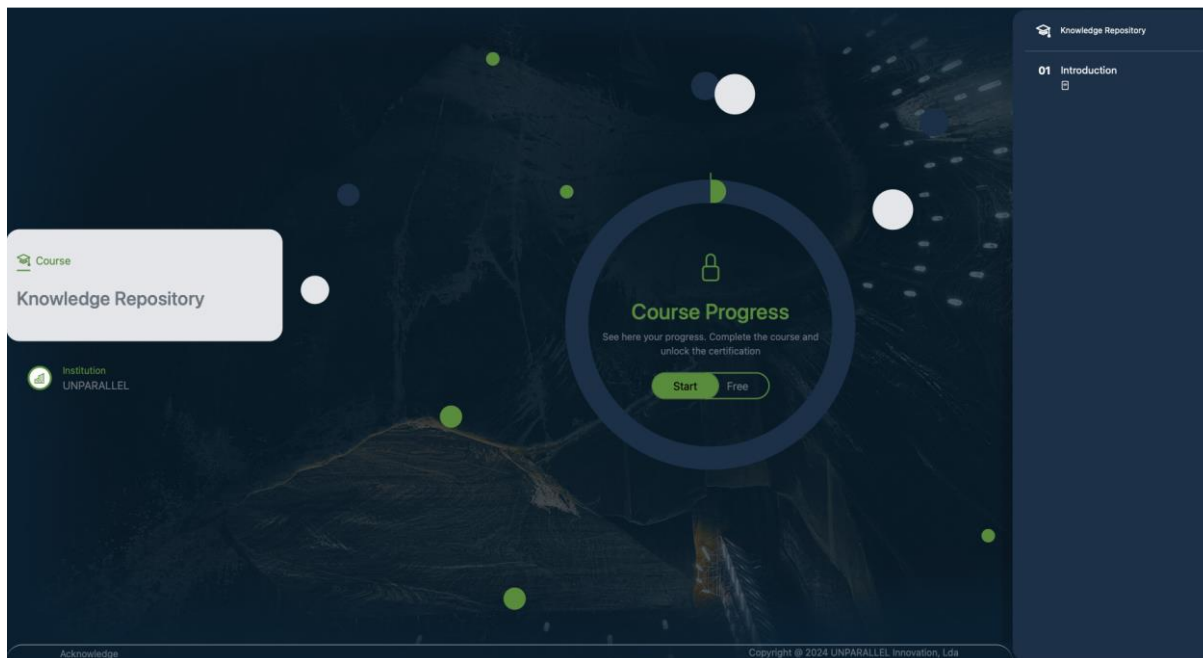
The XTRACT Training Player is currently under development as the digital hub for all educational activities within the project. It is designed to provide a cohesive and enriching learning experience through its well-structured main and chapter pages. The architecture and functionalities are evolving to accommodate user needs and technological advancements, ensuring a dynamic and adaptive learning environment.

XTRACT Training Material Section

The XTRACT Training Material Section serves as the gateway to the XTRACT Training Player (Figure 35), offering users an overview of available resources and easy access to various sections. As development

progresses, the design will be refined based on user feedback and best practices in digital learning environments.

Figure 35 - Home Course View



Homepage Elements

The homepage will feature a dynamic and user-centric layout that enhances accessibility and engagement. The current design phase includes:

- **Dashboard:** A personalized area where users will be able to view their enrolled courses, track progress, and access completed certifications.
- **Achievements:** Visual representations of milestones reached, such as course completions or assessment scores, motivating continued learning.
- **Recommendations:** AI-driven suggestions for additional courses or resources based on the user's interests and past activities, promoting continuous development.

Progress Section

A dedicated progress section will allow users to monitor their learning trajectory in real time. Features will include:

- **Dashboard:** a personalized space where users will be able to view their enrolled courses, track progress, and review completed activities. The dashboard will provide an intuitive overview of ongoing learning paths, ensuring users can seamlessly resume their studies from where they left off.
- **Achievements:** a dynamic representation of learning milestones, such as completed courses or high assessment scores, designed to encourage progress. Users will receive visual indicators of their accomplishments, reinforcing motivation and engagement throughout their learning journey.
- **Recommendations:** AI-driven course and resource suggestions tailored to each user's learning history, preferences, and progress. The system will analyse past interactions to propose

relevant materials that support continuous improvement and deeper exploration of related topics.

Navigation Menu

The navigation menu is being structured to ensure intuitive and efficient access to key resources. The menu will include:

- Course Catalogue: a comprehensive list of all available courses, organized by category or skill level, allowing users to find content that matches their learning objectives.
- Resource Library: access to supplementary materials, including articles, videos, and technical documents, supporting diverse learning preferences.
- Community Forums: links to discussion boards and groups where users will be able to interact, share knowledge, and seek assistance.
- Support: contact information and FAQs to help users resolve issues or answer common questions, ensuring a smooth learning experience.

Legal Disclaimer

As part of the Training Player's regulatory compliance and transparency efforts, a legal disclaimer section is being developed. It will include:

- Terms of Use: Detailed information outlining the rights and responsibilities of users, ensuring clarity on acceptable use of the platform.
- Privacy Policy: Explanation of data collection practices, storage, and protection measures, assuring users of their privacy and security.
- Accessibility Statement: Commitment to providing an inclusive learning environment, detailing efforts to accommodate users with diverse needs.

Chapter Page

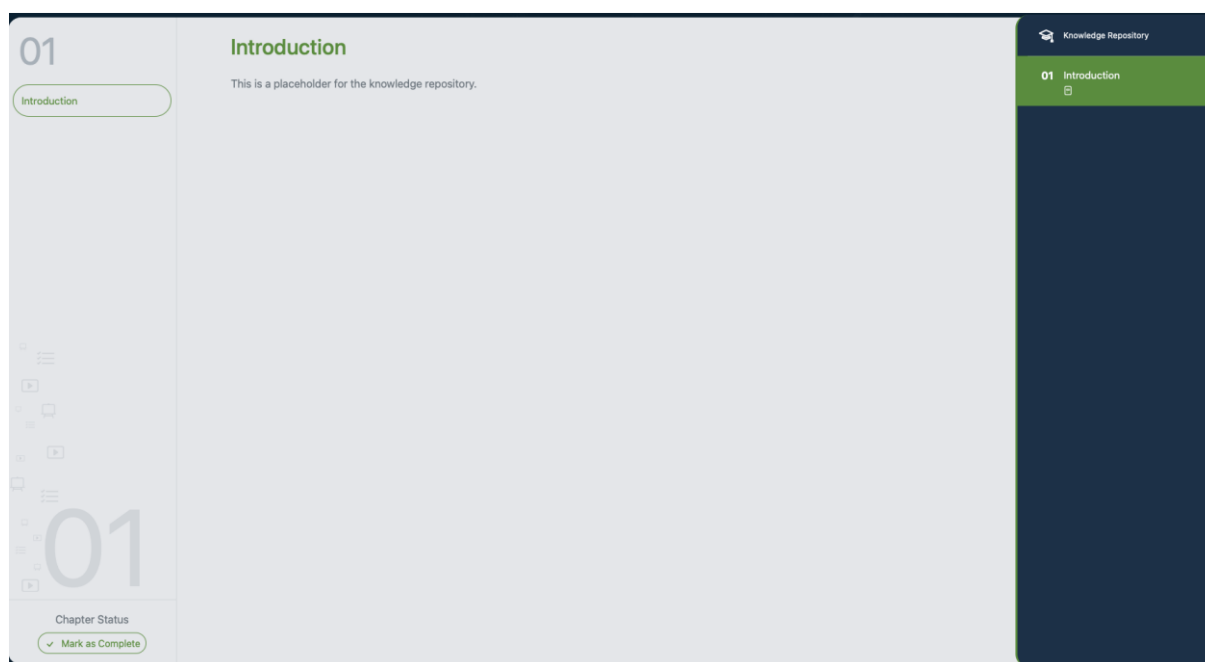
Each course within the XTRACT Training Player is being structured into chapters, facilitating a modular and progressive learning experience. These chapters will allow learners to engage with content in a logical sequence, ensuring comprehension before advancing to more complex topics.

Future iterations of the chapter page will integrate interactive learning elements, such as quizzes, discussion prompts, and AI-powered tutoring assistance, to enhance knowledge retention and application.

The XTRACT Training Player will evolve, incorporating state-of-the-art AI-driven learning enhancements, accessibility improvements, and continuous feedback loops to ensure it meets the educational needs of its users.

The chapter page (Figure 36) is divided in 3 different sections: Left Menu, Content and Menu.

Figure 36 - Chapter Page



The Left Menu, as the name suggests, is located on the left side of the page. This section has the information about the content of a chapter, which can be represented as its subchapters. Besides the name of each subchapter and based on the type of the content, some extra information can be displayed like a media timeline for video or pdf content types. Also, in the bottom of this section, there is a button which allows the user to update the completion progress of the chapter.

The Content section, has the content of a specific subchapter of the Left Menu of the chapter and based on its type of content, can be represented by four different types of visualization: Text, Video, Pdf or Quiz. When the content is “video” or “pdf”, a media player is displayed with some media controls to interact with the media. When the content is “quiz”, is displayed a quiz with some questions with multiple answers where the user can do a self-assessment evaluation about the content presented on the chapter. And finally, when the content is “text”, is displayed the content in a markdown style.

The Menu section has the information about the course and the list of its chapters. This menu allows to open or close a chapter and sneak into its content by only mouseover above the desired chapter. Also, when mouseover above course title, is possible to see some extra information about the instructors, institutions and stats about the course.

Content Navigation

The XTRACT Training Player will incorporate an intuitive and structured content navigation system that will enhance the learning experience by ensuring users can access, track, and interact with educational materials. The navigation system will be designed to cater to various learning styles and levels of expertise, providing an adaptive and user-friendly interface.

Upon logging into the platform, learners will be guided through a personalized dashboard that will display their enrolled courses, ongoing progress, and recommended learning paths. The main navigation bar will allow users to effortlessly switch between different sections, including the course catalogue, community discussion forums, technical documentation, and practical resources.

Each course page will follow a standardized structure, ensuring consistency and ease of access across different learning modules. The content will be divided into chapters and sections, enabling learners to navigate sequentially or jump to specific topics as needed. A progress tracker will be embedded into

each course, allowing users to monitor their advancement in real time and revisit previous topics when necessary.

To facilitate cross-referencing and deeper exploration, the Training Player will provide search and filter functionalities that will allow learners to quickly locate relevant content based on keywords, categories, and topics of interest. Additionally, an interactive table of contents will be present on each course page, enabling learners to see an overview of the curriculum and easily navigate between sections.

The navigation system will also be optimized for accessibility, ensuring compliance with Web Content Accessibility Guidelines (WCAG) to support learners with disabilities. Features such as text-to-speech capabilities, adjustable text sizes, and keyboard shortcuts will make the platform inclusive and adaptable to diverse user needs.

For learners who wish to engage in collaborative learning, the content navigation system will include discussion threads and embedded Q&A sections within each chapter, allowing them to interact with instructors and fellow learners in real time. This will foster a sense of community and engagement, ensuring a richer and more interactive learning experience.

Training Materials

The training materials provided within the XTRACT Training Player will be carefully curated and developed to ensure a comprehensive understanding of XTRACT collaboration. The materials will span a variety of formats, difficulty levels, and delivery methods, making them suitable for both technical and non-technical audiences.

The core training resources will include a mix of text-based materials, interactive exercises, practical demonstrations, and multimedia content, ensuring that learners with different preferences can engage with the material in a way that best suits their learning style.

1. **Video Lectures and Webinars:** Each course includes pre-recorded video lectures, featuring expert instructors, specialists, and mining practitioners who will provide in-depth explanations of key concepts. Additionally, live webinars will be scheduled periodically, allowing learners to interact with experts in real-time, participate in Q&A sessions, and engage on emerging relevant discussions about Zero Emission Mine of the Future.
2. **Case Studies and Real-World Applications:** To bridge the gap between theory and practice, the Training Player will provide detailed case studies that illustrate real-world applications of Zero Emission Mine of the Future. These case studies will be derived from XTRACT project implementations as well as external mining case studies, ensuring a diverse range of examples.
3. **Interactive Simulations and Hands-On Labs:** Practical learning will be a key focus of the XTRACT Training Player. Many courses will feature hands-on lab sessions and mining simulations, where learners can experiment innovative technologies for sustainable and decarbonised extraction, engaging in problem-solving exercises. These practical exercises will reinforce theoretical knowledge and provide learners with first-hand experience in working with the novel concept of the Zero Emission Mine of the Future.
4. **Technical Documentation and White Papers:** Advanced learners and technical experts will have access to a repository of documentation, white papers, and research publications that will detail the algorithms, frameworks, and methodologies used within the XTRACT project.
5. **Quizzes, Assessments, and Certification:** Each course will include quizzes and self-assessment exercises to evaluate learners' understanding. Upon completion of a course, participants will be required to pass an assessment to receive a certificate of completion, validating their newly acquired skills and knowledge.

6. Community-Driven Learning and Discussion Forums: Learners will also be able to engage in peer discussions, collaborative problem-solving, and expert-led forums, creating a dynamic learning environment that extends beyond traditional coursework. The Training Player will encourage knowledge-sharing among learners from different expertise levels.

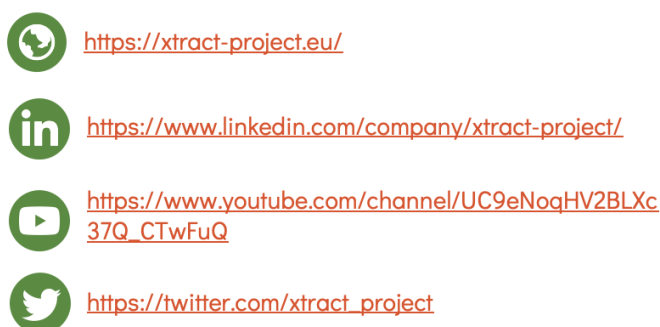
The training materials will be continuously updated to reflect new developments, mining best practices, and user feedback, ensuring that the content remains relevant and aligned with purpose of the XTRACT project.

8.3. INTEGRATION WITH XTRACT WEBSITE

In order to increase the number of visitors to the Knowledge Repository, it will be integrated into the XTRACT website. Here, on the XTRACT website, visitors will be able to see a summary of the Knowledge Repository and be directed to the respective page.

The XTRACT project already has a communication and dissemination plan, which is fully explored in deliverable D9.2 XTRACT Communication and Dissemination Strategy and Plan. According to that, beyond the XTRACT Website, the XTRACT project uses other channels (Figure 37) as [LinkedIn](#) (@xtract-project) and [YouTube](#) (@xtract-project), as well as press releases, blogs, newsletters, videos, events, conferences and webinars to reach the largest number of people as possible. In this regard, by using the XTRACT website as the point of entrance, the Knowledge Repository will benefit from the XTRACT communication and dissemination strategy to draw attention to potential users.

Figure 37 - XTRACT Communication Channels



As

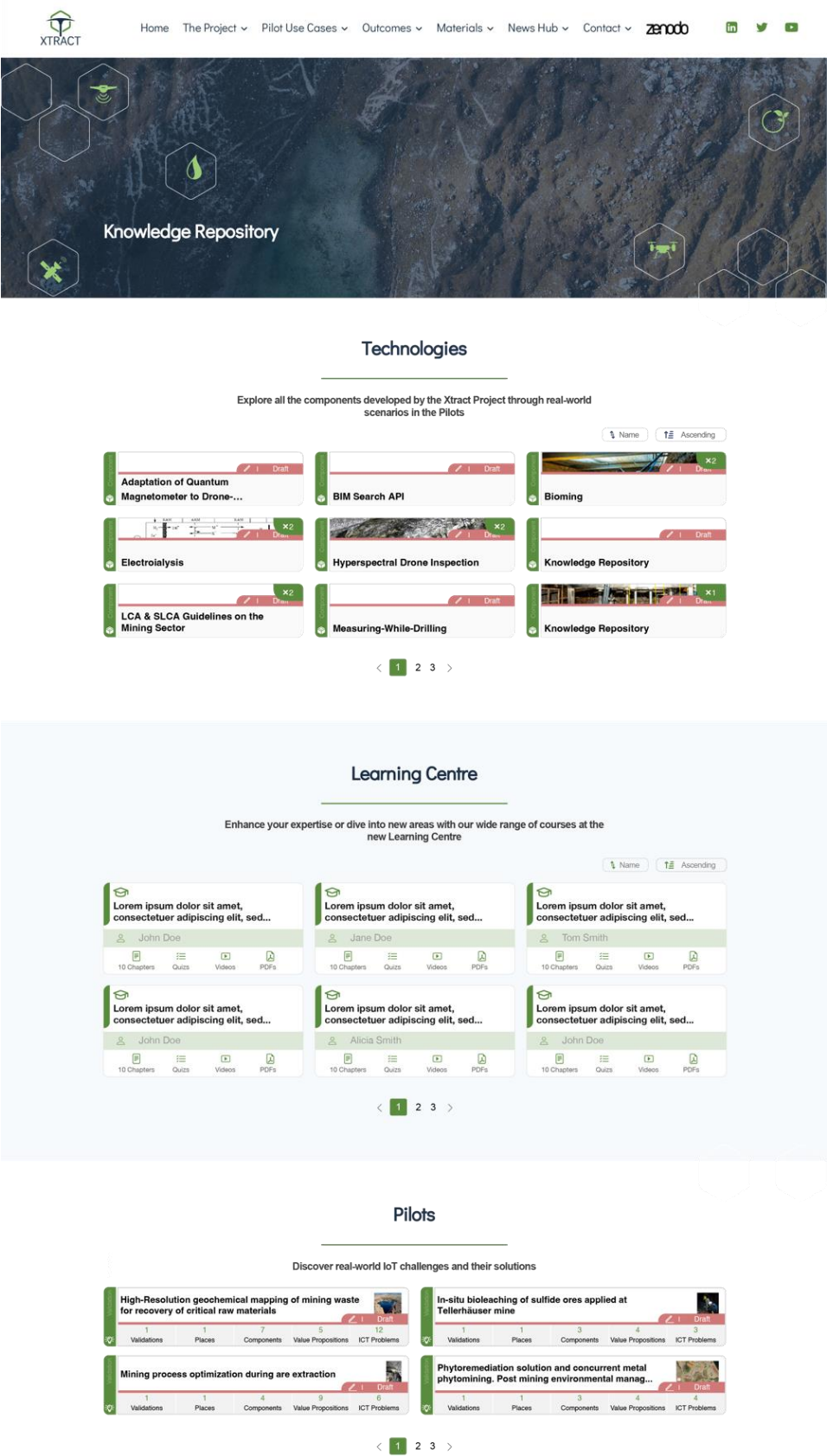
Figure 38 shows, the Knowledge Repository page is divided into three areas: Technologies, Learning Centre and Pilots.

The Technologies area is where the users can find all the tools developed by the XTRACT project and their relevant information such as characterization, description and used on.

The Learning Centre area is where the users can find all the training materials available from the XTRACT project. When choosing a training, users will be directed to the Training Player, which is fully described in section 0.

Finally, the Pilots area gathers all the Use Cases from the XTRACT project. As described in section 8.2.2, the Use Case page provides an in-depth look at a specific Use Case, approaching the main aspects and demonstrating how these technologies were used to overcome this environmental challenge.

Figure 38 - Knowledge Repository Page

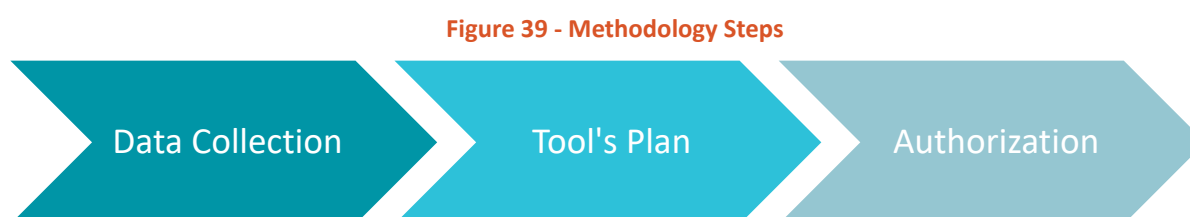


CONTENT DEVELOPMENT

Content Development focuses on the approach taken to populate the Knowledge Repository with meaningful and structured content. It explains the methodology used for content creation and presents the tools of the XTRACT project in a table shape, with information about the partners, the workspaces, the description and the training plan.

8.3.1. Methodology

The Knowledge Repository lives through the information available in it. To populate the Knowledge Repository with all the tools and resources from the XTRACT project, a multi-step methodology was followed (Figure 39).



The first step was a team effort between WP3 and WP9 to identify the available tools of the project and the respective responsible partners.

Next, a plan for each tool was design. In other words, with all the tools identified, the respective responsible partners were contacted to validate the description of their respective tool(s) ensuring accuracy, and to fill out an Excel template containing essential information such as the component name, type of material (e.g., training material, papers, user manuals, etc.), and its availability status.

The Knowledge Repository lives through IoT-Catalogue, which has a very strict approval process for having use cases' information public. This is to ensure quality of information, because the use case partners responsible for the deployments do the final check on the information, and to protect them from confidential information to be made public. The main objective of this process is to guarantee the catalogue always contains updated information for each use case. To tackle this, it was created a private and internal version of the IoT-Catalogue for members of the consortium only, which allows interaction between the use case responsible and the information on the IoT-Catalogue, allowing a feedback process to be made, which ended on an explicit authorization on the information made publicly available. In this regard, the last step of the methodology was the Authorization.

This structured approach guarantees a well-organized and accessible Knowledge Repository, ensuring that all project tools and resources are properly documented and available for future use within the XTRACT platform.

8.3.2. Technologies

This section is dedicated to presenting, in the form of a table, the tools of the XTRACT project according to the responsible partner, the description and the training plan.

Table 7 - Adaptation of Quantum Magnetometer to Drone-Mounted Sensors Approach

Name	Adaptation of Quantum Magnetometer to Drone-Mounted Sensors Approach
Partner	USAL, ACCELI
Link	https://xtract.iot-catalogue.com/components/3568a6a04d16f5697e30aa72

Description	Quantum magnetometer can detect extremely subtle variations in magnetic fields, providing high-precision measurements of geological formations. By mounting these sensors on drones, mining operations can conduct rapid, non-invasive geophysical surveys over large areas, including difficult-to-access terrains.
Training Plan	Paper

Table 8 - BIM Search API

Name	BIM Search API
Partner	UNP
Link	https://xtract.iot-catalogue.com/components/2ebd9116ca09d2b91029e3d3
Description	Building Information Modelling (BIM) is an approach that for a collaborative process supporting the creation and management information about a construction project throughout its entire lifecycle. BIM addresses multidisciplinary information storing, sharing, exchanging, and managing throughout the entire building project lifecycle including the planning, design, construction, operation, maintenance, and demolition phase. BIM Search Application Programming Interface (API) aims to interact with BIM models in a dynamic and programmatic way.
Training Plan	Swagger, White Paper, Software

Table 9 - Biomining

Name	Biomining
Partner	TUBAF
Link	https://xtract.iot-catalogue.com/components/ce38a3ece3ab32faaf7c7b4
Description	Biomining has the potential to recover critical metals from primary and secondary ores, as well as waste materials, where conventional technologies are neither economically nor environmentally viable. Through bioleaching, microorganisms facilitate the extraction of valuable metals while also removing toxic elements from various mining residues that cannot be effectively treated using traditional methods. This technology offers a significantly improved eco-balance compared to conventional pyro- and hydrometallurgical processes, ensuring safer working conditions, operation at ambient pressure and temperature, reduced chemical and energy consumption, lower CO2 emissions, and lower initial investment costs.
Training Plan	Paper, Process Flow Sheet

Table 10 – Drone Magnetometer

Name	Drone Magnetometer
-------------	--------------------

Partner	USAL
Link	https://xtract.iot-catalogue.com/components/77139e660f6b9f29a8100e03
Description	Drones equipped with magnetometers provide a rapid and efficient means of magnetic surveying. These drones can measure variations in the Earth's magnetic field, which helps identify subsurface mineral deposits, such as iron ore and other magnetic minerals. Utilizing drone magnetometers allows for the exploration of large and remote areas with high precision and detail, far surpassing the capabilities of ground-based methods. This technology enhances the accuracy of geological mapping and mineral exploration, leading to better-informed decision-making and resource management. Additionally, drone magnetometer surveys are cost-effective and reduce the need for extensive ground crews, minimizing the environmental impact and increasing safety by keeping personnel away from potentially hazardous areas. This innovative approach streamlines the exploration process, ultimately accelerating the discovery and extraction of valuable resources.
Training Plan	-

Table 11 - Electrodialysis

Name	Electrodialysis
Partner	GEOS
Link	https://xtract.iot-catalogue.com/components/b4e85f6d9cfca75927e249d3
Description	Electrodialysis is a membrane-based separation technology applied for salt splitting, particularly to produce sulfuric acid from the high sulfate content of the Pregnant Leaching Solution (PLS) generated after in situ bioleaching. While electrodialysis has been widely reported and implemented in salt chemistry and lithium recovery, its application in bioleaching and in situ bioleaching remains unexplored. The technique utilizes green energy and offers several advantages, including the ability to integrate seamlessly into in situ bioleaching processes, use metal sulfate solutions from bioleaching for sulfuric acid production, and recycle the acid within the bioleaching process. This enhances process efficiency, sustainability, and resource recovery.
Training Plan	Paper

Table 12 - Ground Penetrating Radar

Name	Ground Penetrating Radar
Partner	USAL
Link	https://xtract.iot-catalogue.com/components/b352957f90aeef291a5a24ac
Description	Ground Penetrating Radar (GPR) offers the ability to visualize and analyse subsurface structures non-invasively. GPR operates by emitting electromagnetic waves into the ground and recording the reflected signals to create detailed images of subsurface

	features. In mining, GPR is used to detect and map geological formations, locate mineral deposits, and identify voids or fractures that may pose safety risks. This technology provides high-resolution data that enhances the accuracy of geological models and informs excavation strategies, leading to more efficient resource extraction. Additionally, GPR is invaluable for assessing the integrity of mine shafts, tunnels, and other underground infrastructure, helping to prevent accidents and ensure the safety of mining operations. Its non-destructive nature allows for repeated surveys without disturbing the site, making it a cost-effective and sustainable tool for ongoing monitoring and exploration.
Training Plan	Paper

Table 13 - Hyperspectral Drone Inspection

Name	Hyperspectral Drone Inspection
Partner	USAL, ACCELI
Link	https://xtract.iot-catalogue.com/components/8ce23156a2dfdc79e59d6a74
Description	Advanced remote sensing technology that utilizes hyperspectral imaging to identify and differentiate minerals with high precision based on their unique spectral signatures. By analyzing the reflected light from surfaces, UAV-mounted hyperspectral sensors can efficiently survey large areas, enabling accurate mapping of ore deposits and reducing waste. In subterranean mining environments, drones equipped with hyperspectral cameras provide real-time data, improving decision-making, optimizing resource extraction, and enhancing safety by minimizing the need for human presence in hazardous areas. This technology significantly improves the accuracy and efficiency of mining operations while supporting sustainable resource management.
Training Plan	-

Table 14 - InSAR

Name	InSAR
Partner	USAL
Link	https://xtract.iot-catalogue.com/components/1abd807ff34b0a94ff087ceb
Description	Interferometric Synthetic Aperture Radar (InSAR), is a powerful tool for monitoring and analysing subsidence and terrain variations in mining areas. This technology utilizes radar signals from satellites to detect ground movements with millimeter-level precision over extensive areas. In mining, InSAR enables continuous and accurate tracking of subsidence, which can occur due to underground excavation activities. By comparing multiple satellite images over time, InSAR can identify even subtle changes in terrain, providing early warnings of potential ground instability. This real-time data is crucial for mitigating risks, planning remediation measures, and ensuring the safety of mining operations and surrounding communities. Additionally,

	the ability to monitor large and remote areas from space makes InSAR a cost-effective and efficient solution for managing the environmental impact of mining activities.
Training Plan	Paper

Table 15 - Knowledge Repository

Name	Knowledge Repository
Partner	UNP
Link	https://xtract.iot-catalogue.com/components/8abf65322e3573ecc0f2993f
Description	Knowledge Repository is a digital knowledge hub that consolidates all the tools and resources from the XTRACT project, ensuring their accessibility and usability for future reference, research, and industry applications, compliance with the UNFC and UNRMS standards. It fosters open knowledge sharing, collaboration, and innovation beyond the project's duration.
Training Plan	Training, User Manual

Table 16 – LCA & SLCA Guidelines on the Mining Sector

Name	LCA & SLCA Guidelines on the Mining Sector
Partner	TUC
Link	https://xtract.iot-catalogue.com/components/281ff9b3e33d209640ef2ec2
Description	This framework offers comprehensive instructions for carrying out social life cycle assessment (SLCA) and life cycle assessment (LCA) that are especially suited for the mining sector. It will encompass methods for assessing the social and environmental implications along the mining value chain, emphasising important areas, such as waste management, resource extraction, processing and the socioeconomic effects of mining operations. By combining environmental, social, and economic goals, these guidelines will attempt to advance sustainable practices in the mining industry, thereby fostering more ethical sourcing and the circular economy.
Training Plan	Guidelines

Table 17 - LiDAR Drone

Name	LiDAR Drone
Partner	USAL
Link	https://xtract.iot-catalogue.com/components/03882652dfb37a2dea62e12e

Description	Provides precise, high-resolution mapping and surveying capabilities. Equipped with LiDAR (Light Detection and Ranging) sensors, these drones emit laser pulses to measure distances to the ground, creating detailed 3D models of the terrain. This technology is especially beneficial in mining for its ability to quickly and accurately map large and complex areas, including steep and uneven surfaces that are challenging to survey using traditional methods. LiDAR drones enable mining operators to conduct frequent and thorough topographical surveys, facilitating better planning, monitoring, and management of mining sites. The data collected helps in identifying resource deposits, assessing environmental impact, and ensuring compliance with regulatory requirements. Additionally, the use of LiDAR drones enhances safety by reducing the need for manual surveys in hazardous areas, allowing for remote and efficient data collection.
Training Plan	-

Table 18 - Measuring-While-Drilling

Name	Measuring-While-Drilling
Partner	LTU
Link	https://xtract.iot-catalogue.com/components/d57ec24b4d56027e2750f4eb
Description	Measuring-while-drilling (MWD) is a technique that enables real time monitoring and recording of several drilling parameters during the drilling operation. An array of sensors (data loggers), installed on the drill rig will be used to collect and register drilling parameters including Instantaneous Advance Speed (IAS), torque pressure, percussion pressure, feed pressure, rotation speed and number or blows per minute during drilling operation. This data will then be analysed using artificial intelligence (AI) and machine learning (ML) techniques to enable development of rock characterisation models. The developed models can further be used in optimising drill patterns and drilling operations and also blasting operations. Optimised drilling and blasting operation will result in a reduction of the amount of explosives used, thus a reduction in CO2 and GHG emission per blast conducted.
Training Plan	Paper

Table 19 - Membrane Filtration

Name	Membrane Filtration
Partner	TUBAF
Link	https://xtract.iot-catalogue.com/components/da8a44674832c0fb8dfbcf10
Description	Membrane filtration is a process that enables the selective recovery of low concentrations of critical metals from complex solutions while producing two distinct process water streams: one containing the target elements and another recycled

water stream, which can be recirculated in the bioleaching process to enhance economic viability and sustainability. A hybrid combination of microfiltration and nanofiltration technology in downstream processing allows for optimized separation of target elements, making it applicable to various water and wastewater treatment challenges. Nanofiltration, in particular, is well-established for removing toxic metal ions and is widely used in commercial wastewater treatment and desalination. The extraction of critical metals such as Indium, Germanium, and Rare Earth Elements (REE) from complex low-pH solutions has been extensively documented, and the technology holds potential for broader applications in addressing diverse water and wastewater issues.
Training Plan

Table 20 - Muon Detection System

Name	Muon Detection System
Partner	Muon
Link	https://xtract.iot-catalogue.com/components/f5c0237883fa42c782dd53b5
Description	A borehole-compatible muon detection system that captures and processes cosmic-ray muons to assess subsurface density variations. The system consists of borehole detectors that operate either in parallel or sequentially to generate a 3D density distribution map. Data are analyzed remotely, with real-time monitoring ensuring that the survey progresses as expected. In XTRACT, this system enhances mining waste characterisation.
Training Plan	-

Table 21 - Muon Imaging Software

Name	Muon Imaging Software
Partner	Muon
Link	https://xtract.iot-catalogue.com/components/4b73280022ae470e934701eb
Description	A software solution that processes data from muon borehole detectors. In favourable conditions—for instance, when multiple boreholes (vertical, cased, or inclined/horizontal) provide diverse vantage points and the detectors’ angular resolution is sufficient—the software can produce muon tomography (3D imaging). Under less ideal conditions—such as fewer vantage points, suboptimal detector resolution, or limited borehole placement—the technique defaults to muon radiography (2D imaging). In typical waste rock pile scenarios, boreholes are assumed vertical and cased. However, drawing on practices described by McLin et al. (2005), our technology also supports muography through inclined and horizontal boreholes, which can be used for subsurface investigations in waste-rock piles. The software enables real-time

	monitoring and post-processing analysis of muography data, generating density maps for resource estimation in old mining waste piles, geotechnical stability assessments, and mineral recovery optimisation. In optimal situations, it integrates with existing mining workflows, delivering a non-invasive imaging solution for subsurface structures.
Training Plan	Paper

Table 22 – Near Real-Time Rock Quality Assessment from Drill Monitoring

Name	Near Real-Time Rock Quality Assessment from Drill Monitoring
Partner	LTU
Link	https://xtract.iot-catalogue.com/components/a5f972e4d13da3480c7e7030
Description	Near real-time rock quality assessment will be performed through Measure-While-Drilling-data analysis.
Training Plan	-

Table 23 - Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals

Name	Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals
Partner	TUBAF, BRGM
Link	https://xtract.iot-catalogue.com/components/3cd0fbcf2047881c6ae567d5
Description	Bioleaching is a sustainable and ecofriendly technology for exploiting low grade resources (primary and secondary ores, mining residues). It uses biological processes naturally occurring in mining environment to catalyse the recovery of strategic and critical metals, at lower environmental and economic costs than conventional pyro- and hydro-metallurgical mining processes. When performed in-situ, energy inputs to recover metals are even lowered, as excavating, transportation and crushing of the ore are not required. The in-situ bioleaching technology allows for sustainable and eco-friendly recovery of metals even from dilute and hard to access resources without harsh chemicals and production of toxic gases. It offers an alternative to other (bio)leaching technologies when the deposit is difficult to mine or when the grade of the ore is too low to be treated by STR leaching, and the environment doesn't enable to implement heap leaching process (lack of large areas and/or natural landscapes not adapted to the installation of leach pads). The costs and the environmental impacts of the technology are significantly lower compared to conventional chemical leaching processes.
Training Plan	Paper, Process Flow Sheet

Table 24 - Optimised Drill Performance

Name	Optimised Drill Performance
Partner	LTU
Link	https://xtract.iot-catalogue.com/components/b1df78eb99c1e26ff2bd69cf
Description	The developed drill performance optimisation asset will be based on Measure-While-Drilling technology. Drilling data will be retrieved during drilling and will be used for optimisation processing including ore/waste boundaries.
Training Plan	Paper

Table 25 - Phytoremediation/ Phytomining Solution Using Trees

Name	Phytoremediation/Phytomining Solution Using Trees
Partner	LAMMC, TUC, NTUA, AMDC, GEOS
Link	https://xtract.iot-catalogue.com/components/302d2dfecb70d6d859807043
Description	Phytomining is a specialized form of 'phytoextraction', a type of phytoremediation in which plants absorb and accumulate metals from contaminated substrates or mine waste. Unlike 'phytostabilization', which uses plants to immobilize contaminants and prevent their spread, phytomining actively removes metals by harnessing 'hyperaccumulator plants' that take up high concentrations of valuable elements. These metals are stored in the plant biomass, which is later harvested and processed to extract bio-ore. While phytomining offers a more sustainable alternative to traditional mining by restoring degraded lands and reducing environmental impact, it is a slow process, limited by species-specific metal uptake and relatively low yields. Despite these challenges, phytomining demonstrates the potential of phytoextraction not only for environmental cleanup but also as an eco-friendly method of metal recovery.
Training Plan	Paper

Table 26 - SLAM-LiDAR

Name	SLAM-LiDAR
Partner	USAL, ACCELI
Link	https://xtract.iot-catalogue.com/components/bcfd31c58f9f9adf595b56ada
Description	SLAM LiDAR (Simultaneous Localization and Mapping) enables drones to autonomously navigate and create real-time 3D maps of underground and GNSS-denied environments while simultaneously tracking their location. This technology is particularly valuable in subterranean mining, where it enhances safety by allowing

	for remote inspection of hazardous areas and reducing human exposure to dangerous conditions. In addition to mine mapping and monitoring, SLAM LiDAR is also applied in fragmented material characterization. UAV-mounted SLAM systems can capture high-resolution 3D data of blasted rock, enabling precise blast fragmentation analysis and the calculation of rock size distribution. This improves operational efficiency by optimizing blasting techniques, reducing material handling costs, and enhancing overall mine safety. By integrating SLAM LiDAR technology into mining operations, companies can achieve more efficient resource extraction, improved decision-making, and enhanced worker safety, making it an essential tool for modern mining environments.
Training Plan	Paper

Table 27 - X-Ray Fluorescence

Name	X-Ray Fluorescence
Partner	UNP
Link	https://xtract.iot-catalogue.com/components/186e4a2e98167e88466b7c53
Description	X-Ray Fluorescence (XRF) is a powerful analytical technique for determining the elemental composition of materials through rapid, non-destructive analysis, making it particularly valuable in environmental and mining applications. It enables the detection and spatial distribution of geochemical compositions across large areas, providing a comprehensive overview of mining environments and mine wastes. Portable XRF sensors allow for efficient on-site assessments, including ore grade evaluation and waste pile mapping. Additionally, the integration of XRF technology with remote sensing platforms, such as drones, enhances large-scale surveying capabilities by enabling high-precision geochemical mapping in previously inaccessible or extensive areas.
Training Plan	User Manual, Software

Table 28 – XTRACT Geospatial Platform

Name	XTRACT Geospatial Platform
Partner	USAL
Link	https://xtract.iot-catalogue.com/components/bdef569183dc05d91eaf47db
Description	Geospatial platforms help improve efficiency by providing a comprehensive overview of the mining site, enhancing exploration efforts, optimising resource extraction, and ensuring regulatory compliance.
Training Plan	Visual PPT

Table 29 – XTRACT Reconfigurable UAV System

Name	XTRACT Reconfigurable UAV System
Partner	ACCELI
Link	https://xtract.iot-catalogue.com/components/5622ae4dd9ee983ccfbb9915
Description	The XTRACT reconfigurable UAV system is a versatile unmanned aerial vehicle designed for a range of missions in challenging mining environments. It can be equipped with various sensors, including multispectral, thermal, and RGB cameras, as well as LiDAR, to gather critical data for ore extraction, environmental monitoring, and waste management. The system is modular, allowing for easy payload swapping based on mission requirements, ensuring flexibility and efficiency in resource management operations. It provides real-time or near-real-time data processing capabilities, enhancing decision-making in remote and hard-to-reach mining locations.
Training Plan	-

8.4. FUTURE WORK

In the next phase of the project (M18-M36), the focus will be on adding the results from the Pilot Use Cases into the Knowledge Repository. These examples will show how the tools developed in XTRACT can be used in real situations, helping others understand their value and how to apply them in similar settings.

At the same time, training materials will be created with input from the partners responsible for each tool. These materials will include clear guides, videos, and practical exercises to help users learn how to use the tools easily. The goal is to make it simple for people to adopt the XTRACT solutions and use them confidently in their work.

9. CONCLUSIONS AND NEXT STEPS

In conclusion, this deliverable outlines the market potential of each exploitable result, detailing IPR management, partner exploitation strategies, and SWOT analysis, ensuring that the advancements within XTRACT align with industry needs and regulatory frameworks.

It also includes a thorough market analysis based on input from technical partners, offering a strategic overview of the project's market positioning and its potential socio-economic impact.

Looking ahead, the forthcoming D10.1 deliverable will offer an in-depth examination of Key Exploitable Results (KERs), strengthening the foundation for the project's commercialization and long-term impact.

ANNEX 1 – EXPLOITABLE ASSETS LIST TEMPLATE



**A SUSTAINABLE ECOSYSTEM FOR THE INNOVATIVE
RESOURCE RECOVERY AND COMPLEX ORE EXTRACTION**

XTRACT

**T9.1 Market Analysis and Strategy definition
&**

**T9.2 Socio-economical sustainability analysis
and XTRACT ecosystem business models and
uptake roadmap**

Analysis of Exploitable Assets

DEFINITIONS AND CLASSIFICATIONS OF EXPLOITABLE ASSETS/RESULTS

TABLE OF EXPLOITABLE ASSETS

Please review the below table and revise the list of exploitable assets or add any assets your organisation is responsible for. Identify the partners responsible for them (introduce, lead or co-lead them according to the XTRACT DoA).

An exploitable asset can be a module, a dataset or knowledge, a pilot etc (please see the list below); anything that will be exploited during XTRACT project and may be exploited after the end of the project.

Please assign the “code letters” in the “category column” based on the provided codes. If it does not apply leave the table unchanged.

Categories:

- F – Framework/Architecture/Blueprint/Guideline
- M – Module/Platform element/Side Product
- D - Dataset/Knowledgebase
- P – Pilot/Use case/application
- I – Intangible/Patent/Publication
- Other (please specify)

Mining value chain:

- Exploration
- Extraction
- Processing
- Waste Management
- Other (please specify)

Table 1: Exploitable Assets Lists

No	Asset Title	Mining Value Chain	Source of Assets (WP/T)	Introduced by partner (name of partner)	Related Pilot	to Category
1	Ore grade assessment in real time thru drill monitoring	EX	T6.1 / 7.1	LTU	P2-SWEDEN	D, P
2	XTRACT reconfigurable UAV system	EP	T6.3 / 7.3	ACCELI	P3-PORTUGAL P2-SWEDEN	M

3	Optimised drill performance	EX	T6.1 / 7.1	LTU	P2-SWEDEN	D, P
4	Electrodialysis and processability index	EX	T4.2 / 5.2	GEOS	P1-GERMANY P3-PORTUGAL P4-GREECE	M, P
5	Muon technology for detecting internal density distributions in mining-related waste rock stockpiles	W	T4.5 / 5.5	MUON	P3-PORTUGAL	D
6	Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals from Low-Grade Ores and Mine Waste	EX, W	T4.1 / 5.1	TUBAF	P1-GERMANY	M, P
7	Novel Membrane Filtration Technology for Higher Metal Recovery, Water and Waste-Water Treatment	EX, W	T4.3 / T5.3	TUBAF	P1-GERMANY	M, P
8	Phytomining – Phytoremediation solution	EX, W	T4.4 / T5.4	LAMMC	P4-GREECE	M, P
9	Adaptation of traditional geophysical long-distance and borehole logging techniques to drone-mounted sensors approach	EP, W	T6.2 / 7.2	USAL	P3-PORTUGAL	D, P
10	UAV-Derived 3D Imaging for in situ and fragmented material characterization, analysis of blast fragmentation and	EP	T6.2 / 7.2	USAL	P2-SWEDEN	D, P

	calculation of rock fragmentation distribution					
11	X-ray fluorescence system survey	EP	T6.3 /7.3	UNP	P3-PORTUGAL	D, P

DESCRIPTION OF EXPLOITABLE ASSETS/TECHNOLOGIES

Please read and complete the table below, with the description and related technology for the exploitable assets

Table 2: Description of Exploitable Assets

No.	Asset's Title	Short Description of the asset	Related to Technology
1	Ore grade assessment in real time thru drill monitoring		
2	Xtract reconfigurable UAV system		
3	Optimised drill performance		
4	Electrodialysis and processability index		
5	Muon technology for detecting internal density distributions in mining-related waste rock stockpiles		
6	Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals from Low-Grade Ores and Mine Waste		
7	Novel Membrane Filtration Technology for Higher Metal Recovery, Water and Waste-Water Treatment		
8	Phytomining – Phytoremediation solution		
9	Adaptation of traditional geophysical long-distance and		

	borehole logging techniques to drone-mounted sensors approach		
10	UAV-Derived 3D Imaging for in situ and fragmented material characterization, analysis of blast fragmentation and calculation of rock fragmentation distribution		
11	X-ray fluorescence system survey		

INTELLECTUAL PROPERTY RIGHTS MANAGEMENT, CONTRIBUTIONS, BACKGROUNDS & FOREGROUND CLAIMS

Each partner shall review the table below, find the column that corresponds to their company, and enter the appropriate letter codes in the cells associated with the assets their organization is interested in.

It is noted that all combinations of letters B, C, F are permitted.

Your organization may have developed new knowledge while working on an asset that is partially or fully owned by another partner.

C – Contribution: Partner claiming to have provided (or will provide) substantial assistive Contribution on the Asset development. Of course, a partner must be participating in the task of the asset with non-zero person hours.

B – Background: Partner claiming to have brought Background knowledge on the Asset that existed before the project. It may have also been mentioned in the Consortium Agreement of Extract (in the Appendix) as background knowledge.

F – Foreground: Partner claiming to have developed (or will develop) new Foreground knowledge while working on the asset, that they can/will exploit).

Table 3: IPR rights/claims

No.	Asset's Title	Short partner's name	Category
1	Ore grade assessment in real time thru drill monitoring	LTU	
2	Xtract reconfigurable UAV system	ACCELI	
3	Optimised drill performance	LTU	
4	Electrodialysis and processability index	GEOS	
5	Muon technology for detecting internal density distributions in mining-related waste rock stockpiles	MUON	
6	Novel In-Situ Bioleaching Eco-Friendly Technology for the Recovery of Strategic and Critical Metals from Low-	TUBAF, BRGM	

	Grade Ores and Mine Waste		
7	Novel Membrane Filtration Technology for Higher Metal Recovery, Water and Waste-Water Treatment	TUBAF	
8	Phytomining – Phytoremediation solution	LAMMC	
9	Adaptation of traditional geophysical long-distance and borehole logging techniques to drone-mounted sensors approach	USAL	
10	UAV-Derived 3D Imaging for in situ and fragmented material characterization, analysis of blast fragmentation and calculation of rock fragmentation distribution	USAL	
11	X-ray fluorescence system survey	UNP	

PARTNER EXPLOITATION PATHWAYS AND INTENTIONS

Please go to the table below and in the cells that correspond to assets of interest for your organization, add the applicable code letters that are listed below. All combinations of letters are allowed.

Please note that it is required for you to set your intentions on the exploitation path you intend to follow (not obliged to do however).

M - Market (Sell): A partner aims to sell the asset by leveraging their existing sales channels to promote it to potential clients. Ownership of the asset is not required, as the partner may obtain permission to sell through a license agreement with the asset owner. This represents a selling intention.

C - Technical Creation, Assembly, Production: A partner seeks to produce the asset, whether for selling it independently or through third-party channels. This reflects a technical development intention.

L - License: A partner is interested in licensing or assigning their asset or related knowledge to third parties for an agreed fee, allowing others to exploit it. This is common for universities without a dedicated sales force.

I - Internal: A partner anticipates opportunities for internal use, expansion, or replication of the asset in the future. This is typical for pilots, demonstrators, factories, or adoption in company product lines.

R - Research Further: A partner plans to conduct further research, including journal or conference publications and other research initiatives.

P - Publish (Non-Scientific): A partner intends to publish non-scientific materials related to the asset, such as handbooks, best practices, presentations, multimedia content, videos, books, charts, etc.

D - Dataset: A partner aims to exploit datasets related to the asset through online marketplaces, for experiments, further research, consulting services, and other purposes.

T - Training: A partner wants to develop training materials and/or offer training services or methods (such as online tests, webinars, printed materials, etc.) related to the asset.

S - Services: A partner is willing to provide complementary services, including consulting, lectures, technical integration, support, maintenance, and other added value services associated with the main asset.

G - Governmental: A partner has connections and can promote the asset to governmental bodies, contribute to EC policy recommendations, or engage with standardization bodies and associations.

Table 4: Exploitation pathways and intentions

No.	Asset's Title	Short partner's name	Category
1	Ore grade assessment in real time thru drill monitoring	LTU	
2	Xtract reconfigurable UAV system	ACCELI	
3	Optimised drill performance	LTU	
4	Electrodialysis and processability index	GEOS	
5	Muon technology for detecting internal density distributions in mining-related waste rock stockpiles	MUON	
6	Novel In-Situ Bioleaching Eco-	TUBAF, BRGM	

	Friendly Technology for the Recovery of Strategic and Critical Metals from Low-Grade Ores and Mine Waste		
7	Novel Membrane Filtration Technology for Higher Metal Recovery, Water and Waste-Water Treatment	TUBAF	
8	Phytomining – Phytoremediation solution	LAMMC	
9	Adaptation of traditional geophysical long-distance and borehole logging techniques to drone-mounted sensors approach	USAL	
10	UAV-Derived 3D Imaging for in situ and fragmented material characterization, analysis of blast fragmentation and calculation of rock fragmentation distribution	USAL	
11	X-ray fluorescence system survey	UNP	

SWOT ANALYSIS

Description: The SWOT (Strengths, Weaknesses, Opportunities, Threats) matrix is a tool to support strategic decision-making and help build a successful market access strategy for your product/service.

How to fill-in your SWOT matrix:

- Always keep in mind your objective, i.e. to commercialise your product/service. The template must be filled from this point of view:
- What are the strengths for your product/service commercialisation? What are the opportunities for your product/service commercialisation? Etc.;
- Distinguish between internal factors (that come from your company, your products, your know-how etc.) and external factors (that come from your environment, competitors, laws & regulation, market trends etc.).

To work out if something is an internal or external factor, ask yourself if it would exist even if your business didn't.

- Rely on facts, not intuitions;
- Provide figures each time it is possible;
- Priorities.

Remain synthetic in the matrix and bring explanations below it if necessary (An external reviewer should be able to understand the foundation of your statements).

For more information on how to perform a SWOT analysis, please look at: https://www.mindtools.com/pages/article/newTMC_05.htm

Please use this template to fill in the SWOT analysis for each XTRACT innovative technology.

	Name Service/Asset (XXX)	
	Favourable Factors	Adverse Factors
Internal Factors	Strengths <i>What do you do well?</i> <i>What unique resources can you draw on?</i> <i>What do others see as your strengths?</i>	Weaknesses <i>What could you improve?</i> <i>Where do you have fewer resources than others?</i> <i>What are others likely to see as a weakness?</i>
External Factors	Opportunities <i>What opportunities are open to you?</i> <i>What trends could you take advantage of?</i> <i>How can you turn your strengths into opportunities?</i>	Threats <i>What threats could harm you?</i> <i>What is your competition doing?</i> <i>What threats do your weaknesses expose you to?</i>

	Name Service/Asset (XXX)	
	Favourable Factors	Adverse Factors
Internal Factors	Strengths •	Weaknesses •
External Factors	Opportunities •	Threats •

REGULATORY FRAMEWORK

In this Section, we ask you to provide information on any applicable laws that govern your technology in question. Laws governing the technology could be focused on matters such as:

- (i) technical specifications,
- (ii) limitations on utilisation and use of the technology,
- (iii) registration and/or licensing required for the technology, etc.

We are focused on 2 legal frameworks, namely:

1. *National/EU policy plans supporting/promoting utilisation of such technologies*
 - *EU regulations/directives:*
 - *National law different from EU law? If yes, how?*
2. *Third countries/beyond Europe*

Please provide the following information for each legal framework:

[100-500 words in each legal framework section, in paragraphs, with different subsections for Points 1 and 2 as above]

- Name of applicable law
- Brief description of law
- Impact of law on XTRACT technology
- Web link access to law

[type here]

ANNEX 2 – COMPETITORS AND STAKEHOLDERS SURVEY TEMPLATE



A SUSTAINABLE ECOSYSTEM FOR THE INNOVATIVE RESOURCE RECOVERY AND COMPLEX ORE EXTRACTION

XTRACT

**T9.1 Market Analysis and Strategy definition
&**

**T9.2 Socio-economical sustainability analysis
and XTRACT ecosystem business models and
uptake roadmap**

Competitive Landscape and Stakeholders

This questionnaire will serve as a guide in providing an analysis of the stakeholders and competitors of the XTRACT exploitable assets under Task 9.1: Market analysis and strategy definition.

All partners shall provide input regarding the potential stakeholders and existing competitors of their exploitable assets/ technologies they offer in XTRACT.

You may complete more than one forms if you are responsible for more than one exploitable technology.

Please follow the guidelines and use the template provided below. To edit the document, please Save As New Document and adhere to the following naming convention:

We thank you for participating in this exercise. Your input is of outmost importance for this task.

Name of Partner:	
Exploitable asset:	
Date:	

DETERMINING OF THE TARGET CUSTOMER

In the following section please identify the Target Customer and who you would like to adopt/ buy/ fund your exploitable asset.

Please provide information about the target customer for your exploitable technology (i.e. the buyer of your product).

Please provide details about the wider sector related to the exploitable asset (i.e. Universities, mines, jurisdictions, manufacturing, IT companies).

How will these technologies bring substantial change/benefits to the target customers?

Please specify the type(s) of broader customers that you envision (*please check the box*)

- ☒ Customers that may potentially pay
 - ☐ Free of charge – Open Source
 - ☐ Adoption or replication of a use case/pilot
 - ☐ A customer who would adopt the Research idea
 - ☐ Governmental authorities/policy makers or standardisation body
 - ☐ Other (please specify)
-

IDENTIFICATION OF EXISTING MARKET

Please select the market that the exploitable asset targets. You may also include any of the following options if applicable (*optional*).

- ☐ Non-Existent: The market currently doesn't exist, and it's uncertain if our innovations have the potential to create one.
- ☐ Market-Creating: The market hasn't yet formed, but there is a strong potential for our innovations to establish a new one.
- ☐ Emerging: Demand for these solutions is slowly increasing, with only a few competitors in the market.
- ☐ Mature: The market is well-established, with numerous alternatives already available.
- ☐ Congested: The market is highly competitive, with many established players offering similar products.

Please select the market size of your exploitation asset:

- ☐ Declining/Shrinking in size
- ☐ Stable
- ☐ Booming

In the broader sector, competitors may offer similar products/services. These include:

- ☐ Direct competitors in the market
- ☐ Potential collaborators, who we could approach to explore partnerships
- ☐ Comparable research initiatives, projects, or clusters
- ☐ Alternatives that utilize different technologies or ideas instead of our solutions
- ☐ Substitutes that don't offer similar solutions but solve the same problems through more basic or less advanced methods

It is common to find alternatives/competition to your exploitable asset?

- ☐ There is no competition
- ☐ Only few alternatives exist
- ☐ Some exist
- ☐ Quite common
- ☐ Many alternatives exist
- ☐ I don't know.

If there are alternatives to the market please specify how your solution/technology is better or different (in terms of price, product size, market experience, innovation & new product, value branding?)

Please specify (max 500 words): _____



A SUSTAINABLE ECOSYSTEM FOR THE INNOVATIVE RESOURCE RECOVERY AND COMPLEX ORE EXTRACTION

The Members of the XTRACT Consortium:

Short Name	Country	Short Name	Country
TUBAF	Germany	LNEG	Portugal
LTU	Sweden	TUC	Greece
MUON	Finland	LAMMC	Lithuania
USAL	Spain	BJORKDAL	Sweden
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Contact:

Project Coordinator: Sabrina Hedrich TUBAF - Technische Universität Bergakademie Freiberg	sabrina.hedrich@bio.tu-freiberg.de
Project Manager: Claudia Kallmeier TUBAF - Technische Universität Bergakademie Freiberg	claudia.kallmeier@bio.tu-freiberg.de