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Abstract

The development of key performance indicators establishes a core component of the evaluation and monitoring model for the SMART-ER virtual research institute, and will integrate information from relevant activities in SMART-ER work packages 3 – 6 and ECIU University alternative research metrics to assess the evolution and impact of SMART-ER over time. This report presents the design and selection of KPIs over a multi-step consultation process and details the considerations for their use during the pilot phase of the project.

Table of Contents

1	Introduction.....	7
2	Objectives.....	7
3	Consultation process.....	8
3.1	Stakeholder groups	8
3.2	Stages of consultation	9
4	Round 1 - Online questionnaires.....	9
4.1	SMART-ER work package leaders.....	9
4.2	Research Information System Officers.....	10
4.3	Initial results	10
5	Round 2 – WP1 evaluation	11
5.1	WP1 feedback.....	11
5.2	Revised KPIs.....	11
6	Executive team discussion and recommendations	12
7	Agreed evaluation and monitoring model for the SMART-ER Virtual Research Institute	13
7.1	Final Key Performance Indicators.....	13
7.2	Data collection and reporting.....	14
7.3	Qualitative assessment of performance	17
8	Conclusions.....	17
9	Bibliography.....	18
	Appendix I: Initial list of proposed KPIs.....	Error! Bookmark not defined.
	Appendix II: Internal stakeholders	Error! Bookmark not defined.
	Appendix III: Rules applied for survey analysis	Error! Bookmark not defined.
	Appendix IV: Online survey results and feedback.....	Error! Bookmark not defined.
	Appendix V: Feedback from WP1 group members.....	Error! Bookmark not defined.

List of figures

Figure 1. Line chart illustrating the levels of agreement on the relevance and the reporting ability of institutions for KPIs 1-35 11

Figure 2. Stacked bar chart showing the relevance and suitability of each KPI according to SMART-ER WP leaders**Error! Bookmark not defined.**

Figure 3. Stacked bar chart showing the reporting ability of institutions according to research information system officers**Error! Bookmark not defined.**

List of tables

Table 1. Revised key performance indicators for the SMART-ER virtual research institute 12

Table 2. Data sources and suggested methods for KPI calculations 15

Table 3. Feedback provided by survey respondents **Error! Bookmark not defined.**

Table 4. KPI selection and feedback from WP1 group members **Error! Bookmark not defined.**

Symbols, abbreviations and acronyms

AAU	Aalborg University
CS	Citizen science
D	Deliverable
DCU	Dublin City University
DORA	Declaration on Research Assessment
EC	European Commission
ECIU	European Consortium of Innovative Universities
ET	Executive Team
H2020	Horizon 2020
INSA	Institut National des Sciences Appliquées
KTU	Kaunas University of Technology
KPI	Key performance indicator
LiU	Linköping University
M	Month
MS	Milestone
OA	Open access
R&I	Research and Innovation
SDG	Sustainable Development Goal
SEPO	Strategic European Partnerships Office
SMART-ER	ECIU University Research Institute for Smart European Regions
SwafS	Science with and for Society
TAU	Tampere University
TUHH	Hamburg University of Technology
UAB	Universitat Autònoma de Barcelona
UAVR	Universidade de Aveiro
UiS	University of Stavanger
UN	United Nations
UNITN	Università degli Studi di Trento
UPE	Unit for Public Engagement
UT	University of Twente
VCSH	Virtual Citizen Science Hub
VRI	Virtual Research Institute
WP	Work Package
WPL	Work Package Leads

1 Introduction

Key performance indicators (KPIs) are quantitative measures used for tracking and guiding performance and evaluating the success of an organisation in meeting its strategic objectives over time. In this regard, KPIs can clearly highlight areas of strength, where adjustments or improvements are needed and allow for evidence-based decision making and future planning.

In establishing the new ECIU SMART-ER virtual research institute (VRI) it is therefore essential to develop KPIs as part of a wider evaluation and monitoring model to drive the ambitions of the alliance and to demonstrate the unique and added value of the VRI to the ECIU research community. The ECIU University has already developed a recommended set of alternative research metrics, alongside associated incentives and supports, to engage the research community in SDG 11-related research that is challenge-based, open and includes industry and societal partners at its core. These metrics also represent measurable values that serve as data points for tracking the research-related activities or processes of ECIU University. In general, numerous metrics can be accumulated or combined to inform a particular KPI. As such, the KPIs designed for the SMART-ER institute should be aligned with and supported by the broader ECIU University research metrics, where applicable.

Although meaningful KPIs allow for the complex and varied status of an organisation to be quickly summarised and understood, care should be taken to ensure these numerical indicators are not misinterpreted or oversimplified. In order to fully contextualise the performance and impact of SMART-ER, qualitative assessment mechanisms should also occur in parallel. Case studies, interviews, expert opinion or other narrative approaches should be incorporated into an overarching assessment model to best capture the activities that are not easy to quantify and together provide the most holistic view of the progress, transformation and achievements arising from the SMART-ER VRI.

2 Objectives

By their nature as key indicators, only a small number of KPIs should be defined to reflect the core strategic objectives of the VRI. In each case, SMART-ER objectives aim to strengthen joint research collaborations and deepen mobility and transnational cooperation across the network.

Specifically, the objectives of the VRI are as follows:

O1: To develop a common Research & Innovation agenda and convergence action plan, in synergy with education strategies and regional engagement, sharing infrastructures and resources

By developing a concrete agenda to drive the joint research strategy for smart regions previously agreed by ECIU University (1), this objective further embeds a common vision across partners at all institutional levels. The development of joint structures and mechanisms for openly sharing expertise and resources promotes a multi/inter-disciplinary approach to addressing the four key themes identified as ECIU priority areas within UN Sustainable Development Goal 11:

- Energy and sustainability
- Transport and mobility
- Circular economy
- Resilient communities

O2: To develop and implement strategies for strengthening human capital and collaborations in research and innovation

To translate knowledge and ideas towards solutions to societal challenges, highly skilled human resources are required. Well-trained researchers that can work together in an open, innovative and entrepreneurial way are key to achieving real impact. This objective emphasises embedded mobility and support at all career stages to train, conduct research or share services and best practices in any of the partner institutions in order to achieve ambitious research goals.

O3: To promote and integrate dialogue with society in R&I activities of SMART-ER.

To ensure a focus on real societal need is strongly embedded in research, SMART-ER aims to harmonise its activities with robust public engagement and to prioritise citizen science as a core part of the identity of the VRI. In doing so, SMART-ER will further develop best practices and support structures to drive transformation towards an open, engaged and co-creative model of research both within and beyond the ECIU consortium.

To compliment these specific objectives, it will also be necessary to broadly capture engagement with SMART-ER across the ECIU research community to determine the overall attractiveness, growth and reach of the VRI over time.

3 Consultation process

A multi-step consultation process for the design of the SMART-ER KPIs was initiated in June 2021. An initial suite of 35 potential KPIs was drafted with the intention that these suggestions could be retained, modified, combined or removed in order to achieve a final set of agreed indicators for the SMART-ER VRI. Within the context of the SMART-ER strategic objectives, the preparation of this initial list was informed by the ECIU Erasmus+ deliverable report for Activity 2.3, O2 '*Results of institutional consultation and agreed research metrics for the ECIU University*' (internal document), and by the SDG 11 research themes identified in the *ECIU University Long-term Joint Smart Regions Research Strategy* (1). The full suite of 35 potential KPIs are listed in Appendix I.

To make apparent the alignment with the objectives and pillars of SMART-ER, the list of potential KPIs were organised around 4 focus areas:

- Focus 1: Researchers working on SDG 11 from across the ECIU Alliance are actively participating in SMART-ER
- Focus 2: SMART-ER research is based on collaboration between ECIU researchers (Objective 2)
- Focus 3: SMART-ER research is excellent research focusing on SDG11 (Objective 1)
- Focus 4: SMART-ER research is open (Objective 3)

3.1 Stakeholder groups

The following stakeholder groups were contacted at different stages of the consultation process:

- SMART-ER Work Package (WP) leaders
- Research information system officers or reporting experts
- Work Package 1 task leads and points of contact

- SMART-ER Executive Team (ET)

Over the course of the process, input from all ECIU SMART-ER partner universities was received to ensure those involved in the implementation of activities were aware of the type(s) of data to be collected and monitored. It should be noted that in some cases individuals may be part of more than one of the stakeholder groups consulted. A breakdown of the partner institutions contributing to each stage is provided in Appendix II. The ECIU Vice Presidents of Research Expert Group, the Research & Innovation Expert Group and the wider research community were previously consulted in the design and agreement of the ECIU alternative research metrics and as such were not re-approached at a later stage as part of this activity.

3.2 Stages of consultation

The consultation and selection process was comprised of the following stages:

Round 1: Two online questionnaires to collect initial feedback on the 35 proposed KPIs took place from August to September 2021. The focus of the questionnaires was adapted according to the target group with SMART-ER work package leaders asked to consider the relevance and suitability of the KPIs and research information system officers asked to consider their implementation and reporting capacity within their institutions.

Round 2: Results from Round 1 were summarised by the WP 1.6 task leader and shared with the WP1 group to evaluate in October 2021. Members were invited to provide written feedback on their suggested approach for each KPI which was then compiled and incorporated into a revised list.

Executive team discussion: The revised KPIs were brought forward for discussion at the SMART-ER Executive Team meeting which took place in Barcelona on 4-5th November 2021. Recommendations for the selection of final key quantitative indicators and qualitative assessment methods were received and integrated into the SMART-ER Evaluation and Monitoring model.

4 Round 1 - Online questionnaires

For the first round of consultation, an online questionnaire was designed using Google Forms to collect feedback on each of the potential KPIs from the perspectives of two stakeholder groups:

- 1) SMART-ER work package leads
- 2) Research system information officers or other reporting experts within each institution

The focus of the questionnaire was adjusted according to the expertise of each group. For each KPI respondents were asked to select their level of agreement using a Likert-type scale and were also provided with free text boxes to include additional feedback.

4.1 SMART-ER work package leaders

To determine the **suitability** and **relevance** of each suggested indicator, SMART-ER work package leads were asked to consider the following question:

'Do you agree that this KPI provides a clear, measurable and valuable index of performance of the SMART-ER Virtual Research Institute?'

Tick-box answer options:

Strongly agree – agree – neither agree nor disagree – disagree – strongly disagree

Open feedback:

- *If you disagree with the previous question, please provide detail*
- *Note here if you wish to recommend a different wording for this KPI*

4.2 Research Information System Officers

To determine the capacity for **implementation** of each suggested indicator, SMART-ER WP1 Points of Contact were asked to forward the questionnaire to the research information system officer or appropriate reporting expert within their institution. These experts were asked to consider the following question:

'Could you report on this KPI using your institution's current reporting system?'

Tick-box Answer options:

Yes – Unsure – No

Open feedback:

- *If you replied NO to the above: What changes to your current reporting system would your institution need to make, in order to report on this KPI?*
- *If you replied UNSURE to the above, please explain here*
- *Please add any other comments you would like to make about this KPI*

4.3 Initial results

Survey responses for both questionnaires were collected and analysed according to the rules applied in Appendix III. A general discrepancy between the agreement levels on the relevance and usefulness of the KPIs versus the ability to implement and report on most of those proposed across current institutional systems is observed, as shown in Figure 1. Additional graphical representation of survey responses per stakeholder group and a summary table of the feedback received is available in Appendix IV.

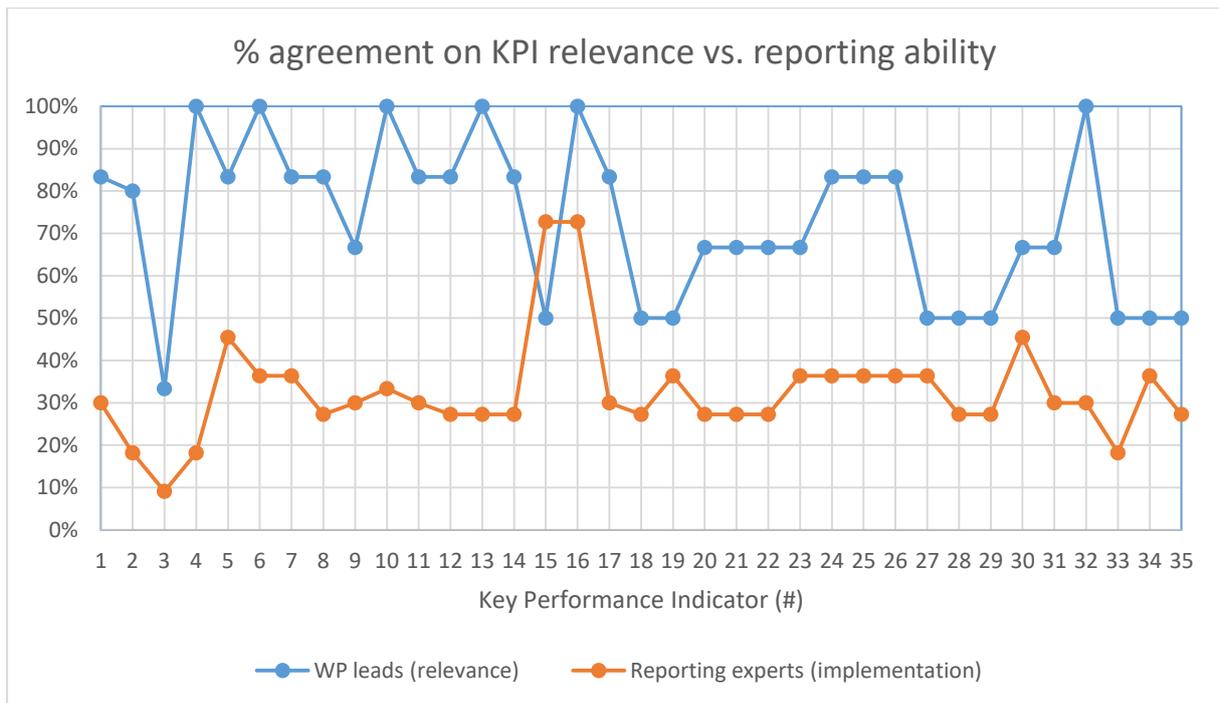


Figure 1. Line chart illustrating the levels of agreement on the relevance and the reporting ability of institutions for KPIs 1-35

5 Round 2 – WP1 evaluation

5.1 WP1 feedback

As clear selection criteria or cut-offs could not be established from the initial survey data, a second round of consultation with the SMART-ER WP1 task leads and Points of Contact took place to ensure collective input in interpreting the results. The WP1 group were presented with the survey results and comments (Section 3.3 and Appendix IV) and based on their evaluation of the data were asked to select whether each KPI should be kept, modified or removed. Comments and justification could also be provided via a written feedback table. A total of 7 responses were received and a summary of the WP1 choices and comments are available in Appendix V.

5.2 Revised KPIs

To refine the proposed KPIs in line with WP1 feedback, those receiving majority decisions to be retained or removed were designated accordingly. In some cases, where modifications to the current wording or approach were suggested, these updated KPIs were also included in the revised list and brought forward for further consideration. In total, 11 KPIs (Table 1) were selected for final consultation.

Table 1. Revised key performance indicators for the SMART-ER virtual research institute

Focus Area	Proposed Key Performance Indicator
Engagement	No. of researchers engaging with SMART-ER activities at all career stages (R1 – R4)
Collaboration & interdisciplinary research	No. of joint ECIU/SMART-ER research grant applications submitted for external funding with participation of at least two ECIU partner universities
	% of joint ECIU/SMART-ER research grant applications submitted for external funding co-created with one or more non-academic stakeholder groups (industry, policy, civil society)
	No. of researchers using research infrastructures at another partner institution
	No. of joint challenge-based initiatives/events arising from SMART-ER research results
Excellence	No. of awarded ECIU/SMART-ER research projects across the alliance
	No. of joint publications in high-impact journals
Openness	No. of Open Access publications derived from SMART-ER projects (including Diamond, Gold, and Green Access routes)
	No. of openly available data sets from SMART-ER research projects
	No. of joint citizen science projects implemented across ECIU/SMART-ER institutions
	No. of webinars and public lectures discussing SMART-ER research projects

6 Executive team discussion and recommendations

A joint discussion of the revised KPIs took place during an interactive session at the SMART-ER Executive Team meeting in UAB Barcelona on the 4-5 November 2021.

The general observations and recommendations arising from the meeting were as follows:

- Only a **limited set** of key performance indicators for the institute should be agreed that clearly represent the core strategic objectives of the SMART-ER VRI. Many of the suggested KPIs in the initial suite and in the revised list are too granular in detail. In such circumstances, these indicators would be most appropriately used as metrics to collect data on specific activities that inform the broader KPIs.
- It is of critical importance that SMART-ER KPIs are **practical to measure** within current infrastructures and make use of data that is already collected or readily accessible where possible. Where new data is required the sources and methods of collection should be clearly defined and understood. Ambiguity or an unreasonable level of added administrative burden needs to be avoided.
- Several of the suggested indicators can be multifaceted and difficult to characterise in specific or quantitative terms. The importance of **qualitative assessment** was stressed to ensure activities in these areas are not pigeon-holed or misrepresented. Impact case studies and other narrative approaches should therefore also be utilised to evaluate the success of the institute.

7 Agreed evaluation and monitoring model for the SMART-ER Virtual Research Institute

The recommendations and feedback from the ET meeting were incorporated into a final evaluation and monitoring model that encompasses both quantitative and qualitative assessment components. It is intended that each indicator should meet the RACER criteria, defined as being Relevant, Acceptable, Credible, Easy and Robust.

In the context of SMART-ER and ECIU University, this implies the following:

- 1) **Relevant** – indicators are closely linked to the strategic objectives of the virtual research institute
- 2) **Acceptable** – mutual agreement is reached on the indicators selected for use
- 3) **Credible** – indicators are easily understood by all stakeholders
- 4) **Easy** – data is feasible to collect and monitor
- 5) **Robust** – indicators are reliable over time

While it can be ensured the first three criteria are met from the outset, given the VRI is currently under development and will continue to evolve, all indicators should be re-evaluated after the first initial period of use to ascertain all RACER criteria can be fulfilled.

7.1 Final Key Performance Indicators

1. Number of researchers engaging with SMART-ER activities at all career stages

This KPI assesses the level of engagement with SMART-ER via its training activities, funding opportunities and its workshops and events. This data provides insight into demand within the research community and the level of interest across different career stages and will demonstrate the growth of the VRI over time. This KPI contributes to all of the SMART-ER strategic objectives (O1 – O3).

2. Number of joint ECIU/SMART-ER research grant applications submitted for funding with participation of at least two ECIU partner universities

This KPI will evaluate how SMART-ER enhances the network dimension of research across partner institutions by assessing the number of collaborative grant applications under SDG 11 submitted for funding (internal and external). This KPI contributes to the SMART-ER strategic objectives for developing a shared R&I agenda and convergence plan (O1) and strengthening collaborations in research and innovation (O2).

3. Percentage of joint ECIU/SMART-ER research grant applications submitted for funding co-created with one or more non-academic stakeholder groups (industry, government, civil society)

This KPI evaluates the extent to which SMART-ER embeds wider society in the research process and captures how well ECIU/SMART-ER activities can stimulate and support societal collaborations. This KPI represents a proportion of the total number of joint ECIU/SMART-ER grant applications captured by KPI 2 and contributes to the SMART-ER strategic objective for promoting and integrating dialogue with society in R&I activities (O3).

4. Number of joint ECIU/SMART-ER research projects awarded external funding (with participation of at least two ECIU partners universities)

This KPI will evaluate the quality and competitiveness of SMART-ER research collaborations under SDG 11 by demonstrating the levels of success in securing external funding. This KPI contributes to the SMART-ER strategic objectives for developing a shared R&I agenda and convergence plan (O1) and strengthening collaborations in research and innovation (O2).

5. Number of citizen science projects supported by SMART-ER across ECIU institutions

Engaging researchers in citizen science is a pillar of SMART-ER and this KPI will illustrate the success of SMART-ER in promoting citizen science initiatives across the network. This KPI contributes to the SMART-ER strategic objective for promoting and integrating dialogue with society in R&I activities (O3).

6. Percentage of open access outputs derived from SMART-ER research projects

SMART-ER is defined by its ambition for comprehensive open science practices and aims to promote open access publishing and the use of open and FAIR data among the research community. This KPI measures the success of the institute in mainstreaming open science practices and ensuring research outputs are widely accessible. This KPI contributes to the SMART-ER strategic objective for promoting and integrating dialogue with society in R&I activities (O3).

During the closing discussion of the six final KPIs with the WP1 group members, it was acknowledged that although it is common to report on the number of publications in high impact or peer-reviewed journals arising from an institution, the philosophy of the SMART-ER VRI is to begin to shift focus away from traditional measures of quality and to emphasise the wider and societal impact of research. For this reason, the number of publications in high impact journals is excluded as a defining indicator for the VRI. It was also recognised that a stronger innovation element should be incorporated into any future adaptations and revisions of the SMART-ER KPIs. At present, all of the agreed KPIs are in specific alignment with the expected impacts of the SMART-ER VRI during the pilot phase of the project.

7.2 Data collection and reporting

The proposed data sources and collection methods for KPI calculations will rely on the knowledge generated from key activities (Table 2). It is likely that some KPIs may be easier to implement than others, and the ability and effectiveness of capturing data through the suggested mechanisms will need to be examined in practice as ECIU/SMART-ER systems and infrastructures continue to be developed. The initial performance data will be collected annually during the pilot phase of the VRI and will be used to inform the future targets of the institute when operations have been fully established.

Table 2. Data sources and suggested methods for KPI calculations

1. Number of researchers engaging with SMART-ER activities at all career stages
Calculation
<p>Researcher engagement with SMART-ER will rely upon knowledge generated by relevant activities in WP3, WP5 and WP6. Career stage can be captured through application processes or registration for events. However, since researchers may participate in more than one SMART-ER activity, caution will be needed when calculating this KPI to prevent over estimation of the total numbers engaging with the VRI.</p> <p>Specific metrics to inform this KPI:</p> <p>WP3:</p> <ul style="list-style-type: none"> - Number of applicants to the online PhD training programme (SMART-ER Academy) - Number of applicants the Open Science and Leadership Blended Training program (SMART-ER Academy) - Number of applicants to the seed funding for PhD co-tutelles (SPA1) - Number of applicants to the seed funding for blended mobility networks (SPA2) - Number of applicants to the Seed Project funding (SPA3) <p>WP5:</p> <ul style="list-style-type: none"> - Number of researchers participating in Citizen Science webinars - Number of researchers participating in the Citizen Science pilot projects <p>WP6:</p> <p>Number of researchers attending SMART-ER-organised events, seminars and workshops</p>
2. Number of joint ECIU/SMART-ER research grant applications submitted for funding with participation of at least two ECIU partner universities
Calculation
<p>Internal funding:</p> <p>Submissions to internal funding opportunities within SMART-ER can be easily captured and recorded for reporting.</p> <p>WP3:</p> <ul style="list-style-type: none"> - Number of applications to the Seed Project funding (SPA3) - Monitoring of outcomes from SPA2 and SPA3 awards i.e. follow-on funding applications submitted as a result of the SMART-ER seed programme <p>WP5:</p> <ul style="list-style-type: none"> - Number of applications to the citizen science pilot projects* - Monitoring of outcomes from the pilot projects i.e. follow-on funding applications submitted <p><i>*this dependent on whether applications are developed following the WP5.2 co-creation process in Q1 2022. The citizen science pilots may proceed via a different process.</i></p> <p>External funding:</p> <p>At present, formal researcher affiliations with the SMART-ER VRI have not been established and are</p>

not captured within institutional reporting systems. A method for defining SMART-ER proposals and systematically tracking grant applications submitted for external funding will need to be developed and tested during the pilot phase of the SMART-ER project.

This may be achieved in part through the ECIU Strategic European Partnerships Office (SEPO), as applications directly supported by the SEPO funding advisor or those that require a letter of support can be easily recorded. For other 'bottoms-up' applications that utilise the ECIU/SMART-ER framework but can proceed without direct involvement from SEPO, manual registration of the submission with SEPO by the affiliated researchers or the institution's research support office may be required, and the storing and processing of data within SEPO or SMART-ER will need to be further considered.

3. % of joint ECIU/SMART-ER research grant applications submitted for funding co-created with one or more non-academic stakeholder group (industry, government, civil society)

Calculation

This KPI represents a subset of the data collected for KPI 2, and highlights the proportion of funding applications that have been co-created with a non-academic partner. This information can easily be recorded for submissions to internal funding opportunities, however a method of capturing external funding applications of this type will need to be developed and tested. As outlined above, SEPO may play an important role in collecting this data for applications in which they are directly involved.

4. Number of joint ECIU/SMART-ER research projects awarded external funding

Calculation

This KPI captures the number of successful awards arising from applications recorded for KPI 2. Notification of external funding awarded cannot be received centrally by SEPO and institutional reporting based on manual follow up from SEPO or other dedicated individual(s)/structures within SMART-ER will be required.

5. Number of citizen science projects/initiatives supported by SMART-ER across ECIU institutions

Calculation

This KPI evaluates the virtual and non-virtual supports provided by SMART-ER to strengthen citizen science activity across the network. The pilot case studies in WP 5.2 represent the non-virtual element, with the total number of projects supported limited by the current budget available. A number of virtual supports for CS initiatives within and between partner institutions will also be provided through the SMART-ER Virtual Citizen Science Hub (VCSH). The approach to monitoring outputs and CS initiatives supported by the Hub will need to be established following the completed development and implementation of the platform.

6. % of open access outputs derived from SMART-ER research projects

Calculation

Publications and datasets:

For internal and externally funded projects captured by KPI 4, a manual analysis of open access publications can be generated using the online SciVal tool. It is also possible to identify articles with linked Open Access datasets available within certain repositories. Access to institutional data repositories is currently under development by WP 1.5. For internally funded projects OA outputs can also be verified via evaluation processes. To collectively capture this data, the individual(s)/team responsible for manual review of SMART-ER outputs will need to be identified and agreed.

7.3 Qualitative assessment of performance

It had been recognised at the outset and during the consultation process that quantitative measures of performance as defined by KPIs contribute only a single dimension towards the large and complex nature of research impact, progress and change. In light of this, it was strongly recommended that qualitative methods of assessment are also included in the overall evaluation and monitoring model of the SMART-ER VRI. These qualitative tools, such as impact case studies, interviews and other story-based models, should serve to accompany the key performance indicators in an equal capacity and an impact framework and guidelines, while outside the scope of this deliverable, should be established for their use.

Areas in which the impact and success of SMART-ER can be showcased in this way include: examples of multi-, trans- and inter-disciplinary research activity; research advancing one or more areas in the SMART-ER R&I agenda; research outputs and excellence in line with best practices in evaluation; the development of new societal partnerships; challenge-based research initiatives; knowledge-transfer of research results into innovation and education; and public engagement activities.

8 Conclusions

Key performance indicators can be powerful tools to track the progress and success of the SMART-ER virtual research institute in meeting its strategic objectives over time, and can be harnessed to motivate researchers and stakeholders. It is important to remain aware that KPIs are designed to gauge success in the long term, and caution will be needed in their interpretation while the activities they assess within SMART-ER are still being piloted and validated. Particularly, the limitations identified in reporting systems and administrative capacity mean initial performance data reported for the institute should be scrutinised within the current structural context. The processes for data collection and monitoring will continue to be developed and improved over time. Notably, the piloting of the alternative research metrics within the ECIU Erasmus+ project will also inform the approach for roll-out and implementation of SMART-ER indicators across the network.

The KPIs identified in this report will initially operate over a two-year life cycle in line with the remaining timeframe of the current H2020 SwafS project. At the end of this period, the indicators and targets may be adapted in line with the continued evolution of the SMART-ER VRI and the on-going development of SDG-related and challenge-based research within ECIU University. Furthermore, to best represent the impact and influence of the SMART-ER institute, qualitative assessments of performance should also hold equal priority in the overall evaluation and monitoring model.

Overall, the adoption and use of the agreed key performance indicators will provide vital information and evidence for the continued development of SMART-ER and to inform the continued planning towards ECIU University's Vision 2030 (2).

9 Bibliography

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