Institute for Scientific Information

A responsible framework for evaluating the societal impact of research

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Foundational past, visionary future

About the Institute for Scientific Information

The Institute for Scientific Information at Clarivate has pioneered the organization of the world's research information for more than half a century. Today the ISI champions responsible research assessment by supporting the principles that consider a holistic and fair evaluation of scientific work.

It remains committed to promoting integrity in research while enhancing the retrieval, interpretation and application of scientific information.

It maintains the knowledge corpus upon which the Web of Science index and related information and analytical content and services are built.

It disseminates that knowledge externally through events, conferences and publications and conducts primary research to continuously expand, improve and strengthen the knowledge base.

For more information and to receive future ISI analyses and reports, please visit https://clarivate.com/the-institute-for-scientific-information/isi-reports/

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Contents

1: Executive summary

This report outlines the development of a framework for evaluating the societal impact of research, which we will incorporate into our forthcoming Web of Science Research Intelligence™ platform.

Research and Development (R&D) plays a critical role in driving economic growth by fostering innovation, improving productivity and addressing societal challenges. As global R&D spending has grown, the demand for demonstrable societal impact has increased.

Funders, governments and institutions now face the challenge of ensuring that R&D investments yield measurable benefits across diverse areas such as health, climate change and technological advancement. However, the absence of a comprehensive framework to evaluate societal impact remains a global challenge.

The Institute for Scientific Information has developed a framework that addresses the three primary challenges in societal impact assessment: acknowledging the diversity of societal needs, balancing qualitative and quantitative approaches and navigating the long timeframes between research and its societal application.

The framework we have created is derived from an enhanced PESTLE model, categorizing societal needs into eight facets: Political & Policy, Legal & Governance, Economic, Human Capital, Medical, Social & Cultural, Technological and Environmental (Table1).

Effective measurement of societal impact needs to be based on sources that extend beyond traditional scholarly output and encompass both tangible outputs and activities. For our framework we make use of the wealth of data within Clarivate – which goes beyond scholarly outputs and extends to sources such as patents and clinical trial data – and will also utilize external data sources where necessary (Table 2).

To mitigate the challenge of lengthy delays between research being conducted and any resultant societal benefits, our evaluation framework contains both lagging and leading indicators (Tables 3 and 4). Lagging indicators offer insights into societal impact by retrospectively analyzing past outputs and activities that have had sufficient time to manifest their effects. In contrast, leading indicators are forward-looking and analyze more recent signals that suggest the potential for research outputs and activities to create societal impact in the future, though without any guarantee.

Each indicator group in our framework contains multiple individual metrics. We will provide data in a format that encourages responsible evaluation, allowing our users to focus on the appropriate profiles tailored for their specific case.

The overall performance for each societal facet will be presented within a Societal Impact Profile™ with the underlying individual metrics available to support transparency and more granular analyses.

2: Introduction

The role of R&D in economic growth and addressing real-world challenges

Research & experimental development (R&D) is a catalyst for economic growth – fostering innovation, improving productivity and creating new industries and jobs. Through the development of new technologies, processes and products, R&D contributes to dynamic and competitive economies, enabling nations to address complex challenges and remain globally competitive. The contribution of R&D outputs and activities to address real-world challenges faced by individuals, communities, organizations and economies is often described as the societal impact of research.

According to the United Nations (UN)[1] a significant expansion of both R&D expenditures and the global R&D workforce is a strategic target to be achieved by 2030. Worldwide R&D spending is estimated at $1.7 trillion[2] bolstered by an expanding number of researchers (currently 8.8 million)[3] and academic institutions. The effective allocation of these growing, yet finite, resources among academic institutions and researchers presents a challenge for funders and decision-makers, including governments, higher education and research institutions, business enterprises and private non-profit organizations[4].

Growing public expectations for demonstrable societal impact

While business expenditure constitutes the largest share of R&D spending in most developed economies (reaching 80% in some cases[5]), governments play a pivotal role in funding basic or 'blue skies' research. Since businesses typically prioritize research that leads to direct commercial benefits, the wider societal impacts may not be their primary concern. Therefore, government investment is particularly vital in sectors and regions where private R&D investment is lacking, to address pressing challenges that may not yield immediate commercial returns.

As R&D funds face increasing pressure from competing priorities, such as climate change, healthcare, energy and food security, there is a growing public expectation that research impact should be both demonstrable and communicated in a manner that can be measured and understood. This combination has led to a heightened expectation from research funders across the globe that their research investments should be evaluated across multiple types of impact. Consequently, there is a growing need for a responsible methodology to evaluate societal impact.

While poor research is of little value in any context, the focus of research evaluation has shifted, moving beyond research excellence alone to include the practical utility and societal application of research outcomes.

The evolution of research evaluation frameworks

The U.K. instigated the world's first national research impact exercise in 1986, with the introduction of the standardized university Research Assessment Exercise (RAE). This framework was expanded in 2014 to address broader impacts through the introduction of the new Research Excellence Framework (REF) which required researchers to submit narratives or 'impact case studies' to articulate the wider impact of their work[6]. This approach has since been adopted internationally, with Australia incorporating similar assessments into its Excellence in Research for Australia (ERA) cycle[7] and the Hong Kong University Grants Committee also included impact case studies into its RAE2020[8].

Germany also uses an institutional funding model characterized by block funding but without regular nationwide evaluations. Institutional evaluations are either carried out by the university departments themselves or through specialized institutional groups or scientific advisory boards.

In the U.S., agencies such as the National Science Foundation (NSF) and National Institutes of Health (NIH) use impact case studies to provide qualitative assessments of how research has led to significant societal benefits. These often highlight breakthroughs or applications that have had a major influence on policy, industry, or public welfare.

Developing a responsible framework for evaluating the societal impact of research

Despite variations in research assessment approaches and disparities across systems, the countries highlighted above, and others showcased in this ISI report, Research assessment: origins, evolution, outcomes, have all shown improvements in comparative research performance over the past forty years – at least as indicated by bibliometric measures. However, there is currently no established framework to comprehensively determine whether these improvements in scholarly impact have been accompanied by improvements in the societal impact of the research.

The Institute for Scientific Information has developed a framework to measure societal impact. This development builds on our longstanding support of the development of research assessment frameworks across the globe, contributing significantly to their effectiveness.

3: Challenges

The desire to measure societal impact is not new, but defining and capturing it has always been challenging. How can we address this growing, global demand — at the institutional, funder or national level — to assess the societal impact of research effectively?

Three primary challenges must be addressed:

1. Acknowledging the diversity of societal needs

Societal needs are complex, encompassing wide-ranging areas such as: improved health outcomes, better disease control, more effective management strategies for the distribution of natural resources, efficient industrial processes, safer and cleaner energy generation and contributions to cultural domains like history, literature and music. These benefits collectively enhance the quality of life — but capturing and quantifying such diverse impacts poses a significant challenge.

The diversity of these benefits does not conform to a simple or standardized scale, and the metrics that could be used to measure them vary widely, complicating efforts to capture and communicate the full extent of societal impact. For example, any relevant signals of technological impact, such as number of patents, will have little relevance for assessing contributions to cultural development. Any comprehensive evaluation of societal impact must account for these differences and be adaptable, recognizing the unique and varied contributions of different fields.

2. Balancing quantitative and qualitative approaches

It was previously assumed that research with high scholarly impact — as measured by citations — would lead to high societal impact. This assumption is now being challenged and there is an increasing demand for more direct and precise measurements of societal impact.

Traditional bibliometric analysis has its limitations when it comes to explicitly demonstrating signals of societal impact. Thus, any framework for evaluating the societal impact of research should incorporate additional indicators that account for a more diverse range of outputs and activities that go beyond the traditional scholarly outputs of journal articles, books and conference proceedings.

Another challenge lies in identifying the appropriate evaluation methodology. In general, evaluation methods can be divided into quantitative and qualitative approaches. Quantitative methods, such as traditional scientometric approaches, are valuable as they offer an easily scalable, objective view. However, they lack the depth required to measure specific facets of societal impact. For example, well-established traditional citation-based metrics are limited to published outputs and do not capture nuances, such as sentiment (positive, neutral or negative).

To address this limitation and extend beyond publications, qualitative methods, such as expert review, user case studies or narrative impact statements, are needed. However, these approaches are less scalable and risk being subjective. As a result, achieving a balanced approach that integrates both quantitative and qualitative methods is critical for a responsible and comprehensive evaluation of the societal impact of research.

3. Navigating timescales

Frequently, funders' expectations contrast sharply with the slower pace of scientific discovery and the extended timeframe required to translate such knowledge into practical applications. An ailing industry might be rejuvenated through technological investment, but the impact may not be felt until long after a research program has ceased to be active. Studies from the 1980s, reinforced by more recent findings, indicate that the typical lag between invention and commercial implementation spans 15-20 years[9,10,11].

Despite these significant challenges, we need to be able to evaluate societal impact in a formal and structured manner, to enhance research management within institutions and inform the development of more effective research policies and guidance.

"…achieving a balanced approach that integrates both quantitative and qualitative methods is critical for a responsible and comprehensive evaluation of the societal impact of research. "

4: Evaluation framework

Classification of societal needs

To address the diversity of societal needs, we have started with the PESTLE[12] (Political, Economic, Social, Technological, Legal, Environmental) typology. To allow for a more comprehensive analysis, we have enhanced this existing classification. We divided the 'Social' grouping into 'Human Capital', 'Medical' and 'Social & Cultural'. We also renamed 'Political' to 'Political & Policy', and 'Legal' to 'Legal & Governance'.

We refer to this modified classification as **societal facets.** Below is a description of these eight facets:

Table 1

Societal facets	
Political & Policy	the need for effective political systems and policymaking institutions.
Legal & Governance	the need for effective interpretation and conversion of political and policy decisions into legislation.
Economic	the need for improving or accelerating economic development and wealth creation.
Human Capital	the need for continuous development of human capital through all forms of education from pre-school education to professional training in the workplace.
Medical	the need for a healthy population.
Social & Cultural	the need for diversity, equity, inclusion (DEI), as well as security, cultural and spiritual development.
Technological	the need for tangible benefits via technological improvements across all areas, such as healthcare, energy consumption and information access.
Environmental	the need to address climate change and environmental protection and remediation.

This classification created by Clarivate is intentionally inclusive (comprehensive) and allows for overlap between the facets, as any examination of impactful research quickly reveals that many research projects affect multiple societal facets. For example, medical research might impact the pharmaceutical sector, health management, social welfare policy, technology and even the legal facet.

Classification of institutional outputs and activities

As previously stated, effective measurement of societal impact needs to be based on sources that extend beyond traditional scholarly output and encompass both tangible outputs and activities. For our framework we make use of the wealth of data within Clarivate – which extends to sources well beyond journals, books, conference proceedings and preprints – and will also utilize external data sources where necessary to include the following:

Table 2

Classification of institutional outputs beyond scholarly outputs

Research	
Professional Publications	includes non-peer reviewed material such as magazines, blogs and online media targeted primarily at a professional, rather than an academic audience. These play a key role in communicating research to a broader audience; in some fields they may even serve as an alternative to traditional academic outputs.
Data Sets	includes research data, software or code snippets, files and images deposited in repositories worldwide.
Art & Cultural Outputs	includes visual arts, performances, designs and architectural plans.
Education	
Teaching Materials	includes lectures, presentations, online courses and other learning objects such as innovative virtual or augmented reality artifacts.
Dissertations & Theses	as the main output of postgraduate studies, these are another important link between R&D and education.
Knowledge Transfer*	
Patents & Patent Applications	patent applications and patent grants are outputs of a formal transfer of intellectual property.
Contributions to Policy Documents	R&D staff also transfer their knowledge and expertise through direct involvement as co-authors or indirect contributions via citations in documents created or utilized by policymakers including governments, NGOs and think tanks.
Healthcare Documents	includes medical guidelines, clinical trials and news statements from pharmaceutical companies and healthcare research institutes.

*Knowledge transfer is often referred to as an institution's 'third mission', alongside R&D and knowledge dissemination (teaching), with the goal of sharing its tangible R&D findings between non-academic stakeholders.

Beyond tangible outcomes, R&D, education and knowledge transfer can also take the form of activities. The supervision or mentoring of students, who go on to drive positive change after graduation, take on entrepreneurial, leadership or advisory roles in relevant organizations or initiatives– are examples of individual or institutional activities which span beyond traditional outputs.

5: Indicators

To mitigate the challenge of lengthy delays between research being conducted and any resultant societal benefits, our evaluation framework contains both lagging and leading indicators.

Lagging indicators offer insights into societal impact by retrospectively analyzing past outputs and activities that have had sufficient time to manifest their effects. They reveal how previous research efforts have contributed to societal outcomes, providing a picture of observed, tangible impact.

In contrast, leading indicators are forward-looking and analyze more recent signals that suggest the potential for research outputs and activities to create societal impact in the future, though without any guarantee. These indicators can guide actions to either refine or adjust research strategy to achieve better outcomes. They can help to determine whether the right teams are in place and working on the most promising activities and depending on the insights gained, this may lead to a course correction or a renewed focus – to enhance the likelihood of achieving a desired outcome.

Below are our initial lists of lagging and leading indicator groups for evaluating impact across all societal facets. Given the diversity of societal needs, the specific quantifiable metrics within each indicator group necessarily varies between societal facets.

Table 3

Lagging indicator groups

Uptake in R&D Beyond Academia	An indication of how stakeholders beyond academia are using, adopting or building upon institutional outputs or activities in their own R&D efforts. By deconstructing traditional bibliometrics and analysing the affiliations of citing authors, we can gain valuable insights into the broader influence of research, e.g. metrics based on citations from research co-authored by pharmaceutical companies can signal impact in the medical facet.
Uptake Beyond R&D	An indication of how stakeholders are applying, adopting or taking advantage of institutional outputs or activities in non-R&D outputs, such as patents, policy documents, industry standards, clinical trials and other practical applications. For example, citations of research documents in patents serve as a powerful indicator that research findings are being transferred from the bench to real-world applications.
Media Coverage	Informal mentions of research, its authors or their affiliations in reputable media outlets indicate societal acknowledgement of research. While media platforms can provide additional sources of information, they require careful consideration, as they lack the acknowledgement conventions found in academic publications and may not be reliable.
Recognition	Acknowledgement of an individual's and/or an organization's activity by high-profile recognition programs, including independent market reports (e.g. 'societal impact' rankings) and surveys is another signal of research impact beyond academia. For example, when a researcher or research group receives a prestigious international award for their contribution to human rights it signifies the broader societal recognition of their research.
Nurture	The training, support and guidance that an individual or an organization gives to other individuals, who go on to demonstrate an impact on society should be credited. It has been argued that the most important output of the public sector research base is its people, as there are few other sources of human capital with the potential to apply problem-solving and risk management skills across every facet of society.

Table 4

Leading indicator groups

Relevance	The applicability of institutional outputs or activities to specific societal needs is a pre-requisite for research to demonstrate future societal impact. Global societal needs are defined in the UN's Sustainable Development Goals, while regional, national or community-level needs can be identified through other frameworks and sources, including qualitative studies.
Engagement	The engagement of academic staff with other stakeholders (including NGOs, governmental organizations and businesses) is a powerful mechanism for understanding community needs. This collaborative approach aligns with the 'Mode 2' research model.[13]
Collaboration	Collaboration between researchers and other stakeholders, resulting in formal partnerships, such as co-authorship. Analysis of co-author affiliations – including government bodies, corporations, healthcare organizations and non-profits – can serve as a basis for metrics to identify the societal facets of research which may be impacted.
Communication	Communication of results via effective channels is essential for research to reach a wider audience and to be utilized in future. This can be achieved through scholarly channels that are accessible to a wider audience, such as open access journals, or reputable media outlets, talks and presentations.
Transferability	Transferability of institutional outputs or activities in addressing specific societal problems may be measured through knowledge transfer outputs beyond academia, such as patent applications, policy documents, industry standards and clinical trials.
Attention	Attention to recently published research can also indicate its future societal impact. Signals of interest ranging from clicks, views and downloads to mentions and bookmarks can provide insights, especially when analyzed from the perspective of specific audiences. For example, the frequency with which research is bookmarked in a reference management app used by healthcare organizations may signal its future adoption in the medical facet of society.

Each indicator group in our framework contains multiple individual metrics and users may wish to look at overall performance by indicator group or societal facet. This can be challenging because combining or aggregating metrics in a meaningful way is not straightforward. Clarivate already provides tools to encourage a holistic approach to decision making, taking care to provide data in a format that encourages responsible evaluation, allowing our users to focus on the appropriate profiles tailored for their specific case.

We are building on this foundation to allow aggregation of individual metrics within a given societal facet. We will include this framework in our forthcoming new Web of Science Research Intelligence platform. It will enable users to responsibly aggregate metrics to suit their own needs. We will provide guidance on the responsible way to combine metrics for each facet.

The overall performance for each societal facet will be presented within a 'Societal Impact Profile' with the underlying individual metrics available to support transparency and more granular analyses.

6: Visualizing societal impact

To facilitate responsible evaluation, impact data must be presented in a format that is both meaningful and accessible to multiple, diverse users. These data must transparently reflect diverse types and levels of impactful activity, while supporting timely decision-making for optimal resource allocation.

In this section we present representative examples to provide a high-level illustration of how societal impact will be displayed in the forthcoming Web of Science Research Intelligence platform to serve different use cases.

The societal impact of an institution is visualized using a radar chart containing eight axes – one for each of the eight societal facets described above. To facilitate effective comparison, each point on the Societal Impact Profile represents a quantile bin, calculated by comparing a given institution's performance against that of nearly 12,000 other organizations globally. Each facet has two points, one calculated using metrics from the lagging indicator groups and the other using metrics from the leading indicator groups.

The Societal Impact Profiles for the examples below were created using the initial set of metrics we have developed using data derived from scholarly output, patents and clinical trial data from Clarivate.

Showcasing individual institutions

Figure 1 shows the leading Societal Impact Profile for an established institution that has consistently performed highly for scholarly impact across disciplines, as measured by its Impact Profile™. Its Societal Impact Profile is also impressive, putting it far above the median performance (represented by the inner circle line) for seven out of the eight facets.

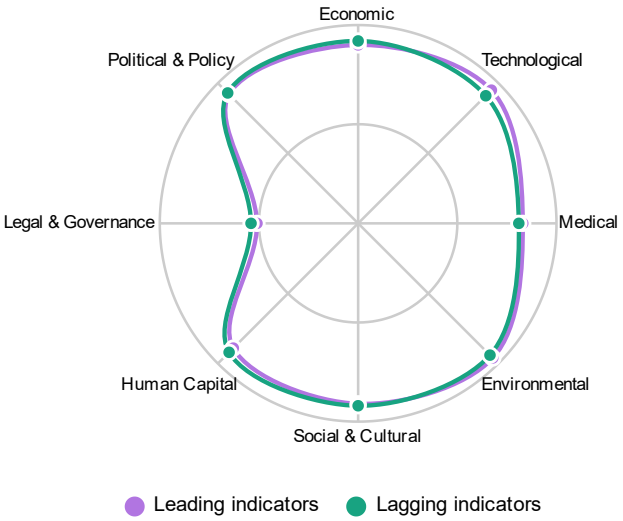

Fig.1: Societal Impact Profile of an established generalist institution

Let's consider an example of another global top-performer, but with a specialization in medicine (Fig. 2).

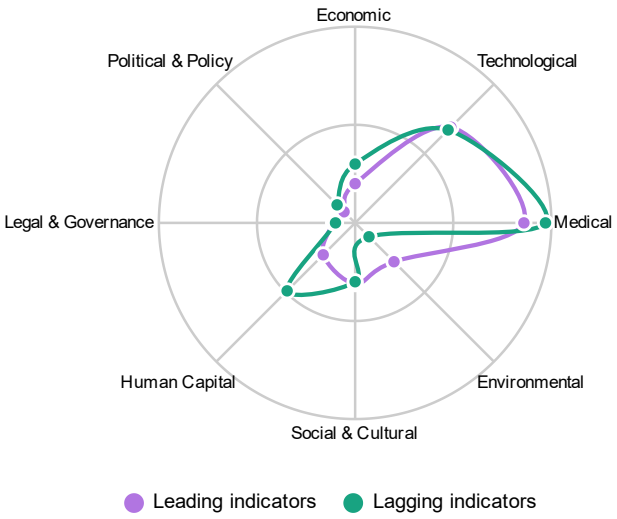

Fig. 2: Societal Impact Profile of a specialized institution

As expected, its performance in the Medical facet is very strong, with a more modest showing in other facets. However, its lagging indicators show that its interdisciplinary research in medicine has had a tangible spillover impact on the Technological and Human Capital facets, while its leading indicators in the Environmental facet show a potential to increase its impact in that facet.

Comparing performance using leading and lagging indicators

For a given facet, if an institution's Societal Impact Profile shows that its performance measured by leading indicators is at a similar level as its performance measured by lagging indicators, this indicates that the magnitude of an institution's future impact is likely to be comparable to its previous impact.

When performance measured by leading indicators is higher than performance measured by lagging indicators, this indicates that an institution's future impact has the potential to exceed its previous impact in that facet.

When performance measured by leading indicators is lower than performance measured by lagging indicators, this indicates that an institution's current capabilities may be lower than its previous capabilities, e.g., due to internal factors such as budget cuts, the de-emphasis of certain research programs, or external factors such as political or economic instability. Some course-correction may be needed to maintain previous levels of impact.

The radar charts above provide institutional views but can also be utilized to provide funder-level views. In this scenario, analysis of lagging indicators will reveal the societal impact of research funded through past investments. In contrast, leading indicators will provide early signals of the future impact of research funded through more recent investments.

Benchmarking against other institutions

Institutions need to benchmark their performance against other institutions. Exploration of competitive strengths and relative weaknesses compared to peer institutions helps to prioritize what to promote and also to identify more successful practices for possible implementation.

Let's consider the following example. Institution Y is a medium-sized university from Eastern Europe that would like to compare its performance against two peer institutions:

- Institution X, a world-class university in APAC, that it aspires to match in the long term; and
- Institution Z, a young university from the Middle East with which it competes for prospective post-graduate students, particularly in Medicine. These students are attracted by institutions that can demonstrate the real-world benefits of their research and teaching outcomes.

In this section we show how Societal Impact Profiles can easily be compared to provide valuable insights on:

- how Institution Y is performing against the two peer institutions of interest
- whether its long-term aspirational goal of becoming a world-class university is realistic
- whether it can compete effectively against Institution Z in attracting post-graduate medical students

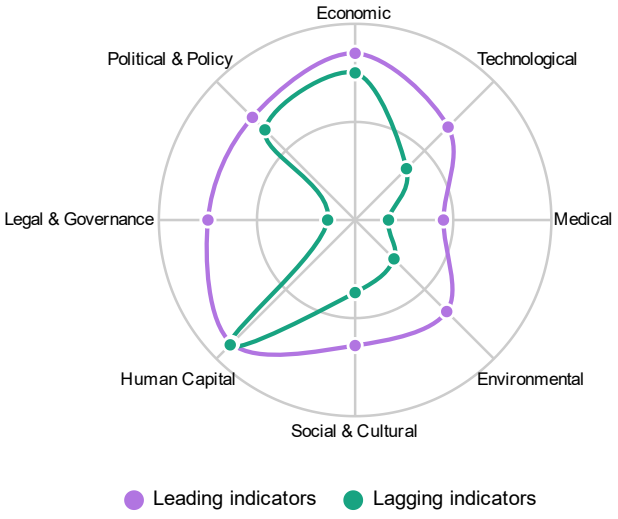

Fig. 3: Societal Impact Profile of Institution Y

Is Institution Y on the right track to meet its aspirational goal?
Comparison of Institution Y's lagging and leading indicators shows that the leading indicators are higher than the corresponding lagging indicators in seven of the eight facets, signalling its future impact has the potential to exceed its previous impact across the board (Fig.3).

The most substantial improvement is seen in the Legal & Governance, Environmental, Technological and Medical facets (Fig. 3). The gains are smallest in the two facets where the lagging indicators are strong – Human Capital and Economic – and its performance is already comparable to the world-class Institution X (Fig. 4).

Comparison of the leading indicators for Institutions Y and X (Fig. 5) reveals that Institution Y has the potential to have comparable impact to Institution X in the Technological, Economic and Human Capital facets. Furthermore, it has decreased the gap between its impact and that of Institution X in all five of the other societal facets.

Overall, the leading indicators point to Institution Y having the potential to become a world class university. Analysis of Institution X's underlying metrics and data points will provide more granular signals on what drives Institution X's success that can help guide Institution Y's long-term development strategy.

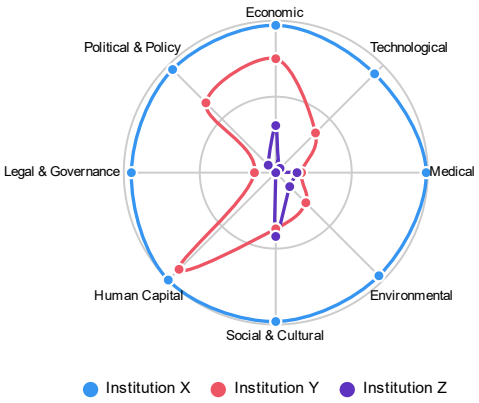

Fig. 4: Comparative Societal Impact Profiles (lagging indicators) for three peer institutions

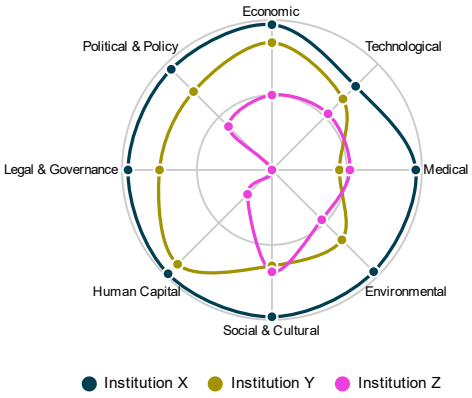

Fig.5: Comparative Societal Impact Profiles (leading indicators) for three peer institutions

Can Institution Y compete effectively against Institution Z for post-graduate medical students?
Comparison of the lagging indicators for Institutions Y and Z reveals that Institution Y's societal impact outperforms that of Institution Z overall (Fig. 4). However, both institutions demonstrate similar performance for the Social & Cultural and Medical facets, with the latter being the key area of competition.

Looking forward, the leading indicators show Institution Y risks falling behind Institution Z in the key Medical facet, suggesting timely action is required for it to compete effectively with Institution Z in future (Fig. 5). Analysis of Institute X's underlying metrics from the Medical facet will help Institution Y identify targets and action plans to improve its performance in this facet.

We are investigating the most appropriate ways to aggregate data to create radar charts visualizing and comparing Societal Impact Profiles at the national and regional level.

7: Next steps

This report is the first in a series to document our development of a comprehensive framework for the evaluation of societal impact. As outlined in our introduction, the growing expectations for demonstrable societal impact from research have created a pressing need for a responsible methodology to assess this impact across multiple facets.

We are refining our framework to support additional features, such as predictive capabilities, and building a comprehensive set of metrics using a wide mix of data sources. This is part of our commitment to provide robust metrics, tools and analytics, as well as best practice guidelines, to support responsible research evaluation.

We plan to share our progress regularly as it evolves, and we welcome feedback on both the framework itself and its applications. This valuable input will play an important role in shaping and refining this framework to deliver a solution that not only meets current expectations but is also adaptable to meet future needs.

Contact us via email: ISI@Clarivate.com

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This report also draws on information included in previous ISI reports and analyses including:

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