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Ease of Doing Research towards R&D, Technological Advancement and Global Development: From a Conceptual Framework to an Instrument for Reliable Indices

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Abstract

Research output and its translation into development remain profoundly unequal across global contexts, with researchers in resource-constrained environments persistently disadvantaged not merely by differences in individual capacity but by systemic disparities in the conditions under which research is conducted. Despite extensive documentation of these disparities, no universally applicable, multi-dimensional framework has been developed to measure and compare the conditions that enable or constrain research productivity across institutions and nations. This conceptual article introduces the Ease of Doing Research (EDR) as a practical framework for systematically assessing the research environment and its contributions to research output and impact. Drawing on analogous logic to the World Bank's Ease of Doing Business Index, the EDR framework proposes three primary, interconnected domains: Governance (encompassing research leadership, policies, regulations, and controlling forces), Ecosystem (comprising the research environment, context and culture, and incentives), and Resourcefulness and Resources (covering human capacity, funding, and infrastructure). The framework further identifies overlapping zones between these domains, recognising that research productivity is determined not only by the discrete quality of each domain but also by the dynamic interactions among them. The EDR is presented as a foremost framework on this subject, with significant implications for research policy, equity in scholarship, and the advancement of national development through science and technology.

Keywords

Ease of Doing Research, Governance, Ecosystem, Research Infrastructure,

Scholarship Leadership, Funding, Resourcefulness, Research Policy, National Development, R&D

1. Introduction

It appears that researchers generally understand that a number of factors contribute to their effectiveness as researchers, as well as to the quality of research output and the impact of the same on their societies. Nevertheless, it is difficult for these factors to be properly identified and described in concrete terms by most researchers. Researchers know that a number of factors are responsible for not just the design and conduct of research activity, but how much of such activities translate into research and development (R&D), innovative solutions, and technological advances (Romer, 1990; Aghion & Howitt, 1992). It is also known that the quality and quantity of research output from developed countries and established institutions typically and significantly outweigh those from under-resourced institutions and societies (UNESCO, 2021; World Bank, 2022). It is worthy of note that even researchers from developing countries with comparatively insignificant research output and impact appear to make significant contributions through research output when they migrate to developed countries with better research environments, resources, and governance structures (Docquier & Rapoport, 2012; Tettey, 2006).

It is therefore clear that in efforts to promote research, as well as the translation of research output into development, there has to be a practical instrument to help researchers gauge their research environment, context, and governing forces, and how these factors interact to contribute to their effectiveness and impact as researchers. Such a practical instrument would also help in shaping research agendas and strategies, as well as in the development of policies that are applicable and relevant to specific contexts. Since there has not been a practical instrument for measuring how an environment, as well as the other factors that interact with it, promotes research and development, the Ease of Doing Research (EDR) is being proposed as a practical instrument for this purpose. This EDR instrument is meant to assess individual researchers' abilities and opportunities to conduct research towards R&D, creation of innovations and solutions, research output and impact and their contributions to economic advancements.

Whereas the idea of the Ease of Doing Research is borrowed from the concept of the Ease of Doing Business—which has been adopted globally and is currently used by the World Bank to provide indices that can guide researchers and stakeholders (Djankov, 2016)—the idea is specifically developed from a proper understanding of research and scholarship, the context of research, and the governing forces that shape research agendas and influence research impact. Three primary key domains have been identified: Ecosystem, Governance, and Resourcefulness and Resources. The postulation in this work therefore is that the overall research

output—including the quantity and quality of the same, as well as its bearing on technological advances, the creation of innovative solutions, and national development—will depend on both the inherent qualities, and the quality of interaction of elements that constitute the governing forces, the research ecosystem, and the resourcefulness and resources available for research activities. The concept of the Ease of Doing Research is hereby presented in this work as a foremost framework on this subject.

2. Literature Review

The conceptual foundation of the Ease of Doing Research is grounded in the well-established Ease of Doing Business Index, introduced by the World Bank in 2002 as one of the most influential benchmarking tools for assessing regulatory environments for business across nations (Djankov, 2016). The index evaluates dimensions such as starting a business, dealing with construction permits, access to electricity, registering property, access to credit, and enforcing contracts, and its influence on national economic reforms has been well documented, with many countries using the rankings to identify and address structural weaknesses in their business ecosystems (Okwudili et al., 2021). Drawing on this paradigm, the role of research and development in driving economic growth, technological innovation, and social progress is equally well established in the literature (Romer, 1990; Aghion & Howitt, 1992). However, massive disparities exist in R&D investment and infrastructure across nations at different stages of development, with high-income countries sustaining robust ecosystems of government agencies, private foundations, and industry-academia partnerships, while low- and middle-income countries collectively account for a disproportionately small share of global R&D expenditure relative to their population sizes (UNESCO, 2021; World Bank, 2022; OECD, 2023). These disparities manifest across every dimension of the research environment—infrastructure, funding, human capital, institutional culture, and translational capacity—making a systematic, cross-nationally applicable framework for evaluating the conditions under which research is conducted both timely and essential.

The phenomenon of brain drain—the emigration of highly skilled researchers from developing to developed countries—has significantly impacted the research capacity of institutions across the Global South (Docquier & Rapoport, 2012). It has been observed that a lack of an enabling environment may prevent intellectuals and researchers from optimising their potential and contributing fully to development if they remain in resource-constrained settings (Tettey, 2006; Zeleza, 2012). Factors driving this migration include poor remuneration, inadequate research infrastructure, limited career progression opportunities, and the absence of a supportive research culture (Tettey, 2006). These structural deficits are not confined to any single country or discipline; they represent systemic features of under-resourced research ecosystems globally, characterised by chronic underfunding, poor laboratory infrastructure, bureaucratic bottlenecks in research ap-

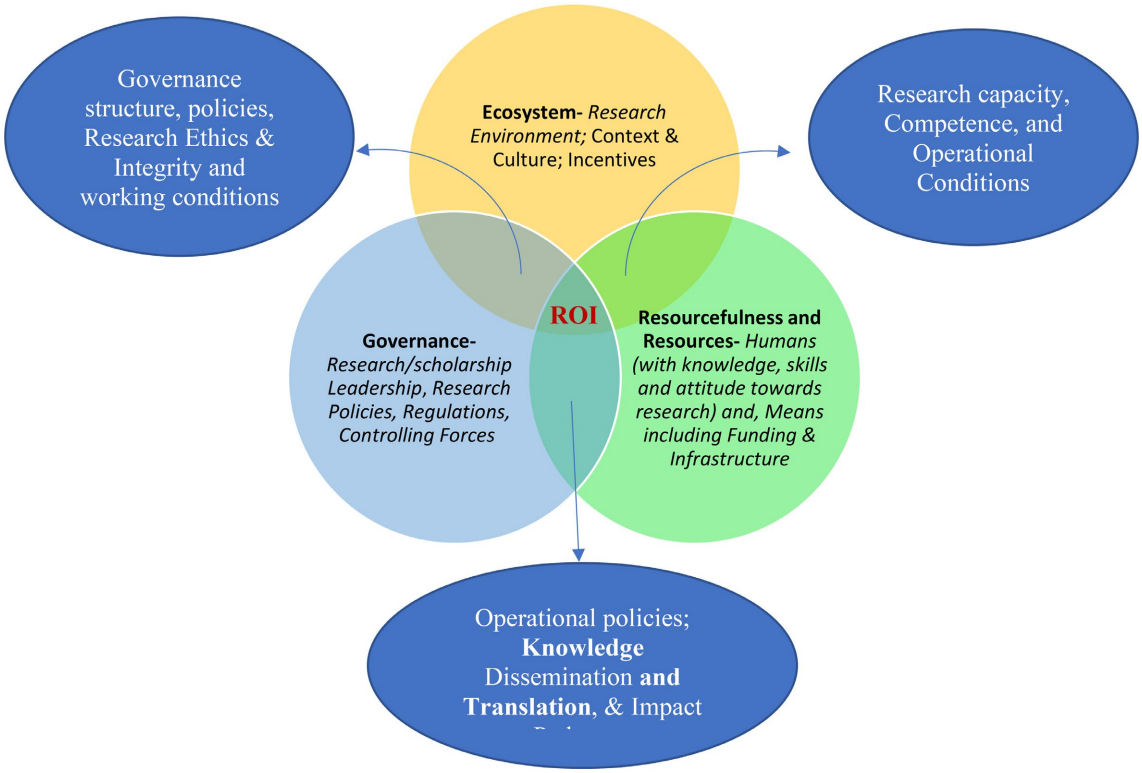
provals, limited access to current scholarly literature and databases, and weak cultures of research-industry collaboration (Oyewale & Adeyemo, 2020; Igiri et al., 2021). Understanding the specific environmental, policy, and resource differentials that drive researcher migration and diminish research output requires a framework that operates at the level of the individual researcher and their institutional context—a gap that the Ease of Doing Research construct is specifically designed to address.

The most directly relevant precedent for the EDR construct is the Ease of Doing Research (EoDR) framework developed by the Indian Council of Agricultural Research (Krishnan et al., 2021), which proposed a methodology for evaluating research environments within agricultural research organisations, encompassing dimensions such as infrastructure, human resources, funding, governance, and research output. While groundbreaking, this framework was designed for a single-country, single-sector context and has not been validated comparatively across nations or disciplines. Other related frameworks include the Global Innovation Index (WIPO, 2022), the Scimago Institutions Rankings, and various university ranking systems; however, none of these specifically operationalise the concept of ease of doing research at the individual researcher or institutional level or enable direct cross-national comparison within a defined disciplinary community. The absence of such a metric means that policymakers, institutional and university administrators, and funding agencies globally lack an evidence-based tool for diagnosing systemic weaknesses in research ecosystems and formulating targeted interventions. The present work represents an attempt to address this gap by developing and presenting the EDR construct through a rigorous comparative methodology, arguing that while the ease of doing business has been studied carefully and systematically, the concept of the ease of doing research remains relatively neglected in the scholarly literature worldwide.

Systems thinking provides a holistic and integrative approach to understanding complex, interconnected phenomena (Senge, 2006; Sterman, 2000), and in the context of research ecosystems, recognises that the ease of doing research is not determined by any single factor in isolation but by the dynamic interactions among multiple subsystems—including human capital, infrastructure, policy frameworks, funding mechanisms, institutional culture, and external collaborations. This perspective is informed by three complementary theoretical frameworks: the National Innovation Systems theory (Lundvall, 1992; Nelson, 1993), which provides the macro-level lens for understanding how national institutions, policies, and networks shape the environment for research and innovation across all countries; Institutional Theory (North, 1990; Scott, 2014), which offers insights into how formal rules and informal norms constrain or enable research activities—configurations that differ fundamentally across national and institutional contexts; and the Resource-Based View (Barney, 1991), adapted from organisational strategy to analyse how the availability and deployment of tangible resources such as funding and infrastructure, and intangible resources such as intellectual capital and men-

torship, influence research productivity within and across national contexts. Collectively, these theoretical lenses support the proposition that the ease of doing research is a measurable, multidimensional construct with universal applicability, offering a transformative tool for shifting the global discourse from merely counting research outputs to systematically understanding and improving the conditions that enable research productivity, thereby contributing to sustainable scientific capacity building and national development worldwide.

THE EASE OF DOING RESEARCH: CONCEPT AND FRAMEWORK



ROI = Research Output and Impact

Figure 1. The Ease of Doing Research (EDR) conceptual indicating 3 identified key domains—*Governance, Ecosystem, Resourcefulness and Resources*—including areas of functional and operational intersections, and the cumulative effects-Research Output and Impact, towards connecting research output and impact together with R&D (Research and Development) with the state and rate Technological Advancement and National Development. This conceptual framework is currently being used for a Case Study of the Academia in Nigeria.

Ease of Doing Research as a Concept: Key Parts

Initial review of existing literature, plus anecdotal evidence, indicates that one of the most significant factors determining not only research effort and outcome, but also the impact of the same in terms of R&D and national development, has a great deal to do with the ease of doing research (Krishnan et al., 2021). The effort to capture these fully draws on the main categories or dimensions of the EDR framework (**Figure 1**), as described below. Literature has already shown that Governance, Ecosystem, Resourcefulness, and Resources are integral to researchers' success in any research situation or nation (Docquier & Rapoport, 2012; Tettey,

2006; Krishnan et al., 2021). Whereas the specific factors that constitute these pillars have been identified, the three pillars provide the main areas that are essential to optimising the efforts, research outputs, and impacts of researchers. A major contribution of this work is the synthesis of the discrete factors identified in literature into three clear pillars.

1) Governance: Research/Scholarship Leadership; Research Policies, Regulations, and Controlling Forces

Governance has much to do with leadership and management as it relates to research and scholarship. This, by extension, involves the roles that researchers, academic leaders, and managers of research personnel play in leading and managing research projects and the research institutions themselves. The governance aspect of the Ease of Doing Research framework therefore includes people with leadership and managerial capacities, and the influences and impacts that they, through their efforts, actions, influence, and judgement, have on the ecosystem and its performance as well as its dynamics.

Governance also involves the quality and functional impacts of policies and practices that regulate and promote research within the contexts of research, such as research centres, institutes, and institutions such as colleges and universities. This governance framework is further influenced by the overarching directions from governments or governmental agencies. There are also additional controlling forces such as industry trends and advances. An example of the latter is the current role of artificial intelligence (AI) in driving educational and technological research in research centres and institutions, or the role of pharmaceutical companies—otherwise dubbed "big pharma"—in the affairs of research institutions. It would therefore be logical to state that research governance in this context includes human actors across research and academic leadership, and encompassing forces including policies, regulations, and the roles of partners and stakeholders with specific interests.

2) Ecosystem: Research Environment; Context & Culture; Incentives

The ecosystem itself is the context within which research activities are taking place. In most cases, these would include research centres, research institutions, academic institutions, and private industries with research capabilities and capacities. Mainly, most researchers whose research work is not tied directly to profit work in academic institutions and research centres often funded by governments and organised institutions. These ecosystems no doubt also have significant influences on the quality of research, the motivations for doing research, research outputs and outcomes, and the translation of research into products through research and development (R&D) pathways (Oyewale & Adeyemo, 2020). Specifically, research aspects would have to do with the research environment in terms of facilities and set-up, as well as the organisation for specific purposes, contexts, and culture—i.e., the particular purpose that the research ecosystem serves, as well as the culture that drives research and the behaviours and performances of researchers and other stakeholders within the ecosystem. Very importantly, the incentives for

not just doing research, but also the quality of research output and the translation of the same into impacts, would also be an important consideration within the ecosystem dimension of the EDR framework. In other words, the ecosystem consists of people who conduct and support research activities in terms of how they are organised, motivated, and incentivised, as well as the culture and contexts of work that define research activities and the qualities of them, which further bear on the outputs, outcomes, and impacts.

3) Resourcefulness and Resources: Humans (with Knowledge, Skills and Attitude towards Research) and Means, including Funding & Infrastructure

Resourcefulness and resources are arguably the most directly identifiable factors in determining the ease of doing research and the quality of the same, including research activities and their impacts on advancement and development, especially as research affects human life activities and qualities as well as the development of human societies at national and global levels (Romer, 1990). For example, humans serve as researchers who raise research questions, develop interests in specific research areas, commit to harnessing resources and pursuing their research agenda to logical conclusions that could include resolving intellectual and practical problems, advancing knowledge, or creating new solutions and products among other outcomes. The resourcefulness of humans or individuals involved in research—especially the quality of that human resourcefulness—is central to research quality, outcomes, and the impacts of the same. Having highly trained and competent, but also highly motivated, researchers would most likely translate into high-quality and high-volume research output, which would also translate to greater solutions and advances in knowledge and innovation. The opposite would also mean negative effects, including a dearth of new knowledge or advances and poor developmental processes or a dearth of innovation. It would therefore be in the interest of societies and institutions to harness human resourcefulness of the highest qualities available, and engagement in research for advancement and innovative solutions.

In addition to the competence of researchers—technological, knowledge-based, and qualifications—motivations and attitudes would also be important considerations. Competent but demotivated researchers could have their research productivity much diminished when they become demotivated. This could explain why several brilliant researchers leave the developing parts of the world for the developed parts of the world, making significant personal sacrifices, yet seemingly motivated by access to enabling research and working environments in their newly found research and living environments (Tettey, 2006; Igiri et al., 2021). Resourcefulness has been specifically used in this instance to capture the research competence and capacity for research by virtue of training, quality of knowledge, and the technical capacity to develop and pursue a research agenda to meaningful conclusion. On the other hand, resources primarily refer to means, including Funding & Infrastructure.

Clearly, funding and infrastructure are clear markers of the gaps in research

support between the centres of research excellence and other places with limited research capacities, hence output and impact (World Bank, 2022; OECD, 2023). For example, the resources available to researchers in places with quality and high research output is well above what is available to researchers in parts of the world where research is significantly underfunded. It would be interesting to estimate research funding per capita available to researchers from place to place and link the same to research output, impact, and development indices. One could almost accurately predict that there would be a meaningful relationship between resources available to support research and advances or development from place to place.

Another consideration that is closely tied to the funding of research is the infrastructure available to researchers. Clearly, research infrastructure such as adequate buildings and facilities for research, research laboratories, centres of excellence for research, as well as innovation centres and research hubs, are important institutional set-ups to support research activities. Countries and societies with high-quality research cultures and practices do not just reflect this in the proportion of their budgets, but also in the quality of attention that is paid to creating and funding local, regional, and national research centres and research centres of excellence with dedicated roles, which are sometimes even tied directly to national development and economy. In the same vein, the quality of attention given to nurturing, leading, or enabling these centres is reflective of appreciation for research and the support of the same, as indicators of effort committed to national development. In the same vein, institutions of learning and research such as colleges and universities are evidently dedicated to research to further advance knowledge, create solutions to problems, and advance the frontiers of innovation, among other roles.

3. Overlapping Parts

While the Ease of Doing Research framework specifically identifies three major domains—namely Ecosystem, Governance, and Resourcefulness and Resources—it is important not to view them as discrete components but rather as interconnected components with overlapping aspects. The overlapping aspects indicate areas that tend to belong to more than one of these primary domains, especially in terms of localisation and operationalisation. Questions that address the EDR's zones of intersection are already under each main domain; the intersection as defined in **Figure 1** are illustrations of relationships that bring together two adjacent domains—nevertheless, the key indicators are already identified under the primary domains. In terms of the EDR's usability as an operational framework, overlaps are not scored independently; they are just illustrations for conceptual understanding. Independent questions are already captured in the primary domains. Some of these overlapping parts are considered as follows:

Governance and Ecosystem: Governance Structure, Policies, Research Ethics & Integrity, and Working Conditions

The overlap between Governance and the Ecosystem encompasses governance

structures, research policies, research ethics and integrity, and working conditions. These overlapping areas are indicative of the fact that the humans responsible for governance are often localised within the research and institutional ecosystem. Furthermore, governing factors and forces—such as policies, ethics, working conditions, and research integrity—are shaped and defined by governance structures, yet it is these very elements that determine the culture and working environment within the ecosystem. Understandably, these areas of overlap are best considered practically as zones of interconnectedness between the primary domains rather than as belonging exclusively to either.

Ecosystem, Resourcefulness and Resources: Research Capacity, Competence, and Operational Conditions

The intersection between the Ecosystem, Resourcefulness and Resources addresses factors such as research capacity, competence, and operational conditions. Contextually, human resources—which include researchers, academic and scholarship leadership, as well as technical and support staff—are responsible for managing the research ecosystem and for operationalising research agendas and projects. To a significant extent, the actual research capacity in terms of resources available, and the capacity of researchers to utilise those resources, is determined by the inherent quality of resourcefulness and resources operating within the ecosystem.

Governance, Resourcefulness and Resources: Operational Policies, Knowledge Dissemination and Translation, & Impact Pathways

The intersection between Governance, Resourcefulness and Resources addresses factors such as operational policies, knowledge dissemination and translation, and impact pathways. For example, these intersections determine how governance structures support the allocation and management of resources for research and how human capacity is developed for conducive developments. Also included in this intersection is how governance ensures that pathways are created for translating the products and outcomes of research projects and intellectual properties into tangible solutions, innovations, and products through vehicles of R&D, patents, and industry engagements.

4. Further Discussions

Purpose of the EDR Framework

It is important to note that the concept of the Ease of Doing Research is born out of the need to provide a practical instrument for researchers to gauge the impact of their environment on their efforts as researchers, especially in terms of governance, researcher resourcefulness and capacity, in addition to resources, as well as the research ecosystem itself. It is considered an integral way of advancing research for the purpose of development. It is also a way to enlighten researchers and promote equitable access to not only resources, but also the creation of enabling environments for researchers irrespective of where they work or conduct research. This idea also challenges the arbitrary nature of measuring research con-

tribution using indices of research output primarily in the form of publications in scholarly journals, without proper consideration for context and the other factors as presented in this work (Amutuhaire, 2022).

It is noteworthy that researchers, who are often intellectuals, are primarily concerned with making optimal efforts to design research activities and execute them in the best way possible, upholding scientific and ethical principles, yet often overlook factors beyond their immediate activities and efforts that significantly determine the fate of their work. This work therefore serves several purposes, including policy advancement as well as the promotion of equity in research and its applications, in different ways including research and development as well as the creation of innovative solutions and products. There are previous works that have obviously addressed different components of this concept of the Ease of Doing Research—such as the effect of policies on research output, or the availability of funding and resources (Oyewale & Adeyemo, 2020; Krishnan et al., 2021). Nevertheless, it is instructive to mention that none of these have been able to carefully construct a concept that brings together these discrete elements and how they interact to influence the effectiveness with which research is carried out in different contexts.

Researchers Need a Comprehensive Understanding of the Research Environment and the Roles Each Factor Plays

This work also throws light on the need for researchers to have a proper and comprehensive understanding of the factors that interact to influence research effort. While the Ease of Doing Research is being developed and refined into an instrument linked to specific indices that could be used from place to place in ways that are contextually relevant and globally applicable, it also helps researchers to have a proper understanding of their research environment. One of the benefits of this is that researchers can properly advocate for better conditions as defined by the Ease of Doing Research framework. Researchers can also properly conceptualise how effective their environments are in promoting high-quality research and best practices. In fact, this tool may be able to project the impact of a researcher's efforts over the years relative to their contemporaries in other contexts. This work therefore takes the idea of the Ease of Doing Research from mere speculation or reliance on discrete and anecdotal evidence to a comprehensive and practical measurement framework. It is therefore considered a significant addition to scholarship.

A Need for Scholarship Leadership and a Proper Understanding of its Influence on R&D

The emphasis on governance in this work—which is further expanded into leadership and management—is instructive in a number of ways. Researchers are made to realise that scholarship leadership is integral not only to designing and implementing specific research agendas, but also to creating an enabling environment, promoting a positive culture of research, and harnessing resources for the best possible outcomes. Instructively, each of the domains overlaps with the other

two domains in significant ways. When this is considered from the perspective of governance, it is clear that the quality of scholarly leadership and management would have significant bearing on the health of the research ecosystem and its performance, as well as on the quality of human resources and material resources, infrastructure, and funding harnessed for the purpose of research (Krishnan et al., 2021). Consequently, this understanding will encourage researchers to also acquire leadership qualities, to advocate for sound policies, and to champion the provision of resources for quality research output and, by extension, meaningful impact.

Linking EDR to National Development

An initial review of literature points to the fact that more developed countries, ranked higher based on economic and development indices, commit larger proportions of their national budgets and spending to research and development activities, including research activities that take place in academic institutions such as universities, colleges, and research centres (OECD, 2023; World Bank, 2022). On the contrary, countries ranked lower on the basis of economic and developmental indices commit very small, and oftentimes almost insignificant, proportions of their national budgets and spending to research and development activities (UNESCO, 2021; Igiri et al., 2021). It is therefore instructive to state that there is a clear relationship between national technological and economic development and the effort committed to research and development (Aghion & Howitt, 1992).

Noting that research is carried out by individuals, it is also instructive to observe that researchers in developed and economically higher-ranked countries operate in better Ease of Doing Research environments—or score higher on the Ease of Doing Research scale—compared to their contemporaries in developing countries or those that are significantly under-resourced (Docquier & Rapoport, 2012; Tettey, 2006). This is also a pointer to the unrealised potential and the underutilisation of the full capacity of research in such underdeveloped environments. It is worth noting that the ultimate output and impact of a researcher does not depend entirely on their innate brilliance or hard work, but also on how enabling their context is, as measured by a framework such as the Ease of Doing Research. This mirrors the way in which businesses do not survive and thrive solely on the ingenuity of the business owner's idea or their initial means, but also on the indices of the Ease of Doing Business—which is determined by governing forces, the ecosystem within which they operate, and the resources made available to them (Djankov, 2016; Okwudili et al., 2021).

Linking EDR to Researchers' Satisfaction, Productivity, and Return on Investment of Efforts and Intellectual Properties

Another important benefit of promoting a framework for the Ease of Doing Research is that it will help measure how well the potential of researchers is optimised in ways that can lead to their satisfaction. This is in turn because the Ease of Doing Research will influence researchers' productivity and the return on investment for their efforts and inputs. For example, it is not unexpected that re-

searchers, per unit number, in developed and well-resourced institutions and contexts will have better indices for research output—such as their scores on platforms that quantify research impact, the number of patents per capita, as well as the translation of research ideas into tangible innovations, products, and solutions (WIPO, 2022). In terms of rewards, researchers who operate within contexts of higher Ease of Doing Research metrics or indices could also enjoy greater financial and material rewards for their efforts, for example through patent and research and development pathways.

Anecdotally, researchers know their research outputs and impacts have a clear link to their environment, even when there has not been a standardised tool for measurement. This lacuna is being addressed by the proposed EDR framework. This constructed EDR framework, upon going through a peer-reviewed process, will be validated and optimised through progressive iterations targeting key sectors of the research industry and academia. Methods such as the Delphi approach could help with further contextual adaptation.

5. Conclusion

In conclusion, this work is considered ground-breaking as it approaches the Ease of Doing Research from multiple concrete dimensions, not in a discrete way but in an interconnected way, yet with the opportunity to appreciate the contribution of individual groups of factors as well as the interactions between them. A limitation of this work is that it is an attempt to model the Ease of Doing Research despite the inherent variations between the research context and the business context from which the concept is borrowed. Nevertheless, it is clear that the Ease of Doing Research framework is not meant to be used in the same way that the Ease of Doing Business is used. It is not presented as a tool to rank countries or researchers. Rather, it is presented as a universally relevant yet contextually practical instrument for measuring the ease of doing research, as defined by governance, ecosystem factors, and human resourcefulness, as well as the material resources available to researchers.

Clearly, further work is required to refine this idea and to eventually develop the framework into an actual instrument with clear indices to more practically measure Ease of Doing Research indices. In its current form, it is important to state that it is an imperfect but promising instrument, with significant potential for filling a gap that is currently unaddressed—a gap that carries significant attendant implications without an intervention such as this.

Limitations

The Scope of the Ease of Doing Research (EDR) Framework is based on the understanding of the formal environments and contexts for research, especially in academia or research-based industry; it might not be well adapted for creative non-structured research and endeavours not subjected to rigorous scientific protocols or structured scholarship. The EDR is also meant to measure individual

researchers' EDR quotients, and the cumulation of the same-subject to analyses, is used to determine the EDR quotients for a population or country; hence, it does not measure the EDR value of a nation directly. While the EDR tool is designed to be simplified for quality global adaptability and suitability, its simplicity might also limit its ability to capture very nuanced feedback that is deeply contextual. Finally, the EDR Framework in its current form cannot be said to be definitive; it is therefore subject to further improvement.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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