Knowledge Transfer Plan

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Executive Summary

The knowledge transfer plan aims to foster the transfer of knowledge generated by **BIG** to wider society. Specifically, it aims to solve the weakness identified in the grant agreement:

W5. Lack of innovation, entrepreneurship and intellectual property management - Despite efforts aimed at building connections with industry partners, and towards promoting spin-offs and entrepreneurship from its student body, INESC-ID and LARSyS lack an adequate innovation, entrepreneurship and intellectual property management structure focused on the data economy. This includes a better connection of Técnico's research efforts with industry needs and opportunity matching.

This plan will consider the overall Knowledge Transfer needs and practice of LARSyS, INESC-ID and Instituto Superior Técnico (IST) - Lisbon, providing an opportunity to devise a general strategy for the organisation. This plan includes all the aspects relevant to Knowledge Transfer:

- Identification of current and future areas of application of blockchain and distributed ledger technologies and design innovation approaches.
- Collaboration with industrial organisations to co-develop research areas that are of benefit to the local Portuguese and the regional European economy, enabling a direct link between the activities of the BIG project and the questions of greatest interest for the industry.
- Development of collaborative research networks between Portuguese institutions and the broader commercial and research networks across the European Union - linking the researchers to ongoing activities in Blockchain.
- Identification of organisations in the public and private sectors that might benefit from these approaches.
- Development of strategies for effective knowledge transfer;
- Exploitation of results and intellectual property rights.

1. Knowledge Transfer Goals for BIG

As highlighted in our proposal, BIG's goal is to expand the research and innovation potential of Técnico – Lisbon contributing to foster a digital ecosystem taking advantage of Blockchain technologies and design Innovation for Social Good. Through the hiring of an ERA Chair, the aim is to develop a critical mass of interdisciplinary research in deploying and testing blockchain technologies in strategic application domains aligned with the smart specialisation strategy of Portugal and Lisbon. BIG is particularly well suited to expand the increasing potential of Lisbon as a European high-tech hub for the data economy. BIG will be a campus-wide initiative in blockchain and distributed ledger technologies and design innovation to better integrate Técnico – Lisbon with the

European Research Area (ERA) and to promote structural changes in the school and improve the participation of its associated ICT research labs LARSyS and INESC-ID in the Horizon Europe and ESIF programs.

BIG will pursue the following strategic objectives:

1. **Upgrade the existing research and technological development capabilities** by expanding the human potential and fostering a critical mass of researchers with interdisciplinary expertise in blockchain and related technologies (distributed computing, security and applied cryptography, AI, machine learning, big data, and cloud computing) and design thinking.
2. **Improve the innovation potential and impact** of Lisbon and Portugal as a key platform in the Euro-Atlantic region of the EU through design-driven innovation for the data economy.
3. **Raise international awareness** about the research institutes (LARSyS and INESC-ID) and connect Técnico – Lisbon and its industry affiliates to the global knowledge networks: work with mentoring institutes based at prestigious universities in Europe.

2. Summary of Achievements - 2021-2022

The BIG ERA Chair Holder and the BIG ERA Chair Team have already begun working on knowledge transfer activities. These activities are listed in the action plan, however, for convenience, we provide a quick summary of the goals we have already achieved.

First, the ERA Chair Holder and members of the ERA Chair Team have begun a collaboration with the University of Lisbon, Faculty of Law on the creation of a Hackathon which seeks to build tacit knowledge in the Portuguese technology and legal communities regarding regulatory and technological issues surrounding Decentralised Autonomous Organisations, or DAOs. Currently, this Hackathon is scheduled for the end of October 2022. This collaboration links into the first point of the BIG Research Strategy, as it builds a link between the technology and legal communities to solve cutting-edge Blockchain-related problems.

In addition to creating links across different academic disciplines, we have been working on transferring knowledge between academic and cutting-edge technology companies, as outlined in the second point of the BIG Research Strategy. We have teamed up with the Portuguese Blockchain alliance in joint leadership of the Working Group on Energy Usage of Blockchain for the World Economic Forum's Crypto Sustainability and Impact Accelerator. The BIG project will be represented at both the UN Climate Week (21st September 2022) and Davos for the World Economic Forum (January 2023).

The ERA Chair Holder has also contributed to the CRADL UX design toolkit for accessibility of Cryptocurrencies, a sprint report on the UX of cryptocurrencies. Moreover, the ERA Chair Holder has submitted a successful application to the ONTOCHAIN project together with LARSyS (led by

company Acumen Research Labs) for Semantic Blockchain marketplaces for Smart Cities. These activities aim to solve real-world problems and have real-world impact, and as such link to our second point of the BIG Research Strategy.

Finally, the ERA Chair Holder and ERA Chair Team worked towards raising the bar on scientific merit by teaching new courses on cutting-edge Blockchain themes, performing one faculty secondment, hosting two visiting masters students, and mentoring masters students during their thesis. These activities work towards the fourth point of our BIG Research Strategy.

3. Why transfer knowledge? What knowledge to transfer?

The BIG project is delivered through the DCentral lab, supported by pre-existing infrastructures at IST, such as the Technology Transfer Office, LARSyS and INESC-ID.

The BIG project enables cutting-edge research in the areas of Blockchain Technologies and Design Innovation to advance social good. However, this research cannot live in a silo. If the research were performed but not transferred, the goal of creating Blockchain and Decentralised technologies might be achieved, but the goal of social good would not. Specifically, to achieve the BIG ERA Chair's goal of sustainability, we must ensure that the knowledge we generate is transferred to relevant interests and put into practice. To maximise the impact of the research of the BIG project, the findings of our research and other insights related to Blockchain and Decentralised technologies must be transferred both within the BIG project and outside of it particularly through design innovation efforts.

In the BIG project, we work to create cutting-edge technologies with our research and transfer it to interested parties. However, not all knowledge is of the same type; some knowledge can be stated factually and simply, and thus can be transferred more straightforwardly, while other knowledge must be internalised, that is, be transferred through hours of guided practice and experience, rather than through clearly communicated facts, and thus cannot be taught simply through repetition, lecture, or academic publication. To aid in our goals of knowledge transfer, in this section we define two types of knowledge, explicit and tacit, which must be communicated in different ways. A final and separate type of knowledge transfer is the uptake of knowledge created in the project - for example, usage of our toolkits in a commercial or NGO environment, uptake of software that we develop, and more.

Explicit

Explicit knowledge is the knowledge that is easily quantifiable or qualifiable, and thus can more easily be transferred directly. Examples of explicit knowledge include measurements, factual statements, mathematical equations, proofs, algorithms, and more. The BIG project will be generating large amounts of explicit knowledge through its research activities related to Blockchain, decentralisation, and related technologies. We will transfer this knowledge using the proper methods depending on the interested party. These methods are covered in the section *Knowledge transfer*

strategy. methods, and tools, and include lectures, academic publications, research meetings, data sharing, documentation, and more.

Tacit

Tacit knowledge is the knowledge that is derived more from experience and is more intuitive in nature, and as such is not as easily transferred straightforwardly. Examples of tacit knowledge include how to write an algorithm or generate a mathematical proof, techniques for deriving properties of technology, choosing the correct method for measuring some aspect of a system, and more.

Tacit knowledge is much harder to identify and transmit than explicit knowledge, and it is difficult to estimate the amount of tacit knowledge that the BIG project will generate during its research activities. However, the tacit knowledge that is built will be identified and transmitted to relevant parties using the relevant method discussed in the *Knowledge transfer strategy, methods, and tools* section of this plan.

4. The Knowledge Transfer Process

The knowledge generated by the BIG project has implications that can impact multiple stakeholders and other interested parties. To transfer this knowledge in the most efficient way possible, knowledge transfer must be planned with the interested parties in mind (section below: Parties in the Knowledge Transfer). To this end, we present a non-exhaustive list of interested parties who will benefit from effective, clear, and efficient knowledge transfer.

5. Parties in the Knowledge Transfer

These parties fall into one of three categories of the BIG Project: internal parties, or parties who belong to DCentral and/or Instituto Superior Técnico, external parties who do not belong to DCentral and/or Instituto Superior Técnico (IST), and hybrid parties that begin as members of DCentral and potentially transition out of DCentral, such as Unicorn companies.

5.1. Internal

Multiple parties internal to DCentral and/or IST will benefit from the transferral of knowledge generated by or curated by DCentral.

Technology Transfer Office

Technology transfer at Técnico is focused on IST's intellectual property management, on the promotion of corporate partnerships and entrepreneurship. Técnico stimulates intellectual property protection as a means of fostering knowledge valorisation and currently has a portfolio of more than 250 patents. The school has been promoting a policy that favours the link between university and industry, offering top academic training focused on innovation and entrepreneurship, which will largely contribute to Portuguese economic growth.

LARSYS/ITI

ITI is dedicated to the interdisciplinary field of HCI and encloses Psychology and Social Sciences, Computer Science, and Creativity and Design as core scientific areas. The cross-pollination of these areas allows thriving application areas directed towards societal needs. HCI with a focus on user needs, tasks, experiences, and social and political contexts is well suited to address a new breed of socio-technical systems that combines emerging technologies (such as blockchain) with the underlying cultural and social fabric. LARSyS and ITI will participate in knowledge generation based on the HCI aspects of blockchain and will contribute with their expertise with design innovation methods (including speculative and other artistic forms of knowledge transfer) and will benefit from knowledge transfer from DCentral related to blockchain, including design, the intersection of blockchain and learning, intersections of Blockchain and sustainability, and more.

INESC-ID

INESC-ID, "Instituto de Engenharia de Sistemas e Computadores: Investigação e Desenvolvimento em Lisboa" is a Research and Development and Innovation Organization (R&D+i) in the fields of Computer Science and Electrical and Computer Engineering. The group from INESC-ID affiliated with BIG is the Distributed, Parallel and Secure Systems which broadly addresses Systems, ranging from the underlying architectural support for high-performance systems, networks and applications, scalable and secure distributed platforms for cloud computing, big data storage and processing, to autonomic computing and peer-to-peer systems of Internet scale. Yet, INESC-ID's research impact is focused on four Thematic Lines to which it makes relevant contributions: digital transformation and citizenship, life and health technology, energy transition, and security and privacy. INESC-ID will both participate in and benefit from knowledge generation in these areas, specifically focusing on computer science techniques, building blockchain systems and technologies, and performing research on blockchain and related technology and the associated issues of cybersecurity and distributed systems.

Students

The main goal of the BIG Project team and partners is to generate knowledge in blockchain technologies and design innovation. This knowledge could be useful for the extensive and high-quality IST undergraduates, masters, and PhD students as well as faculty and BIG Project researchers. Due to the nature of the project the BIG team have been working with master's students to get master's projects finalised - this is therefore the largest focus of the BIG team in 2022 and 2023 - to graduate master's students and build a recruitment pool for PhD students. Through these student projects, we also create forms of knowledge transfer with external parties, including companies, NGOs, governmental organisations, etc. who act as end-user communities who can pose problems that

the students can use their masters' projects to solve. Through this, we also create an increasing community of students and projects that are acting as knowledge transfer and in the generation of long-term sustainable impact from the BIG project. Due to the inception period of BIG now, the use of master's students is, therefore, the strongest link between the External and the Internal Knowledge partners/parties.

5.2. External

Multiple parties outside of DCentral and IST will benefit from the knowledge generated and transferred by DCentral. These include partners from multiple areas, including the public and private sector, academic institutions, and the general public, such as students, researchers, similar labs across the world, industry partners in Lisbon´s lively corporate and start-up ecosystem in particular in the area of blockchain and cryptocurrencies - as well as Public Sector Partners, Communication and Dissemination organisations, and cultural organisations, which can benefit the knowledge generated. Expected stakeholders include entities like UNESCO, The Portuguese Blockchain Alliance, companies such as Zharta and Anchorage, the University of Lisbon's Law School, Florida University, Purdue University, Imperial College London, local and national policymakers, the World Economic Forum, the cybersecurity academic community (attendees of high impact conferences such as *CCS*) the human-computer interaction academic community (attendees of high impact conferences such as *CHI*), the political economy academic community (readers of high impact journals such as *Regulation and Governance*.), and the networking community (attendees of high impact conferences such as *MSWIM*).

6. Staffing and Resources

In terms of resources, the IST has the Technology Transfer Office and its three pillars are: 1) Higher Education, 2) Research Development and innovation and 3) Technology Transfer (Figure 1). Established in 1910, it has been the pioneer in Portugal in the protection of intellectual property as a way to maximise its value, being the Portuguese entity with the largest number of registered patents, the majority resulting from research projects involving companies.

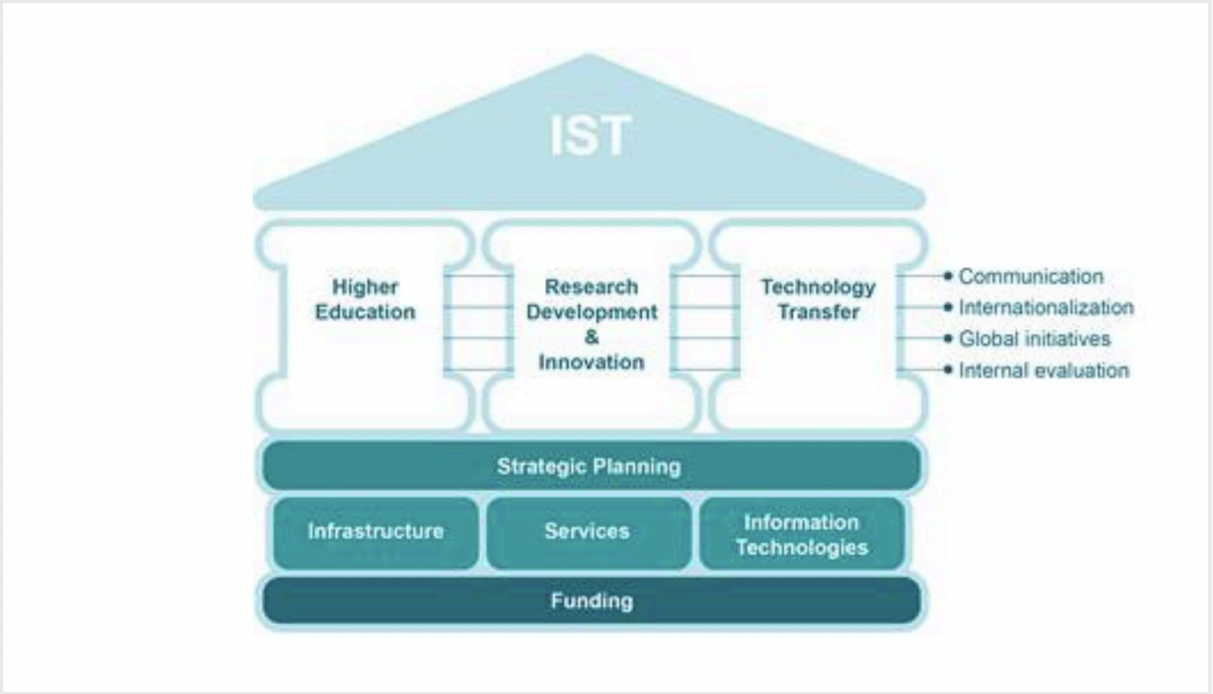

Figure 1 - The IST´s Technology Transfer Office strategic pillars.

Some of the startups that spun out of IST have licensing agreements for the exploitation of intellectual property rights of IST or its associated research centres.

Aiming to recognize the entrepreneurial spirit of its former students, researchers and professors, IST created the IST SPIN-OFF Community to bring together technology-based companies with connections to IST. These companies have permission to use the Community trademark logo to be identified as a successful example of IST's impact on Society.

The TT@Técnico is composed of two units: the Intellectual Property Unit and the Business Partnerships Unit, supported by 4 staff members.

The BIG project also collaborates with the Research and Development and Innovation Organization (R&D+i) in the fields of Computer Science and Electrical and Computer Engineering INESC-ID. Recognizing the importance of Technology Transfer at the department level, INESC-ID has created the Innovation Management Office (IMO), led by Senior Researcher Filipa Borrego, who was a Portuguese National Contact Point for the Security theme of the European Framework Programme Horizon 2020 (H2020) and a Portuguese National Expert for the Committee of Information and Communication Technologies (ICT) of H2020.

We will collaborate closely with IST´s technology transfer office which has oversight of the university's technology transfer, as well as the know-how on how to operate in Portugal. Furthermore, we assume a commitment that the support team (SRM and Lab Technician) will work together to continue to promote synergies between both labs, building on existing resources.

7. Knowledge transfer strategy, methods and tools

We wish to have an agile and flexible approach to knowledge transfer. Therefore, we state our strategy below, and we will adapt the tools according to our Knowledge Transfer Goals.

1. Identify knowledge to be transferred;
2. Identify knowledge holder(s);
3. Identify knowledge type (Explicit or Tacit);
4. Identify interested party/parties
5. Identify partners who can aid in knowledge transfer (if applicable)
6. Choose the method(s) of knowledge transfer for optimal impact
7. Choose venue(s) of knowledge transfer for optimal impact
8. Choose a lens for knowledge transfer for each interested party
9. Transfer knowledge.

In the table below we highlight some of the methods of Knowledge Transfer

	Explicit	***Tacit***
Internal	• Group Meetings • Classroom Activities • New Courses • Research Meetings • Email Notifications • Internal Site • Documentation • Free Open Source Software • Shared Data	• Mentorships • Thesis work • Workshops • Demos • Living Lab Access • Collaborative Projects
External	• Seminars • Summer Schools • Conferences • Academic Publications • Media Articles • Blog Posts • Social Media • Policy recommendations • Video Hosting Sites • Free Open Source Software Releases • Published Data • Spin-out companies	• Personnel Exchange • Workshops • Demos • Living Lab Access • Collaborative Projects • Consulting • Spin-out companies

8. Barriers to Knowledge Transfer

The transfer of knowledge is a complex task that can have many barriers - this section of the report covers some of the barriers that have been identified so far within the BIG project at IST and plans around how to overcome them.

IST is a university with a strong tradition of knowledge transfer, as it is illustrated by the number of spin-offs and industry collaborations. While IST has a strong track record, the issues of staff with experience in modern knowledge transfer within university organisations is somewhat lacking. IST lacks a modern approach to for example:

- **Attracting and retaining industry investment.** IST still approaches this strictly from an IPR / Intellectual property perspective. The nature of software and technologies such as blockchain, however, require a far more nuanced approach to these issues. As a result, the ERA Chair recommends that the KTP of other universities across the EU are assessed and more flexible models developed to manage the new era of technology and knowledge transfer. BIG has attempted to start developing deeper collaborations through the Recovery and Resilience Plan (PRR), funded by the EU for post covid recovery), collaboration between academia and industry partners is mandatory.
- **Assisting students to create viable spin-outs.** IST has a strong track record of spin-outs and this is something that can be useful for both IST and the Lisbon area to continue to encourage. The ability of students to spin out companies seems to be slightly associated with luck right now, however, with those students who meet the right professors or have the right family connections. There is room, therefore, for some structure around entrepreneurship activities within both the Computer Science (DEI) and the Management (DEG) departments that enables all students to think about creating a spin-out and possibly aligning that with VC / Accelerator companies in the Lisbon area.
- **Transfer of PhD knowledge.** IST produces high-quality PhD students however there are not enough research career paths available for PhDs across Europe. As a result, it might be useful to contemplate creating a specific spin-out path for PhD level projects - e.g. similar to Conception-X in the UK. This enables the transfer of knowledge far beyond paper outputs
- **Transferring Scientific Knowledge (Papers):** IST continues to have a strong record of publishing in high-quality journals in various fields, however, there is less success in transferring that knowledge into real-world impact. Scientific communication, outreach, and engagement with broader society can all be improved. We will use the BIG project to work with professional science communication teams to improve science communication.

9. Training

As mentioned previously, we will draw on existing Knowledge transfer infrastructures at IST.

Outside IST, we are also part of a consortium of companies and Universities funded by the Plan of Recovery and Resilience (*PRR*), integrated with partners such as Pedro Roseiro, a member of the Innovation Global Network, with more than 25 years of experience working at the intersection of industry and academia, with particular expertise in Local and Regional Government domains. He

cooperates actively on strategic planning activities, Information Systems alignment, Organisational Learning and Performance Evaluation at Municipalities. As an Executive Board Member at Associação TICE.pt, the Cluster in the domains of Information and Communication Technologies and Electronics, compassing all the value chain in TICE in the regions of Lisbon, Braga, Porto, Coimbra e Lisboa. Despite pending funding for our proposal, we have established links and a network of partners we can draw on.

Furthermore, we also wish to draw on successful examples of Knowledge Transfer between academia and industry at the international level.

10. Deliverables and Success Metrics

The Knowledge Transfer Plan is a deliverable from Work Package 4 (Deployment of BIGLab, Test Beds and Living Lab) of the BIG Project.

As highlighted on our proposal, some of our Knowledge Transfer Plan´s KPIs, objectives and Success Metrics are:

Type of indicator	**Indicator**	**Knowledge Type**
KPI	Number of industry partners involved in the partnership	Both explicit and tacit and External
KPI	Number of end-user organisations involved in the partnership	Both explicit and tacit and External
KPI	Number of external partners using the BIGLab annually	Both explicit and tacit and External
KPI	Annual number of non-technical publications targeted at stakeholders to promote knowledge transfer and the exploitation of research results	Both explicit and tacit and External
KPI	Annual number of research exchanges (>5 days) between INESC-ID and LARSyS researchers and other research partners regarding blockchain themes	Both explicit and tacit and External
KPI	Annual number of researchers trained on EU Framework Programs	Both explicit and tacit and Internal
KPI	Number of top-level researchers working on blockchain themes attracted to Técnico - Lisbon	Both explicit and tacit and External

Type of indicator	Indicator	Knowledge Type
KPI	Researchers with PhD involved in the Blockchain LARSyS and INESC-ID joint-research group	Both explicit and tacit and Internal
KPI	Annual number of peer reviews by the advisory board of the BIG research programme	Both explicit and tacit and External

KPI	Annual number of new graduates from Técnico involved in innovative Master training (MEng) on blockchain themes	Both explicit and tacit and Internal
KPI	Percentage of new graduates from Técnico involved in Master training on blockchain themes with industry partners	Both explicit and tacit and both Internal and External
KPI	Annual number of new graduates from Técnico involved in innovative Doctoral (PhD) training on blockchain themes	Both explicit and tacit and Internal
KPI	Percentage of new graduates from Técnico involved in Doctoral training on blockchain themes with industry partners	Both explicit and tacit and both Internal and External
KPI	Annual number of papers on blockchain themes in peer-reviewed high impact journals (Q1) or top conferences (A or A*)	Explicit and External
KPI	Annual number of contracts with public and private organisations to provide services regarding DLTs and blockchain technologies	Both explicit and tacit and both Internal and External
KPI	Annual number of innovations/research results adopted by end users to develop practical applications of DLTs and blockchain	Both explicit and tacit and both Internal and External
KPI	Annual number of EU funded projects focusing on DLTs and blockchain themes involving LARSys and INESC-ID as partner	Both explicit and tacit and both Internal and External
KPI	Annual number of EU funded projects focusing on DLTs and blockchain themes involving LARSys and INESC-ID as coordinator	Both explicit and tacit and both Internal and External
Type of indicator	Indicator	Knowledge Type
Success metric	600K€ of Horizon 2020 funded projects per year in 5 years;	Both explicit and tacit and both Internal and External
Success metric	500K€ / year of industry / end-user funding in 5 years	Both explicit and tacit and External
Success metric	5 new pilots / prototypes and 1 testbed after 5 years	Both explicit and tacit and External
Success metric	5 researchers/faculty per year working in industry sabbaticals or partly funded by industry contracts	Both explicit and tacit and both Internal and External

Action Plan

This plan outlines activities we have performed or will perform in order to transfer knowledge to target internal and external groups outlined in the sections above.

Type of Activity	Activity Name	Target Group(s)	Knowledge Transfer Method	Knowledge Type Transferred	Deadline	Status	Additional Information
Publication	ERA Chair Grant Announcement	Internal, general public	Internet Site	Explicit	04/2020	Completed	Published on IST's Website
Outcome	Project Website	All	Internet Site	Explicit	09/2020	Completed	Updated and made publicly available
Outcome	Announce the selected ERA Chair	All	Internet Site, Social Media Posts	Explicit	05/2021	Completed	Published on Project Website and Social Media
Outcome	Announce the selected ERA Chair Team	All	Internet Site, Social Media Posts	Explicit	10/2021	Completed	Published on Project Website and Social Media
Event	Kick-off Meeting	All	social media, direct mail, websites, in-person networking,	Explicit	11/2021	Completed	

			video hosting sites				
Publication	Research Team Blog Posts	All	Internet Site, Social Media	Explicit		Ongoing (3 of 5 published)	
Class	5 Classes in Blockchain and Blockchain-related themes	Graduate and Undergraduate Students	Presentations, Projects	Explicit and Tacit		Ongoing	Over 300 students
Event	Horizon Grant Application Training Sessions	ERA Chair Team	Presentations	Explicit	06/2022	Completed	Attended 3 Sessions
Event	ERC Grant Application Training Sessions	ERA Chair Team	Presentations	Explicit	06/2022	Completed	Through Enspire Science
Event	Blockchain Hackathon	Professional Community, Graduate Students, Academic Community	Projects	Tacit	11/2022	In Planning	
Event	Blockchain Summer School	Graduate Students, Professional Community	Presentations	Explicit	07/2023	In Planning	
Event	Blockchain Conference	Graduate Students,	Presentations	Explicit and Tacit	09/2023 (?)	In Planning	

	Hosted by BIG ERA Chair Team	Academic community					
Outcome	Creation of Living Lab	Professional Community, Academic Community, ERA Chair Team	Living Lab Access	Tacit	11/2023	Ongoing	
Exchange	Faculty Secondment	Academic Community, ERA Chair Team	Projects, Presentations, Meetings	Explicit and Tacit	Ongoing Throughout the Project	Ongoing, One Completed	Secondment of ERA Chair Team Member or Investigator to a partner university
Outcome	Student Mentorship	Graduate Students	Presentations, Projects, Meetings	Explicit and Tacit	Ongoing Throughout the Project	Ongoing	Masters and PhD student mentorships in the area of Decentralisation and Blockchain
Exchange	Masters Student Secondment	Graduate Student	Projects, Presentations, Meetings	Explicit and Tacit	Ongoing Throughout the Project	Ongoing, Three Completed	Hosting visiting students working in the area of Blockchain
Outcome	Conference Presentations	Academic Community, Professional Community	Presentations	Explicit	Ongoing Throughout the Project	18 Completed	
Outcome	Relevant Article Publications by	Academic Community	Presentations	Explicit	Ongoing Throughout the	2 Completed	

	ERAChair Team				Project		

Conclusion

We have presented our Knowledge Transfer Plan (KTP) in the context of the BIG project, where we layed out the Knowledge Transfer (KT) goals. We reflected on the importance of KT and what knowledge to transfer. We have proposed our process, the parties involved in it, the staffing and resources required as well as our KT strategy, methods and tools. We have also considered barriers to KT, the training required and sources for effective KT and linked the KT to our deliverable, as well as the different types of knowledge highlighted (Explicit and Tacit as well as Internal and external against our KPIs and Success Metrics. Finally, we have provided a detailed action plan of our completed and planned knowledge transfer activities.