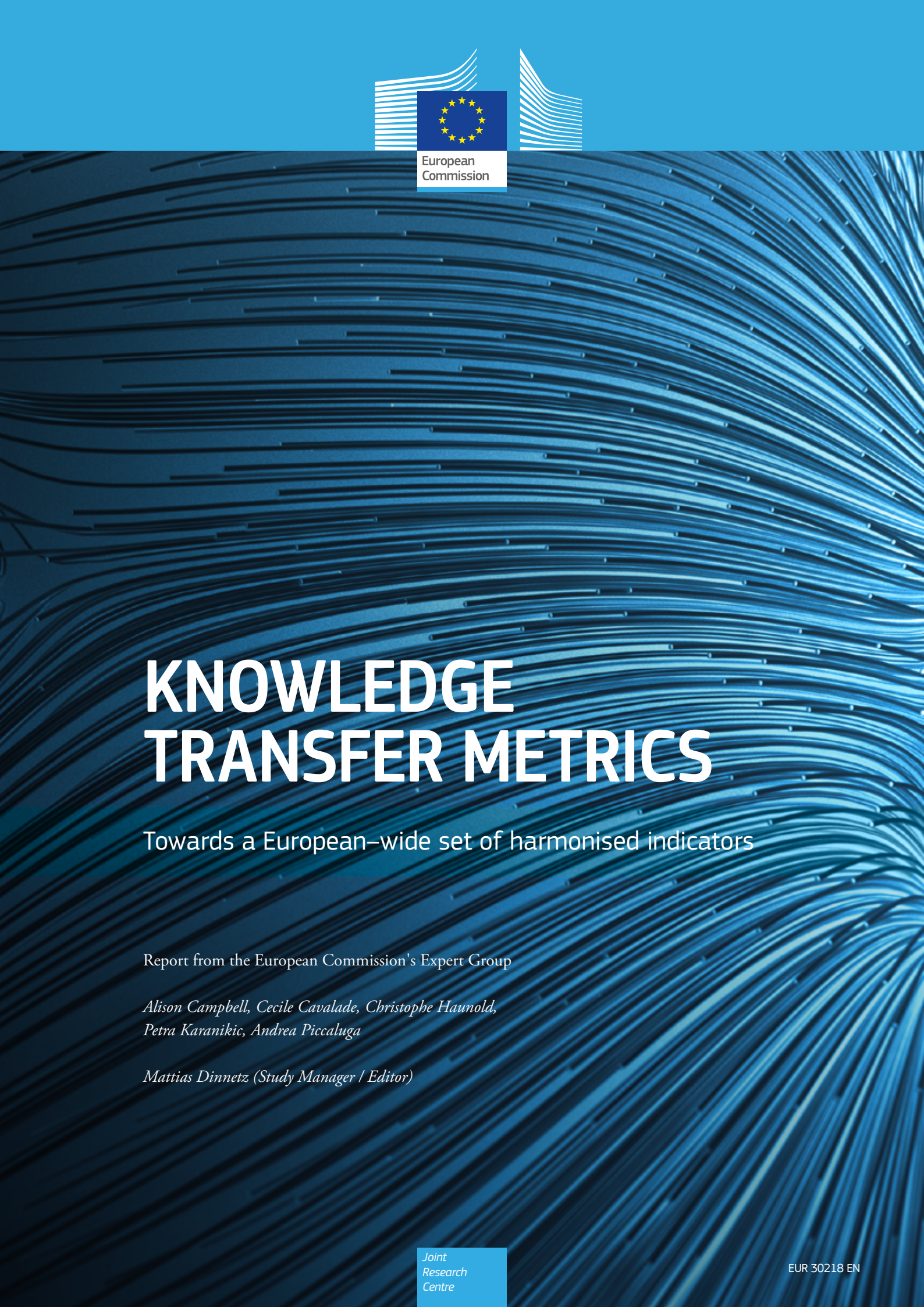

KNOWLEDGE TRANSFER METRICS

Towards a European-wide set of harmonised indicators

Report from the European Commission's Expert Group

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KNOWLEDGE TRANSFER METRICS

Towards a European–wide set of harmonised indicators

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Foreword

This report has been prepared by an Expert Group on Knowledge Transfer Metrics appointed by the Competence Centre on Technology Transfer of the EC's Joint Research Centre in partnership with the Association of European Science & Technology Transfer Professionals (ASTP).
The group undertook the study in the period September 2019 – February 2020.
Additional input has been provided by through individual and group consultations.
All individuals have contributed as experts and practitioners and not as representatives of their respective Member States or organisations. The views expressed in the report are those of the Expert Group and do not necessarily represent the views of the European Commission, any Member States, or any organisations with which any member of the Expert Group is affiliated.

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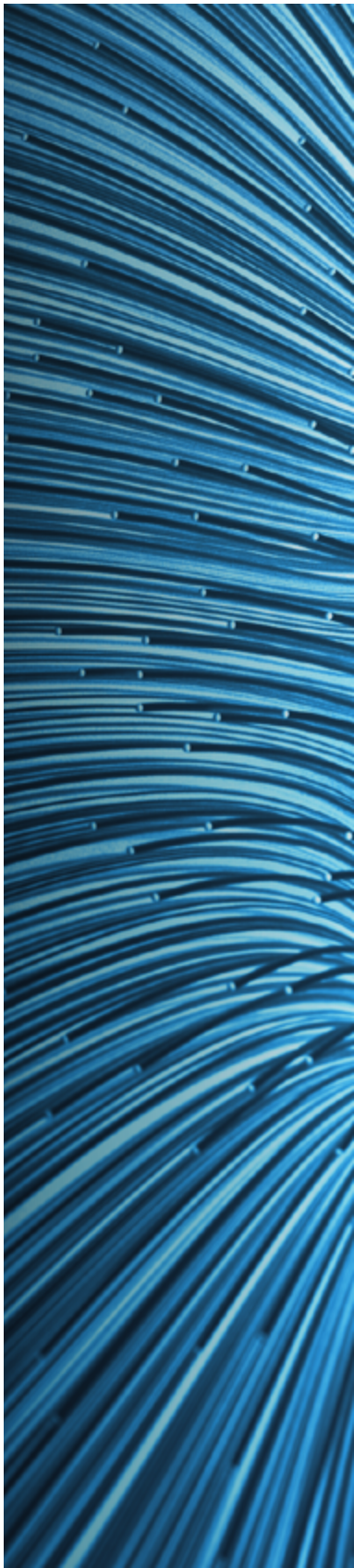
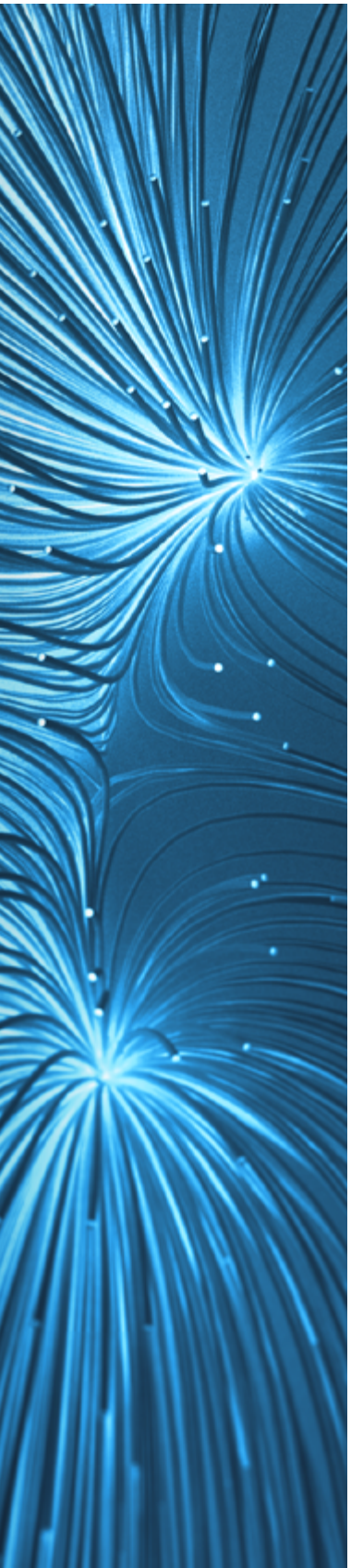




1. INTRODUCTION

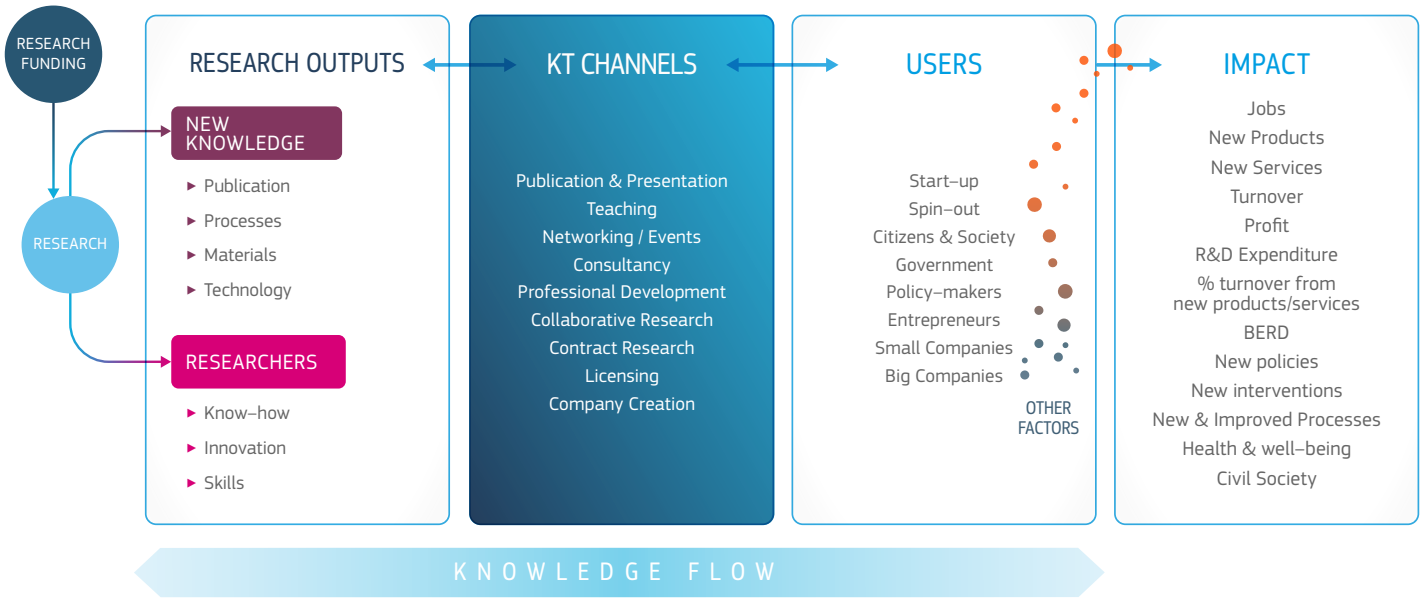
Knowledge Transfer (KT)[1] aims to maximise the two–way flow of technology, IP and ideas. In turn this enables companies (existing and new) or other non–academic organisations and the public sector, to drive innovation leading to economic and social benefit and enables publicly funded research organisations (PROs)[2] to advance research and teaching. KT is now a recognised activity in which PROs are expected to engage and has been adopted as a part of the "third mission" alongside teaching and research by many, but by no means all, PROs and universities across Europe. For many, KT is seen as an essential source of innovation and a mechanism for the dissemination of research results.

KT and commercialisation is usually a long and risky process, involving many factors and actors external to the research institution. This is best illustrated in the schematic below, modified from Cullen.[3]

There has been much evolution over the past twenty years which has seen the concept of knowledge transfer move from the more traditional concept of commercialisation and monetisation towards a more rounded approach which supports both co–creation and the dissemination of research results with, and to, non–academic third parties. This has become increasingly striking since the earlier work of the previous Expert Group of 2009 which reported on EU–level metrics and has a bearing on this current report. Funders and recipients of public research alike recognise the need to demonstrate, in the broadest sense, the value return from this investment.

With KT and its impact now in sharp focus, there is an excellent opportunity to further explore the development of common and consistent European indicators for KT and their adoption.

Figure 1: Knowledge Transfer: from research to impact



1 There are several terms in use to describe the processes of knowledge valorisation. Knowledge Transfer (KT) and Knowledge & Technology Transfer (KTT) are often interchangeable. Technology Transfer (TT) tends to refer to research commercialisation and may be considered a subset of KT. This report will use the KT terminology.

2 Publicly Funded Research Organisations (PROs) includes universities, colleges and other governmentally research institutions. The term PRO is used in this report.

3 Available at: *http://www.innovationbycollaboration.se/wp-content/uploads/2015/09/Kevin-Cullen.pdf*

There is a heterogeneity in terms of national and local policy, legal and regulatory context, resources, public support, organisation and syndication of KT stakeholders. The nature of the organisation participating in a survey will also affect the data and analysis, for example public vs private universities, universities with medical schools, research hospitals etc. These will determine KT results. Achievements against indicators therefore need to be assessed holistically which means that simple "benchmarking" of outputs is dangerous and the search for a single indicator is neither helpful nor meaningful. Simply put, indicators are a tool, not an end in themselves. The use of indicators has value beyond simple assessment of outputs, offering a window on progress which, in turn, can inform and influence policy and practice. The users of such information include the research producers, their institutions, their KTOs and governments, ministries and policy makers. In addition to an underserved audience, the public.

A challenge when considering indicators is that quantitative indicators, such as financial data or intellectual property assets, are insufficient to describe the complexity of knowledge transfer and commercialisation processes and their longer–term impact. This is recognised by the major international KT associations. For example, AUTM produces the "Better World"[4] case studies to complement its Annual Licensing Survey, CURIE has produced a summary of "20 years KT Successful stories"[5] and Knowledge Transfer Ireland publishes impact case studies as part of the national Annual Knowledge Transfer Survey[6].

However, having a core set of data, along with consistent underpinning definitions provides a route for comparative and longitudinal analyses, provided the viewer is suitably aware of the complexity of the field to appreciate an informed analysis. This has been a responsibility for the Expert Group — to provide not just recommendations for core indicators and routes to their adoption, but also on interpretation of those indicators which necessarily includes expansion to input indicators which set the outcomes in context.

In reaching its recommendations, the Expert Group consulted widely across the Member States and beyond and considered current data collection and the literature on the topic. The Expert Group would like to thank all those who contributed to its work. The conversations were frequently insightful and enlightening and the group gained a strong sense of the dynamism and expertise that has developed across the EU, putting us in a strong position to deliver across the breadth of KT practice and policy. Additional thanks are due to the European Commission Joint Research Centre (JRC) for continuing to lead on this topic, providing the impetus to share EU practices and develop a common framework which is useful for academia, practitioners, commentators and society.

4 Available at: *https://autm.net/about-tech-transfer/better-world-project*

5 Available at: *https://www.curie.asso.fr/IMG/pdf/2019_indicateurs_de_la_valorisation-2.pdf*

6 Available at: *https://www.knowledgetransferireland.com/Reports-Publications/KTI-Review-and-Annual-Knowledge-Transfer-Survey-2018.pdf*

2. EXECUTIVE SUMMARY

At its heart, KT is about getting research and expertise put to use which, by its nature, is wide–ranging and complex. In practice, KT indicators that have been adopted internationally are diverse and range far wider than the traditional measures of patenting, licensing, number of spin–offs and revenue. In many countries they extend over different channels of industry engagement *e.g.* including research collaboration and often move beyond industry to encompass other "non–academic" users and engagers. The recommendations in this report take this into account, whilst striving to present a limited set of core indicators.

A word of warning. Output indicators cannot be assessed in isolation. Context matters. Often overlooked is the fact that KT indicators are a measure of the performance of the PRO and not of its KTO[7]. KT and impact are not the sole responsibility of the KTO. The KTO provides a professional service function within the overall PRO context and the PRO mission, environment, priorities and support determine its activities and performance.

Recommendations are summarised below and elaborated in Chapter 6.

7 Knowledge Transfer Office (KTO) may also be referred to as Technology Transfer Office (TTO), Innovation Office or similar variations. For this report the terminology KTO is used.

1 Scope of KT Indicators

Indicators should reflect the range of KT channels and not be limited to licensing and spin–offs.

2 Core indicators set

Indicators should include both inputs and outputs which fall into four groups:

Inputs		Outputs	
Internal Context	Environment	Activity	Impact
PRO & KTO character-istics	National factors that influence	Delivery through KT channels, PRO/KTO actions	Longer term economic and societal returns

3 Evidence–based case studies

Numbers alone are insufficient to understand the outcomes from KT and the data must be complemented with evidence–based case studies.

4 Tracking the development status of KT

Harmonised indicators should not be viewed as a league table of good or bad performance. Their value is in allowing the developmental status and trajectory of KT to be understood and used as the basis for continuous improvement.

5 Common definitions

A common set of definitions should be adopted, consistent with those used in the major international longitudinal surveys, as proposed by the 2009 Expert Group.

6 Implementation Expert Group

A further Expert Group should be convened by the EC JRC to work with stakeholders, at KTO and senior levels in PRO, to gain consensus on adoption of the indicators and mechanisms to implement.

7 Eu–wide centralised collection and reporting

EC should explore a centralised approach for an EU–wide KT data collection and reporting involving an organisation that understands KT and is recognised by the KT profession.

8 Integrated database

EC should support the creation and management of a central database as a repository for EU–wide PRO KT data.

9 Involvement of governmental bodies

Governments and their Ministries and Departments should encourage and incentivise their PROs to engage in KT, to collect data and to report on performance.

10 EC cross programmes consistency

The EC should itself develop a common set of indicators across its programmes that support KT and research.

3. CONTEXT

The European Commission Joint Research Centre (JRC) convened an Expert Group to consider how best to progress towards an EU–wide set of harmonised metrics for knowledge transfer in PROs (including universities). The tasks identified were to:

- Explore with those active in knowledge transfer across EU Member States the appetite for harmonised metrics and the factors that would influence their adoption
- Review the 2009 seven core and seven supplementary performance indicators for PROs and test their validity in 2019
- Recommend a set of harmonised core indicators and a methodology for their adoption

The Expert Group was set up in partnership with the European Association of KT professionals (ASTP), under the framework of the MoU signed between EC JRC and ASTP. The Expert Group drew on ASTP's support in engaging with members of the various national KT associations and in sharing experience of managing a pan–European data survey[8].

The current study builds on the Finne et. al. report (2009), from the previous Expert Group, which set out to address the need for comparable metrics across Europe. In that report, the group identified indicators used in existing recurrent surveys and recommended seven core and seven supplementary performance indicators for PROs served by KTOs, providing a harmonised set of definitions for them. They further proposed an implementation plan consisting of: (1) gaining agreement of current survey owners on adoption of core indicators; (2) setting up arrangements

8 Available at: *https://www.astp4kt.eu/publications*

for the accumulation of data from differing surveys and; (3) creation of a forum for discussing potential expansion into other KT channels.

This current study was commissioned by the EC JRC to kick start the next phase of the work. Since 2009, there has been a growth in the number of KT offices in the EU Member States and the past ten years has also seen the creation of a number of national KT professional associations and informal national forums. This reflects the importance placed on KT as a mechanism for the dissemination of research results and access to knowledge and expertise and as an important conduit for the valorisation of research for social and economic benefit. Against that backdrop, it has proved timely to undertake this study.

There are three main categories of organisations for whom indicators are relevant:

i) **governments/ministries/policy makers/ funders** are interested in evaluating outcomes of public investment in research. This may be in terms of short and longer–term contribution towards society and the economy and may be viewed at the level of a single academic, a research domain and/or the research institution. These organisations are also interested in indicators to inform policy and strategy decisions. Often the desire to qualify a short term "success" can be at odds with the longer–term impact. According to Peters (2019) performance ranking in KT is a complex and delicate issue and contrasting views often emerge and, in themselves, KT indicators should be considered only as one of the many components used to assess PRO's contribution to society;

ii) **rectors/universities/PROs** use TT indicators to demonstrate their contribution to society to different types of stakeholders in a period in which this kind of accountability is particularly important as well as to monitor their performances in this field (Jensen et al. 2009; Rossi and Rosli 2015). This group will also be interested in the analysis of indicators to inform strategic and operational decisions.;

iii) **Knowledge and Technology Transfer Offices (KTOs)** use indicators to monitor their performance, make comparisons with other offices/countries and to support reporting and communication both within and outside the PRO (Cesaroni and Piccaluga, 2016). Again, this group also find indicators useful to inform strategic and operational decisions.

This current study has afforded the opportunity for a meaningful engagement with the KT community across Europe, in both those countries with a well–established KT system and, significantly, in those where a professional KT infrastructure is evolving.

The group met seven times (in person and by videoconference) between September 2019 and February 2020. It reviewed the 2009 recommendations, interviewed 29 individuals in 25 countries, including those representing 26 formal and informal national KT associations and assessed the current provision of national data and the literature on the topic. This informed the initial recommendations of the Expert Group which were tested at a meeting hosted by the EC JRC in Brussels in January 2020 and with the ASTP National Associations Advisory Committee (NAAC). The final recommendations are presented in this paper.

4. LITERATURE REVIEW

Publications on measuring knowledge transfer and its effectiveness include academic papers, government commissioned reports and practical reports and commentaries from knowledge transfer associations and governmental agencies. Whilst there are differing views depending on perspectives, there are also some common themes that have arisen in the literature. Expanded metrics are not new. Back in 1990, Souder et al. suggested counting the number of new products resulting from TT.

Following on from the 2009 report from Finne et al. described earlier, a further report was issued in 2011 which explored the concept of a composite indicator for KT. The authors identified three categories of component KT indicators: (i) KT through trained people; (ii) institutional co–operation and other phases of innovation and; (iii) commercialisation of research (Finne et al., 2011). The report offered a weighted, aggregated and normalised model to bring together 22 component indicators to produce a composite. The model is complex and may not be easy to apply and focuses only on output indicators. In terms of information required, while it is recognised that certain data will be difficult to gather, the model also illustrates the importance of having a knowledge transfer survey in place.

Indicators of KT have tended to be confined to commercially oriented output indicators such as invention disclosures, priority patent application, patents first granted, revenues from IP, contract and collaborative research agreements, spin–offs and start–ups created, with volume of activity and revenue return being the most utilised.

This can be seen in surveys and reports from national associations such as AUTM in its USA and Canadian Licensing Survey[9] and the ASTP Annual Survey and in papers such as that from Jensen et al. about Australia. The Jensen paper also talks to other KT channels such as networks, continuing professional development (CPD), consultancy and teaching. Another common perspective in reports and in the literature is to view KT as an activity confined to the STEM disciplines. The UK HEBCI survey[10] and UK REF[11] exercise are notable exceptions.

Holgersson and Aaboen (2019) explain that as PRO/ universities expand beyond teaching and research to include the "third mission" there is a transition from an *appropriation* to a *utilisation* mode, which would lead to the use of some additional indicators. Recently, the US Association of Public Land Grant Universities (APLU) recast the role of technology transfer (research commercialisation) in the report which it published in 2017, Technology Transfer Evolution: Driving Economic Prosperity[12].

Agasisti et al. (2019) have evaluated the impact of several academic activities (among which KT, measured as the number of spin–offs) on local economic development. Some countries, aware of the necessity of moving towards a broader assessment of KT which should encompass impact on society, have started to launch evaluation exercises which include both new quantitative indicators and new qualitative tools. For example, the Performance Review of the Australian Innovation, Science and Research System[13] considers knowledge creation, knowledge transfer and knowledge

9 Available at: *https://autm.net/AUTM/media/SurveyReportsPDF/AUTM_2017_US_Licensing_Survey_no_appendix.pdf*

10 Available at: *https://www.hesa.ac.uk/data-and-analysis/business-community*

11 Available at: *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/768162/research-excellence-framework-review-evidence-report.pdf*

12 Available at: *https://www.aplu.org/library/technology-transfer-evolution-driving-economic-prosperity/file*

13 Available at: *https://www.industry.gov.au/data-and-publications/performance-review-of-the-australian-innovation-science-and-research-system-2016*

application and proposes a balanced scorecard approach to national research and innovation performance that takes into account some environmental factors.

There is much literature on the specific types of indicators that might be used. Sorensen and Chambers (2008) suggested a new indicator — access metrics — which refers to the extent to which the KTO facilitates access to knowledge produced by the PRO. In the context of the US Federal Laboratory system, Choudhry and Ponzio (2019) have proposed expanding indicators to assess the efficiency of commercialisation of which partnerships with industry is put forward as a component of US technology transfer activity. The use of indicators in academic–industry partnering decisions and performance assessments is an interesting topic.
At a recent Summit at Oxford University (2019), that brought together a triple helix of industry, academia and government agencies, the consensus was that while metrics may be useful there are other factors that determine partnership development and project success, a key one being the quality of the relationship[14]. Exploring the drivers for university–industry engagement, Perkmann et al. (2011) conclude that there are different motivations for engagement across the scientific disciplines (including the social sciences) and these do not appear to involve consideration of KT indicators. Rossi and Rosli (2015) make the case that a variety of innovative indicators should be used in order to better represent the complex and multifaceted phenomenon of KT and avoid undesirable incentive effects. This is a particularly relevant issue since different PROs might be more oriented towards KT activities which are non IP–based and which might be poorly captured by traditional indicators. The authors argue that in order to assess all the different types of KT performed by PROs "a possible approach could be to recognise that institutions are different and may require different sets of indicators, for example by developing a very broad range of indicators representing all possible activities, and allowing universities to choose the indicators that best fit their "KT profile".

In their literature review, Phan and Siegel (2006) find that efficient knowledge transfer depends on the characteristics of the institution, such as its research focus, the incentive structure, and organisational characteristics of the KTO. At the level of KTO, Scanlan (2018) proposed the use of a maturity model to assess the capacity and capability of a PRO to support KT. Whilst the KT Office Maturity Model is not in itself an indicator it offers a strategic development tool both for KT management and senior PRO management.

Consideration of the KT profile extends to the profile of the KTO. Kreiling and Scanlan (2020) propose a model to formalise the characteristics of the KTO with 11 quantitative variables that determine KTO similarity based on key drivers of KT activity in four dimensions: budget for KT, structural characteristics, internal KT culture and external KT ecosystem. This framework approach ('KTO DNA') provides for clustering of KTOs to aid comparison of similar offices, transcending the boundaries of more limited KT output information.

As the importance attributed to KT is growing across Europe, the choice of indicators is crucial. Metrics chosen influence behaviours and outcomes, as explained in the papers by Rossi and Rosli (2015) and Choudhry and Ponzio (2019).
It follows that consideration of the policy objectives and longer–term outcomes and impact are factored into the discussion underpinning the choice of indicators.

14 Available at: *https://www.knowledgetransferireland.com/Reports-Publications/*

5. NATIONAL SURVEYS

There are many national surveys in existence that look at KT metrics and other information. Data may be collected on a voluntary contribution basis by KT associations or may be mandated by government agencies.

The two longest standing surveys are the annual AUTM Licensing Survey which takes in voluntary data from Technology Transfer Offices in the USA and Canada (started 1991) and the annual UK Higher Education Business Interaction Survey (HEBCIS) which is run by the government agency UKRI and to which mandatory data are provided by all UK universities (started 1999). HEBCIS is considered to be the most robust and best longitudinal data set for the sector, due to its breadth, the mandatory nature of the return and data audit. ASTP ran its first survey in 2006 and relies on voluntary contributions from KTOs across Europe.

The latest 2019 survey (for 2017 financial year) presented data received from 475 KTOs across 27 countries. 80% of the data were contributed directly from five national data sets. In Europe, countries undertaking annual KT surveys are listed in *Table 1*.

This study revealed that the rationale and interest in conducting national KT surveys has matured since the 2009 Expert Group report. Consistent at national and individual institutional level was use of data to:

- Track performance and practice development
- Benchmark against comparable institutions
- Make decisions on policy, funding and operations
- Report on return on investment

However, based on the evidence gathered, the Expert Group would challenge whether these objectives can be met based on the current methodologies for data collection. These can be summarised as:

- Inconsistency of definitions for each data set between individual surveys
- Inconsistency in data that are collected
- Incompleteness of national data as not all institutions provide data

Table 1: Countries in Europe undertaking annual KT surveys

Country	Via government agency (or similar)	Via KT association	Published
Belgium		✓	✓
Denmark		✓	✓
France		✓	✓
Ireland	✓		✓
Italy		✓	✓
Spain		✓	✓
Switzerland		✓	✓
UK	✓		✓

Source: Authors

- Optional nature of data return leading to incomplete data returns by institutions and inconsistencies of reporting by institutions from year to year
- Quality of data, which are not routinely validated as part of the collection process
- Heterogeneity of participant organisations which are not disaggregated (*e.g.* universities, PROs, research hospitals, *etc.*)
- Lack of, or lack of ease of access to, complementary information that informs the context of KT in country or within the PRO and without which analyses are dubious
- Extreme difficulty for respondents to access "end–user" data (e.g. jobs, business and economic data, company's data)

The Expert Group interviewed 29 people across 21 EU member states and four neighbouring states[15], working at senior levels in KTOs and government agencies. The questionnaire is available at Appendix 1. Many people interviewed were involved in national KT associations. There was a broad appreciation of the value of national surveys and an appetite to bring more consistency across these. Some inroad has been made to this. As other national surveys have been developed, they have often drawn on these existing surveys to select indicators and definitions. For example, the Irish Annual Knowledge Transfer Survey (AKTS) aligns its definitions in large part with the HEBCIS survey, cognisant of the ASTP survey. However, barriers to development and adoption of EU harmonised indicators were identified and these include:

- Changes to data and definitions may mean that longitudinal surveys are not useful as the datasets may differ over different years
- Inability to access all the information required
- Funders requiring differing data and applying differing definitions – nationally and across EU programmes
- Volume and complexity of data requested leading to non–compliance
- A set of indicators that do not resonate with countries that are in the process of developing KT systems
- Over–reliance on revenue return as a value metric
- Analysis of published data — crude benchmarking where the sector is not understood sufficiently
- How and where data collection and collation is managed – locally and nationally
- Resourcing and costs associated with of data collection for national associations
- Lack of initiative at national level or organisational configuration of national KT networks or government bodies.

15 The UK withdrawal from the EU is in transition phase until 31 December 2020 and is considered within the group of EU member states at this time.

6. RECOMMENDATIONS IN DETAIL

1 Scope of KT indicators

Indicators should reflect the range of KT channels and not be limited to patenting, licensing volume, spin–offs and commercial revenue. KT channels include:

- Publication & presentations
- Teaching
- Networking / Events
- Consultancy
- Professional Development
- Collaborative Research
- Contract Research
- Licensing
- Company Creation

2 Core indicators set

Given the breadth of KT, the significance of underlying factors and the desire to balance complexity with simplicity, it is recommended that a core set of indicators is combined with a supplementary set of indicators and that a number of contextual indicators are also reported. These are based on those used commonly across the EU and more widely and also take into consideration a range of reports on the topic and reflect the conversations held by the authors across the EU member states. The Expert Group has tried to limit the number of core indicators for simplicity of harmonisation. However, these should not be viewed as the only measures that a PRO should use. Other indicators may further illuminate the situation and a range of additional indicators are also provided.

These supplementary indicators may not all be appropriate for every PRO and they are encouraged to pick those that best suit their context.

The indicators recommended in this report include both outputs and inputs and fall into four groups:

Table 2: KT Input and Output Indicators

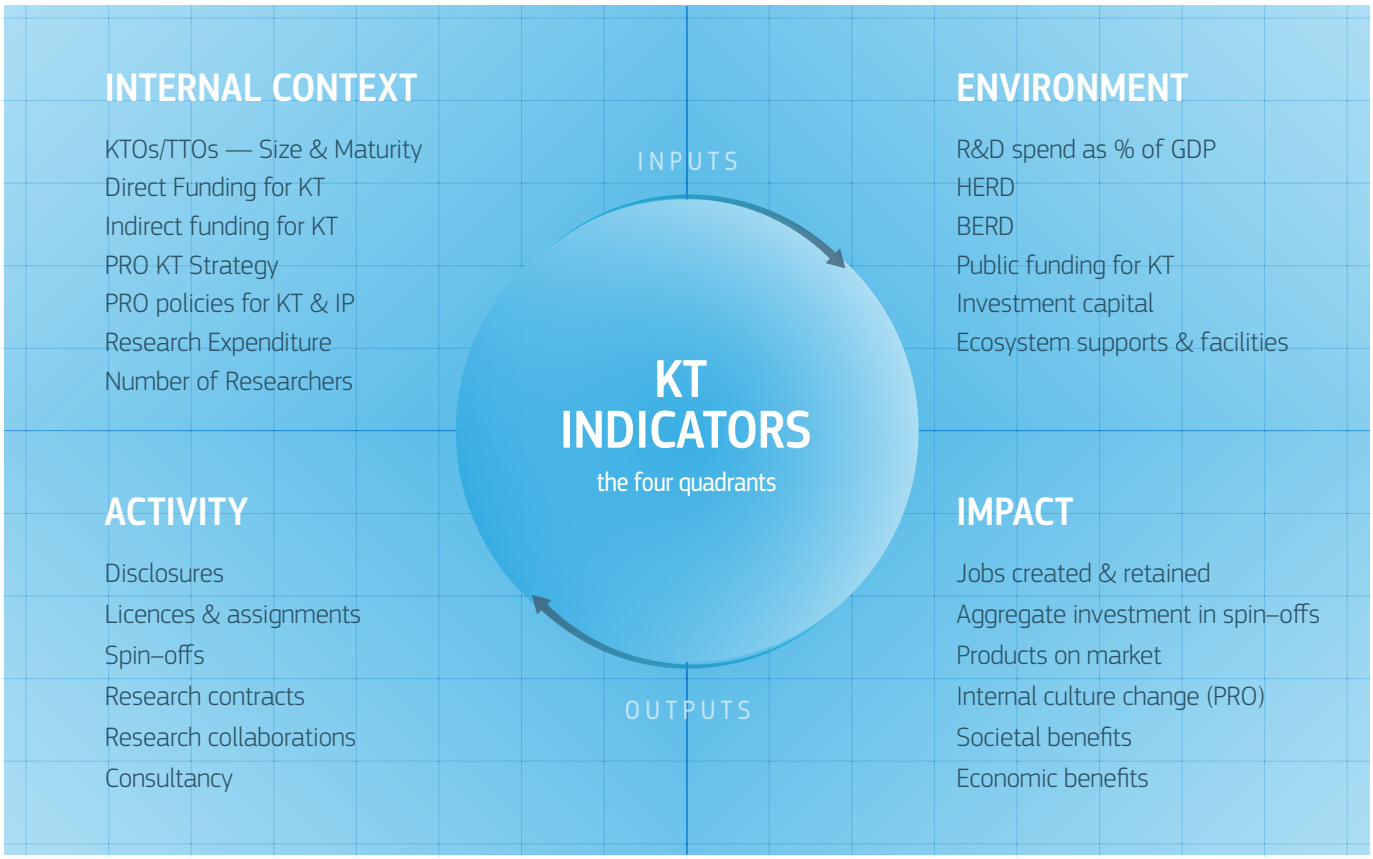
Inputs		Outputs	
Internal Context	Environment	Activity	Impact
PRO & KTO character-istics	National factors that influence	Delivery through KT channels, PRO/KTO actions	Longer term economic and societal returns

Input indicators describe the environment in which KT is performed, both within the PRO and at regional and national level and can have a significant impact on the outcomes that can be achieved. For example, a low level of attention to KT within the PRO through lack of strategy or funding for KT will result in minimal outputs.

Conversely a well–structured KTO operating within a local environment where there is little access to investment capital will be challenged to produce a large number of spin–offs. Similarly, in a country or region with a large component of SMEs and few policy actions and incentives to encourage their engagement in R&D, a well–funded KTO may struggle to achieve a large number of research collaborations.

Data should be collected by year and not be an accumulated figure. Such longitudinal studies will follow from annual data collection. The indicators that will influence knowledge transfer activity and outcomes can best be represented across the quadrant in the figure below.

Figure 2: Input and Output KT Indicators: the four quadrants



2.1 Inputs: Internal Context Indicators

This set of indicators consider the minimum components within a PRO that are required to create a fertile and effective environment within which to carry out KT.

Supplementary indicators are suggested that may allow the PRO to drill further into its operations.

Table 3: KT Internal Context Indicators

Core Indicators	Answer	Supplementary indicators
Existence of PRO KT & IP Policies	Yes / No	—
PRO KT Strategy	Yes / No	—
Direct funding via the PRO for KT *e.g.* to KTO	Yes / No	• Total annual budget for KTO • IP & Patent budget
Indirect funding via the PRO for KT *e.g.* proof of concept	Yes / No	• Annual budget
Existence of KTO	Yes / No	• Number of FTE in KTO • Number of RTTP qualified FTE
Age of KTO	Years	—
Research expenditure in PRO	Total expenditure in year, from all sources of research funding to the PRO including from non–academic third parties	—
Number of researchers*	No	• STEM • Other

* The definition of researcher varies between countries. Pragmatically, the national/ministry practices and definition for researchers is recommended.

2.2 Inputs: Environment Indicators

Environment indicators address the environment external to the PRO. Availability of funding, innovation facilities and the appetite from companies to engage with the PRO will all affect the outcomes from KT that can be achieved.

The supplementary indicators consider the national and regional dimensions and the regulatory and legal frameworks. These require a more narrative consideration.

Table 4: KT Environment Indicators

Core Indicators	Answer	Supplementary indicators
National R&D spend as % GDP	%	—
National Higher Education Expenditure on R&D (HERD)	Value	—
National Business Expenditure on R&D (BERD)	Value	—
Availabililty of public funding programmes to support KT/Industry engagement	Yes / No	• National • Regional
Availability of investment capital	Yes / No	• National • Regional
—	—	Incubators & accelerators • National • Regional
—	—	Local company types *e.g.* SME/ MNC mix, absorbative capacity • National • Regional
—	—	National policy, legal & regulatory environment as it affects KT

2.3 Outputs: Activity Indicators

This set of indicators are the more traditional KT indicators. They encompass volume of activity and revenue across the transactional KT channels.

The core indicators represent the key measures and the supplementary indicators provide more detail and are frequently collected by PROs.

Table 5: KT Activity Indicators

Core Indicators	Supplementary indicators
Invention disclosures (IDF) — number	% of IDFs resulting in license or assignment
Licences & assignments — number*	**Licence by type — number:** MTA Patent, copyright, trademark & know–how Software IP Protection by type: Patent filings Copyright registration Trademark registration Plant variety By type of transaction: Licence Assignment **Other:** % of patents licenced or assigned
Licences & assignments — gross revenue to PRO	**Licence by type — gross revenue to PRO:** MTA Patent, copyright, trademark & know–how Software By type of transaction: Licence Assignment
Spin–offs** — number	**Stage — number:** Formed, pre–investment Receiving first investment Maturity — companies in existence 5+ years Acquired
Spin–offs — gross revenue to PRO from equity sale	—

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Core Indicators	Supplementary indicators
Research collaboration agreements & research contracts with non–academic third parties — number	**Detail by**: Collaborative research (Where both the firm and the PRO participate in the design of the research project, contribute to its implementation and share the project outputs) Contract research (Where all research is performed by the PRO) Further breakdown: Number with companies By other non–academic third parties **Other**: % of Research collaboration agreements & research contracts which have led to IP licence or assignment
Research collaboration agreements & research contracts with non–academic third parties — gross revenue to PRO	**Detail by**: Collaborative research Contract research Further breakdown: By companies By other non–academic third parties Direct funding from non–academic third party Total funding (non–academic third party plus any co–funding *e.g.* from EU, national government)
Consultancy agreements with non–academic third parties — number	**Further breakdown**: By business By other non–academic third parties
Consultancy agreements with non–academic third parties — gross revenue to PRO	**Further breakdown**: By business By other non–academic third parties

* Options have been excluded from the list of indicators. An option is a prelude to a licence or assignment at which stage the company must make a decision to pay for access to, or ownership of, intellectual property. Additionally, an option is frequently embedded into a collaborative agreement to provide a window of opportunity for the partner to consider whether it wishes to execute a licence or assignment. Licences and assignments are therefore considered, in this report, to be the more meaningful.

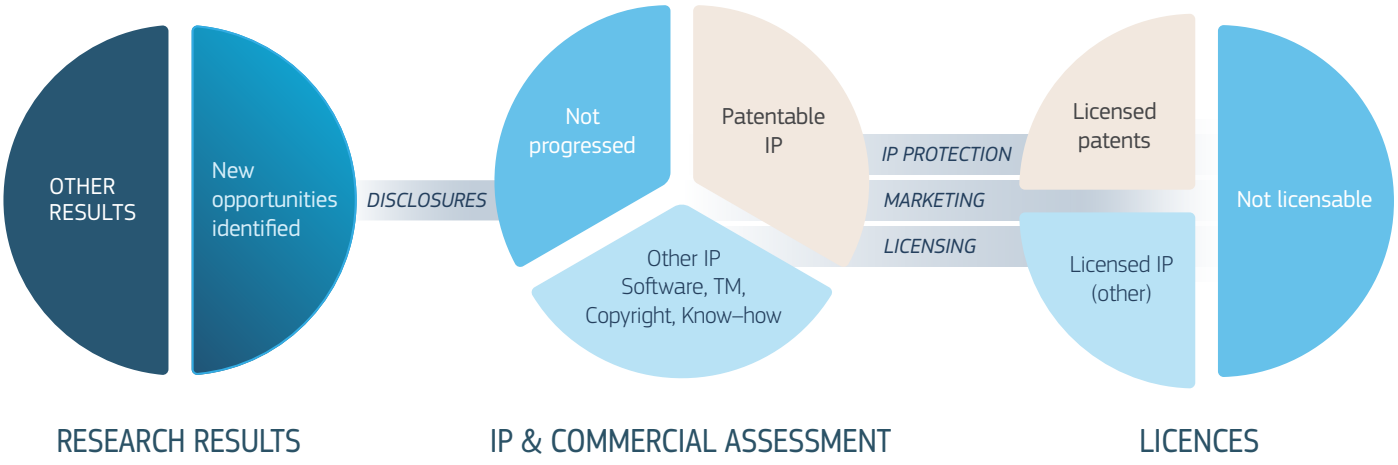
** Spin–off is also referred to as Spin–out and relates to a company formed using PRO IP (see **Recommendation 5**). It is different from a Start–up. While a more complete picture of KT at the PRO could be built by measuring start–ups that do not rely on PRO IP and student–led start–ups, as these tend to be created outside of the purview of the PRO administration they are notoriously hard to track. Where they are recorded, particularly student start–ups, this will tend to be on the back of a specific programme run through the PRO. As such, although important, these indicators do not form part of the recommendations for core indicators from the Expert Group.

It may seem curious that the number of patent filings and granted patents are not listed as core indicators. A theme running through the consultations, and a view shared by the Expert Group, is that patenting is an artificial measure of activity, in the sense that patents are important but that they are often misused as KT indicators. The more meaningful indicator is the fate of the IP, *i.e.* whether it can be licenced. This does not diminish the importance of patent filings as a feedstock to licensing and innovation and it is recommended that patent filings are included as supplementary indicators by the PRO, where relevant in the technological fields. However, it should be remembered that patenting activity is dependent on both patent budget and capacity and capability within the PRO to manage patent protection and prosecution.

And the granting of a patent is dependent in large part on the licencee who may have taken over patent prosecution and the performance of the Patent Office itself.

The diagram below represents some, but not all, of the major forms of intellectual property that is licensable. The ratios are for example only and will differ for sector and for PRO. The diagram illustrates that while patenting is an important activity it is by no means the only route by which IP, ideas and technology are transferred to companies for further development towards the market. It also shows that not all disclosures will be commercialised, which may be due to, amongst other things, lack of freedom to operate, the ability to secure IP protection, commercial appetite.

Figure 3: Intellectual property underpinning licence transactions



2.4 Outputs: Impact Indicators

Understanding and measuring impact is gaining more importance as the third mission of PROs develops. In some PROs the KTO remit and function is expanding to include innovation and impact, while in others there are separate functions to support the impact agenda.

Impact is both societal and economic. The indicators proposed below are deliberately limited in number to those for which it should be possible for the PRO to drive. How the information can be captured and relayed, combined with the challenges are described.

Table 6: KT Impact Indicators

Core Indicators	Commentary
Jobs created in spin–offs	PRO will need to retain relationship with the spin–off and/or actively monitor public information. Data harder to access/interpret when a spin–off is acquired.
Aggregate investment in spin–offs	PRO will need to retain relationship with the spin–off and/or actively monitor public information. Data may be difficult to access as company and investors may wish to keep confidentiality.
Products on market	PRO will need to retain relationship with the spin–off or licencee company and/or actively monitor public information. Data harder to access over time due to causality — as the company will often not recall the source of the IP. Easier to collect where the Product is linked to a royalty stream.
Culture change in PRO	Indicators could include: • Percentage of researchers engaged in KT (and change over time) • Net promoter score for engagement in KT • Prominence of KT in PRO strategy • % change in PRO funding for KT/KTO
Societal benefits	Best captured through evidence–based case studies. In addition to IP and technology–based outcomes, many benefits are generated through gaining new knowledge, for example impact on new products or process (pollution, costs, hazard etc); impact on policy; healthcare interventions etc. In many cases the outcomes are a result of access to technology and new knowledge.
Economic Benefits	The broader economic benefits are challenging to capture and will often require externally commissioned expert support. Usually such studies are lengthy and expensive and rely on assistance from the companies and other non–academic “users”. But such studies which may demonstrate Economic Value Added (EVA) and job creation within a region or country can be powerful. They should be undertaken on an occasional basis.

3 Evidence–based case studies

Numbers alone are not sufficient to understand the outcomes from KT and the data must be complemented with evidence–based case studies that describe the benefits across all KT channels.

4 Tracking the developmental status of KT

Harmonised indicators should permit the developmental status of KT to be understood and tracked, enabling more meaningful analysis, strategic and operational planning and continuous improvement — for all stakeholders.

Harmonised indicators should not be viewed as a league table of good or bad performance. The Expert Group had a strong steer by many of the KT leaders with whom they spoke. How this might be implemented is also discussed in Chapter 7.

5 Common definitions

A common set of definitions supporting the recommended indicators should be adopted, consistent with those used in the major international longitudinal surveys, as proposed in 2009 by Finne et al. so that the Core Indicators proposed in this report may be implemented. These definitions are as follows:

Indicators	Definition
Research agreements	Contracts where a firm funds the PRO to perform research on behalf of the firm, with the results usually provided to the firm. Include collaborative agreements where both partners provide funding and share the results. Exclude consultancy agreements and cases where the firm funds a research chair or other research of no expected commercial value to the firm.
Collaborative research agreements	Contracts where both the firm and the PRO participate in the design of the research project, contribute to its implementation and share the project outputs.
Contract research agreements	Contracts where all research is performed by the PRO.
Invention disclosures	Descriptions of inventions or discoveries that are evaluated by the KTO staff or other technology experts to assess their commercial application.

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Indicators	Definition
Licences & assignments executed[16]	Include all licences and assignments for all types of IP (copyright, know–how, patents, trademarks, etc.). A licence grants the right to use IP in a defined field of use or territory. An assignment transfers all or part of the right to IP to the licencee. Software licences should be accounted for separately[17].
Licences & assignments — gross revenue to PRO	Total income from all types of know–how and IP (patents, copyright, designs, material transfer agreements, confidentiality agreements, plant breeder rights, etc.) before disbursement to the inventor or other parties. Include licence issue fees, annual fees and milestone, termination and cash–in payments. Exclude licence income forwarded to other institutions than those served by the KTO or to companies.
Spin–offs established	A new company expressly established to develop or exploit IP or know–how created by the PRO and with a formal contractual relationship for this IP or know–how, such as a licence or equity agreement. Include, but do not limit to, spin–offs established by the institution's staff. Exclude start–ups that do not sign a formal agreement for developing IP or know–how created by the institution.
SME	The European Commission's SME definition 1 applies. The three main points that need to be satisfied simultaneously are: • Less than 250 employees • Either an annual turnover of 50 mill € or less, or a total balance sheet of 43 mill € or less • Autonomous, *i.e.* not owned or controlled to more than 25% by another enterprise or public body.
Research expenditures in PRO	Total expenditures on all types of basic and applied research (science and humanities) in the affiliated institution(s) from all funding sources: all levels of government, industry, non–profit foundations, etc. Include share of academic costs dedicated to research, costs of administrative support and capital expenditures on new equipment. Exclude cost of new buildings or land. *The definition is in line with the Frascati manual (OECD, 2002).*
Number of researchers	Average number of research personnel in the reference year in FTEs. Include time spent by academic staff on research, other researchers (post–docs, PhD students, researchers on fellowships, part and full time researchers), technicians and administrative support personnel. Exclude time spent by academic staff on teaching.

16 This report recommends exclusion of Options, and exclusion of financial threshold for licences which Finne et al previously included

17 Addition for this report to address issue of multiple licences to same IP

6 Implementation Expert Group

The Expert Group probed barriers to adopting common indicators which ranged from reluctance to adopt new measures where there were well established metrics through to the inability to collect a full range of indicators where a system was evolving. Further challenges were the consistency of definitions and the reporting year used (academic vs calendar). A further Expert Group should be convened by the EC JRC with the aim of working with stakeholders to gain consensus on adoption of the indicators and mechanisms to implement. To aid adoption of output indicators within PROs it is essential that senior leadership *e.g.* VP Research/ Innovation/Transformation is involved in the work of the Expert Group, in addition to the KTO, and that key government agencies are consulted.

7 EU–wide centralised collection and reporting

The EC should explore a centralised approach for an EU–wide KT data collection and reporting in a consistent and professionally managed way to provide a pan–European annual survey and report. It will be important to support national data collection aligned with pan–EU data collection and to provide the necessary incentives at a national level. Data collection must be accompanied by the publication of meaningful regular reports. This is a complex project requiring considerable work to deliver a robust and consistent survey.
The complexity of indicators (including macro–level data) means that data collection and curation must be by a credible organisation that understands KT and recognition by the KT profession.

8 Integrated database

The EC should support the creation and management of a central database as a repository for EU–wide PRO KT data. Data collection must be accompanied by the publication of meaningful regular reports.

Collected data must be linked to the individual PROs to allow data cleansing and interpretation.
PROs should be encouraged to make their data public, however anonymity may be permissible at publication. The availability of such a database permits data cleansing, analysis and longitudinal reporting. This is consistent with the concept of open research and transparency of data. However, one of the barriers identified in this study was the way in which data may be interpreted "in anger" and desire, in some cases, for confidentiality. A central database could be maintained in confidence, with data analysis and reporting at a macro anonymised level and with those PROs submitting open data being given access to other open data, enabling their own analyses. Ideally, publication of non–anonymised data and analysis would be beneficial to EU institutions. Such a database will enable review and reporting of "like with like", taking into account both output and input metrics, and support exchange of good practice amongst similar institutions. A centralised database should be capable of translation into national languages to assist with usage and should have flexibility to allow the collection of national specific indicators *in addition* to the core pan–EU ones.

9 Involvement of governmental bodies

Governments and their Ministries and Departments should encourage and incentivise their PROs to engage in KT as part of their mission and to collect data and report on performance.

10 EC cross programmes consistency

The EC should itself look across the units that support KT and research funding and develops a common set of indicators across its programmes.

7. USING INDICATORS IN PRACTICE

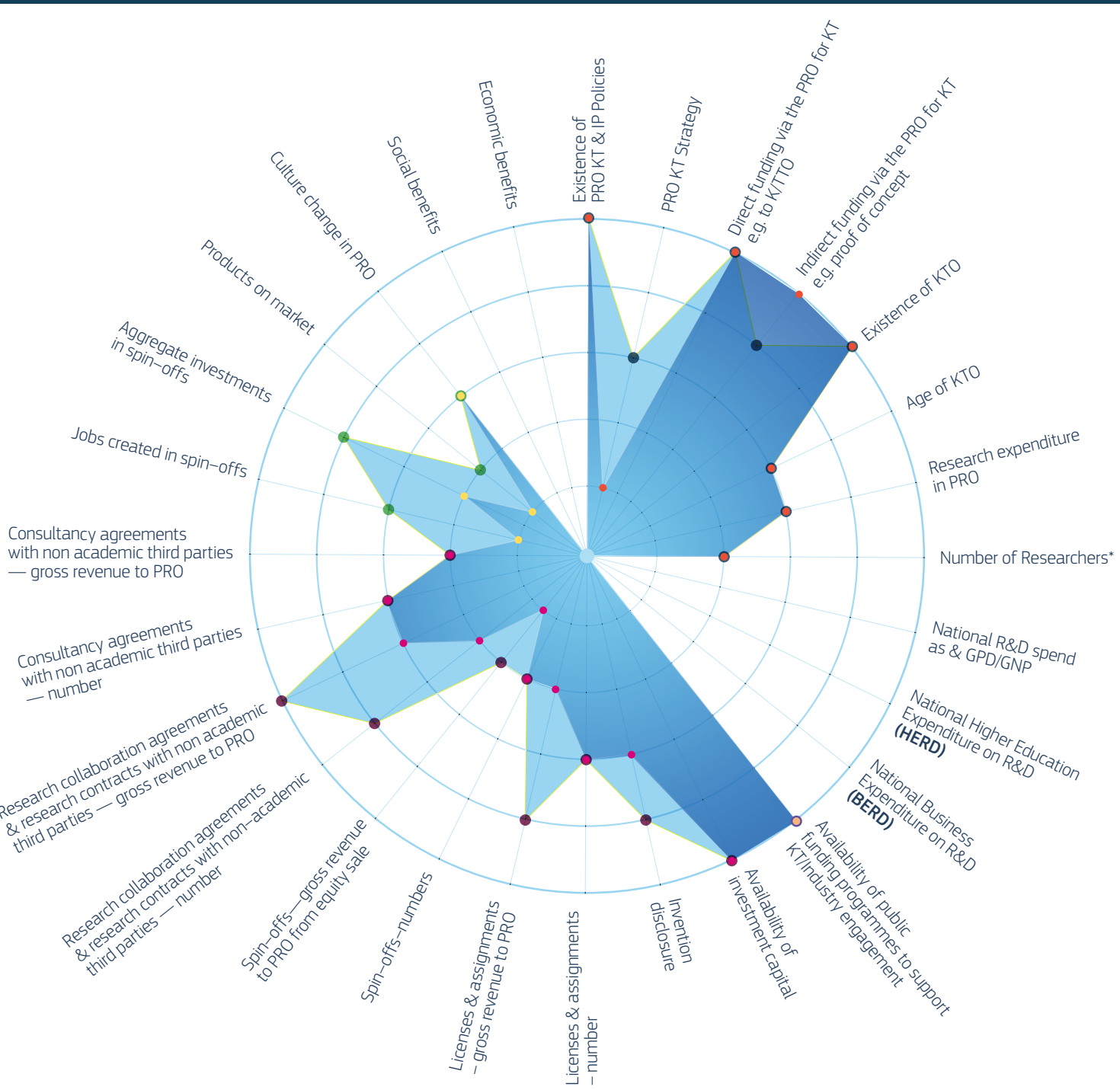
The core indicators offer a flexible framework for future use. Some examples of how they could be used are described below.

Many of the indicators require an absolute value to be ascribed and are amenable to direct comparison from year to year. This can be coupled with a narrative understanding of some of the environmental factors, such as the regulatory and legal environment within which the PRO works.

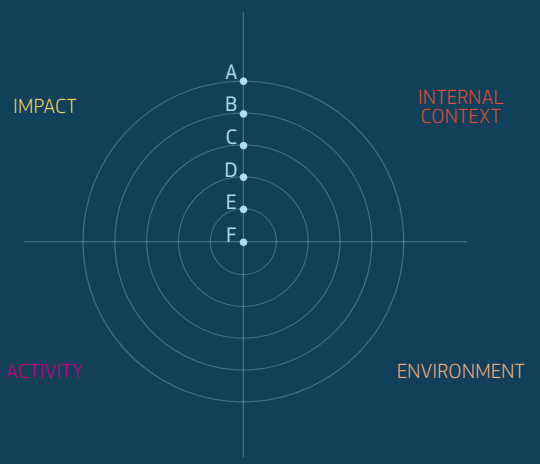
Assessment could be undertaken at the level of an individual PRO or amongst a group of PROs. The concept of grouping is a useful one as it permits a more meaningful comparison of PROs that, for example, may be of a similar size and may have a similarly mature KTO. Using the input and output indicators will enable a PRO to get a sense of the effects of external factors or internal operational factors. To do this, however, requires the ability to access the data or data comparisons and this is where a centralised repository has an important role to play.

It is possible to visualise performance and the hypothetical example below shows how a university might use the core indictors to build a profile and to track its progress. In this case, the university is using the profiling as a self–assessment tool and scores itself across a number of indicators that it finds meaningful, where A — excellent; B — strong; C — moderate; D — emerging activity; E — not active.

Figure 4: Use of core indicators for profiling



Legend



2019

- Impact
- Internal context
- Environment
- Activity

Previous

- Impact
- Internal context
- Environment
- Activity

In the example profile above, the university is comparing its activity in 2019 to the previous year. In 2019 it issued a strategy for KT and it continues to invest in the KTO and associated activities. This has been bearing fruit as the university has seen increases in spin–offs, licence revenue. However proof of concept funding for early stage inventions has undergone a slight decrease in 2019 due to the termination of a national funding scheme. This has not yet affected the activity outputs but may do so in subsequent years. The university has been tracking longer term impact in terms of spin–off investments and jobs created and this may have contributed to the positive internal strategy developments. The university has seen a boost in collaborative research, and this may reflect both internal strategy and external environment. Compared to some KTOs, the KTO is not considered fully mature, having been created eight years ago.

Some national environment data were not used by the university for this profiling, as it wished to look at the implications of local actions. Available comparisons, for example: OECD; international innovation scoreboards, national evaluation processes and; a weighting for the size of the university research base against other selected universities, could allow for a more complex assessment completion.

At a national and pan–EU level, similar profiling could be used. An interesting route to explore here is the use of composite indicators which will permit easier assessment. An important factor in the development and use of composite indicators is the access to the underlying data and information which permits a detailed understanding of the situation. This is where the adoption of harmonised KT indicators and definitions is essential.

8. CONCLUDING REMARKS AND NEXT STEPS

This report builds on existing studies and a depth and breadth of practice across EU Member States. The development of EU–wide harmonised metrics, if done correctly, has much to offer to support development of KT activity and policy by PROs and at national level by funding agencies and policymakers.

This report offers a basic set of core indicators that could be used EU–wide and suggests supplementary indicators that would add value. It would be for the local PROs to select from these supplementary indicators and to include others of their own.

There are several barriers to adoption of core harmonised indicators, from the practical through to the philosophical. The latter includes a fear of how such data will be used and the implications for PROs and their KTOs. This is not without foundation as there has tended to be a crude interpretation by commentators, without consideration of the context. A significant recommendation in this report is that any analysis used both output and input data.

At a practical level there are some topics that require further exploration and conclusion through the convening of a further Exert Group. These are:

- gaining consensus on adoption of the indicators, definitions and mechanisms to implement
- agreeing a consistent reporting year for data collection.

Further such discussions, if they are to lead to implementation, must go beyond the KTO community to involve key decision–makers such those in senior leadership positions in PROs, universities and government agencies.

There is also the issue of how the EU–wide data are collected, curated and reported. The Expert Group has recommended that collection and analysis is managed by a credible organisation that understands KT and is recognised by the KT profession. It needs to be neutral and to collaborate with national KT associations and government agencies as appropriate. Incentives may be required at a national level to stimulate and support the ability to engage at the pan–EU level. A next action will be to explore this, and an associated business model, with the Commission.

A further topic for consideration is the use of the core indicators in this report to inform development of composite indicators, which might enable a simpler top–level assessment of KT activities by country. Having detail on core indicators will be essential to interpretation of composites which require drilling into the kind of detail provided by the core indicators.

In the short term it will be important to disseminate the outcomes of this study to a broad audience that must be wider than the KT practitioner community. Successful KT is the responsibility of the PRO leadership and researchers and the national ministries and agencies. For this to work, they need to be part of the ongoing conversation.

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APPENDICES

1 Appendix 1 Questionnaire

1.1 Background

- National association represented
- Position in the NA if relevant
- Affiliation to another KT association?
- Background on KT metrics at local, national or international level

1.2 Existing national survey

Is a national survey conducted? Yes / No

IF YES

- Is the survey done regularly and if so, on which time period?
- Does it cover every University/PRO or just a few? If not all, why?
- What metrics does it cover?
- Which metrics do you think are important to collect and why?
- Who uses the survey? What for?
- Are there other related surveys conducted in your country than the one previously mentioned?
- Do you see value in a pan–European survey such as ASTP survey?
  - **If NO** — why not?
  - **If YES** — would you share your national data with ASTP?
    - *If NO, why not?*

IF NO

- Why not?
- Would you like to see one created?
- Is there an expressed interest for a national survey from any national bodies/associations?
- What are the barriers to creating a national survey?
- What could assist your country to develop a national survey
- Which metrics do you think are important to collect and why?
- Would there be interest in using the ASTP survey for your country?

1.3 Measuring Impact

- Is there an appreciation of the importance of explaining the impact of KT – nationally and/or in your organisation?
  - **If YES** — how do you measure and explain impact and which indicators do you use?
  - **If NO** — why not?

1.4 Toward a harmonised core set of KT metrics

- Do you think a set of harmonised KT metrics for the EU member states is a good idea? Why? Or Why not?
- Would there be barriers, and what would they be, to the set-up of a harmonised core set of KT metrics at European level?
  - How might they be overcome?

Is there anything else you would like to say on the topic?

2 Appendix 2 Networks, organisations and their representatives interviewed

Country	Network	Contact	Role
Austria	Austrian TT Network	Sara Matt-Leubner	Head of Transfercenter Science-Economy-Society University of Innsbruck
Belgium	Reseau Lieu	Michel Morant	CEO, University–Industry Liaison Office University of Liege
	TTO Flanders	Paul Van Dun	General Manager KU Leuven R&D
	TTO Flanders	Jürgen Joossens	Head of the Valorisation Office University of Antwerp
Bulgaria	Bulgarian Network of Technology Transfer (BNTT)	Kostadin Kostadinov	Advisor to the Minister Ministry of Science & Education
Croatia	Informal TT network	Smiljka Vikić-Topić	Head of Research & Technology Transfer Office, School of Medicine, University of Zagreb
Denmark	Danish National Network for Technology Transfer (DNNT)	Inie Nør Madsen	Chief Consultant Universities Denmark
Estonia	Informal TT network	Relika Alliksaar Williams	Development Cooperation Expert Enterprise Estonia
France	Réseau C.U.R.I.E	Stéphanie Kuss	Director General Réseau C.U.R.I.E
	Réseau SATT	Celine Clausener	Director of Public Affairs Erganeo
Germany	TransferAllianz	Christian Stein	CEO ASCENION GmbH
		Jorn Krupa	Head Technology Transfer Office Helmholtz Centre Postdam, GFZ German Research Centre for GeoSciences
Greece	PRAXI Network	Karniouras Panagiotis	Director PRAXI Network
Hungary	Technology and Knowledge Transfer Forum of Hungarian Universities	Tamas Bene	Director of Technology Transfer
Iceland	Iceland TT Network	Einar Mantyla	CEO TTO Iceland

Country	Network	Contact	Role
Ireland	Irish Knowledge Transfer and Innovation Group (IKTIG)	David Corkery	Operations Manager University College Cork
Italy	Netval	Shiva Loccisano	Head of Technology Transfer & Industrial Liaison Department Politecnico di Torino
Latvia	None	Lita Lazdina	Senior Expert, Innovation & Technology Transfer Centre Riga Technical University
		Lauma Muizeniece	Deputy Director, Head of Technology Transfer Unit Investment and Development Agency of Latvia
Malta	None	Anton Bartolo	Director of Knowledge Transfer Office University of Malta
Netherlands	Dutch Technology Transfer Professionals Association	Koen Verhoef	Manager, TTO Netherlands Cancer Institute
Norway	Association of Innovation Companies in Norway (FIN)	Anders Haugland	Managing Director VIS
Poland	Polish Network of Academic Technology Transfer Centres (PACTT)	Krystian Gurba	Deputy Director Centre for Technology Transfer CITTRU Jagellonian University Krakow
Portugal	Informal network Portugal (UTEN/ GAPI)	Marta Catarino	Technology Transfer Director, TecMinho University of Minho
Slovenia	Slovenian TT Network	Špela Stres	Head of the Center for Technology Transfer and Innovation Jožef Stefan Institute
Spain	RedTransfer	Fernando Conesa Cegarra	Head of Service, Promotion & Support Service for Research, Innovation and Transfer — I2T Polytechnic University of Valencia
Sweden	Swedish Network for Innovation and Technology Transfer Support (SNITTS)	Henric Rhedin	Deputy Head of Department, Health and Community Medicine Gothenburg University
Switzerland	The Swiss Technology Transfer Association (SwiTT)	Stefan Lux	Technology and Licensing Manager ETH Transfer ETH Zürich
Turkey	University-Industry Collaboration Centers Platform (USIMP)	Fazilet Vardar Sukan	Director, Nanotechnology Centre (SUNUM) Sabanci University
United Kingdom	PraxisAuril	Tamsin Mann	Head of Policy PraxisAuril

3 Appendix 3 Glossary

Assignment: Contract transferring ownership of right in IP to a third party.

ASTP: European association for Knowledge Transfer professionals.

AUTM: Association for Technology Transfer professionals, USA headquartered.

BERD: Business Expenditure on Research and Development (R&D).

CURIE: Réseau C.U.R.I.E, French national knowledge transfer association.

EC: European Commission.

EU: European Union.

FTE: Full Time Equivalents — People working part–time are only included for the fraction that they are employed.

GDP: Gross Domestic Product.

HEBCIS: Higher Education Business Interaction Survey (UK).

HERD: Higher Education Expenditure on Research and Development (R&D).

Invention disclosure/IDF: The invention disclosure is when a potential new commercial opportunity is recorded by the KTO. It usually involves completion of an Invention Disclosure Form (IDF) which contains basic information, which helps to evaluate and subsequently, potentially, protect and commercialise any underpinning intellectual property.

IP: Intellectual property.

JRC: Joint Research Centre of the EC.

KT (KTT/TT): Knowledge transfer – the sharing of expertise, capability, technology and intellectual property between the research base and industry or the public sector with the aim of developing new or improved products, processes and services that deliver societal and economic benefit. The terms Knowledge Transfer (KT) and Knowledge & Technology Transfer (KTT) are often interchangeable. Technology Transfer (TT) tends to refer to research commercialisation and may be considered a subset of KT.

KTO: Knowledge Transfer Office (KTO) may also be referred to as Technology Transfer Office (TTO), Innovation Office or similar variations. For this report the terminology KTO is used.

Licence: A contract under which IP rights are transferred from one party to another for the purpose of commercialisation.

MTA: Material Transfer Agreement.

OECD: Organisation for Economic Co–operation and Development

Option: A contract under which the PRO grants a potential licencee a period of exclusivity during which it can decide whether it may wish to take a licence or assignment and negotiate the terms of such an agreement.

Patent filing: The first filing of a patent application with a relevant patent office.

PRO: Publicly Funded Research Organisation. PROs include universities and colleges.

RTTP: Registered Technology Transfer Professional, the international standard for professional competence & experience in knowledge/Technology Transfer.

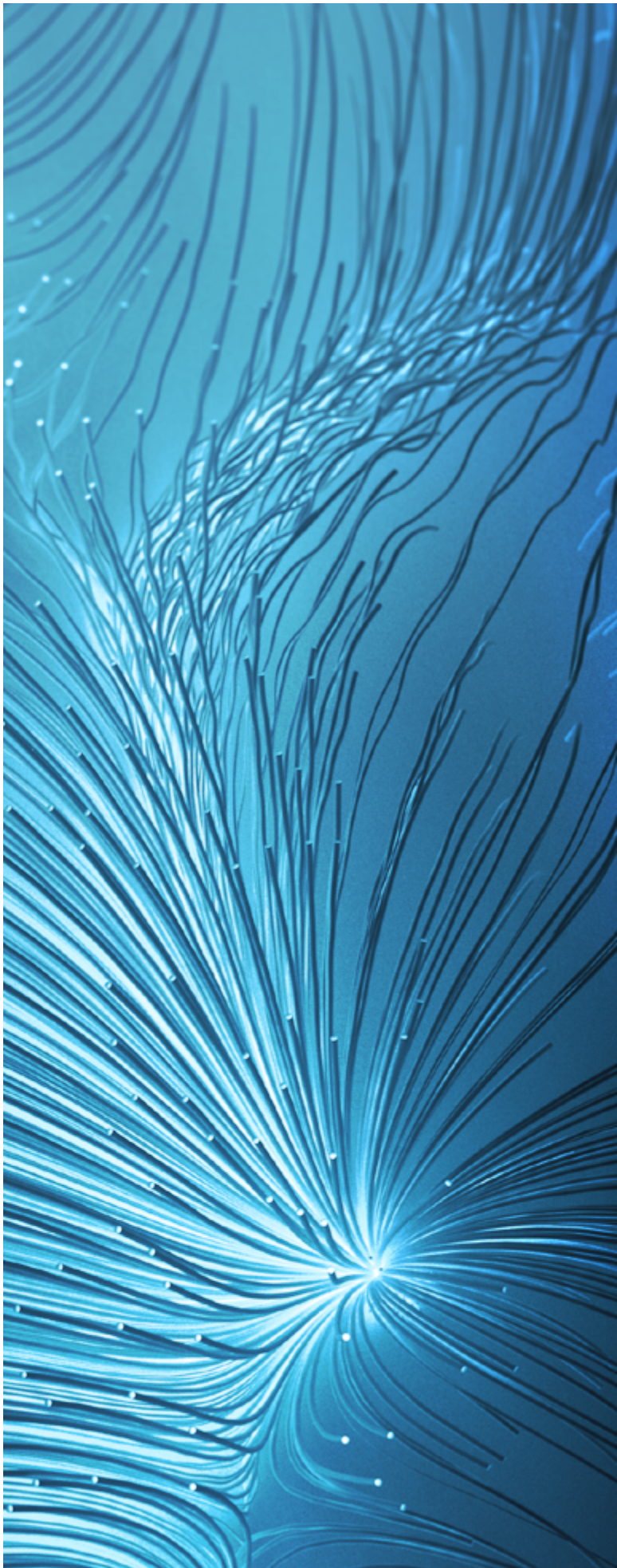
SME: Small and medium sized enterprises.

Spin–off: A new company expressly established to develop or exploit IP or know-how created by the PRO and with a formal contractual relationship for this IP or know-how, such as a licence or equity agreement.

Start–up: Company formed by staff or students from the PRO not based on knowledge or IP generated by the PRO and where there is no formal IP licence or equity share with the PRO.

STEM: Science, technology, engineering, and mathematics.

VP: Vice President. Equivalents in some universities include Vice Principal, Vice Rector and Pro–Vice Chancellor.



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