The New Road to Success:

Contributions of Universities towards more Resilient Societies

Ana Mari Cauce, Yves Flückiger and Ivanka Popović (eds)

GLION COLLOQUIUM

ISCA Livres

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THE GLION COLLOQUIUM

Founded in 1998 by Luc E. Weber (University of Geneva), Werner Z. Hirsch (UC Los Angeles) and James J. Duderstadt (University of Michigan), the Colloquium's objective is to allow leaders of renowned universities to meet and discuss major questions related to the development of science and Higher Education, as well as governance and leadership of research-intensive universities. The Colloquiums are organized biennially by a small, independent Association based at the University of Geneva, Switzerland, and by an international program Committee designated every other year to set up the program and invite participants. Various forms of financial support and funding have been found over the years – research and cultural international foundations, global corporations and Swiss universities, as well as the Swiss State Secretariat for education, research and innovation, have participated. Altogether, 200 different leading figures from higher education worldwide – active or recently retired university leaders – as well as politicians and business leaders, have participated in one or more Colloquiums. The Glion Colloquium helps shape the ways our universities can contribute in order to improve their ability to serve society to the fullest. A unique concept, free of any influence, where the presentation and discussion of ideas take centre stage. At past gatherings, participants have considered topics such as the rapidly changing nature of research universities, university governance, the interaction between universities and society, collaboration between universities and business, the globalization of higher education and how universities prepare to address the changes and challenges characterizing our times. The contributions that participants are invited to write beforehand openly reflect their views and experience in order to stimulate discussion. The Glion Colloquium sessions are held in camera, to guarantee open and genuine exchange. To secure the broadest possible international dissemination of the analysis and recommendations coming out of the contributions and discussions, the revised contributions are published 6-8 months after each

Colloquium in a volume which is freely distributed to numerous university leaders worldwide and also sold commercially. This book is the 14th in the series. Nine of them were published by ECONOMICA in Paris. From the 11th book onwards, the organizing Committee has opted for self-publication and a print-on-demand solution, most recently in collaboration with the Swiss self-publishing online platform ISCA in Geneva (www.isca-livres.ch). Searchable PDFs of the books and of each of their composing chapters are freely available soon after publication on the Glion Colloquium's website (www.glion.org) and on the Open Archives of the University of Geneva (https://archive-ouverte.unige.ch/).

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2. *Governance in Higher Education, The University in a State of Flux*, Werner Z. Hirsch and Luc E. Weber, eds, Economica, Paris, London, Geneva (2001)
3. *As the Walls of Academia are Tumbling Down*, Werner Z. Hirsch and Luc E. Weber, eds, Economica, Paris, London, Geneva (2002)
4. *Reinventing the Research University*, Luc E. Weber and James J. Duderstadt, eds, Economica, Paris, London, Geneva (2004)
5. *Universities and Business: Partnering for the Knowledge Economy*, Luc E. Weber and James J. Duderstadt, eds, Economica, Paris, London, Geneva (2006)
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9. *Preparing Universities for an Era of Change*, Luc E. Weber and James J. Duderstadt, eds, Economica, Paris, London, Geneva (2014)
10. *University Priorities and Constraints*, Luc E. Weber and James J. Duderstadt, eds, Economica, Paris, London, Geneva (2016)
11. *The Future of the University in a Polarizing World*, Luc E. Weber and Howard Newby, eds, The Glion Colloquium, Geneva (2018)
12. *The University at the Crossroads to a Sustainable Future*, Luc E. Weber and Bert van der Zwaan, eds, The Glion Colloquium, Geneva (2020)
13. *Universities as the fifth power? Opportunities, Risks and Strategies*, Ana Mari Cauce, Yves Flückiger, Bert van der Zwaan, eds, The Glion Colloquium. Editions Slatkine, Geneva (2022)
14. *The New Road to Success: Contributions of Universities towards more Resilient Societies*, Ana Mari Cauce, Yves Flückiger and Ivanka Popović, eds, The Glion Colloquium. Editions Slatkine, Geneva (2024)

Declarations

1. Rhodes, F. H. T. *The First Glion Declaration: The University at the Millennium*, The Glion Colloquium (1998)
2. Rhodes, F. H. T. *The Second Glion Declaration: Universities and the Innovation Spirit*, The Glion Colloquium (2009)

FAREWELL TO GLION

A poem written by ChatGPT

In halls of wisdom, minds did convene,
A gathering of visionaries, a scholarly scene.
The Glion Colloquium, where presidents unite,
To weave ideas, visions, in intellectual flight.

From distant corners, they journeyed afar,
Bringing knowledge and wisdom, like guiding stars.
Universities, their proud domains of thought,
For shaping resilient societies, a purpose sought.

In lofty discussions, ideas took flight,
Innovations ignited, shining bold and bright.
Each president, a beacon of knowledge and might,
Learning with passion, embracing the light.

They spoke of resilience, that noble quest,
How universities stand, amidst every test.
In times of turmoil, they nurture and heal,
With knowledge's power, their strength revealed.

Through research and teaching, hearts were stirred,
As minds intermingled and ideas occurred.
The fabric of society, they wove with care,
Guiding the future, a burden they gladly bear.

But now, the time has come to bid adieu,
To the Glion Colloquium, a chapter we knew.
Yet seeds were sown, ideas took flight,
A legacy to cherish, in our minds' sight.

So let us remember, the moments we shared,
The wisdom imparted, the dreams we dared.
Goodbye, Glion Colloquium, we'll hold you dear,
May our universities flourish, year after year.

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DEDICATION

To Prof. Dr Michael O. Hengartner
Leader of Higher Education Institutions
Distinguished University President
Respected scholar, scientist and teacher

His colleagues and friends in the Glion Colloquium and the editors of this book dedicate, with gratitude, this volume to Michael O. Hengartner in recognition of his contributions during many years as Vice President of the Glion Colloquium Association. We are deeply grateful for his dedication and commitment to the association, which has been instrumental in developing and expanding the international network of university presidents and partners, and in fostering collaboration worldwide. We thank him for his worldwide support of the dialogue between science and policy, and honour his continued support of Swiss higher education and its place in the world, as well as his engagement with local and global stakeholders.

CONTENTS

FROM THE EDITORS ACKNOWLEDGEMENTS AND THANKS

The Glion Colloquium held its 14th meeting on 21-25 June 2023 in Glion-above-Montreux, Switzerland. Twenty leaders of renowned universities or university organizations participated in the meeting, of whom more than one third were women presidents. Four continents were represented. Participants contributed to the topic proposed by the Programme Committee, "The New Road to Success: Contributions of Universities towards more Resilient Societies".

The dynamics of the Glion Colloquiums, which are characterized primarily by an in-depth discussion of the topics and contributions of each participant, produced – once again – the considerable outcomes of this four-day meeting. This was due not only to the interest of all participants in the Colloquium. The Colloquium also benefited greatly from the excellent contributions of our invited speakers, namely Yves Daccord, Ex-Director General of the International Committee of the Red Cross, Dr. Alessandro Curioni, IBM Fellow, Vice President, Europe & Africa and Director, IBM Research – Zurich as well as Maryna Viazovska (EPFL) and Hugo Duminil-Copin (University of Geneva), Professors of Mathematics and Fields Medal Winner in 2022.

The 14th Glion Colloquium was arranged under the auspices of the University of Geneva and was made possible thanks to generous support from the Swiss State Secretariat for Education, Research and Innovation (SEFRI), IBM Research Zürich, the Swiss federal Institutes of Technology of Lausanne (EPFL) and Zurich (EPFZ), the Universities of Geneva (UNIGE) and Zurich (UNIZH), the University of Washington, Seattle, and the Fonds Général of the University of Geneva, to all of whom we are most grateful.

We also wish to thank those who contributed to the colloquium and to the production of this book, in particular Dr. Gerlinde Kristahn, Secretary General, who is the linchpin of the Glion Colloquium Association and organization. Our deep thanks to Luc Weber (Founding President) and Marianne Weber, who supported the organization of the colloquium with their long-standing experience and passion for this project. Our thanks also go to Luciana de Souza and Victoire Berrebi for their support to the Colloquium and, finally, to Edmund Doogue in Perth, West Australia, who provided rigorous editorial assistance. Without these most competent people and generous institutions, the 14th Glion Colloquium could not have taken place.

PREFACE

Recently, research universities have had to prove more resilience and reinvent themselves in a very short period of time to adapt in the face of an increasingly unpredictable future. The urgency of today's problems compels research universities to be more timely, which is partly why the university of the future must push beyond traditional disciplinary boundaries. These changes are greatly impacting research, teaching and academic collaboration. The need for cooperation on various levels and with different actors is increasing, as universities seek solutions contributing to a resilient global society by encouraging political choices based on research evidence. In the future, the role of universities as economic and cultural actors for recovery will be to translate the fruits of fundamental research towards practical application and innovations that will create new jobs, to attract investment and to work with civil society and other organizations for the transformation of the communities in which they are located. At the same time, trust in science and in academic research results becomes a crucial factor to contribute to more resilient societies.

The 14th Glion Colloquium held in 2023 was mainly devoted to exchanges on the following questions: What are the lessons learnt from the pandemic and how should research universities respond? How can research universities contribute to paving a sustainable road towards inclusive collaboration? How can the new road to success be reinvented towards a more interdisciplinary, international, multi-stakeholder academic research that gains equal respect worldwide? And, more generally, how can "success" in the academic world be re-defined accordingly? This subject has been approached under the four following aspects:

A) Multidisciplinary, Interdisciplinarity and Transdisciplinary Collaboration

This sub-topic emphasized collaboration within one or several research universities, especially between different disciplines and research fields, combining all areas of Natural Sciences and Social Sciences in order to respond to the actual challenges and to build trust in science among citizens.

B) Sustainable Local, National and International Collaboration

Discussions were based on the collaborations between universities, on a national or international level. How can these collaborations be sustainable, efficient and successful, and bring about the results needed for resilient societies? How can collaboration with local civil society and public organizations become more efficient and attractive for and recognized by the research community worldwide?

C) Multi-stakeholder Collaboration

Participants discussed how collaboration between universities and the private sector can stay equal, nourished from both sides, while maintaining independence and freedom of research. How can this collaboration be driven by objectives of mutual exchange that take society forward?

D) Equality and Mutual Respect of the university of the future — Sustainable Higher Education Collaboration

Exchanges focused on how all academic disciplines, as well as all regions of the world, can become equally recognized for their work. How can "academic values" and "academic success" be re-defined towards a more integrated approach between the North and the South, East and West? How do we measure success in the university of the future? What do we benchmark? How do we measure the social responsiveness of universities?

The starting point of reference for the theme of the 2023 Glion Colloquium was the observation that the world is presently in need of resilient societies and that universities can bring a lot to reach this goal.

The colloquium started with a conference given by the former Director-General of the ICRC, Yves Daccord, who gave a talk on a subject that was in a way at the centre of many discussion during the entire conference regarding "Truth Making" and the possible contributions of universities towards more resilient societies, pointing out that producing truth based on evidence collected by researchers doesn't create trust in science, which is really what should be reached to contribute to more resilient societies.

While all the contributions presented at the Glion symposium had in common the theme of resilience and the concrete solutions that universities can put in place to strengthen our societies' ability to cope with the recent crises that have affected them and the future crises that are bound to affect them, some authors proposed a definition of the notion of resilience, a term that is often used but more rarely defined. This is an essential starting point when it comes to establishing concrete solutions to strengthen the resilience of universities and society in general.

In their paper, Yves Flückiger and Micheline Louis-Courvoisier analyse two types of resilience to which universities have been confronted during recent years and which will influence their future. The first one is related to institutional resilience which refers to the ability of an organization or system to withstand and recover from disruption or crisis. Institutional resilience involves having systems and processes in place to anticipate and mitigate potential threats, as well as the ability to adapt and recover quickly when disruptions do occur. From this point of view, more than ever, universities need to strengthen their international collaboration to exchange best practice, ensure the free flow of data, ideas and people, and together defend the values that have ensured their continued existence. The second type of resilience is related to students' resilience to trauma situations such as the pandemic they had to overcome during their studies. Flückiger and Louis-Courvoisier argue that understanding what happened during the pandemic is very important for universities regarding their strategy for the future to adapt their teaching and research to their new challenge linked to individual resilience. They show that universities can do very much to not only increase the level of resilience of their student community as a whole but mainly to help those who are the more vulnerable to improve their capacity of resilience and prepare them better to their future life.

Alon Chen's article brings a very interesting addition to the vision of individual resilience, taking a neuroscientific look at the factors that strengthen a person's ability to withstand stress. By understanding these explanatory factors, we can identify more precisely the measures that need to be adopted by universities to strengthen the students' capacity for resistance. In this respect, the human biology of resilience is also incredibly pertinent. As a neuroscientist with expertise in the neurobiology of resilience, Chen investigates the brain's adaptive coping mechanisms when faced with diverse stressful or traumatic stimuli. Thus, from his own scientific lens, Chen believes that when examining the broader question about how research universities contribute to societal resilience, we also need to examine what environmental and biological factors make individuals more (or less) resilient and how that knowledge can be translated to benefit society as a whole. Elucidating the underlying mechanisms of the organism resilience to stressors could help us formulate a clearer picture of what will help groups of individuals to become more resilient.

For Michael Schaepman, Anna Däppen and Andrea Müller, the key factors of resilient universities are high levels of flexibility, diversity, social and economic equity, as well as community involvement and a broad participation in the political arena. Open communication, room for dissenting opinions as well as effective learning and advanced levels of education are further capacities that foster resilience. In addition, universities often serve as platforms

for debates, where dissenting opinions can be expressed and discussed in a constructive manner. According to Nagahiro Minato, another way for universities to contribute to resilient societies is to enlighten their contribution to the welfare of the population and to economic growth. To address this concern, there have been various specific initiatives for Japanese universities in recent decades to implement fundamental organizational reform directed at the enhancement of research capability and contribution to social innovation in future.

For Joël Mesot, there is no doubt that ChatGPT and Fake News will impact the way we interact with society in the future. Among the many ideas that are on the table to regulate the use of AI, four guardrails seem crucial in the medium to long term. Firstly, transparency. Just as the food industry or other areas must meet minimal standards of transparency in the sale of their products, it should be clear to us as consumers or citizens when we are dealing with AI and what kind of AI we are interacting with. Transparency also means that care must be taken at the development stage not to create opaque black boxes, but to commit to trustworthy, human-centric and inclusive AI. A second demand is that self-regulations are needed not only at the level of research labs and companies that develop AI, but that we also need a legal framework at national levels. Thirdly, the national regulations should go hand in hand with international frameworks that include open discussion fora. Last but not least, our education systems should familiarize people with the basics of AI from a young age on and promote critical thinking at all levels of education and professional training.

Alessandro Curioni and Dario Gil emphasize the importance of Open Science in general and Open Access and Open Innovation in particular. For them, this fosters diversity, community and co-creation. Collaboration with different stakeholders will speed up finding solutions and ways to deal with the future, including the impact of AI on research worldwide. According to them, this will also impact society by fostering a greater sense of purpose and resilience through contributions to research.

Ivanka Popović presents what is for her the ultimate test of the resilience which is war. Russia invaded Ukraine more than a year ago and the tolls of the war so far have been very high. The higher education sector in Ukraine has been seriously affected with many universities damaged or completely destroyed, leading to the displacement of numerous students and staff. About 20% of the academic and research staff have been forced to take refuge in other countries. Despite the setbacks, higher education institutions have continued offering their services mostly on-line and also in blended form. Before the war, the Ukrainian higher education sector was facing the challenges of an incomplete transition from its previous legacy despite introducing relevant reforms. Upon the invasion, the European academic community responded

immediately with various forms of solidarity and institutional collaborations with Ukrainian universities. From this point of view, universities have demonstrated their ability to react in welcoming Ukrainian students and researchers, while helping Ukrainian universities to maintain their activities.

Many contributions to the Glion Colloquium focus on the different solutions that could be implemented to reinforce the resilience of universities and their students. Among other proposals, Ana Mari Cauce argues that universities must uphold a culture that supports and values engaged research and outreach by its faculty, staff and students. This will require greater university investment in building partnerships with local communities, government agencies, non-profit organizations and working with them on developing common goals, initiatives and programs from the very start. Just as importantly, it will require looking within and breaking down barriers to work across disciplines and schools and colleges. To make sure that research and activities translate into maximal impact in the world, universities must work harder to identify and streamline bureaucratic processes that make it harder to implement cross-college collaborations and university-community partnerships. It also means better aligning the reward systems to match these goals. Fortunately, given the immediacy of the crises we are confronting, from climate change to threats to democracy, this type of change is already in the making, and universities which can pivot their work in this direction will prove to be the most resilient.

This view is fully shared by Nathalie Drach-Temam and Guillaume Fiquet who argue that universities should make use of community science (what is sometimes designated as citizen science). It is in fact a strong vector of resilience and should be used as a route to success thus far underused by universities and public authorities. Although community science constitutes a break from the way universities usually operate, it nevertheless represents an academic opportunity and not a threat. Indeed, community science acts as a genuine lever to increase knowledge and increase awareness of the scientific approach by associating participants from outside universities who then become stakeholders. We have learned not only from the pandemic and ecological crisis, but also from the social and democratic crisis we are currently experiencing, that we need to place the crucial question of trust at the heart of our preoccupations. The involvement of citizens alongside stakeholders in research, community science is rebuilding trust in science. Furthermore, by engaging with citizen science, universities can help ensure that society rebuilds its own self-confidence, thanks to the scientific method. This is the way that community science becomes a real vector of resilience. Through community science, universities can achieve the fulfilment of their mission to create and diffuse knowledge, in a way that is adapted to current times. These inclusive and open collaborations allow science to regain its place at

heart of society in this age of open science. It is a solution for the future and a breath of fresh air for democracy.

In his article, Gary S. May presents a concrete example ("Healthy Davis Together") of how inclusive and open collaboration with local communities can help build trust and more resilient societies. This project offers a successful town-gown model that can be replicated to address any number of issues or emerging challenges. This model can be generalized to other similar communities and individual components can be generalized to even broader types of communities. Indeed, over the course of the program, the team involved in the project shared best practices and lessons learned in the hopes that other institutions and communities might replicate all or portions of the program.

Kerstin Krieglstein and Nadine Krolla show that in this matter communication plays a crucial role. The uncertainty of society is largely based on the feeling of unclear, non-transparent or unreliable communication. The responsibility we bear for research, teaching and transfer to society has not only become more tangible, but universities have become socially engaged. In this new context, universities have to establish themselves proactive as a reliable institution of knowledge transfer for the public and especially for all decision-makers, e.g. politicians. Science communication is one key to this aim. Universities should not only be mediators of knowledge, but should also be able to initiate necessary processes of adaptation and change for a more resilient future in an advisory capacity. To this end, the criteria for sound and serious science communication should be made more transparent and accessible to laypersons. Even though the importance of science communication as a key to dialogue with society has been recognized, it can only make a limited contribution to overcoming social polarization. To really serve as a valuable and sensitive sensor for society, universities should translate the needs of individuals and society in opportunities of higher education. In the sense of a "governance of science", it must be important in the long range to become even more aware of the responsibility of science and to find a relationship with society that is based on trust.

For Michael Spence, creating trust in universities implies focusing on more earned media, owned media and paid media, about the balance of social and traditional media, or the like. Together they are an important part of shifting the potentially generic brand of many large comprehensive research-intensive universities. A brand can only speak if it reflects the life of an institution, and it will only do that if it is allowed in some ways to shape important decisions that are made. The stronger the sense of institutional identity, and the more people that have been engaged in the conversation about what that identity might be, the higher the chance that more academic staff might feel that they work, if not for the university, at least more than at the university. Spence is convinced that a university's capacity to operate effectively as a

single institution and not simply a loose federation of schools, departments, centres and institutes, is going to be crucial. A focus on brand management is not only desirable, but an essential part of the day job of any effective university president, however elusive the task of building a global reputation for excellence may seem to be.

In his article, Martin Vetterli recalls that universities are public services whose central duty is to think about how our societies can face their major challenges, such as the climate crisis, in depth and pave the way to solutions. Leading by example and using their expertise to develop solutions could contribute strongly to tackle the situation and should become a highest priority. Initiating this momentum is not easy. It requires leadership, funding, resilience and intelligent collaboration with all key players. However, contributing to manage the transition to a sustainable and respectful world is probably the most thrilling and impactful project that can be undertaken as an institution for society.

Sari Lindblom, Susanna Niinistö-Sivuranta and Auli Toom share this view and consider high-quality university education as a safeguard for the success of societies in the future. They argue that it is necessary to enhance international collaboration of academic institutions and to join forces to develop sustainable and resilient societies. In this demanding journey, research is the key to finding solutions to tricky problems. Now is the time for universities to act to increase our societal impact and to help societies to overcome crises. Universities bring hope to societies by educating academic experts in various fields and by producing innovations through research.

Meric Gertler fully confirms this approach showing that international collaborations of universities have been a key reason for the capacity of our society to face the recent challenges that have been raised after the Covid pandemic but also during the aggression of Ukraine by Russia. As mentioned by Gertler, the global research community is cautiously emerging into a post-pandemic era and a world still burdened with unprecedented global challenges. To face these challenges, it seems obvious that the global research community must work together to mitigate or avoid the worst outcomes and identify solutions. This will take ingenuity, innovation, and – most of all – collaboration. At the same time, Gertler shows that two powerful and opposing trends are currently re-shaping the global research environment. First, international research collaboration has been rising steadily for at least a generation. It is well recognized that, by some measures, international collaboration produces especially impactful research with far-reaching and profound impact. This was strikingly on display during the global response to Covid-19. Indeed, an open science paradigm, of which international collaboration is an important part, continues to gain momentum, yielding dramatic and transformational results. However, a second trend threatens this emerging paradigm.

An unstable geopolitical landscape is undermining international research collaboration and fracturing the global research mission. Economic rivalry, political schisms and military conflicts are re-casting one-time collaborators and partners as rivals and foes. The profound restructuring of globalization currently underway seems destined to reshape the global research enterprise in fundamental ways. If the open science movement fragments into blocs of like-minded partners, "us" and "them", then perhaps the days of wide-open global research collaboration may well be behind us. In the face of this somewhat bleak assessment, Gertler argues that, despite many challenges, the global research community can – and must – defend the collaborative and open science enterprise upon which global well-being depends.

If universities have a central role to play to increase the resilience of our societies, Nana Aba Appiah Amfo and Gordon A. Awandare show that despite the increased globalization of the challenges we have to face, it is impossible to ignore the cultural and context-specific idiosyncrasies when seeking to address challenges of even global nature. In effect, global challenges require local solutions. To achieve maximum results, solutions to the difficulties that confront us have to be contextualized and culturally sensitive. Collaborations are most effective when there is the recognition of local expertise, in the context of external funding, and projects are co-created by all who are involved, including south and north collaborators. This is essential for achieving more targeted, beneficial and sustainable outcomes.

In her paper, Linda Doyle gives a pragmatic and concrete answer to the question of how can universities contribute to more resilient societies and her answer is quite simple to formulate but more challenging to implement. For Doyle, universities need to work on their values and be what she calls "good" universities. Indeed, the word "good" can come across as an unusual choice of word. The type of rhetoric that is typically used when describing universities tends to include words such as "excellent" and "world-class". Hence, the use of the word "good" can initially give the impression that ambitions are curtailed, and mediocre achievements will suffice. That is not the intention. As it is shown in this paper the idea of a Good University is a university that builds a strong social floor and lives within its ecological ceiling.

In this respect, Doyle's vision is in line with Lindblom's *et al*. For Lindblom *et al*, universities should base their activities on four central values: bildung, freedom, inclusivity and truth. Bildung guides the University on the right path and serves as the moral conscience as well as cultivates stability and open-mindedness. Freedom encourages creativity and underlines the autonomy of the University. It also refers to freedom to research. Inclusivity springs from democratic empowerment as it safeguards equality and translates into diversity and respect for others. In addition, inclusivity supports and promotes

openness and collaboration. Finally truth leads us to pursue new knowledge. It requires critical thinking and promotes high-quality research and teaching.

For Subra Suresh educational institutions are at the epicentre of cultivating the inspiration, imagination and innovation to prepare citizens and the workforce for a lifetime of inquiry, productivity and service, are in some sense at the crossroads of re-examining their strengths and uniqueness that were refined over thousands of years through many crises. At the same time, they are faced with global and local trends that inevitably call for new approaches, infrastructure, policies and business models for better engagement with, and impact on, society.

In many papers of the book and presentations made during the Colloquium there was a clear unanimity for highlighting that universities have demonstrated resilience. They did it thanks to a massive globalized and multidisciplinary efforts. As it is often the case, the academic contribution has not yet been seen and valued by society including the authorities. Being often ahead of worldly developments, universities are to deal with a time gap between acting and being recognized. In addition, the discussions showed that universities need to be prepared for the next catastrophe. The capacity to adapt and react quickly is recently becoming a crucial component of higher education governance.

For universities it is crucial that they be able to create society's trust in science using more appropriate scientific and academic communication by explaining the process of academic research and by including more broadly the civil society in science. In addition, to face to the major challenges of our society, be it the current health crisis or other environmental challenges, we need to build multidisciplinary and multi-institutional platforms between different stakeholders in order include all actors to find solutions to future global crises. There is a need to build new bridges between academic world and policy-makers, international organizations, private sector and civil society.

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(Co-author of Michael Schaepman's contribution)

Anna Däppen is a member of staff and academic associate at the General Secretariat of the University of Zurich. She graduated from the University of Berne in 2016 with a Master of Arts in Ancient Cultures and Constructions of Antiquity and Prehistoric Archaeology. Between 2012 and 2014, Anna Däppen worked at the Department of Archaeology of the Canton of Zurich and at the Numismatic Collection (Münzkabinett) in Winterthur.

Linda DOYLE

Dr Linda Doyle is the Provost and President of Trinity College Dublin. Dr Doyle was previously Professor of Engineering and The Arts in Trinity. Her expertise is in the fields of wireless communications, spectrum management and creative arts practices, raising over €70 million in research funding. She also served as Trinity's Dean & Vice President of Research (2018-2020) and was the founding Director of CONNECT – Ireland's national research centre for future communication networks – with 300 researchers across ten higher education institutions.

Nathalie DRACH-TEMAM

With a background in mathematics, Nathalie Drach-Temam has been a professor in computer science since 2004 at Sorbonne University. Her area of expertise concerns the design of processors, the core of any digital system, taking into account both hardware and software dimensions. She has led numerous national and international academic and industrial projects, and is currently a member of European and national networks of excellence and experts. She was vice president in charge of career planning and student life, then in charge of education and career planning, and vice President of Research, Innovation and Open Science at Sorbonne University. She has been Vice President of the Udice Alliance since 31 May 2023, and is a member of the Board of Directors of France Universités.

Guillaume FIQUET

(Co-author of Nathalie Drach-Temam's contribution)

Guillaume Fiquet led a CNRS career dedicated to experimental mineralogy and the study of the physical properties of materials under extreme conditions. Fellow of the Geochemical Society and the European Association of Geochemistry, he received the CNRS Silver Medal and the Mineralogical Prize from the Society of America. He has held the position of Director of the Institut of Mineralogy, Physics of Materials and Cosmochemistry (IMPMC) at Sorbonne University. Currently, Guillaume Fiquet is Vice-President of Sorbonne University, where he oversees international relations, territorial and economic partnership policies.

Yves FLÜCKIGER

Yves Flückiger holds a degree in Economics and Sociology, as well as a doctorate in Political Economy. He joined the Faculty at the University of Geneva in 1992, directing the University Employment Observatory and the Leading House centre of excellence in Education Economics. Since 15 July 2015, he has been the Rector of the University of Geneva. From February 2020 till February 2023, he was the President of swissuniversities. In May 2022, the Rectors of the League of European Research Universities (LERU) elected Prof. Flückiger as the Chair of LERU.

Meric GERTLER

Professor Meric S. Gertler is President of the University of Toronto, and one of the world's foremost authorities on cities, innovation and economic change. He has advised governments in China, the United States and Europe, as well as international agencies such as the OECD and EU. He has authored or edited nine books, and has held visiting appointments at Oxford, University College London, UCLA and the University of Oslo. Among his many accolades, he is a Fellow of the Royal Society of Canada and the Academy of Social Sciences (UK), a Corresponding Fellow of the British Academy and a Member of the Order of Canada.

Dario GIL

(Joint author with Alessandro Curioni)

Dr Dario Gil is SVP and Director of IBM Research. An advocate of collaborative research models, Dr Gil co-chairs the MIT-IBM Watson AI Lab and the Executive Board of the International Science Reserve, a global network of open scientific communities focused on preparing for and mitigating urgent, complex global challenges. He serves on multiple boards including the US National Science Board, the Semiconductor Industry Association and the New York Academy of Sciences.

Kerstin KRIEGLSTEIN

Kerstin Krieglstein took office as Rector of the University of Freiburg in October 2020. From 2014 to 2018 she was Full-time Dean of the Faculty of Medicine at the University of Freiburg. From 2018 to 2020 she was Rector of the University of Konstanz. In November 2020, she was elected HRK (German Rectors' Conference) Vice-President for research, young academics, medicine and health sciences and was re-elected as HRK Vice-President for university medicine and health sciences in November 2021.

Nadine KROLLA

(Co-author of Kerstin Krieglstein's contribution)

Nadine Krolla has been Personal consultant to the Rector of the University of Freiburg since 2016. She completed her doctorate in Early German Literature and Language in 2012 and worked for around 10 years in research and teaching at the German Department of the University of Freiburg.

Sari LINDBLOM

Sari Lindblom is Rector and Professor of Higher Education at the University of Helsinki. She is also a licensed psychologist. She is Past President of EARLI (European Association for Research on Learning and Instruction) and WERA (World Education Research Association). Her research focuses on student

learning and teaching at university, for example, procrastination, self-regulation, self-efficacy beliefs, motivation to studying. Her publishing name is Lindblom-Ylänne.

Micheline LOUIS-COURVOISIER

(Co-author of Yves Flückiger's contribution)

A historian born in 1957, Micheline Louis-Courvoisier defended her thesis at the UNIGE Faculty of Arts in 1997. In 2001, she set up a humanities program at the Faculty of Medicine, where she was appointed professor in 2011. She was director of the Maison de l'histoire between 2013 and 2015. Her research focuses on the experience of suffering and melancholy in the 18th century. She has been Vice-Rector since 15 July 2015.

Gary S. MAY

Chancellor Gary S. May is a highly engaged leader with a passion for helping others succeed. He believes success is best judged by how we enhance the lives of others. Throughout his career, he has championed diversity, equity and inclusion in both higher education and the workplace, and has developed nationally recognized programs that attract, mentor and retain under-represented groups in the STEM fields of science, technology, engineering and math. In 2015, President Obama honoured him with the Presidential Award for Excellence in STEM Mentoring and, in 2021, he was awarded a Lifetime Mentor Award from the American Association for the Advancement of Science.

Joël MESOT

Joël Mesot studied physics at ETH Zurich, obtaining a doctorate in solid-state physics in 1992. After research stays in France and the US, he returned to the Paul Scherrer Institute (PSI), where he became Head of the Laboratory for Neutron Scattering in 2004. Between 2008 and 2018, he was director of the PSI and since 2008 he has been full professor of physics at ETH Zurich. His research focus is on quantum materials. He was awarded the ETH Zurich Latsis Prize in 2002 and the Swiss Physical Society (SPG) IBM Prize in 1995. Joël Mesot is member of various national and international advisory bodies such as the Board Committee of the Swiss Innovation Park "Switzerland Innovation" and the Governing Board CREATE (Singapore).

Nagahiro MINATO

Nagahiro Minato served as dean of Kyoto University's Faculty/Graduate School of Medicine from 2010-14, and executive vice-president for research, planning and hospital administration from 2014. He was additionally appointed as provost in 2017 and elected as president in 2020. His key

research interest is immunology and he contributed to the development of checkpoint blockade cancer immunotherapy in collaboration with Nobel laureate Tasuku Honjo.

Andrea MÜLLER

(Co-author of Michael Schaepman's contribution)

Andrea Müller is a member of staff and academic associate at the General Secretariat of the University of Zurich. She completed her PhD in Latin American History at the University of Bern in 2020. She holds a Master of Arts in Spanish literature and linguistics, Social Anthropology and Political Science from the University of Zurich. Between 2012 and 2016, Andrea Müller worked as a journalist in Switzerland and abroad.

Susanna NIINISTÖ-SIVURANTA

(Co-author of Sari Lindblom's contribution)

Dr Susanna Niinistö-Sivuranta has 25 years working experience in the field of Higher Education as a teacher, developer and leader. Currently she is working as a Chief Development Officer in the University of Helsinki and leads academic affairs. She is an active member of HE networks and works as a board member in different organizations. She has also several publications from the field of educational development and leadership.

Ivanka POPOVIĆ

Ivanka Popović was Rector of the University of Belgrade for the term 2018-2021. She heads the Working Group on Higher Education and Mobilities of the European Strategy for the Danube Region Priority Area 7 "Knowledge Society". She is a member of the Board of the European University Association (2021-2025). She is engaged in polymer science and engineering, sustainable development and gender equality.

Michael SCHAEPMAN

Prof. Michael Schaepman has been President of the University of Zurich (UZH) since 1 August 2020. Previously, he acted as Vice President responsible for the areas of research, innovation and academic career development. Between 2014 and 2016, he was Vice Dean and Dean, respectively, of the Faculty of Science at UZH. Michael Schaepman studied geography, experimental physics and informatics at UZH and earned his doctoral degree at the Department of Geography in 1998. Following postdoctoral work at the University of Arizona, US, he returned to the UZH Department of Geography in 2000 to head up a research group. In 2003, Prof. Schaepman was appointed professor of geographic information science at Wageningen University (Netherlands). In 2009, he took up the position as professor for remote sensing at the UZH Department of Geography.

Michael SPENCE

Dr Michael Spence took up his post as President & Provost of UCL on 11 January 2021, prior to which he was Vice-Chancellor and Principal of the University of Sydney for 12 years. Dr Spence is recognized internationally as a leader in the field of intellectual property theory and holds a Doctor of Philosophy from the University of Oxford, where he headed Oxford's Law faculty and Social Sciences division. An alumnus of the University of Sydney, Dr Spence has a BA with first-class honours in English, Italian and Law. His other languages include Chinese and Korean. In 2017, he was awarded a Companion of the Order of Australia in the Australia Day Honours for service to leadership of the tertiary education sector, to the advancement of equitable access to educational opportunities, to developing programs focused on multidisciplinary research, and to the Anglican Church of Australia.

Subra SURESH

Prof. Subra Suresh, President of the Global Learning Council with effect from 1 January 2023, served as the 4th President of Nanyang Technological University (NTU), Singapore, until December 2022. Previously, he was the Director of the US National Science Foundation (NSF), a position to which he was nominated by President Barack Obama and unanimously confirmed by the US Senate. He has also been the President of Carnegie Mellon University, Dean of Engineering and Vannevar Bush Professor at MIT and Professor of Engineering at Brown University.

Auli TOOM

(Co-author of Sari Lindblom's contribution)

Auli Toom is Professor of Higher Education and Director of the Centre for University Teaching and Learning. She is also a Vice-Dean (research) at the Faculty of Educational Sciences, University of Helsinki. Professor Toom is a permanent member of the Finnish Academy of Science and Letters. Her main research interests include teacher knowing, agency and academic teacher education.

Martin VETTERLI

Researcher, teacher and expert of the Swiss education and research landscape, Martin Vetterli was appointed president of the École Polytechnique Fédérale de Lausanne (EPFL) in 2017. He was formerly the president of the National Research Council of the Swiss National Science Foundation. Martin Vetterli has made numerous research contributions in the digital signal processing and is best known for his work on wavelets. His research has earned him numerous national and international awards, including the National Latsis Prize in 1996.

Luc E. WEBER

An economist and professor of public economics at the University of Geneva, Luc Weber served for more than 30 years in Higher Education and Research in Switzerland, Europe and the wider world. Vice-Rector and Rector of his University and President of the Swiss Rectors' Conference, he then served numerous international university organizations, governmental and non-governmental, European and worldwide: President of the Steering Committee for Higher Education and Research of the Council of Europe, Vice-President of the International Association of Universities and founding Board Member of the European University Association. His excellent knowledge of the sector inspired him to create and conduct, from 1998 onwards, the Glion Colloquium.

GUESTS

Yves DACCORD

Yves Daccord is a renowned humanitarian leader, international strategist, influencer and changemaker. He is currently leading the first-ever Harvard's Pop-Up Institute – the Edgelands Institute – to imagine the terms of new social contracts that work for cities and people in the age of pandemics and digital surveillance. Yves Daccord co-chairs the #Principles4Peace initiative to reshape peace processes around the world and chairs the Board of leading Swiss newspaper *Le Temps*, the board of International Human Rights Film Festival of Geneva and the board of Our Common Home, an organization that promotes civic participation to build solutions to our changing natural environment. He is member of the Board of Trustees of ODI, a leading global affairs think tank working to inspire people to act on injustice and inequality, and of the board of Trial International working towards fighting impunity for international crimes and supporting victims in their quest for justice. From 2010 to March 2020 he was Director-General of the International Committee of the Red Cross (ICRC), a global humanitarian organization employing 20,000 staff. A former journalist, TV producer and UNIGE political science graduate, his ICRC career spanned more than two decades in a variety of posts and challenging contexts – including Israel and the Occupied Territories, Sudan, Yemen, Chechnya and Georgia.

Hugo DUMINIL-COPIN

Born in 1985 in Châtenay-Malabry (France), Hugo Duminil-Copin grew up in the Paris region. After passing through the École Normale Supérieure in Paris, he graduated from the University of Paris-Saclay. Appointed professor of mathematics at the University of Geneva in 2013, he has also been a permanent professor at the Institut des Hautes Etudes Scientifiques in Bures-Sur-Yvette since 2016. In 2022, he received the Fields medal from the IMU.

Maryna VIAZOVSKA

Maryna Viazovska is full professor and Chair of Number Theory at the Institute of Mathematics of the École Polytechnique Fédérale de Lausanne in Switzerland. She earned a master's from the University of Kaiserslautern in 2007, PhD from the Institute of Mathematics of the National Academy of Sciences of Ukraine in 2010, and a doctorate (Dr. rer. nat.) from the University of Bonn in 2013. She was awarded the Fields Medal in 2022. In 2016, Prof. Viazovska solved the sphere-packing problem in dimension 8. Her dimension 8 solution quickly led to collaboration with others, and a solution in dimension 24.

Chapter 1

Sustainable Higher Education Collaboration for Resilient Societies

Yves Flückiger & Micheline Louis-Courvoisier

INTRODUCTION

Covid–19 has unveiled the fragility of our societies and ecosystems. The pandemic has plunged the whole world into a state of stupefaction from which it has not yet emerged. Moreover, the health crisis has been compounded by a deadly war that has completely upset the fragile geopolitical balance and by unprecedented attacks on human rights in Iran and Afghanistan. Thus, the health crisis is coupled with a no less serious economic and societal crisis.

In this context, scientists have been and are more and more called upon as experts in the urgent need to save lives. Answers are expected from them by political decision-makers, as well as by citizens. The questions addressed to the scientific world by the pandemic were as varied as they are complex: what is the nature of the virus, its origin, its mode of propagation, its mutation mechanisms, what are the best treatments and the best vaccines, how to best mitigate the impact of the crisis on the mental health of the population, how to re-launch employment, etc.? The same kind of questions are put to the scientific community in the case of the climate change. Undoubtedly the health crisis triggered by the coronavirus pandemic marked a consecration of the role of experts, who were called upon, in the face of an immediate risk and a new threat, to shed light on public decision-making in a situation of uncertainty. As such, it offers a privileged opportunity to reflect, in a

comparative perspective, on the ways in which expertise is integrated into the decision-making process.

The public witnessed the science "live", and could therefore observe that certain assertions were contradicted a little later. It is probably the first time that we witnessed the progress of science so live, with all the doubts that go with it. The result is damage to public opinion: confidence in expertise is weakened, and mechanisms for blocking extreme opinions are being put in place. The responsibility of the media is also largely engaged. This important question of the role of experts in times of crisis was the subject of an article published in the context of the 13th Glion Colloquium under the title "Science, Information and Democracy" (Flückiger & Laufer, 2022).

Covid-19 represented an environmental "shock" that has required rapid adaptation to the planning and delivery of health services internationally. As well as evidence pointing to additional negative effects associated with Covid-19 (Mahase, 2020), there is a line of management research that points to positive, sometimes unintended consequences that have emerged from the process of responding to the pandemic. A prominent theme is that Covid-19 represented an environmental challenge that spurred health system innovations (e.g. Phillips, Roehrich, Kapletia & Alexander, 2021). It represented a pressure for adaptation that resilient health systems could take advantage of.

For example, Swaithes *et al.* (2020) speculate that Covid-19 may have acted as a pressure that gave "permission" for health system improvement. Covid-19 was regarded as a "catalyst" for introducing adaptations to existing services, notably telemedicine, by motivating teamwork among health professionals that aided implementation. We could say that this is the optimistic view as health care systems have come out of the crisis rather washed out, but we should not ignore that we have learned during these past years and that we should build on these lessons learned.

Crises are not easy to handle. They always involve complex systems (companies, families, transport networks, economic structures, value hierarchies…). Crises have six main characteristics. They:

1. are unexpected,
2. create uncertainty,
3. pose a serious threat,
4. introduce a deep sense of collective and individual destabilization,
5. signal that the existing system is approaching its stress limits and
6. act as a destabilizing factor, both systemic and individual.

Even though there are crises of natural origin (volcano eruption for instance), the majority of them are man-made. Despite their complexity, we are not helpless in the face of crises. In principle most of them can be overcome with the correct actions. The intervention aims to rapidly contain the crisis and differs from therapy which is usually a long-term solution.

A successful intervention is one that keeps what is already there and strengthens instead of changing it. That can often be sufficient and work well depending on the situation. It is also easier for people to accept because it allows everybody to adapt to the new situation with small changes (additional staff, budget cuts, subsidies, …) but nothing has to be fundamentally questioned. One major hurdle for any crisis management is the backlash from those people expected to be affected against preventive measures. They often refuse any action to protect them, even though the extent of this would be far less painful than if the disaster were to be allowed to run rampant. In particular, people who are somewhat inert or resistant in good weather struggle even more with the changes imposed by crises.

On a positive note, it must be acknowledged that a crisis also creates new freedom. Gradual decline rarely does. Only crisis, the collapse of the known and established allows for fundamental reflection and opens up new perspectives for new opportunities. It releases tremendous forces, frees the mind and actions for the outdated solutions. For example, only when the Covid-19 pandemic made it unviable for millions of people to go to work did we open our eyes to new ways of organizing work. Such transformations rarely happen on their own. We can't be prepared for everything, but we have to be prepared for anything.

However, the human dimensions of the pandemic reach far beyond the critical health response, as all aspects of our future have been affected, economic, social, political, psychological as well as environmental. The responses brought by all governments around the world were taken in urgency. It is the time now to think in the long term, by analysing among others how higher education institutions can work for a more resilient society and this has to be done on a global scale.

In this article, we are going to analyse two types of resilience to which universities have been confronted during the two years of Covid-19 and how this will influence their future. The first one is related to the ways institutions reacted to the crisis, while the second one is related to the ways students were affected by the pandemic, and the way universities could help them overcome the crisis.

INSTITUTIONAL RESILIENCE

Despite their closure to the public in the spring of 2020 as part of the fight against the pandemic, universities have ensured educational continuity, participated extensively in Covid-19 research, invited themselves into the public debate, and, like many other organizations, have been able to rapidly generalize telecommuting to ensure the production and dissemination of knowledge. As such we may say that universities have contributed to Building Socio-Economic Resilience to Global Shocks.

The "open" movements have played an important role in this rapid adaptation. They originate from the free software movement, initiated by Richard Stallman with the GNU free operating system in the 1980s (https://www.gnu.org/gnu/thegnuproject.fr.html). The GNU Project is a free software, mass collaboration to give computer users freedom and control in their use of their computers by collaboratively developing and publishing software that gives everyone the rights to freely run the software, copy and distribute it, study it and modify it.

What makes it original is the object to which it applies: software, which is non-rival, meaning that giving a copy of it does not deprive the person who gives it, unlike a physical object such as a book for example. Quickly, people realized that these principles could be applied to any kind of computer data and we saw the birth of the "open data" movement, which liberates data, "open education", which liberates educational resources, "open science", which liberates scientific productions, and "open hardware", which liberates the manufacturing plans of physical objects.

All the qualities of free software were once again demonstrated during this crisis. For example, the software infrastructure of higher education institutions could be adapted to telework very quickly by deploying VPNs (virtual private networks): thanks to the OpenVPN free software, staff could access "business" software as if they were in their offices, whereas external access to software handling sensitive data is usually blocked.

To facilitate virtual classrooms and remote meetings, we have seen a rapid deployment of free collaborative work software (such as jitsi, BigBlueButton, etherpad, nextcloud, mattermost, peer-tube...). The fact that software is open source has allowed universities to be very reactive because they were not obliged to use service providers to deploy them and integrate them into the institutions' information systems, which would have wasted precious time. When preparing for the start of the school year, since there is less of a rush, schools can take the time to use service providers to get outside help with free or proprietary software solutions.

The Open Education movement, in the sense of Open Education Global, is a fundamental movement that is not well known, especially among teachers. It consists first of all in the production, the availability and the referencing of educational resources that can be reused, or even modified, by other teachers than their initial producer.

The liberation of educational resources is an issue of democratization of education since the goal is to break down certain barriers to access to documents and manuals for teachers, but also for learners, here or elsewhere, now or later. It aims at building the education commons. Indeed, if the author does not explicitly give the right to reuse a resource, any reuse is forbidden by copyright. It is therefore necessary to explicitly release it by using one of the Creative Commons licences, for example.

At the UNIGE, for the last ten years, it is in particular the Thematic Digital Universities that have been leading this movement, referencing thousands of resources ranging from simple texts to files including videos, exercises or serious games. But, as the European Commission says, "open education" is broader and includes any open approach aimed at disseminating knowledge to as many people as possible. It includes open science, which aims to freely disseminate the results of scientific research. It is indeed the ideal of the free circulation of knowledge that is sought here. It refers also to MOOCs (Flückiger & Achard, 2018).

At the University of Geneva, we have been, as in other universities, very active to implement Free Open Education. The list below shows that many innovations have been developed in our university to promote openness and greater accessibility of teaching.

a. The Master of Science in Learning and Teaching Technologies which has existed since 1996 and offers not only a sandwich course, i.e. one week of face-to-face followed by 4 weeks at a distance, but which is above all very innovative in terms of pedagogy, i.e. project-based pedagogy, Making, and open, in particular with the contributions from students to the EduTechWiki. Sketchnote 3D aims to facilitate the provision of three-dimensional scientific resources in a pedagogical context.
b. The project, initiated by the Lamylab, of the Faculty of Medicine's Anatomy Unit, offers a library of 3D anatomical resources that can be manipulated, annotated and made available in open source to all.
c. The hackathons, designed as drivers of innovation around a challenge with a digital component, are both a tool for career development, a place for training, a place for learning about digital technology, a place to develop soft skills and a gateway to new opportunities for collaboration, sharing and innovation (see for example Hackademia or Sustainable Finance Hack organized by the Faculty of Economics and Management).
d. Beyond scientific publications, there is the issue of opening up research data. Here too, the University of Geneva advocates, with all other Swiss universities, for the systematic opening of publicly funded research data.
e. The "Make-IT-easy", an online platform which is accessible to the entire university community, which enables not only students but also all our employees to stock their digital skills and develop them further. Among other benefits of this innovation is the fact that it will make the skills acquired by our students more legible to future employees.

f. To make its continuing education programs even more accessible and flexible, the University of Geneva began offering micro-credentials as of 2023. A micro-credential is a document certifying the acquisition of knowledge and skills after a module or short course, and it allows for the possibility to acquire ECTS credits. They may stand alone or be combined (stacked) in certain cases to form a more extensive certification. A flexible, targeted way to help people develop the knowledge, skills and competences they need for their personal and professional development.

The strength of these "open" movements lies in collaboration within communities. This is one of the fundamental values of science. This does not mean that there are no arguments between researchers – which is normal when one is interested in the unknown – but it is by confronting ideas that research advances. And to confront ideas, they must be expressed openly.

In the same way, for teaching, it is much more effective to develop resources together that can be used by each member of the community rather than building a course on their own. This does not prevent the pedagogical freedom of choice among the available materials and the pedagogical path proposed to students by each teacher. If universities want to use the past experiences made during Covid-19 to improve even further the quality of their education programs, they will have to collaborate openly and take advantage of all the open resources that already exist. This is one of the reasons why the University of Geneva decided to join the European alliance 4EU+ in 2022, formed by Charles University (Prague) and Sorbonne University (Paris), as well as the universities of Copenhagen, Heidelberg, Milan and Warsaw.

This alliance brings together some of the most widely recognized universities – all of them are members of LERU or LERU-CE7 – with whom the University of Geneva already works closely both in teaching and research. Thanks to this alliance, our university will now be able to take our projects one step further, strengthen academic mobility and share Open Education resources for our students and researchers. The complex challenges that Europe is facing, like the digital transformation of society or the sustainable development goals set forth by the United Nations can only be met through a multidisciplinary approach, allowing researchers to work within comprehensive networks such as the 4EU+. The participation of our university in this European alliance will further strengthen the implementation of micro-credits, which will greatly facilitate the mobility of our students within the alliance, and the eventual creation of genuine European diplomas obtained through the accumulation of credits acquired at one of the alliance's member universities.

This crisis could be another great opportunity to emphasize collaboration instead of competition, and the technical and legal tools for that

collaboration. Some researchers believe that collaboration also works in the field of innovation and talk about "open innovation" as a way for companies to recover faster from the economic crisis caused by the pandemic. Will the next world be more open? Let's hope so.

Individual Resilience

While universities made a fundamental contribution to the resilience of society, particularly through their research, their education programs as well as their outreach activities throughout the Covid-19 years, they also enabled their students to get through the health crisis by building their own resilience. Indeed, institutions had to help the students to identify their specific needs and to find quick answers in their services, be it in the form of social and/or financial exceptional support, to participate in social, cultural and sports activities for example (even while staying at home), to obtain psychological support if necessary. This kind of targeted help can help students quickly regain confidence and focus on their studies. In this sense, the degrees awarded to students in these years have not been devalued by distance learning. On the contrary, they have been enhanced by the experience accumulated under particularly difficult learning conditions. They have proven that they are capable of sustaining an effort despite the circumstances and overcoming the multiple obstacles they may have faced.

Students' resilience can be seen in particular as the maintenance of sufficiently good mental health in spite of traumas suffered to be able to continue to learn and to adapt to the new conditions of distant learning. While the trauma suffered by students during this period has sometimes been associated with the loss of loved ones or the shocking images projected by the news on TV channels or reported in the print media in a sometimes-obsessive manner, other less noisy or spectacular traumas were involved. Their character is more insidious, and these traumas develop in the form of daily worries with significant erosive power. They generate psychological suffering or even psychopathological disorders because of their frequency, in other words their chronicity. We now know that the chronic nature of a toxic situation leads to more disorders (among others psychological) than a serious but punctual circumstance.

To speak of individual resilience is now a matter of noting the lasting victory of the protective factors that enable to maintain satisfactory mental health over the risk factors. Among the many situations that are deleterious because of the chronic nature of the constraints they inflict on subjects, is that of students. This statement may come as a surprise, since it is legitimate to consider the possibility of studying as an opportunity and a luxury that any person of age has.

However, not all students are equal in terms of their abilities to cope with this opportunity. We should remember that a significant proportion of our

student population must work for a living while they study. This obligation to support themselves makes them particularly vulnerable in times of individual or collective crisis. During the Covid period, they lost their jobs overnight, which precipitated them into acute economic difficulties. Usually, this type of resilience is considered more as a criterion for establishing an overall state of resilience rather than as one of its variations.

Academic resilience refers to one of the three main environmental contexts that promote resilience for students. In this sense, it has a significant importance. The other two contexts are family and community (Anaut, 2008). Academic success, coupled with positive relationships with peers and with adults, could become a relevant criterion for assessing resilience. If this definition is adopted, it implies that institutions must be administratively prepared to support students in difficulty on an ad hoc basis, so that they can quickly refocus on their academic work. In general we could define academic resilience as the inclination of students to pursue learning experiences over the long term. In this conception, academic resilience would then consist of "holding on" over a time that is recognized as long.

Although this vision seems partial, as it only takes into account long studies – while other types of academic opportunities resilience – it highlights the fact that the difficulties generated by the training and its context, because of their repetitive nature, can generate psychological wear and tear. This is the result of a series of events which, when accumulated, end up overwhelming the psychological management capacities of the subjects concerned. The risk incurred would then be to experience a dropout due to emotional exhaustion. In reality, pursuing studies is not the exclusive sign of good intelligence or of an ease in gathering knowledge. If it were so, we would not observe the failure of particularly talented students.

Contemporary research in education science shows that successful academic pursuit is not just a matter of naive optimism that denies the steps to be taken or the simple desire to obtain a diploma or training. This success requires a realistic approach to the difficulties associated with academic studies. It is not just a matter of the student's ability to succeed. It is not only a matter of the complexity of what is being taught, but also managing the side issues that also make up student life, such as housing, transportation, financial autonomy, etc.

Success at university depends, in large part, on the student's ability to cope with all these constraints and thus to develop a set of skills that go far beyond the circumscribed framework of learning. It also depends on the institution's ability to provide clear and effective responses to the needs expressed. If this is the case, it encourages students to be clear about their needs, easy to ask for help, and to see that some factual and relevant help can solve difficulties.

These skills (clarity, simplicity, resourcefulness) are constituents of resilience (see Chen, 2019). Being intellectually brilliant is no guarantee of success at university if, in addition, the student is not able to manage the other aspects of his or her daily life (Bouteyre, 2008).

Several studies emphasize the importance of depressive disorders in the dynamics of academic performance. Many of these studies agree that the risk of academic failure or dropout significantly increases as soon as the level of depression of students reaches a level assessed as average. Moreover, this depression is strongly associated with a decrease in course attendance which is by the way more difficult to observe in cases of remote teaching, a drop in academic performance and emotional immaturity. According to these studies, the proportion of highly depressed students is five times greater among those who drop out than among those who continue.

In addition to risk factors, there is a heavy and discouraging state of loneliness, which is particularly intense when entering university for the first time or when changing universities. The risk of social isolation which has been amplified by the Covid crisis, is evident at the university despite the high number of students in the same structure. Student life is often described as alternating between moments of interaction and moments of solitude. Students must manage a schedule that they discover throughout the first year and that proves to be very different from the one they knew in high school. Moreover, they have the stress to face a sometimes-fierce selection of first year exams.

During the academic year, they must organize important free time and be able to provide, within a short period of time, a consequent effort of work. This roller-coaster schedule is not for everyone because of the self-discipline involved. The time is severely restricted during work periods and offers, more rarely than in the past, the opportunity to engage in different types of activities and to maintain social relationships and friendships. It is characterized as much by its excess as by its lack, which generates frustration.

Another explanation for failing or dropping out is related to the very high proportion of young people who leave their hometown to study. This phenomenon is undoubtedly less perceptible among students living in university towns; whereas it is obvious for those who are far away, even if it is only a few dozen kilometres, or whose training can only take place far from the family home, or even abroad. This brutal reshuffling of social ties has a depressing effect.

University entry leads to the loss of parental support and a reduced sense of control over the environment which causes psychological conflicts that facilitate the appearance of depressive disorders. Dropping out of school can be seen as a consequence of the student's difficulties in adapting to a new environment. In fact, although entering university is considered a positive life

event, it requires, on the part of the student, an adaptation that can be quite difficult. This is because it occurs at an age when the student is still oscillating between adolescence and adulthood. The preceding lines reflect the intense interest – by researchers – in the mental health of students, no doubt because of the massive reorientations or dropouts observed in the first years of study and the societal concerns that they generate. While it is important and necessary to take stock of the aspects that constitute real risk factors (and therefore academic failure) among young people, it is equally important to understand the reasons that lead to the successful completion of a course of study.

There is little research on this issue. The notion of hardiness promotes resilience. It would have a "buffer" effect, i.e. it acts as an air cushion between the subject and the impact of the stressor. The notion of hardiness essentially highlights the character traits of the subjects concerned, leaving aside the protective factors related to the environment and to family and friends. Some research proves that optimism and the feeling of being competent influence the academic performance and adjustment to university life of young people.

There is no lack of resilient students. The qualities that can be attributed to resilient students are not dissimilar to those of resilient individuals in areas other than academics. For example, there are personal qualities that complement those listed above, such as a sense of humour, a certain pugnacity, the need to find meaning in what puts them in difficulty (such as understanding the reasons for a poor grade), the ability to reach out to teachers, to make friends with other students, to overcome the inevitable periods of discouragement, to look for solutions by being creative (for example, to find an internship). The environment can be an important asset, by providing resilience mentors (family and teachers), by protecting the student from overwhelming material constraints, affirming his or her value and value and confidence. The adaptability of students depends on different factors, psychological, behavioural, environmental. Some are better equipped than others. Institutions are there to support those who need it and to help them have confidence in their ability. In this way, they participate in the learning of resilience and universities contribute to more resilient citizens for the future.

To conclude, let us remember the idea that resilience is revealed on the occasion of a trauma, sometimes spectacular, as much as at the turn of a daily life full of pitfalls whose chronicity can seriously affect the mental health of the subjects. Faced with this type of adversity, some students prove to be more resilient than others. For the latter, the situation is far from being irreversible.

Resilience is a process, it has to be built and accompanied, and this from the earliest childhood. School, college, high school and university play a major role in this process. Universities have to make sure that their students are well prepared to resist all kinds of crises that they may have to face during their future life.

CONCLUSIONS

In this paper we have analysed two types of resilience to which universities have been confronted during the last two years and which will influence their future. We also looked at how universities can and should build both types of resilience to strengthen their role in society and give all their students the assets to continue their personal development beyond their degrees.

The first one is related to universities as institutions and as an important part of the society which can contribute to its resilience. Institutional resilience refers to the ability of an organization or system to withstand and recover from disruption or crisis. This can include things like natural disasters, technological failures or other types of shocks. Institutional resilience involves having systems and processes in place to anticipate and mitigate potential threats, as well as the ability to adapt and recover quickly when disruptions do occur. This can involve things like having backup systems and plans in place, training staff able to assimilate and embody its mission and who therefore will be able to respond to emergencies, and building strong relationships with other organizations that can provide support during times of crisis. From this point of view, more than ever, universities need to strengthen their international collaboration to exchange best practice, ensure the free flow of data, ideas and people, and together defend the values that have ensured their continued existence.

The second one is related to their students' resilience to trauma situations such as the pandemic they had to overcome during their studies. We believe that understanding what happened during these two last years is very important regarding their strategy for the future to adapt their teaching and research to their new challenge linked to individual resilience. It refers to the ability of the students to bounce back from adversity, stress or trauma. It is related to the ability to cope with challenges and difficulties in a healthy and adaptive way. Individual resilience can be developed and strengthened over time through various means, such as building a strong support system, developing coping skills, and maintaining a positive outlook. We have shown that universities can do very much to not only increase the level of resilience of their student community as a whole but mainly to help those who are the more vulnerable to improve their capacity of resilience and prepare them better for their future life.

Finally, building their resiliency will help universities to contribute to the resilient society and they do it in a number of ways. First of all, thanks to their research and knowledge production. Universities are centres of research and knowledge production, and their research can help inform policies and practices that contribute to the resilience of societies. For example, universities conduct research on the impacts of climate change, the effectiveness

of different disaster response strategies, or the social and economic impacts of pandemics.

Second, through education and training, universities can provide programs that help individuals and communities develop the skills and knowledge needed to respond to and recover from crises. This can include training in fields such as disaster management, public health, engineering and social work.

Third, thanks to their community engagement, universities can collaborate with their local communities in a number of ways to promote resilience. This can include partnering with local organizations to address community needs, conducting outreach and education programs, and supporting community-led initiatives.

It should be also remembered that universities often have infrastructure and resources, such as buildings, equipment and trained personnel, that can be made available to support disaster response and recovery efforts.

Last but not least, universities can use their expertise and influence to advocate for policies and practices that promote resilience at local, national and international levels. This can include collaborating with policy-makers, participating in policy debates and conducting research to inform policy decisions.

There are some good practices that universities can adopt to foster resilience. For instance universities can incorporate resilience-related topics and skills into their curricula to help students develop the knowledge and abilities needed to respond to and recover from crises. This could include courses on disaster management, emergency planning and risk assessment. Moreover, they can support research on resilience by providing funding and resources for researchers, hosting conferences and workshops on resilience-related topics, and collaborating with other institutions and organizations on resilience research. To achieve this in an efficient and sustainable way, we must never forget that the resilience of our universities is fundamentally based on the versatility of knowledge, which requires the maintenance and development of all types of knowledge and disciplines, including the study of Acadian. The mistake that is all too often made would be to favour a purely utilitarian approach, as our politicians sometimes wish, sacrificing the humanities and social sciences on the altar of short-termism.

Connecting with all the resources available in the community and having fluid and easy relationships with them is certainly one way to participate in collective and individual resilience. Universities can engage with their local communities in a number of ways to promote resilience. This can include partnering with local organizations to address community needs, conducting outreach and education programs and supporting community-led initiatives.

Last but not least, one fundamental asset on which universities should rely on to build their resilience capacity is by developing and fostering

international collaboration. Some examples of how international collaboration can contribute to resilience include sharing knowledge, data and research results on resilience-related topics, such as disaster risk reduction, emergency preparedness and recovery efforts. This can help universities learn from each others' experiences and best practices, and improve their own resilience.

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Chapter 2

Israel and the Weizmann Institute of Science: A Case Study of Research Institutions as a Backbone of a Knowledge-Based Society

Alon Chen

INTRODUCTION

Scientific research institutions spur discovery and generate new layers of knowledge that undergird new revelations and understanding, usually with unforeseen benefits, and, in some cases, breakthroughs translate into new medications and technologies that benefit society. By generating a continuous flow of new knowledge, research institutions also foster a scientifically literate public and enable individuals and societies to make more informed decisions and live healthier, more productive lives. They also educate and graduate alumni with skills that they can take to the job market, thereby strengthening the local and global economy, by enriching the economic and social ecosystem through job creation in academia, business, education and government.

All of these elements are critical contributing factors to societal resilience. This article will examine Israel and the Weizmann Institute of Science specifically as a case study for influencing societal resilience.

In an example rather unique in the world, institutions of higher education and research were foundational pillars upon which the State of Israel was established, in a strategy advanced by Zionist leaders starting in the late 19th century – more than 50 years before Israel's creation in 1948. Three such entities opened their doors in the early decades of the 20th century, including the Weizmann Institute, the singular entity at that time to focus exclusively on scientific research. As envisioned by their founders, these institutions laid the groundwork for a knowledge-based economy in a small country with limited natural resources, located in a troubled region that would demand a large degree of self-sufficiency to ensure survival.

Indeed time and experience have shown that Israel's resilience is derived in great part from these (and other) public institutions of higher education and research. Today, Israel, with a population of over 9.3 million, is a knowledge-based economy that has become a world-leading hub of scientific innovation and entrepreneurship. As has been said before, this is not only despite Israel's complex internal and external political landscape and its relative isolation in the region, but perhaps because of it. The pithy saying "necessity is the mother of invention" certainly underlies at least part of Israel's achievements in science and technology.

In this article, I describe how the Weizmann Institute in particular, and Israeli institutions of higher education in general, have played proactive roles in engaging with and strengthening society for instance through science literacy and education; responding to crises; and serving as the basis of spinoffs for the commercial marketplace that power the economy.

At the same time, I also assert the greatest contribution of research institutions is interdisciplinary, curiosity-driven research, unfettered by outside directives and financial interests, operating in environments of complete academic freedom. Indeed, this is the *primary* role of scientific research institutions: as the world's main bastions of knowledge creation. The resulting ever-expanding reservoir of knowledge about the universe is the oasis from which all of society can draw its sustenance – and thus provides an extraordinary source of resilience.

THE FOUNDATIONAL ROLE OF ACADEMIC INSTITUTIONS IN ISRAEL

Israel may be unique in the world in that its founders foresaw the need to develop the future country's brainpower via the establishment of academic institutions.

The Technion – Israel Institute of Technology, the Hebrew University of Jerusalem and the Weizmann Institute were founded before the establishment of the State.

From its earliest days, the Sieff Institute (precursor to Weizmann Institute) was engaged in addressing urgent, basic needs for the country-in-the-making, including food, medicine and energy. Sieff scientists helped develop novel fertilizers and insecticides that would enable better crop yields; worked with industry to develop new pharmaceuticals; and investigated new methods of harvesting sunlight for energy. In 1941, the Institute established a pharmaceutical company, Palestine Pharmaceutical Products, to produce anaesthetics, antibiotics, pain medications and anti-malaria drugs which the Allies needed for troops stationed in Southeast Asia and the Pacific. Because the Institute was engaged in both basic research and what we would call today translational research, it set out the rules of engagement around precluding conflicts-of-interest and protecting basic research from commercial interests. (Mirelman, 2020)

The two-pronged approach of basic research and R&D to address immediate societal needs had its origin in Dr Weizmann's own two-pronged scientific approach. A chemist who believed strongly in protecting basic research from outside influences, he also owned more than 100 patents and famously invented a new process for creating acetone, which filled an urgent need of the British forces during WWI. Acetone was an essential solvent required for the production of cordite, an explosive that is smokeless and therefore harder to detect by enemy forces. This invention won him the goodwill of the British, who went on to pen the Balfour Declaration in 1917, asserting the right of the Jewish people to a homeland in Palestine. Thus science and state-building went hand in hand.

Over time, the Institute's purview expanded to the full range of exact and natural sciences. Through its five faculties (Biology, Biochemistry, Chemistry, Mathematics and Computer Science, and Physics, as well as a Department of Science Teaching), the Institute advances curiosity-driven basic research. It later established a graduate school whose alumni enter the workforce, infusing business, academia and other sectors with robust scientific understanding – and thus offer a continuous outflow of talent that contributes to societal resilience.

Its emphasis on interdisciplinary research – in which walls between departments and fields are totally superficial – is a major driver of research strength, with each field informing and bolstering another. Interdisciplinary research is a hallmark of the Institute, drawn naturally from Israel's informal interactive culture.

The Institute directly engages with the local and global economy through its technology-transfer arm, Yeda, which licenses discoveries that lead to drugs and technologies; revenues then feed back into the Institute endowment to nourish basic research. The recently established Bina unit engages the scientific community in programs via funding schemes that lead to the identification of discoveries with potential for commercial development. Together,

Yeda and Bina form an "innovation ecosystem" that rests on insights that emerge from the research bench.

Fast forward to today, and Israel consistently ranks among the top countries in the world on indices of economic prowess, as well as some indicators of social and educational achievement. Israel's reputation as a world hub for high-tech and biotech start-up companies is typically attributed to the expertise around technology creation that emerged from the Israel Defense Forces, as well as academic research and higher education.

READINESS IN TIMES OF CRISIS

It is important that research institutions also rise to the occasion as societal challenges arise, and not remain exclusively in their ivory towers. This is how Weizmann sees itself, as an active potential contributor to solutions when urgent or relevant. Universities are "intellectual stem cells that can reinvent themselves to respond to crises, while simultaneously possessing longevity that surpasses most institutions of government and commerce." (Chan & Keyes, 2022).

In the most obvious example, the Covid-19 pandemic posed a sudden threat to societal resilience across the world, and the world turned to science for solutions – with expectations of both basic and clinical research. In February and March 2020, scientists at Weizmann – which has a robust history in immunology research –initiated about 60 projects on various aspects of the virus, across dozens of labs. In one example, Prof. Nir London's Moonshot project, a massive open-science drug-discovery effort, aims to identify preclinical candidate molecules for a globally accessible and affordable Covid-19 antiviral pill. The project has whittled down candidates to a single advanced lead, called DNDI-6510, which is now being prepared for Phase I studies.

Several of our scientists served in ad hoc public health roles as well, as consultants to Israel's Ministry of Health and the U.S. Food and Drug Administration (FDA), leveraging their data-crunching tools and expertise on immunology and infectious disease, which became the basis of national decisions on quarantine, travel and vaccination rollouts.

Early in the pandemic, computational biologist Prof. Eran Segal and his lab developed population-wide surveys and associated algorithms that revealed the most prevalent and distinguishing symptoms caused by the virus, to model and predict the dynamics of the pandemic. The Ministry of Health used these surveys to identify outbreak regions and prioritize individuals for testing. The Segal lab also built models for predicting the future number of cases, hospitalizations and deaths, which were used by policy-makers in deciding on measures to combat the pandemic, including decisions around preparing hospitals accordingly. The Segal model also accurately predicted the number

of critically ill patients during subsequent waves of SARS-CoV-2 infections. Prof. Segal has contributed to about a dozen publications detailing his findings over the past two years.

Israel was the first country in the world to roll out a Covid booster vaccine (Pfizer BioNTech) and has been a critical source of information for policy-makers in the US. At the request of the FDA, Prof. Ron Milo presented to the key FDA advisory committee about the efficacy of the third and fourth vaccines in Israeli studies. As a result of a presentation he made to the FDA in September 2021 about the third dose, the FDA decided shortly thereafter to endorse a third vaccine (booster) for older Americans. (Alroy-Preis & Milo, 2021).

TRAINING A CORPS OF PHYSICIAN-SCIENTISTS

One of the most direct and meaningful ways in which a scientific research institution can enhance the health resilience of society is by establishing robust links with the medical world. Science should continuously be informed by the medical sphere, so that scientists can best understand (and address) real health challenges. And vice versa: medicine gains from close alignment with scientific research. The dialogue is critical.

As a way to thicken that dialogue, and also as a means to address Israel's acute physician shortage, the Weizmann Institute is in the process of establishing an MD-PhD training program, in partnership with Sheba Tel Hashomer Medical Center and with major philanthropic backing. The Institute will thus help address what has become a problem of national urgency: Currently, Israel isn't training enough doctors to keep up with the country's rapid population growth, and nearly half of Israel's doctors receive their medical education abroad.

While Israel has a slightly lower percentage of physicians than the OECD average (3.3 per 1,000 population as compared to 3.6 per 1,000), Israel's 38% increase in working physicians over the last decade was not enough to keep pace with its 44% population growth rate. It was the only country in the OECD not to increase its physician rate per population at a higher rate than the country's population growth. Making matters worse, practising physicians are reaching retirement age in greater numbers – and percentage terms of the physician workforce – than ever before. This is a reflection of the aging of doctors who came to Israel with the wave of mass immigration from the former Soviet Union countries in the 1990s. (Health at a Glance, 2021).

The Weizmann understood it could play a role in the solution that would be mutually beneficial for scientific research. While the OECD average for medical school graduates per population is 13 to 100,000, Israel falls way below that average, at 6.9 medical graduates per 100,000 population. With

too few training spots in medical schools in Israel, many aspiring medical students enrol in medical schools abroad – representing about half of all Israeli medical students. Weizmann is thus enhancing the health resilience of Israeli society by addressing this urgent national need. (Medical graduates, OECD, 2021).

RESILIENCE THROUGH RESEARCH: KNOWLEDGE CREATION

While responding to societal needs when relevant, curiosity-driven research in an environment of academic freedom is essential to developing new knowledge about how the world works. Stories abound of serendipitous discoveries that emerged while scientists were simply exploring, and the new outcomes from science which the world tends to conceive of as "breakthroughs" are in fact the result of layers upon layers of scientific insight, often over decades.

In fact, a recent study in *Nature* found that the overall pace of real breakthroughs has fallen dramatically over the past 75 years compared to the "growing mountain" of scientific research such that progress is mostly coming from incremental knowledge creation, which garnered headlines in *The New York Time*s in January. The study's authors saw two of this century's most celebrated findings as representing "triumphs of ordinary science rather than edgy leaps": the mRNA vaccines for the coronavirus "were rooted in decades of unglamorous toil" and so too the 2015 observation of gravitational waves was "the confirmation of a century-old theory that required decades of hard work, testing and sensor development." (Broad, 2023).

"Almost every discovery has a long and precarious history," Abraham Flexner wrote in his timeless 1939 essay *The Usefulness of Useless Knowledge*. "Someone finds a bit here, another bit there… Science, like the Mississippi, begins in a tiny rivulet in the distant forest. Gradually other streams swell its volume. And the roaring river that bursts the dikes is formed from countless sources." (Flexner, 2017).

This is the reality of science, and this ordinary "doing" of science must be protected from external influences and fleeting trends, such as political agendas and commercial interests, which could lead them astray from fundamental scientific inquiry.

Anna Däppen and Michael Schaepman articulated the point most eloquently in their recent article on the contribution of research-intensive universities to the future of progress. "In a rapidly changing world and with many countries entering the Fourth Industrial Revolution brought about by technological change, it becomes increasingly difficult to assess today which kinds of knowledge and abilities will be needed tomorrow. Hence, universities should be all the more concerned to remain independent and flexible

in their research and funding strategies as well as in scientists." (Däppen & Schaepman, 2022).

Because the ultimate value of any particular line of research is not easily predicted, a research ecosystem should ideally include a *spectrum* of research avenues, some with less-applied potential and some with more. Ultimately, it is this kind of science that drives the real advancements that benefit and strengthen humanity.

THE NEUROBIOLOGY OF STRESS RESILIENCE

The human biology of resilience is also pertinent here. As a neuroscientist with expertise in the neurobiology of resilience, I investigate the brain's adaptive coping mechanisms when faced with diverse stressful or traumatic stimuli. Thus, from my own scientific lens, I believe that when examining the broader question about how research universities contribute to societal resilience, we also need to examine what environmental and biological factors make *individuals* more (or less) resilient – and how that knowledge can be translated to benefit society as a whole. Elucidating the underlying mechanisms of the organism resilience to stressors could help us formulate a clearer picture of what will help groups of individuals to become more resilient.

For instance, one of the questions we ask in the neurobiology of resilience is whether the sex of an individual plays a role in how he or she reacts to stress. A recent Weizmann study, by Dr Meital Oren-Suissa and Prof. Elad Schneidman of the Department of Brain Sciences, identified sex-related differences around fearful or painful stimuli, such that female worms fled immediately at the first signs of pain whereas males were unmoved, requiring greater negative stimulation until they reacted. (Oren-Suissa, 2022). A better understanding of how men and women react differently to stressful stimuli is a key step in creating better, more refined therapies for anxiety and depression and possibly establish social safeguards and services.

Stress resilience, essential for good health and well-being, is the outcome of an individual's ability to retain a set of adaptive characteristics that enable coping and recovery from stressful challenges or trauma and help a person to thrive despite challenging environmental conditions. An organism's aim is the maintenance of homeostasis in the face of real or perceived challenges. When a situation is perceived as stressful, the brain activates many neuronal circuits, linking centres involved in sensory, motor, autonomic, neuroendocrine, cognitive and emotional functions to adapt to the threat.

While there is still much research to do, there is a consensus among neurobiologists that inappropriate or disproportionate intensity of the brain's stress response system is at the core of an array of physiological and behavioral disorders. The flip side of that research approach is the study of those

individuals (and animal models) who have a rapid activation of the stress response – and its termination. Research is uncovering molecular, cellular and genetic changes associated with stress resilience.

For years, the prevailing dogma in the field was that improving neurobiological resilience was just a matter of tweaking or fixing the pathways in which neurobiological resilience is reduced or thwarted in certain individuals. However, it was recently found that an entirely separate pathway is responsible for heightened resilience. This insight opens the door for scientists to explore how this alternative pathway (or pathways) could be improved and strengthened, regardless of the deterioration or compromised state of the main resilience pathways.

In addition to the neurobiological factors underlying whether a person is more or less susceptible to stressors, psychosocial factors are known to play a role as well – with relation to these alternative pathways. These factors include cognitive and behavioral traits such as optimism, cognitive flexibility, active coping skills, social support networks, physical activity and a personal moral compass. Resilience-promoting factors include having caring and supportive relationships, good communication and problem-solving skills, and the ability to manage strong feelings and impulses. (Chen, 2020).

Measuring neurobiological resilience is a challenge, but many new tools are now at our disposal, including: quantitative biological factors like biomarkers (epigenetic markers, genes, SNPs [single nucleotide polymorphism, a variation at a single position in a DNA sequence], proteins, metabolites, RNA molecules). None of these are yet used clinically.

One could certainly extrapolate from the individual to the community, such that a stronger society is one comprised by many individuals who have these neurobiological characteristics that promote resilience as well as the cognitive, behavioral and environmental conditions – alternative pathways that help overcome major challenges to society and community. Israel, for instance, has faced unrelenting security threats throughout its history, but it is also known for its strong support networks of family and friends, which is both encouraged culturally and bolstered by Israel's small geographical space and mandatory army service which serves a unifying force. I would also add that the "silver lining" of living in a society that is hyper-focused on defence and security in the context of regional strife – and the fact that political conflict has touched the lives of almost all Israelis – is that Israel is a society that has been forced to develop resilience.

SCIENCE LITERACY ACROSS ALL SECTORS OF SOCIETY

I also believe that the very process of scientific exploration is a journey that is worth sharing with society – regardless of whether those who are "listening" choose to pursue careers in science. If scientists can succeed in exciting others about science, showing others the intellectual experience of engaging in exploration of the world around us, that is also a wonderful outcome because an intellectually curious public – one that questions common assumptions and is on a continuous quest for more crystalline truths – is a resilient public. They will have the wherewithal to question authority, hold leaders to high standards and make the choices necessary to continuously improve health and living standards. Similarly, the engagement of philanthropists – like Weizmann's worldwide network – become engaged in, and fund, science and thus play a key role in a healthy "ecosystem of resilience".

Beyond discovery, research institutions have a role to play in nourishing a science-literate public. This can be done by direct links between scientists and policy-makers, and other means. The core mission of the Davidson Institute offers dozens of free or subsidized science programs to schools and youth, across all sectors of society. That includes communities at the lower end of the socio-economic spectrum and those in outlying areas with limited access to a substantive science education, to those at the highest end of the spectrum of advantage, including youth who are already excelling.

Ensuring all sectors of society have a baseline of understanding of science is critical, and an appreciation of science as a driver of healthier, more productive and more democratic societies – because more informed individuals are better equipped to make more informed choices.

This is the value that undergirds the Davidson Institute of Science Education, the science literacy and education arm of the Weizmann Institute on the campus. The Davidson Institute is a nonprofit organization that offers curricular and extracurricular literacy and education programs to all sectors of Israeli society. The concept being: a truly democratic society is one in which all sectors are sufficiently knowledgeable about science and health such that they are best able to make informed personal and communal decisions.

During the pandemic, Davidson served a critical role in conveying information about the virus specifically, but also infectious disease, immunology and vaccination more broadly. Its Science Communications unit published thousands of articles and served as a source of reliable information for the media.

The Davidson website (Davidson Institute, 2023) receives about 10.5 million page views per year, mostly articles in Hebrew but also English and Arabic. It plans to devote more resources to expanding Arabic content,

which is read by Arabs in Israel and throughout the Middle East and North Africa; and it recently launched a new platform for children in Hebrew. The advancement of science content in Arabic is especially important to strengthen peaceful ties with our neighbours in the Arab world.

ADVANCING WOMEN IN SCIENCE

Resilient societies are ones in which the brightest minds in all fields have the opportunity to contribute to society, and often this requires breaking down barriers. Weizmann has pioneered efforts, since replicated by other Israeli institutions, to address the gender imbalance in Israeli academia in the natural and exact sciences. It has done so via a pioneering program, initiated in 2007, which set out to expand the ranks of women in science.

While a gender imbalance exists worldwide, Israel faces a particular challenge. Mandatory service in the Israel Defense Forces means that both men and women begin their higher education later than their peers in other countries, which in turn means that by the time women complete their PhD studies, many are married and already have one child or more. The unwritten rule in Israeli academia is that to attain a faculty-track job in academia, a scientist must have completed a postdoctoral fellowship abroad. Yet Israel is geographically far from the world scientific hubs in Europe and the US, and relocating a young family is not an easy decision, especially when it also means uprooting a husband from his career path.

The Israel National Postdoctoral Award Program for Advancing Women in Science was the Weizmann Institute's creative response to this challenge. It awards annually 10 Israeli women PhD graduates (from any institution in Israel) generous funding to supplement low postdoc salaries and assist with relocation costs and living expenses in costly scientific hubs like Boston, San Francisco, and New York.

To date, 155 women have participated in the program; of them, 104 have completed their postdocs and 60% of those who have done so have gone on to attain faculty-track positions in Israeli academia. Several other institutions of higher education have followed suit and launched similar programs, as has the Israel Science Foundation – creating a ripple effect across the country and ensuring that the best scientific minds are brought to bear on the pursuit of research. I see this as a success story for strengthening Israeli society in various ways, and ultimately world science benefits.

CONCLUSION

When approaching the question of how research institutions bolster societal resilience, the case of the Weizmann Institute of Science and of Israel more broadly is a worthy example of exploration. In an example likely unique in the world, research and educational institutions were a deliberate precursor to the establishment of the State of Israel. Ever since, they have ensured Israel's resilience in the face of ongoing security threats, and internal demographic challenges.

The contributions of these institutions, including Weizmann, help ensure that all sectors of society have a baseline of understanding of science, and because more informed individuals are better equipped to make more informed choices, they help drive resilience in the society and the communities in which they live. Ultimately, such institutions contribute in three critical directions: knowledge generation, interdisciplinary research and scientific literacy.

Lessons can also be drawn from the deep understanding of neurobiological resilience, where alternative genetic-molecular pathways underlie individual resilience. Fostering research in this field will advance individual health and, by extrapolation, societal resilience. Implementing improved methods to measure resilience on an individual level is an important step toward this goal.

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Chapter 3

Resilient Research Universities for Resilient Societies

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WHY RESILIENCE MATTERS

With imminent environmental risks, the ongoing war in Ukraine and countries struggling with the aftermath of the coronavirus pandemic, societies worldwide are facing a multi-crisis situation. The pandemic in particular has revealed the dangerous fragility of prevailing socio-economic systems and the importance of resilience of both societies and organizations (Schaepman *et al.*, 2022). The failure of building resilience to crises is very likely to entail high costs – both on societal and economic levels. New research by the World Economic Forum suggests growth differentials in a range between 1% and 5% of annual global GDP growth (WEF, 2020). But what does it take for societies to absorb shocks and to cope with multifactorial crises? And what role do universities play in this context?

It seems obvious that research and education are essential to increase the resilience of systems worldwide. Universities, on the one hand, contribute actively to solving global problems. For example, by developing new medicines or researching renewable energies. On the other hand, institutions of higher education also play an indirect "developmental role" (Gunasekara, 2006) as spaces for reflection and knowledge production, and by educating the thought leaders of tomorrow. There is ample evidence that an educated population is an essential precondition for promoting resilience throughout society (WEF, 2020). Little research, however, has been conducted so far (e.g. Minocha & Hristov, 2022) on what competencies universities can teach their

graduates that will help promote societal resilience, and what effective ways of teaching them might look like.

The aim of this article is, in a first step, to analyse different concepts of societal resilience to point out key elements of resilient societies, and to elaborate a working definition for the university context. In a second step, we will look at universities as resilient organizations and present some specific measures that universities can implement to foster resilience. Using the example of the University of Zurich (UZH), the initiatives presented include areas of governance, research and teaching, as well as individual competencies of university graduates.

UNDERSTANDING RESILIENCE: KEY ELEMENTS OF BUILDING A RESILIENT SOCIETY

The term "resilience" in its common, non-academic use refers to the ability to successfully cope with a shock and to return quickly to normal functioning (Doorn, 2017; Brunnermeier, 2021). Over the past decade, the notion of resilience has found its way into academia and has been used in a variety of context and research areas, ranging from psychology, structural and engineering science to the body of knowledge on corporate strategy or the natural and social sciences. Across disciplines, however, slightly different definitions of resilience have emerged, as several studies point out (e.g. Doorn, 2017; Folke, 2006; Sharma, Tabandeh & Gardoni, 2018). For an overview of often cited conceptions of resilient systems see Bahadur *et al.* (2010). Furthermore, the units of analysis differ across disciplines and from one conceptualization of resilience to another. In psychology, for instance, resilience is generally seen as the capacity of people to withstand stress. Thus, resilience is analysed at the level of the individual. In engineering science, resilience is understood to be a capacity of infrastructure or buildings, whereas in the field of corporate strategy, resilience is seen as a capacity of enterprises or organizations in general. In the social sciences, resilience is mainly analysed in relation to communities or socio-ecological systems, emphasizing the interconnectedness of societies and their environment (Bahadur, 2010). In addition, the understanding of the term "resilience" has also shifted over time (Doorn, 2017). While the theoretical ecologist Crawford Stanley Holling referred to resilience in the 1970s as the ability of an ecosystem to return to a stable state after a disturbance (Holling, 1973), recent literature emphasizes less the aspect of stabilization than the importance of flexibility and adaptation to new circumstances after a disruptive event (Doorn, 2017; Norris, 2008). Brunnermeier (2021), for example, states that "if we are able to adapt and change, we will strengthen our resilience". As Doorn *et al.* (2019) note, the conception of resilience as a system's capacity to adapt, learn and reorganize is among the most widely

supported nowadays. Resilience is thereby often used in a normative way and seen as a desirable quality of a system.

In this article, we argue from a university management perspective and refer to resilience as an adaptive capacity enabling an organization or a community to successfully get through crises and to use disruptive events for advancing – a concept also referred to as social-ecological resilience (Robinson & Laycock Pedersen, 2021). In the following, we will focus on the following three units of analysis: The university itself – as an institution constituting an essential part of the infrastructure of a community and contributing to its stability, on communities in which public universities are embedded and on the individuals constituting these societies. (We do not, however, consider mental or emotional capacities, but concentrate mainly on job-related skills.)

How To Strengthen Societal Resilience: Key Factors

What does it take for societies to become more resilient? As Benedikter and Fathi (2017) note, there is not yet a convergent definition of a resilient society. During the past decade, however, several authors have suggested a set of overlapping characteristics to describe resilient groups, communities or societies. Benedikter and Fathi (2017), for example, outline four current lead concepts of resilient societies. First, they identify a resilience idea, dominant in the Anglo-American world, which is closely associated with the security discourse and defines societal resilience as emergency preparedness and the ability to systematically mitigate damage thanks to enhanced infrastructure and technology. The second school of thought is "innovation-oriented", focusing on adjustment and transformation, encouraging network approaches and experimental thinking. The third school analytically assesses the capacity of regions or cities to act flexibly. The fourth strand of thought originates from the future discourse of Silicon Valley and highlights the importance of general access to technology and knowledge for the resilience of societies.

In addition to the four concepts summarized above, research on the topic mentions a range of factors contributing to societal resilience. Based on their comprehensive analysis of scholarly literature on resilience, Bahadur *et al.* (2010) have established the following key characteristics of resilient communities:

- High level of diversity (regarding the voices included in policy processes, but also the resources available to the group),
- Effective governance and institutions that are decentralized, flexible and enhance social cohesion,
- General acceptance of uncertainty and change, community involvement (participation) and inclusion of local knowledge in policy processes,

- Preparedness, planning and readiness – which includes "planning for failure", to make sure that breakdowns of infrastructure, for example, do not cause the system to collapse,
- High degree of social and economic equity, strong social values and structures,
- Acknowledgement of non-equilibrium systems dynamics (meaning that strengthening resilience should in any case be rather about managing change than returning to a status quo),
- Continual and effective learning, and finally
- Adoption of a cross-scalar perspective on events, as resilience is built through networks reaching from a local to a global scale.

Similarly, Brunnermeier (2021) lists qualities such as fairness, social norms, equality, flexibility, adaptation and a culture of open communication as essential to societal resilience. In addition to the enabling factors already mentioned by the authors cited above, Brunnermeier also emphasizes the importance of trust in scientific and rational reasoning, as well as room for dissenting opinions, especially in times of increasing uncertainty: "Critically, a resilient social contract must leave space for mavericks and dissenters. They are the ones who might create unexpected solutions to unexpected shocks".

Finally, we would like to cite also the capacity and principles for resilience-building in communities listed by the United Nations in their "Guidance on Helping Build Resilient Societies", which was published in 2020 and is based partly on scholarly literature (e.g. Cutter *et al.*, 2008; Béné *et al.*, 2017), partly on practical experience of UN Teams. The following resilience capacities are mentioned:

- Absorptive capacity, i.e. the ability to preserve basic infrastructure and functions after a shock, as well as the capacity to recover from disruptive events,
- Adaptive capacity, meaning the ability to adjust to disruptions in order to continue functioning without major qualitative changes,
- Anticipative capacity, meaning the anticipation of potential threat and taking early action,
- Preventive capacity, which is mainly the (early) reduction of existing risks, and
- Transformative capacity, meaning the ability to create a totally new system if necessary.

When it comes to the principles informing the assessment, planning and implementation of resilience-building activities, the United Nations also stress the importance of equality, non-discrimination and participation from all stakeholders involved, especially full respect for human rights under all circumstances. Furthermore, it is noted that resilience approaches must be

flexible and sustained, assessing not only immediate risks or needs, but considering also the "root causes" (United Nations, 2020) of risk, such as poverty, vulnerability, human suffering, while acknowledging at the same time the various interdependencies among political actors, civil societies, and institutions.

Considering the factors assessed in scholarly literature and understanding resilience as an ability to adapt, learn and reorganize in crises, we identified the following key aspects characterizing resilient societies:

- Flexibility, i.e. the ability to adapt, change and reorganize, but also transformative capacities as mentioned in the UN guidance on resilience,
- Diversity,
- Equality,
- Participation,
- Preparedness (including anticipation and prevention),
- Learning and Education,
- Open communication,
- Scientific reasoning, and
- Room for dissenting opinions.

These characteristics form the basis of the following discussion about the potential of universities in shaping resilient societies.

THE POTENTIAL OF UNIVERSITIES IN SHAPING RESILIENT SOCIETIES

As outlined above, flexibility, diversity or equality, among others, are key capacities for building a resilient society. The question we address in this section is how universities can contribute to strengthening these capacities, and thereby take an active part in shaping the transformation towards a more resilient society.

The section is divided into two parts. In a first step, we look at the university and its organizational structure. We argue that the university, as a complex system, is inherently a resilient organization and thus plays an important role in building resilient communities. It can be shown that key factors identified as characteristic for resilient societies are equally important in the context of higher education institutions.

In a second step, we go beyond general assessments and look at specific initiatives fostering resilience at the University of Zurich, the authors' home institution. The examples include areas of governance, research, teaching, services and knowledge transfer. They highlight the variety of actions aimed at empowering society and individuals in a time of multiple global challenges.

The University as a Resilient Organization

It is widely acknowledged that universities play a central role in society: as knowledge generators, educators, but also as driving forces in social transformation processes, for example, through the promotion of sustainability or engagement in diversity and inclusion (Bartusevičienė *et al.*, 2021). Furthermore, current global disruptions like the Covid-19 pandemic have highlighted the importance of scientific research in the management of crisis. In other words, and as pointed out by Lisa Gibbs *et al.* in relation to the challenges posed by climate change: universities generate knowledge that helps societies in crisis to take immediate action and to deal with long-term consequences. Consequently, the authors see universities "as part of the critical infrastructure of society" and they highlight their "role and their resilience as a public good" (2022).

By virtue of its status as key player in society, it seems logical that universities, as well as other educational systems, must be resilient institutions with the ability to "respond to a crisis and continue to provide uninterrupted services through adaptation and adjustment" (Bartusevičienė *et al.*, 2021). Or, as expressed pointedly by Bartusevičienė *et al.*, "the idea of resilience […] will become a matter of survival for higher educational institutions" (2021). But what is it that makes a university a resilient organization?

According to Pinheiro and Young, universities are resilient organizations by their very nature: "In many respects, the history of the university as an institution, going back to the medieval era, is an example of resilience in the face of enormous socio-economic, political and technological changes" (2017).

Universities are seen as complex organizations (Robinson & Laycock Pedersen, 2021) that are "characterized by many sub-entities and multiple connections or linkages between them" (Pinheiro & Young, 2017). In a figurative sense, Pinheiro and Young compare the university to a coral reef, "since both are multi-level systems, that is, both are actors as well as function as arenas for other actors" (2017). An older, but still frequently mentioned concept in the literature on organizational resilience in the university context is that of "organized anarchy" (Cohen, Olsen & March, 1972; Selmer-Anderssen, cited in Karlsen & Pritchard, 2013). Basically, this organizational form points to the multiple goals and decision arenas and to "a structural decoupling" (Pinheiro & Young, 2017) within universities. Pinheiro and Young argue that decoupling, together with organizational redundancy and diversity, are key features that strengthen the organizational resilience of universities: "By allowing the system to emerge and evolve rather than trying to steer it into a given direction or predisposed outcome, self-adaptability to new environmental dynamics is enhanced. This, in turn, increases the system's ability to overcome or absorb major disturbances, resulting in enhanced resilience […]"

Nevertheless, in recent years, because of a process of rationalization, scholars have identified a tendency – enforced also by the European Commission

– to "couple the internal structures, strategies and value-systems (cultures) within universities". Pinheiro and Young criticize this tendency of "formalization" and "managerialism" in higher education, arguing that this makes universities more vulnerable to shocks (2017). Other authors, too, have claimed that universities should preserve their identity as complex systems (Gibbs *et al.*, 2022), and withstand "increasingly business-orientated models of governance" (Robinson & Laycock Pedersen, 2021).

Another tendency influencing the organizational structure of universities is mentioned in the report on university autonomy by the European University Association. Especially during the Corona pandemic, policy interest and state intervention in universities have increased, leading in some cases to "[…] overuse of steering instruments, or ad hoc interventions" (Bennetot Pruvot *et al.*, 2023). This ultimately leads to reduced autonomy and – alongside the aforementioned trends – complicates the preservation of universities' core mission, that is, value-free, basic research.

In summary, higher education scholars identify a tension between efficiency and resilience, arguing that streamlining organizational structures is always at the expense of diversity and buffering capacity leading to increased vulnerability in case of disasters. Diversity, as pointed out earlier in relation to society, is a key value also for organizational resilience, or, as highlighted by Pinheiro and Young, "the level of internal variety – in terms of structures, skills, knowledge, people, etc. – needs to match the variety present in the external environment if the organization is to survive and prosper" (2017).

In the following section, we will take a closer look at the following capacities that strengthen resilience: diversity, community involvement and flexibility. Looking at the University of Zurich, we will present a selection of processes, projects and values that promote resilience on different levels – organizational and individual – and in the different core areas of the university.

Building Resilience – the Example of the University of Zurich

Diversity at UZH – a core value

Diversity plays a crucial role in the functioning of the university on very different levels. First, we think of diversity in the social context and of diversity policies. Through its "Diversity Policy: Promoting, Practicing and Benefiting from Diversity", the University of Zurich (UZH) is committed to the active and systematic promotion of diversity and prevention of discrimination. As Switzerland's largest education and research institution, active in Europe and worldwide, UZH embraces diversity as a central value.

UZH is a comprehensive university with seven faculties covering more than 100 different subject areas thus embracing diversity at its core. With

approximately 28,000 enrolled students and almost 10,000 employees, UZH is the largest university in Switzerland. One key asset of comprehensive universities are so-called "small subjects", which, contrary to the broad public perception as "niche" disciplines, have proven to represent fields of knowledge that contribute to the understanding of issues or events that in a fast-changing world come to the fore in often unpredictable circumstances. At UZH, such is the case with Japanese Studies, for example. As a result of the growing importance of Asian countries in world politics, this study program has become more and more popular with students in recent years (see also Däppen & Schaepman, 2021).

However, the existence of a broad variety of subjects or study programs alone is not a resilience factor. In research, the university increasingly focuses on interdisciplinary collaboration. This makes it possible to address an even broader range of current issues and complex challenges. For instance, UZH has established University Research Priority Programs, which create academic networks across disciplinary borders and advance knowledge in areas of research that benefit society: Digital Religion(s), Dynamics of Healthy Aging, Evolution in Action, Equality of Opportunity, Human Reproduction, Financial Market Regulation or Language and Space, to name a few. In a context of increased disaster exposure, knowledge production must take place in a networked context.

Finally, there is room for diversity at the operational level, too. For example, UZH has committed itself to a reduction in actual flight emissions of at least 53% by 2030. The faculties and organizational units of the university can develop different approaches for the reduction of air travel, according to their size, academic culture, and mission. Diverse models, instead of a universal approach, do not only strengthen participation of organizational units, but also their commitment to sustainability through self-responsibility.

Community Involvement: Dialogue, Hands-on Research and Global Solidarity

Along with the critical role of universities in society goes a social responsibility. As a public university, knowledge transfer and involvement of communities and players from outside academia – often referred to as "third mission" – are part of UZH's tasks. Engagement with communities is happening at a local as well as at a global level. At a local level, the University of Zurich promotes knowledge transfer and dialogue with the public. Exhibitions, talks or open lectures are organized on a regular basis with the aim of discussing current issues and sharing promising initiatives for a positive societal impact. Formats of exchange and platform for debates are encouraged by central services such as the Communications Office, as well as by individual faculties and institutes.

As mentioned by Gibbs *et al.* (2022), citing the "Sendai Framework for Disaster Risk Reduction 2015-2030" of the United Nations, it is the role of academia to "support action by local communities and authorities; and support the interface between policy and science for decision-making" (United Nations, 2022). At UZH, high priority topics, such as digital transformation, are addressed by a community involving researchers of local higher education institutions but also by practitioners and decision-makers at the communal or cantonal level. An example is the Digitalization Initiative of the Zurich Higher Education Institutions (DIZH), run by the four partner higher education universities of the canton of Zurich. In a network of researchers, students and practitioners from the sectors of business, engineering, training or public administration, DIZH promotes solution-oriented cooperation on digitalization issues. The project "DSS_Embrace", for example, aims at developing decision-making instruments for businesses or city planners, who are dealing with deep uncertainties in the context of climate risks.

Finally, community involvement takes place at a global level, too. Thanks to more than 1,000 partner institutions worldwide, UZH is part of a dynamic global network that strengthens meaningful engagement in education and research. As a member of the League of European Research Universities (LERU), Universitas 21 or Una Europa, the University of Zurich is collaborating with like-minded institutions to achieve common goals such as cross-border research and innovation partnerships. Furthermore, UZH assumes its responsibility towards society by providing unbureaucratic assistance in current crises. During the Corona pandemic, some students experienced financial hardship. With the lockdown, they lost their part-time jobs and could no longer pay their rent or health care costs. For them, the university set up an emergency aid and paid out amounts between 1,000 and 6,000 Swiss francs in a fast and efficient way. In the case of the war in Ukraine, one measure taken by UZH is to offer free visiting study programs for Ukrainian students.

"Shaping Resilient Societies": A Multiselectoral Initiative for Sustainable Development

Taking the Covid-19-led situation and the "2023 Sustainable Development Strategy" of the Federal Council of the Switzerland into account, the University of Zurich and the University of Geneva in collaboration with the Swiss Federal Department of Foreign Affairs, launched the "Shaping Resilient Societies" initiative in 2020. With a transversal and multi-stakeholder approach, the initiative is dedicated to building resilient and sustainable societies to future shocks. More specifically, it aims at better understanding crises response mechanisms in Switzerland and beyond. Believing that global resilience and sustainability are only achieved through

a cross-sectoral and cross-societal approach, the Shaping Resilient Societies community is both diverse and interdisciplinary: it is composed of 60 experts, ranging from scholar to private and public sector practitioners to governmental and non-governmental officials.

Flexibility in a Rapidly Changing Environment

Self-organization, organizational flexibility, or, as mentioned above, "self-adaptability" are further key factors that contribute to the resilience of the university. Autonomy is a core element of UZH's identity as a university, and it is an enabling force in the continuous adaptation of management structures.

In 2020, the new governance program, "Governance 2020+", was launched with the aim of empowering faculties by giving them more organizational and management responsibility in their core businesses: research, teaching, continuing education and services. In turn, improved managerial competencies, ethical behaviour and transparency of leadership were requested and implemented, along with a more collaborative management approach. Two years after the implementation, a survey has shown that the increased flexibility and decision-making power are highly appreciated among faculty members. It enables them to set their own targets and has a positive effect on networking within the units. Cooperation between faculties and university leadership has improved, but collaboration and appreciation of co-leadership remain to be optimized.

Also in research, the university should strive to achieve a maximum degree of flexibility. In professorial appointments, the university must be able to react to new questions society is facing and to adapt the technical focus of a professorial chair. Medical science provides a good example of this. Research has shown that women and men get sick in different ways. They can develop different symptoms with the same diseases or react differently to medications. Nevertheless, medical research has been mainly focused on men, resulting in medical malpractice or failure to recognize diseases in women. Because more attention should be given to gender in medical research, UZH has established a chair in gender medicine – the first in Switzerland for this discipline. Finally, UZH has several competence centres that address current challenges and thus strengthen the resilience of society and its institutions. The Center for Crisis Competence, for example, serves as a lab for interdisciplinary research and is working on new solutions for an integrated crisis management.

From the Organization to the Individual – and Vice-Versa?

It has already been suggested that resilience must be considered at different levels. Looking at diversity, flexibility or open communication, it seems

obvious that these key factors for the resilience of a community or organization are just as important for the individual. It has been pointed out in scholarly literature that only resilient organizations can contribute to resilient communities: "[…] if organizations are not sufficiently prepared to mitigate impacts and effectively respond to crises, neither will the communal- or supra-systems to which they belong" (Shaya *et al.*, 2022). We argue that this is true also regarding the individual: If individuals do not have the competencies to cope with crises, neither can the organizations of which they are part. Therefore, the question is: how can universities promote competencies that graduates need to successfully enter the workforce? Recently, several higher education experts have drawn attention to the global talent mismatch as well as to the "urgent need to integrate workforce development requirements into our current creation and dissemination models in Higher Education" (Minocha & Hristov, no date). The same authors – with a focus on the United Kingdom – criticize that "employability is a buzzword on most campuses, but, in reality, relegated to the offer from Career Services or through the provision of extracurricular programs or guest lectures by Employers."

UZH has recognized this need and has launched various teaching initiatives considering also new labour market requirements. For example, UZH is using its Una Europa membership to co-develop and test micro credentials to make education more flexible. Another example is the School for Transdisciplinary Studies, founded in 2021, that acts as a hub for promoting inter- and transdisciplinary studying and teaching.

In addition to these new initiatives, however, there are some key competencies that universities have taught their students since their foundation and that continue to be valid in today's workplace. As described in the Future of Jobs Report of the World Economic Forum, critical and analytical thinking, complex problem-solving or active learning strategies have been topping the list of skills since the first report in 2016 (WEF, 2020). These are "classical" competencies that students learn at a university and that continue to be central not only on the job, but also as basic mindsets that enable a constructive culture of debate in times of societal division.

Finally, it is worth mentioning that resilience is important for every employee, but indispensable in leadership. The Center for Leadership in the Future of Work at the University of Zurich focuses on the future of work and offers lifelong learning programs on people-centred leadership. Its aim is to create an ecosystem of current and future leaders who understand the value of people in and for business. New ideas and expertise by various stakeholders such as civil society, government, start-ups and corporate partners are integrated.

CONCLUSIONS

Resilience matters, today more than ever. In the context of a world full of crises, societies worldwide are challenged to strengthen their adaptability as well as their capacity to learn and reorganize themselves in a rapidly changing environment. Scholarly literature from different disciplines and theoretical backgrounds consistently points out that high levels of flexibility, diversity, social and economic equity, as well as community involvement and a broad participation in political processes, are key elements of resilient societies. Open communication, room for dissenting opinions as well as effective learning and advanced levels of education are further capacities that foster resilience.

As has become clear from the selection of examples from the University of Zurich, universities have a high potential to help shape resilient societies. On the one hand, they are themselves diverse and adaptive organizations and thus resilient by their very nature, which makes them a part of a critical infrastructure supporting the resilience of the community in which they are embedded. On the other hand, in particular diverse research universities such as UZH contribute to empowering communities through their teaching and research activities and by addressing current challenges, but also by promoting community engagement in fields of high societal relevance, such as sustainability or digitalization. In addition, universities often serve as platforms for debates, where dissenting opinions can be expressed and discussed in a constructive manner. Last, but not least, universities provide their graduates with skills that are crucial for adapting to rapidly changing circumstances: analytical and critical thinking, advanced problem-solving skills and learning strategies. In this way, too, universities contribute to resilience-building within communities. To define in which ways or with which kinds of measures universities can foster societal resilience most effectively, more research, particularly more specific data, would be needed. Currently, universities generally educate "by design" for resilience, but resilience as a core competence or even part of a strategic plan is generally absent. It might be worthwhile to assess a transition from serendipitous, ad hoc resilience competencies to building overarching and strategic resilience competencies.

Further, it is evident that if universities wish to effectively contribute to building societal resilience in the future. Hence, they should maintain and strengthen their own organizational resilience, too. As scholarly work on university resilience points out, universities must make sure that their own organizational structures meet the growing complexity of contemporary challenges, while at the same time preserving their autonomy and remain true to their core missions of value-free, basic research and teaching, despite growing pressures from outside. Finding a balance between maintaining traditional values and structures and adapting to new requirements will remain a challenge in the years to come.

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Chapter 4

Revitalizing Kyoto University as a Research-Oriented University

Nagahiro Minato

Last year, the Japanese government launched a new initiative called "Universities for International Research Excellence," aiming at the enhancement of Japanese research universities. In the background of the initiative, there seems to be an increasing concern about the apparent declining global competitiveness of Japan's industrial productivity and a sustained economic stagnancy over the last three decades. It seems that the declining research capability and productivity of leading Japanese research universities may be partly responsible for that situation. While a number of government initiatives with various specific purposes have been launched for Japanese universities in recent decades, the current initiative is quite unusual in terms of both its long-term budget scale and its purpose, requiring a long-term perspective and commitment to fundamental organizational reform directed at the enhancement of research capability and contribution to social innovation in future. Considering the ever-increasing expectations and demands placed on research universities to play proactive roles and contribute to social innovation to tackle emerging global problems, the current government initiative seems to be quite adequate and reasonable. Recognizing the good opportunity that it represents, Kyoto University has submitted a comprehensive plan for organizational reforms to "modernize" itself over the course of the coming two decades.

A BRIEF HISTORY OF JAPANESE NATIONAL UNIVERSITIES

Modern universities in Japan only began to be founded after the Meiji restoration and establishment of the new government in 1868. The first was established as a national university (NU) in Tokyo in 1877, followed by a second NU in Kyoto in 1897. In these early stages, the first and main mission of an NU was to foster the human resources who would become governmental bureaucrats and technocrats in the new era. That mission, which was aided by the recruitment of established scholars and experts from overseas, was almost exclusively pursued by the University of Tokyo, where it was not unusual for senior government bureaucrats to be co-assigned as university faculty. In due time, however, as the modernization of society progressed, there came increasing demands for the development of academic activities for the benefit of society, including the development of science and technology. That atmosphere promoted the foundation of a second NU focused on academic research, and, as such, Kyoto University was founded as a research university from its very beginning. In this regard, I think it has attained significant success, producing 11 Nobel laureates in diverse fields of the natural sciences — more than any other institution in Asia — and two Fields Medalists in mathematics. It was also the birthplace of the Kyoto School of philosophy, a unique school of Eastern thought, that had a significant spiritual impact on Asian culture.

After the end of WWII, when the new school system, including universities, was introduced based on that of the US, the number of NUs rapidly increased in tandem with robust social and industrial reconstruction. There are currently as many as 86 NUs, covering all regions of Japan. It is worth noting that all of the national universities have been governed centrally and uniformly by the Ministry of Education in accordance with central government policy and regulations, including aspects such as the numbers of students and faculty members, and the financial operations of NUs were almost entirely dependent on single-year subsidies from the central government. The system, which was often referred to rather cynically as a "naval convoy system," because the course of the NUs was so strictly directed, appeared to function quite efficiently at least until 1990, when the Japanese economy and GDP saw remarkably rapid-paced growth, with a corresponding increase in the overall NU budget.

As Japan moved forward into the 21st century and economic stagnation became gradually more evident and persistent, the entire government budget for the NUs was gradually but steadily reduced, forcing each NU to scale down its overall operations. To promote their self-reliant operation, the government

decided to incorporate all of the NUs in 2004, making them independent agencies, and intending to facilitate an increase of external funding acquired through their own efforts; however, the easing of the tight government regulations on NUs was quite limited, and the situation has remained largely unchanged. Most significant of all, the Japanese NUs had become so deeply accustomed to their operations being dependent on central government subsidies, as they had been for many decades, that their management systems were completely unprepared for the change. More recently, the government has introduced a modified NU budget system, whereby a certain portion of the annual budget for each NU is pooled and reallocated depending on the overall achievements of NUs, which is assessed based on various indices. However, the overall NU budget itself remained unchanged, and the effects appeared minimal, if any. Another government strategy was to provide application-based competitive subsidies in addition to the basic NU budget, which was intended to be used for addressing currently important issues relating to research, education and management. While such subsidies might have a certain impact on stimulating incentives to conduct research, they were only short-term, and were not sufficiently applicable to personnel expenditure and infrastructure to cause any substantial organic reform of the NUs.

MAJOR PROBLEMS FACED BY JAPANESE RESEARCH UNIVERSITIES

The general concern that Japanese universities are falling behind in terms of global competitiveness in recent years seems to be based on various research-related data indices, such as the so-called university rankings. It could be quite disputable whether such research-related indices genuinely reflect the overall picture of the research capability and potential of universities; however, there is no doubt that Japanese research universities are currently facing several serious problems with both internal and external causes.

One of most striking problems is the sustained decline of the 18-year-old population in Japan in recent decades. The 18-year-old population exceeded 2 million in 1990, but it has dropped steeply since 1992 down to 1.12 million in 2023 (MEXT, 2023, p.20; MIC, 2023, table 3). Since the declining birthrate is progressing even beyond previous estimates, it is now certain that the 18-year-old population will be less than 0.8 million by 2040 (MHLW, 2022, p. 4), and there is little sign of a recovery. Furthermore, while the rates of people entering university seem to be reaching a plateau at around 50%, the number who advance to graduate school has been steadily decreasing over the past ten years (MEXT, 2022, p. 5; Cabinet Office Gender Equality Bureau, 2021,

fig. I-5-1). This trend is a serious concern for research universities. It seems to be attributable to a combination of multiple factors, such as insufficient scholarships for graduate students and uncertain career paths after graduation. In general, there seems to be only minimal social advantage or merit in holding a PhD degree in Japan, for instance in terms of the employment requirements of most domestic companies. Also, in the academic sector, most research grants available in Japan are impaired by the historic defect of not including any provision for the cost of hiring personnel, including postdoctoral fellows. These issues are apparently causing considerable uncertainty among graduate students with regards to their future career paths. The recent stall in the number of young researchers going abroad to study may in part reflect the feelings of uncertainty surrounding academic career paths. All in all, these situations represent a serious concern that the domestic human resource pool for next-generation researchers in Japanese research universities might progressively shrink.

The second problem for Japanese research universities is the rigidity and closed nature of the overall research environment. During the last few decades, amid the persisting economic stagnancy, there has been minimal government investment in the infrastructures of NUs and in full-time human resources for university management and research support, such as university research administrators (URAs). This has resulted in an increasing administrative burden being placed on researchers. For instance, open technical support systems (which include cutting-edge equipment and technical support personnel) that are easily and openly accessible to all researchers are becoming crucial for advanced research, but the establishment of such core facilities at NUs has been much delayed and remains insufficient. It should also be stressed that an antiquated hierarchical small-scale faculty organization, consisting of a full-professor chair with only a few junior professors at most, is still maintained in many departments. Such small chairs often tend to be closed and may be hampering the open and free interaction of researchers and the flexible and timely recruitment of junior faculty. Such a closed environment is not helpful for the study endeavours of graduate students either. Also, diversity, in terms of gender and nationality, remains in need of much improvement.

The third issue is the paucity of the funds held by each NU, which are essential for enabling self-reliant operation and investment from a long-term perspective. As stated, the financial operation of Japanese NUs is largely dependent on single-year subsidies from the central government and fixed tuition fees, which are relatively cheap compared to those of private universities. Those limited resources make the implementation of new initiatives (such as

the establishment of facilities or increasing personnel) practically impossible. After the incorporation of the NUs in 2004, the government encouraged them to expand their external funding, such as endowments and commissioned research with the industrial sector. Accordingly, Kyoto University established new offices for fund-raising and academia-society collaboration to increase, over the past 10 years, the university funds available for those purposes. Currently the proportion of governmental subsidies in the total revenue (excluding university hospital), which used to be far in excess of 50%, has been reduced to close to 30%. The process could be further facilitated by a system of complete tax-deduction for donations (at least for donations to higher education institutions) to enhance the donation climate in Japan, as well as an increase in the indirect costs for collaborative academia-industry research. Nonetheless, the scale of the funds held by NUs remains smaller by far than those of major research universities in other countries, and insufficient for self-reliant university operation using the investment profits from the funds. Current government initiatives include a financial mechanism to boost the formation of university funds over the long term, and we hope that this will greatly help our efforts toward achieving the self-reliant operation of research universities.

Lastly, I think that some overarching masterplan may be needed for the Japanese NU system, which was expanded, almost haphazardly, to comprise as many as 86 NUs with a uniform policy, mostly during the post-WWII era, as the national population and industrialization were in a phase of robust expansion. However, unlike most EU countries and the US, Japan is clearly entering a phase of steady decline of the total population, and in particular, a sharp decline of the younger generation, which is almost certain to continue in coming decades. It is estimated by the government that the population of under-20-year-olds, which was about 26% of the total population in 1990, will have declined to only 15% by 2040, and to less than 13% by 2060 (MHLW, n.d., p. 2; MHLW, 2020, p. 1, figure 1-1-1). On the other hand, the rates of people entering university appear to be reaching a plateau (around 50–55%), and no significant increase is expected in coming decades. Faced with these demographics, one way to reorganize the Japanese NU system may be to introduce a differentiation of their missions and functions. It was probably with that idea in mind that the government introduced its Designated National University Corporation (DNU) System in 2017, for which it selected ten NUs with high research potential capable of creating social innovation, including Kyoto University. This may remind you of the masterplan for higher education in the state of California in the US, comprising the University of California (UC) group, primarily responsible for research, the California State Universities (CSU) for general higher

education, and the California Community Colleges (CCC) for more practical occupational training. However, the DNU system seems to be focusing primarily on incentivizing selected research universities, and the impacts, if any, on the overall NU system remain to be seen. A more systemic and functional reorganization of the entire NU system, including the number of institutions, might eventually be needed.

KYOTO UNIVERSITY'S LONG-TERM PLAN FOR ORGANIZATIONAL REFORM

As part of its efforts towards being adopted for the current government initiative, Kyoto University has formulated a long-term plan for organizational reform, which takes into consideration the current major problems being faced by the university.

The plan consists of the following three pillars:

1. Active investment in human capital and the university's research environment to strengthen research capabilities.

To get away from the antiquated small chair system, that tends to be closed and exclusive, open and inclusive research units that are larger in scale will be organized to enable free interaction and flexible collaboration among researchers in related fields. Also, to maximally realize the research potential of individual researchers, the research support systems and infrastructure, with respect to both personnel and equipment, shall be enhanced. The openness of the research environment may be particularly important to motivate and attract the younger generation into academic research and foster the next generation of creative and original researchers.

The concrete plans under the first pillar include:

A. An agile organizational structure for research that enables the development of creative new research areas. Faculties will be organized into larger-scale department units with a chairperson and lab manager. The university will also support the formation of flexible platforms for pioneering and interdisciplinary research with space, finance and management personnel being shared across departments.
B. Provision of a research environment that adapts to the rapid technological advancement of research. Highly-centralized multifunctional core facilities, which provide every researcher with one-stop access to advanced equipment and devices, along with technical advice and education, will be established for core research areas. The core facilities will include laboratories that aim to develop new technologies

in collaboration with the industrial sector and the provision of a technical education course for graduate students and young researchers to promote the understanding of technical principles.

C. Cultivation of next-generation researchers through open research environments. It is important to ensure postdoctoral positions to facilitate a career path toward becoming a principal investigator (PI). The university will launch an institutional fund for postdoctoral research positions, which will also provide financial support for PIs to hire postdoctoral fellows.
D. Recruitment of excellent research personnel from overseas and the internationalization of career paths for faculty through the acceleration of international "brain circulation". The provision of scholarships for both inbound and outbound graduate students and young researchers will be enhanced. The university has already established "onsite laboratories" in collaboration with as many as 10 overseas institutions, and we plan to expand some of them into larger-scale departments, which will include local researchers, graduate students and management staff.
E. Expansion of research support personnel to help researchers maximally realize their potential research capabilities in various ways. The number of professional university research administrators (URAs) with PhDs will be increased, with an efficient central organization managing them according to their individual expertise.
F. Promotion of diversity, equity and inclusion. The robust improvement of gender and international diversity and inclusion is one of the most urgent matters at Kyoto University. Special support for individual working styles and everyday life will be provided for minority groups.

II. Establishment of the mechanism to realize the social value of research results.

Ensuring that the latent value of research results is effectively and swiftly applied for the benefit of society is one of the most important functions of a research university, and, for that purpose, it is necessary to establish an efficiently organized system by employing diverse specialists in various roles. While the trend towards academia-industry collaboration has significantly increased in recent decades, the internal mechanisms incentivizing the social application of the latent value of research results have been lagging considerably in Japanese research universities, in part due to the tight governmental regulations on the business activities of NUs.

The concrete plans under the second pillar include:

A. Reform of the management structure to promote the utilization of research results. The university will establish the Growth Strategy

Office (GSO) to centrally integrate the activities and businesses related to value creation and social application. The GSO will include fundraising, innovation and stakeholder relations departments. Current university subsidiaries in charge of the management of intellectual properties, technology transfer/licensing and start-up investment will all be connected to the GSO to be well managed in accordance with university policy and compliance.

B. Establishment of an effective process from the research stage to the utilization of outcomes. The university intends to provide total-package support for the utilization of research outcomes, from the excavation of potential business seeds, start-up preparation and launch of venture companies to business growth. This will include financial support for start-ups. In addition to regular investment in ventures, an institutional fund to financially support incubational research toward start-ups (called a "gap fund") should be an effective way to drive the early stages of commercialization.
C. Development of a global innovation strategy. To expand the potential market for business activities based on university-derived outcomes, the university plans to establish overseas innovation centres. A current example is the Kyoto University centre at UC San Diego in California, which holds periodic showcase presentations, and where new drug development and clinical trials for regenerative medicine are underway in collaboration with UCSD. Similar activities will be planned in other regions of the US and in ASEAN countries.
D. Formation of an open innovation network. Collaboration with the industrial sector will be more focused on comprehensive organization-to-organization contracts with long-term vision, whereby the university will seek to establish collaboration from the very early stages of research and development.
E. Recruitment and training of specialists in promoting the creation of social value. Along with the efforts to recruit professional experts for the support of start-ups, the university plans to develop a certificate-bearing program to train the "innovation producers" that are crucial for providing practical assistance to entrepreneurs.
F. Strategies to enhance fund-raising by the university. To financially support the abovementioned activities, the creation of substantial university funds is essential. The university will enhance the function of its fundraising office by increasing the number of professional fundraisers.

III. A new style of governance and management enabling autonomous and self-reliant university operations.

To ensure autonomy and social responsibility, it is necessary for NUs to be equipped with distinctly organized strategic decision-making and operational/managerial decision-making functions. Under the governance of a decision-making body that works in consultation with external members from the university's broad spectrum of stakeholders, we plan to establish an effective management system that separates academic functions (overseen by the provost), administrative functions (overseen by the chief operations officer), financial strategy/business functions (overseen by the chief financial officer), and compliance (overseen by the chief compliance officer). This will ensure the effective management of the internal organizations responsible for each function. It will be of utmost importance to functionally separate matters directly relating to the university's education and creative academic research from matters relating to its effective and productive management and operation under a unified university policy and mission.

The plan represents a radical reform of the current organization of NUs in Japan. It may take some time to realize the reforms, but it will be crucial to revitalize the NUs, with public consensus, in coming decades.

REFORMING AS A RESEARCH UNIVERSITY

The aim of Kyoto University, since its establishment in 1879, has been to create intellectual value through original and diverse research founded on academic freedom, and thereby to contribute to human welfare and the benefit of society. However, it appears that its organizational structure is becoming decrepit and lagging behind the times, and I believe we need to implement fundamental reforms to revitalize university functions for the future, while maintaining the hallmark pioneering spirit and original principles of the university.

Humankind now faces numerous major global challenges, such as the serious problems caused by climate change, devastating natural disasters, the destruction of the natural environment and ecosystems due to globally-expanding human economic activities, emerging infectious diseases and pandemics, ever increasing disparity and poverty, hyper-aging societies in advanced countries, and many others. The expectation for and responsibility of research universities and their international collaboration efforts to address such global issues is becoming more important than ever. The problems involved are becoming increasingly complex, and it is difficult or even practically impossible to approach such global issues through any single scientific

discipline. Considering that aspect, it will be important to establish open and flexible organizational structures for research universities that enable the free interaction of researchers and students in diverse disciplines, intramurally as well as internationally.

Through our efforts to implement fundamental structural reform to achieve autonomous and self-reliant operations based on a long-term development strategy, and to forge a new university paradigm that can perpetually evolve to meet the needs of coming eras, we aim to firmly establish Kyoto University's status as a key academic hub for students and researchers from Japan and overseas. That goal will be achieved by earning the unwavering recognition and respect of the international community through providing the genuine innovation needed by society and contributing to the development of solutions to the critical issues faced by humankind — contributions that shall be made through genuinely creative scholarship and scientific research founded on robust research capabilities.

A PERSONAL PERSPECTIVE

Many decades ago, as a research associate in my late 20s, I spent three years in a research laboratory at the Albert Einstein College of Medicine in New York. The department consisted of a professor chairperson, several young professors (more than half of whom were women), seven or eight postdoctoral fellows (all from different countries around the world), two technical staff, a lab manager and nearly ten graduate students on a PhD course. The research subject of each staff member and student was highly respected by all of the other lab members, and there were always open and frank discussions and arguments generating new ideas and potential for collaboration. Furthermore, it was quite usual for staff members and students from other laboratories to freely come in and join the discussion and collaboration, depending on the subject. Also, researchers and graduate students were allowed free access to advanced equipment and facilities anywhere in the institution. Coming back to Japan after that experience, I experienced quite a culture shock in the small-scale lab managed by a full-professor chair, with only a few staff, which tended to be closed-off and have little interaction with other labs. That was what I experienced in Japan nearly 40 years ago. The situation has much improved in recent years, but, regrettably, that rigid and closed environment and system still remain in many Japanese university departments. I hope that the planned structural reforms will sweep away the persisting antiquated environment of Japanese research universities, and, most of all, will stimulate the motivation and incentive of the young generation toward creative science and social innovation with a global perspective in the future.

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Chapter 5

Core Elements of a Renewed Dialogue Between Science and Society After the Pandemic

Joël Mesot

INTRODUCTION

In the last 200 years, mankind has undoubtedly made enormous progress thanks to science. For millions of people, this means a healthier, more self-determined life. As drivers of the industrial revolution, technology and innovation have brought growth and prosperity to large parts of the world, even if it is still very unevenly distributed today. However, technological change has a Janus face. If not properly used by man, it always has the potential to disrupt natural balances, allow abuses and reverse progress. Climate change and the decline in biodiversity, as well as the recently overcome pandemic and regular financial crises, are ultimately examples of out-of-control balances. They are also reminders of how interwoven and vulnerable the world of the 21st century has become. Systemic crises keep reappearing in new guises. Collective risk has become a defining feature of a technologized and globalized world since the German sociologist Ulrich Beck coined the term of *Risikogesellschaft* back in the mid-1980s, shortly after the Chernobyl disaster. (Beck, 1986)

THE ROLE AS HONEST BROKER

It is part of the social fabric of open, democratic societies that scientific breakthroughs and technological change are always the subject of public debate. In this process, different interests come together and are negotiated. Science is part of this public debate, in which – particularly in the Swiss context – compromise has proven to be a powerful means of finding viable solutions. From the point of view of science, this does not always make it easy, because the various actors are not only soberly guided by facts, but their decisions are influenced by a multitude of factors. For science, this means that it must first become clear about its own role in the dialogue with politics and society. At the same time, it seems undisputed that the need for independent expertise is increasing in view of the complexity of the challenges we face. It is the privileged, but not exclusive, role of science to shape the dialogue in a fact-based manner. The role of science, in the sense of an "Honest Broker", is thus to provide facts, point out options and translate them into understandable language. But facts do not speak for themselves. It is necessary to interpret them and think in scenarios what the advantages and disadvantages of certain approaches are and what risks and opportunities they entail. Finally, science representatives must make transparent the assumptions on which their assessments are based, put on the table what is secured knowledge and where there are still uncertainties.

NO DIALOGUE WITHOUT WILLINGNESS TO DIALOGUE

For a dialogue to be possible at eye level, it first needs the willingness to engage in dialogue on the part of all those involved. By this I mean the ability to treat dissenters with respect and to adhere to certain rules of fairness, as well as to know and respect their role in the dialogue. Science must accept that it is expected to provide facts and expertise, but that decisions are reserved for politics. In return, policymakers should accept that certain facts are given and not everything is negotiable. To put it bluntly: The earth is round, whether we like it or not – even if supporters of the Flat Earth movement never tire of claiming the opposite. Debates are part of the democratic game, but I observe a tendency towards phony debates in the click-driven media. What is supposedly presented as two equal camps of experts turns out to be a broadly supported scientific consensus that a few dissident voices deny. This is where the media must assume their responsibility to distinguish between genuine controversy and pseudo-debates.

GENETIC ENGINEERING AND CLIMATE CHANGE

As unique as many of the experiences of the Corona pandemic of the last three years have been, we should not forget that science, in its various roles, was exposed to sometimes heated political and societal debates well before the Corona-related exceptional situation. Let's recall, for example, the genetic engineering debate in Switzerland some 20 years ago, leading to the introduction of a moratorium, which to this day prohibits the cultivation of genetically modified plants in agriculture and permits such cultivation only for research purposes (Die Bundesversammlung, 2005). Or let's think of climate science, which for years had to fight resistance from parts of society and from companies that spent millions to cast doubt on the statement of man-made climate change (Oreskes, 2010). While the anthropogenic greenhouse effect is mostly accepted today, the discussion about the right path towards the net-zero target is still very passionate and sometimes ideological. From a scientific point of view, there is no way around the net-zero target if we are to meet the commitments of the Paris Climate Agreement.

THE PANDEMIC OR SCIENCE IN THE SPOTLIGHT

The Corona virus that spread across the world from February 2020 not only triggered a global health crisis, it also catapulted science into the bright public spotlight. Scientists found themselves in the media and were expected to assess the current state of knowledge about the threat and the potential for pandemic mitigation. Governments and parliaments also decided to increase research funding for the study of the pandemic and possible countermeasures. Thus, with the rapid success of mRNA vaccination, a scientific achievement contributed significantly to the subsiding of the acute phase of the pandemic.

Scientists not only had to provide expertise for the authorities and government bodies on a moving target as the virus spread in all directions and mutated, they also had to provide transparency to the public. This was particularly important because severe restrictions were sometimes imposed on the public's freedoms. In Switzerland, the electorate had the opportunity to vote on the Covid-19 Act three times – and ultimately supported the government's position in all of the votes.

The most important body of scientific policy advice during Covid in Switzerland was the Swiss National COVID-19 Science Taskforce. This ad hoc expert body was established on the initiative of the ETH Domain and was composed of experts from a wide range of research institutions. The Task Force had an interdisciplinary composition. From the beginning, the expert group included not only researchers from the life sciences and medicine, but also economists and ethicists, for example. This took account of the fact that the pandemic was more than "just" a health crisis but affected all areas of life.

LESSONS FROM THE SWISS COVID-19 SCIENCE TASK FORCE

The pandemic has shown that research, as well as politics and administration, have to take a step towards each other and that the roles have to be clarified from the beginning. Researchers were immediately available to put their expertise at the service of society. As the measures continued in 2021 (mandatory masks, restrictions for the unvaccinated), the initial solidarity lost ground and more tensions between fractions of society and administration became evident. The opponents of the measures (in German: *Massnahmengegner*) took their protest to the streets.

In this heated atmosphere, representatives of the authorities as well as particularly exposed members of the Task Force were not only sharply criticized – they also received anonymous threats. Nevertheless, science overall enjoys a high level of trust and respect among the Swiss population. But it became clear that scientists need to invest in the dialogue with society. I fully agree with ETH Professor Tanja Stadler, who chaired the Task Force from August 2021 until its dissolution in March 2022, when she says that one of the major lessons from the pandemic was that some form of policy-interface is permanently needed in order to be able to act on an already existing relationship of trust in the next crisis.

THE 'THREE-PILLAR MODEL' OF DIALOGUE

Dialogue is a give-and-take interaction. As a university, we formulate both our needs and our science-based assessments vis-à-vis politics and society and, in return, take into account the specifications and expectations placed on ETH. Our drive is to contribute to a Switzerland and a world that prosper environmentally, socially and economically. I am convinced that research and science can bring about positive changes provided they serve society and not the other way around.

We refer to a "three-pillar model" covering the most important areas in which ETH actively seeks dialogue with its primary stakeholders. Inspired by Harvey Brooks (Brooks, 1964), we subsume under "Policy for Science" all efforts of the university towards politics to fulfil our core tasks under optimal framework conditions. The counterpart to this is "Science for Policy", which includes various forms of scientific policy advice that ETH researchers provide to political authorities and organizations. Here, research results and expertise flow into the political decision-making process. Finally, the third pillar comprises the science communication of the university and its members in order to maintain a dialogue with citizens. In practice, these three areas cannot always be sharply separated. We will discuss them in more detail below.

POLICY FOR SCIENCE

To understand the first pillar of the policy for science, it is helpful to know the legal and political context in which ETH Zurich operates. The Swiss higher education landscape consists of the two federal institutes of technology in Zurich (ETH Zurich) and Lausanne (EPFL), ten cantonal universities, and ten universities of applied sciences. ETH Zurich – like its sister institution in Lausanne – is thus subject to the overall supervision of the Swiss Confederation and is also mainly funded (ca. 70%) by federal institutions. The Federal Act on the Federal Institutes of Technology (ETH-Gesetz) of 1991 forms the legal framework in which the autonomy – so central to universities – is anchored.

The university represents its interests at different levels and with different instruments. While the campus development of the university is considerably influenced by municipal and cantonal legislation, the bulk of the framework conditions is defined and negotiated in Bern by the Federal government and the parliament. ETH Zurich's President, in close coordination with the entire ETH Domain, is in constant exchange with policymakers to assure that the ETH Domain has reliable funding, enough autonomy to set its own priorities in research and education, and finally remains connected with Europe and the world. This is done within the framework of the Dispatch on Education, Research and Innovation, which the Federal Council and Parliament adopt every four years.

This so-called ERI Dispatch determines the level of financial resources and sets the overarching strategic goals for the institutions involved. On a practical level, "Policy for Science" materializes in the form of visits by parliamentary delegations and political parties to ETH Zurich, as well as our participation in hearings in advance of the legislative process. However, policy-making does not end at the national border; it also has an international component. ETH Zurich is member of several higher education alliances and it also takes advantage of opportunities abroad to emphasize the importance of international cooperation and Switzerland's integration into the European Research Area.

SCIENCE FOR POLICY

Scientific policy advice in Switzerland is a field that takes place in a heterogeneous landscape and draws on a variety of mechanisms. Switzerland has a strong public administration with highly trained staff who already bring a great deal of expertise themselves. In addition, there are extra-parliamentary commissions, commissioned research by the federal government and federally owned research institutes, as well as formal and informal contacts

between researchers and politics and administration, to name just a few of the most common mechanisms (SWR, Schrift, 3/2022). In addition, the Swiss National Science Foundation can launch special programs to promote problem-oriented research. Finally, as shown in the Covid pandemic, the federal government also has the possibility to convene ad hoc scientific committees (Bericht des Bundesrats, 2022).

At ETH Zurich, scientific policy advice is seen as an important pillar of dialogue and knowledge transfer, for which the Vice President for Knowledge Transfer and Corporate Relations is responsible. She is supported in this work by her staff, who coordinate the science-for-policy activities of ETH Zurich and systematically develops them further.

FROM KNOWLEDGE TRANSFER TO KNOWLEDGE EXCHANGE

I am convinced that the linear model according to which basic research generates knowledge that then diffuses into application is not an appropriate blueprint for collaboration between science and policy in most cases. As a university, we need to ask ourselves what inputs are needed from us and what we need to do to ensure that we provide policymakers with the information they need. I believe that we should be guided by four basic principles here:

First, as a university, we should aspire to be "policy-relevant" but not "policy-prescriptive", as the Intergovernmental Panel on Climate Change (IPCC) puts it. While we must be aware that science can never be completely value-neutral, it is equally clear that science alone is never sufficient to justify a societal decision. Second, complex societal challenges require interdisciplinary knowledge that not only addresses technological and scientific aspects, but also includes societal costs, interests and value issues. Therefore, a good dialogue between research and policy also requires a dialogue within research across disciplinary boundaries as a basic prerequisite.

Third, good collaboration between science and policy requires a continuous dialogue at eye level. In other words, between experts from science and administration. If researchers know the values, time horizon and scope of action of policymakers, it is easier for them to provide the knowledge that is really helpful for a political decision. Thus, instead of a unidirectional knowledge transfer, the focus should always be on the mutual exchange of knowledge. And fourth, we must be aware that even the best science is never complete and incontrovertible. There always remains a residual uncertainty. While we in science can see this uncertainty as an incentive for further research, policymakers must make decisions in light of this uncertainty.

TESTING OUT NEW FORMATS

In line with the four principles mentioned above, we have launched various activities at ETH Zurich to strengthen and further develop Science for Policy activities. Many of these activities serve as test balloons for us. However, I would like to highlight two of these examples: In 2023, ETH Zurich is launching a pilot project for policy fellowships with the federal administration. In these short placements of five to ten working days, we will network executive employees from the administration with research groups that are of interest to them. We are supported by the federal administration in this pilot project. The focus of these placements is the mutual exchange of knowledge and the foundation for an ongoing dialogue. We are also strengthening so-called policy roundtables where we bring together our researchers and decision-makers from the administration so that they can exchange views on certain topics in a confidential setting. In a federal country like Switzerland, such formats must not only be conducted at the national level, but at all levels of government. After all, many of the decisions are also made at the local and cantonal levels.

COMMUNICATION AND OUTREACH

The third pillar of the dialogue concerns classical science communication, as universities and their exponents have been doing for a long time. On the one hand, this includes institutional public relations work, for example in the form of media relations or the organization of public events for the interested public, but on the other hand it also encompasses the various outreach activities of researchers themselves. As a publicly funded university, ETH Zurich is particularly required to engage in dialogue with the various stakeholders in society and to reflect its core activities with citizens of this country. In Switzerland, dialogue with society has a special significance insofar that voters at all levels of government – local, cantonal and federal – can repeatedly bring about direct decisions through their right of initiative or reverse decisions previously taken by the parliament in a referendum.

Over the years, the university has developed various dialogue formats for venues in Switzerland and abroad. To mention just a few of them here for illustrative purposes: Treffpunkt Science City is a series of events for the local community with sample lectures, tours of the campus and special programs for children and young people. With the bi-annual Scientifica, ETH Zurich and its neighbour, the University of Zurich, jointly open their doors and seek dialogue with citizens. Finally, due to their tradition and history, universities play a special role as places of intellectual and cultural exchange. As an internationally networked university, ETH also repeatedly set up stages abroad, as illustrated by the ETH Meets You series or this year's participation in the Design Week in Milan.

TRAINING FUTURE SCIENCE COMMUNICATORS

From our own experience, we scientists know how difficult it is at times to conduct technical discussions beyond our own disciplinary boundaries and to find a common language, for example between the engineering sciences and medicine. The challenge is even greater when scientists address a lay audience and try to explain their work in a comprehensible way. US economist and Nobel laureate Daniel Kahnemann summed it up nicely when he said: "No one ever made a decision because of a number. They need a story."

In today's media landscape, researchers are increasingly engaging in direct exchange with society, policymakers and the business world. How well they communicate their work shapes how people perceive science and universities. Though not every researcher is born a natural science communicator, communication is a skill that can be learnt. At ETH Zurich, we therefore developed an advanced training program in science communication for doctoral students, postdocs and professors. The courses of our Communication Academy (ETH Zurich, 2023) aim to empower our scientists to communicate their research in a compelling and comprehensible way to a non-scientific audience. We train them in storytelling, writing, social media, various presentation techniques, video production and in how to engage with policymakers and the media. With this continuing education program, we not only want to impart practical skills, but also promote self-reflection on one's own role as a scientist in society.

DIALOGUE IN TIMES OF CHATGPT AND FAKE NEWS

However, the negotiation process within society described at the beginning of this article is lagging behind the fast pace of technological change. This is exemplified by the discussions in recent months about the various forms of generative Artificial Intelligence (AI), which is propagating like a tsunami into the lives of millions of people. Meanwhile, governments, parliaments and supranational bodies are trying to find a way to establish rules for dealing with ChatGPT and other increasingly popular AI-based tools. (Fichter & Oertli, 2023)

AI applications per se are not new. The unfolding digital transformation without AI is not imaginable. AI is omnipresent in recommendation systems that suggest music, books or, if needed, the ideal partner to us. They assist our doctors in diagnosing diseases or disrupt industry and transport with their autonomous robots. The latest generation of language models, however, is now lifting AI to a new level by "entering into a dialogue" with us humans and generating smooth texts and polished images and videos that are indistinguishable from man-made artifacts.

At the same time, ChatGPT reveals glaring weaknesses and flaws. Texts, as smooth as they come across, happen to be incomplete, biased or simply wrong. When AI-based avatars tell us the weather forecast, this may seem harmless. But when the same technology is used for political propaganda (Paul, 2023), the question of transparency, credibility and ethical guidelines for AI applications becomes even more pressing.

WARNINGS AGAINST UNCONTROLLED DEVELOPMENT

While the public debate so far has been focused on concerns that AI could replace humans in their work, today the focus is shifting on the defining elements of humans and what sets them apart from machines. Since the latest form of AI has been able to create and manipulate human language, whether in words, via sounds or with images, it has hacked into the operating system of our civilization, wrote the historian Yuval Noah Hariri in an essay (Hariri, 2023). Language is the fabric from which almost all human culture is woven. Human rights, Hariri argues, were not written into our DNA; rather, we humans created them via storytelling and laws. Gods, he continues, are not physical realities, but were created via myths and religious scriptures, invented and developed by humans. If AI now takes on language in its various forms, nothing less than the core of human culture is at stake. Hariri belongs to the prominent group of intellectuals and tech entrepreneurs led by Elon Musk, who warned in an open letter published in March 2023 of – I quote – "great risks for society and humanity", calling on the leading AI labs to impose a six-month development freeze (Metz & Schmidt, 2023). These critical voices need to be addressed. Nevertheless, I have my doubts about the practicability of the requested development stop.

SOME CONCLUSIONS

ChatGPT and other forms of language models are likely to change the way we interact with society in the future. Among the many ideas that are on the table to regulate the use of AI, one seems of particular relevance to me: transparency. Just as the food industry or other areas must meet minimal standards of transparency in the sale of their products, it should be clear to us as consumers or citizens when we are dealing with AI and what kind of AI we are interacting with. Transparency also means that care must be taken at the development stage not to create opaque black boxes, but to commit to trustworthy, human-centric and inclusive AI (ETH AI Center, 2023).

It is my conviction that rules for AI should not be left to the tech companies that develop AI. We need legal frameworks at national levels that go hand

in hand with international guardrails. In this respect, it will be interesting to follow the further discussion in Europe, where the EU Parliament has adopted a common position for a risk-based regulation of AI (Zenner, 2023). Thus, a distinction is made between low-risk, limited-risk, too-risky and finally prohibited AI, such as real-time biometric facial recognition in public spaces. It will now be the task to work out a viable solution with the member states that effectively mitigates risks pertaining to AI applications without stifling innovation.

Last but not least, our education systems should familiarize people with the basics of AI from a young age on and promote critical thinking at all levels of education and professional training. Only an independently thinking person can develop a certain resilience against AI-based deception and manipulation attempts, which will undoubtedly still exist in the future despite all guardrails.

Amidst all the risks and potential calamities, we must not forget that there are also huge opportunities and possibilities that AI opens for society and humanity. How much repetitive and dangerous work can be delegated to the machine, what enormous potential lies in the use of AI in healthcare and medicine, and what creativity can be unleashed, and new degrees of freedom attained if AI is used sensibly in both our professional and private lives.

Having said this, I am fully aware that the growing gap between the furious technological race and the wearisome process of defining rules bears the risk that at some point we will no longer be able to tame the genie we have let out of the bottle.

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Chapter 6

Open Science as a Catalyst for Resilience in Society

Alessandro Curioni & Dario Gil

INTRODUCTION

The world is at a turning point. Technology is maturing fast, making our lives better, healthier, easier. But this progress comes at a great cost to the environment, energy, physical means, societal and economic impact. With the richest 1% owning 63% of global wealth (Christensen, 2023), and carbon emissions from opulent investments producing a million times more carbon than an average person (Maitlant, 2022), the scale and timing of solving global problems is quickly becoming more pressing and complex. Think about some of the challenges we face, such as the need for accelerated drug discovery, more efficient energy storage, feeding the world's growing population, mitigating climate change and developing more sustainable batteries, to name a few. They are a testament to the fact that the urgency of science has never been stronger than it is now. We know that the scientific method has been humanity's best model for discovering solutions to complex problems. However, while this method remains undoubtedly important, it is time to rethink how we approach it. The progress in AI, classical and quantum computing, and, even more, the capabilities that the convergence of these technologies offer, provide us with unique opportunities. We have the tools to radically change the process of discovery by streamlining and accelerating the traditional scientific method. However, we need more than

advanced technologies. Furthermore, we need to leverage the power of shared data, skills, expertise, interdisciplinary knowledge, large teams, understanding of demographics and global span, incorporating the needs from different economic structures and business models. We need the contribution from parties and communities across various disciplines, country boundaries, skills, perspectives and expertise. Under the high speed and wider-spread risk of today's problems' evolution and societal response, we also need innovations that are scalable, sustainable, responsible and inclusive. Aspects such as access, reproducibility, generalizability, agility and continuous relevance need to be addressed. Most importantly, as we must rely on science not only to produce critical breakthroughs but as a rigorous methodology for decision-making to shape the future of humanity, governance of knowledge, data and their usage need to be part of every solution. This ambition requires that communities have (epistemic) access to scientific method and the tools that support it and are involved in its development, use and proliferation.

We need **open science**.

> "With Open Innovation, we harness the power of **diversity, community,** and **co-creation** to achieve outcomes that no individual, team or even company could hope to achieve alone." – Dario Gil
> "Linux is an incredible platform for innovation. I think it's the greatest community for collaboration the world has ever seen. And Linux today is shaping the future of so many cutting-edge technologies: Cloud. Artificial Intelligence. IoT. Quantum Computing." – Arvind Krishna, IBM Chairman and Chief Executive Officer

Open science can help us navigate this complex environment. It can enable us to not only address complex problems, but also to foster resilience in society across all dimensions, enabling insight sharing and collaboration, and supporting sustainable innovation to improve our lives.

An initiative to make research, data, tools, communication and sharing of scientific advancements and dissemination more accessible to all is the key to accelerating progress and fostering a more collaborative, diverse, knowledgeable and inclusive scientific community. In this chapter, we are going to discuss the importance of open science in modern society – facilitating open access to publications, data, algorithms, knowledge and technology in an open, agile, sustainable and responsible way – with a call to action for researchers, governments, academia, businesses and all citizens to embrace **responsible open science** for the benefit of humanity.

OPEN SCIENCE: THE BEDROCK OF HUMAN PROGRESS

Science and the scientific method have been the driving forces for humanity's most significant achievements. Open science can help accelerate this progress by promoting a culture of transparency, collaboration and inclusivity. It can ensure that scientific discoveries are made in the most relevant areas and the benefits of discoveries are shared by all, increase public awareness of scientific progress, and help combat disinformation. The importance of open and fair access to research products and processes has become more prominent – so much so that in the US, the White House and other federal agencies (Science.gov, 2023) have declared 2023 the Year of Open Science. To bring the virtues of open science to fruition, we need to define how we want to collaborate and what ethical principles should guide research and innovation in this new framework. It is crucial that researchers, governments, businesses and citizens seize this opportunity and work together to create a brighter future for all. The time to act is now – let us embrace open science and unlock the full potential of human ingenuity. But science doesn't exist in a vacuum. Technological advancements have consistently enabled researchers to uncover new insights and push the boundaries of human knowledge. Today, artificial intelligence, quantum computing and cloud-based computing are transforming the scientific landscape and access to powerful tools and resources is being democratized. Embracing open science can help us leverage these innovations to accelerate scientific discovery on a global scale and maintain a global talent pipeline. Open science hinges on the free exchange of data and knowledge, and by fostering a collaborative environment, we can catalyse groundbreaking discoveries and drive scientific progress. In doing so, we must commit to upholding freedom of thought, autonomy, integrity and other ethical considerations, such as inclusivity and reflexivity, to ensure that open science promotes the responsible use of information and technology. We need to work together and address issues such as IP rights, quality control and ethical considerations, including fairness, equitable access and remuneration. It is important to establish a system that is inclusive, and which provides fair, empowering and sustainable rewards. Industry, academia and governments need to adjust their ways of working and communicating and create new policies and metrics to reflect these values. As the pace of scientific advancement accelerates, it is also crucial to develop new ways of evaluating research and assessing its societal implications. Open science can help establish appropriate guardrails to encourage positive societal outcomes, while mitigating the risks associated with potentially harmful or dystopian scenarios.

CHAMPIONING THE PURSUIT OF KNOWLEDGE

Open science calls for a re-examination of the distinction between **fundamental** and **applied** research. The pursuit of knowledge should be considered a basic human right, with governments allocating sufficient resources to supporting scientific research and businesses providing fair access to valuable data. By prioritizing both types of research, we can maximize the potential for scientific breakthroughs and societal benefits. Initiatives that encourage the pursuit of knowledge can be implemented across various societal systems. The education system – comprising public as well as private institutions – plays a pivotal role in leading learners to access and create knowledge. It is important to emphasize that this is not only about engaging with scientific disciplines such as chemistry, physics and engineering, but also about integrating knowledge from other fields such as ethics, philosophy and social sciences to foster a holistic perspective. And it is this holistic view that enables people to become responsible open science contributors, fully aware of how a particular innovation may impact their environment. A key to propelling innovation is citizen science – the involvement of non-professional scientists in research activities. Citizen science is becoming increasingly popular, enabling wider participation in the scientific process and the generation of valuable data and knowledge. By integrating citizen science in mainstream research, open science can help ensure that the benefits of scientific progress are shared more broadly, and that a diverse range of voices contribute to the advancement of human knowledge.

THE VIRTUES OF OPEN SCIENCE

Open science offers significant benefits that can be outlined in eight categories:

1. Acceleration
2. Accuracy
3. Creativity
4. Education
5. Harmonization
6. Inclusion
7. Financial relief
8. Social impact

The following paragraphs elucidate how exactly open science creates value in each of the above-mentioned dimensions.

- Acceleration

Open science accelerates research by connecting people from various organizations and backgrounds who can work together to jointly explore new scientific possibilities. Openly shared findings and experimentation results speed up the process of discovery as already conducted analyses can inform others about any future attempts. Consequently, testing time is reduced and products such as new medicines and vaccines can be discovered more efficiently (see Lee, 2015; OECD, 2020). Faster development enables earlier market entry, so customers can be served sooner, improving prevention and early-stage intervention measures.

- Accuracy

Wider and faster testing and feedback are a natural result of the open science process. When more people with diverse skillsets share insights into scientific discoveries, there are more materials that inspire further research on a topic. In general, access to larger amounts of data and more extensive documentation (Allen & Mehler, 2019, p.7) can improve reliability. Moreover, there is a larger pool of peers that can give feedback and make important suggestions that could increase the likelihood of successful research outcomes.

- Creativity

Creativity will flourish in an open science community, with diverse perspectives and an open mindset sparking new ideas that change the way a challenge is approached. Various opportunities to exchange insights with a global community allow for a multilogue in which the collective wisdom of innovators and inventors can shine a light on new paths of discovery.

- Education

Larger amounts of data generated through open science can be used as the basis for new educational materials (Allen & Mehler, 2019, p.7). Students have additional opportunities for engagement and can actively participate in open science. They can leverage code to design experiments and projects, share their research and benefit from global community support. In addition, participation in open science projects itself is a process of education and learning for the participants.

- Harmonization

An open science environment necessitates common global standards for various steps and dimension of the research process. Tools, testing and validation methods need to be harmonized to ensure consistency across otherwise

independent systems. Once common standards are defined, researchers can collaborate more efficiently thanks to seamless transferability of scientific resources.

- Inclusion

Scientific processes tend to be exclusionary as they focus on top universities and research organizations, often of a similar type as similar equipment and access to infrastructure enable collaboration across institutions. Open science can lead to a much wider range of institutions and communities by providing them access to data, algorithms and infrastructure. This benefits scientific discoveries as it increases diversity of perspectives, but also significantly widens the solution space. Knowledge that is not available in traditional or established forms can be leveraged and can contribute to new discoveries and solutions. Importantly, with open science following the principle of fairness, these processes can be established in non-exploitative ways.

- Financial relief

Open science can bring financial relief in numerous ways. First, it can remove financial barriers to funding by making research publicly accessible (see Allen & Mehler, 2019, p.8). Hence, smaller organizations with modest resources can also leverage scientific insights. Second, code can be reused outside the original project, resulting in cost savings. Similarly, personnel costs can be reduced with human skills creating value in multiple organizations. All of this opens up new opportunities, lowers financial risk and increases business model flexibility.

- Societal impact

An open science approach can have a positive societal impact as it encourages active participation of diverse social groups and furthers the democratization of science. In the case of citizen science, in principle, anyone who has access to the necessary means and who wishes to contribute to the scientific community can do so. This also presents an excellent opportunity, e.g., for retirees to keep using their skills in service of significant common goals such as the development of more sustainable products. Open science also inspires a culture of sharing and giving back, and it emphasizes inclusivity and collaboration. Overall, a greater sense of purpose derived from making meaningful contributions to the community can also boost resilience and make everyone stronger (see e.g. Schaefer *et al.*, 2013).

CHALLENGES IN OPEN SCIENCE

While open science presents many opportunities, there are also potential drawbacks linked to this approach. Sharing research data openly can put intellectual property (IP) rights protection at risk, especially when there are no clearly defined use terms. If IP rights are not attributable to a specific contributor, quality and liability issues are also difficult to resolve. For this reason, common ethical principles need to guide every participant's action to ensure good conduct throughout the system. Financially, there might be compromised revenues due to unrealized IP premiums such as those resulting from patents. It can generally be challenging to discern what an adequate balance between investment and return looks like in an open science context. An important question related to this issue is what constitutes equitable remuneration in such an environment where there are contributors with varying degrees of impact. This also requires clearer specification of conditions for participation. Open science relies on the principle of open and fair contribution of and by *all* participants. Clear principles must be established that avoid free-rider situations. Additionally, with a diverse set of institutions of varying degrees of economic endowment and socio-political influence, mechanisms need to be established that work to avoid imbalanced power dynamics and risks of exploitative behavior. Finally, there is currently no widely established reward system (Allen & Mehler, 2019, pp.5ff.) that encourages participation in open science. Existing reward systems would need to be extended to include awards for open science contributions. All the issues mentioned above need to be considered and addressed in a transparent, democratic and easy-to-adopt manner. They should support the enablement and empowerment of open science so all can embrace it in a fair and rewarding way.

TRENDS IN AI AND THE NEED FOR A NEW APPROACH

One of the key enablers of open science is the field of artificial intelligence (AI) (Turing, 1950; Wang, 2019). AI is currently driven by two main trends: self-supervised learning and generative foundation models. These two innovation streams facilitate access to large data models, leading to faster, more effective solutions and reduced costs. Moreover, they open up new business opportunities and enable the development of novel solutions (Yee *et al.*, 2023). Potential areas of application include, for example, accelerated drug discovery and climate scenario modeling. The purposeful use of AI tools can provide faster access to new medications, saving and improving lives. In climate science, AI models allow more accurate predictions of potential

risk factors and give insight into appropriate measures for mitigation and prevention. While AI self-supervised learning and generative foundation models offer significant advantages, there are also risks associated with these innovations. If self-supervised AI models retrieve data from sources they are not authorized to use, IP and **personal data rights** might be infringed. Not only does this disregard the rights of third parties, but it also means that an AI model could be trained with data that is not reviewed based on criteria such as legal compliance, ethical principles and scientific relevance. This implies legal and reputational costs, as well as social risks resulting from inappropriate and unauthorized data provenance and data use. Beyond data protection breaching and the associated risks, a new major concern is that the **value chain** is now shifted from the data to the models, and, in particular, to foundation models. Decision-making is based on large foundation models developed with the help of huge data collections and aimed at addressing the needs of individuals and businesses at large. AI is currently aggregating and conveying knowledge and, in an invisible, unconscious and uncontrolled way, is slowly taking over the creation and management of knowledge. Considering the risks and lack of governance in the creation and usage of foundation models, the data they are trained on, and the metrics used to train them, raises major concerns related to the quality, trustworthiness and impact of knowledge in our society. Organizations need to carefully consider the principles and values for an AI approach before deciding whether it is responsible. This is especially important when an application could be used to retrieve or process sensitive data or is being used in high-stakes contexts such as the medical field. On the one hand, some organizations may opt for closed AI, tightly managing their AI tools internally without granting access to any third parties. This approach may ensure that AI is applied in ways that align with company values and ethical guidelines. Furthermore, it allows for more effective intervention if algorithmic biases or technical errors are detected, but suffer from a complete lack of transparency when offered as-a-service and potential users are asked to fully trust the service provider regarding data provenance, IP ownership and possible biases. On the other hand, there are organizations that favour fully accessible AI that is freely available without any restrictions. While some would argue that this approach leads to more reliable results and faster solutions due to a large number of contributors training the model, the quality of such AI models might be compromised. Uncontrolled model training could generate data that are neither compliant nor ethical, causing potentially harmful outcomes such as manipulation, fraud or social biases (see e.g. Ryan-Mosley, 2023). An important question we need to ask is how we can reap the benefits of AI while minimizing negative consequences. The solution we propose is about finding a healthy middle ground between restricted, guarded models (closed AI) and fully accessible AI. In pursuit of guarding

rights of privacy and data ownership but also for assessing and safeguarding the way the effects of AI-based decision-making can affect citizens in their everyday life, governments and governmental institutions, like the European Union, have taken the initiative to protect their citizens through laws and regulations such as Article 28 of the EU Artificial Intelligence Act (European Commission, 2021).

Principles and governance are essential to the responsible use of AI. First, organizations providing AI have to define clear principles for data provenance, model training and testing, as well as ways to mitigate unintended uses. Second, organizations using AI should be clear about their own principles and mitigation strategies. Third, governments need to define what constitutes responsible AI and what regulatory measures should be taken to prohibit and mitigate against harmful applications. There are three major approaches on how emerging AI technologies are developed and offered: closed AI, controlled by few commercial organizations, fully accessible and open AI, enabled by self-governing organizations and governed open AI, which can be provided by both academia or private organizations for the purpose of fundamental research and beyond. All of them have the power to create and manage knowledge. They are the driving forces of progress and have a profound impact on the development of AI tools. Organizations promoting fully accessible AI can contribute to more equity by allowing broad participation in AI development and removing some access barriers to technological resources. Closed AI organizations are particularly well positioned to further responsibility goals by restricting access and use rights to authorized parties that meet specified criteria according to an organization's ethical principles. Fully accessible and closed AI organizations seem to pull in different directions, but what they have in common is the quest for viability. They aim to create solutions that are valuable and profitable. The third kind, governed open AI, can function as middle ground. For example, institutions and likeminded organizations can act as moderators and can diplomatically try to balance these two other approaches to AI while also advancing the technology. Thus, to make AI available for research users in academic as well as private settings in the true spirit of open science, this middle ground approach of governed open AI needs to be institutionalized.

THE POWER BACK TO ACADEMIA

Universities have historically been the engines to create, curate and disseminate knowledge (De-Graft Johnson Dei *et al.*, 2020). For this reason, working collaboratively, we strongly believe that academic institutions have the expertise, network and the ability to create a consortium governed by universities and like-minded organizations that believe the future and the

value creation of AI have to be principled, open and transparent. With the foundations and the power to create and manage knowledge, society's trust and willingness for public collaboration, academia can be the third power to drive, through a consortium-based collaboration, the compliance in mindset, technology, data and skills to enable fully accessible AI and to empower open science. Academic institutions are in a unique position as they are involved in education, knowledge creation and governance. Thus, they have multiple levers to influence knowledge, the use of technologies such as AI and open science in general. An open science culture may include technical literacy and leadership courses, capstone projects, collaboration-promoting metrics, providing resources and technology access, as well as support for and collaboration with start-ups, industry and other institutions. University education can emphasize open science-to-business programs that bridge the gap between theory and practice by showing how open-science resources can be turned into business opportunities. As educators, they can design curricula that foster a holistic understanding of technological advances and raise awareness of the importance of ethical principles. In knowledge creation, they can deliberately choose research topics and methods which promote responsible and sustainable AI. Finally, academia has the power to impact AI governance through active participation in forums defining AI standards. As a moderator and key power, academia can engage in a dynamic multilogue with various stakeholders and ensure that new insights are integrated into education, research and regulation.

IBM'S CONTRIBUTION TO OPEN SCIENCE

At IBM, we contribute to open science in multiple ways. Integrity guides us in all our endeavours, and, in particular, in how we approach open science. We aim to set an example, showing that responsible open science can create value in and for society and positively impact business performance. Open-access publications in scientific journals give insight into experiments and discoveries that are of relevance for the scientific community, as well as businesses and the general public. The IBM Open Innovation Community (OIC) actively encourages employees to engage in open science projects. Moreover, we are involved in open-source science communities as well as open-source code development on GitHub, and the establishment of globally accepted metrics for research quality control. Beyond that, partnerships with other organizations from academia as well as civil society can provide opportunities to offer open science experiential learning courses, such as, for example, Qiskit, the quantum information science software toolkit.

SUMMARY

Our world is changing at lightning speed – and is facing complex problems that demand us to act now. The complexity and scale of the global challenges that we face today and will face tomorrow require solutions that are holistic, agile, generalizable and reproducible. We need to accelerate the rate of discovery of solutions to the world's most pressing problems. We need to tap into the strengths and the power of the scientific method which has helped us solve complex problems throughout history, bringing forward innovation and progress. However, as the challenges become more complex and the problems more pressing, we need to collaborate and share in new ways; we need to further tap into the power of open science. Open science brings unique opportunities to all. By embracing open science, we can foster a more collaborative, inclusive and innovative scientific community, better equipped to tackle global challenges of the 21st century. By sharing data, knowledge and resources, AI models' progress has been sped up and democratized. But, as AI becomes open and aligns with open science and foundation models provide answers to more and more complex questions and challenges, there is an increased risk associated with how they are created and how we use them. Let us foster collaboration, contribute to common goals and commit to shared values. Let us all, researchers, academics, governments, businesses and citizens, **embrace open science for the benefit of humanity.**

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Chapter 7

Resilience Put to the Test – Solidarity and Sustainable Collaboration with Universities in Ukraine

Ivanka Popović

The ultimate test of the resilience of a society is war. Russia invaded Ukraine more than a year ago and the tolls of the war so far have been very high. The higher education sector in Ukraine has been seriously affected, with many universities damaged or completely destroyed, leading to the displacement of numerous students and staff. About 20% of the academic and research staff have been forced to take refuge in other countries. Despite the setbacks, higher education institutions have continued offering their services mostly on-line and also in blended form.

Before the war the Ukrainian higher education sector was facing the challenges of an incomplete transition from its previous legacy, despite introducing relevant reforms. Upon the invasion, the European academic community responded immediately with various forms of solidarity and institutional collaborations with Ukrainian universities.

The paper will present an assessment of the higher education sector in Ukraine before the war, its operation since the invasion and a vision of the role of higher education in the post-war reconstruction of Ukraine.

INTRODUCTION

The Ukrainian education system is based on the Soviet model as was the case in other post-Soviet countries. The country has implemented numerous reforms since the collapse of the USSR, including the introduction of private education. Ukraine adopted the European Bologna reforms in 2005. The standard university degree under the old Soviet system was a long, single-cycle degree, the Bologna two-cycle structure has now been implemented across the board, except in professional disciplines such as medicine and veterinary medicine. Ukraine has a centralized education system overseen by the Ministry of Education and Science (MOES). The National Agency for Quality Assurance in Higher Education (NAQAHE), an associate member of ENQA, is the designated regulatory authority in tertiary education. Originally established by law in 2014, the NAQAHE is a new organization that did not start to fully operate until 2019. It is responsible for the accreditation of universities and academic programs, the approval of dissertation committees, and other matters related to academic quality. At the moment, institutions are still accredited by the State Accreditation Commission of the MOES to award state-recognized degrees and diplomas. Most academic institutions in Ukraine are public. (Trines, 2019)

HIGHER EDUCATION IN UKRAINE PRIOR TO THE INVASION

Before the war Ukraine invested 5-6% of its GDP on education – one of the highest rates of public spending on education in the world. (WB Data, 2023)

Year	2013	2014	2015	2016	2017	2018	2019	2020
% GDP	6.41	5.87	5.74	5.01	5.42	5.32	5.44	5.38

Table 1 – Percent of investment in education in Ukraine (WB Data, 2023)

At the beginning of the 2021/2022 academic year, there were more than 1,046,000 students in higher education, according to the State Statistics Service of Ukraine. Enrolments in tertiary education in Ukraine were high: in 2020, 57.1% of 30-34-year-old Ukrainians (49.7% of men and 64.8% of women) had completed a tertiary level of education, compared to 41.0% in the EU (46.1% among women and 36.0% among men). Many students pursued a masters' degree in Ukraine – in 2018, 74% of bachelor's degree graduates entered master's programs. In spite of high enrolments in tertiary education, the absolute number of tertiary students has decreased steadily over the last years. The student population in universities declined by 45%

between 2010 and 2021, from over 2,417,000 students in 2010 to 1,328,000 in 2021, according to government data. This was largely due to the declining population, as well as to the brain drain of students. The number of students from Ukraine going abroad for tertiary education increased by 176% between 2009 and 2016, ultimately reaching nearly 70,000 students. (Trines, 2019)

The country's academic institutions were considered to be inflexible and out of touch with labour market demands and societal needs. Despite its long tradition, the reputation of the Ukrainian education system suffered from increased quality problems. In response to such problems, Ukrainian authorities adopted a series of reforms to increase transparency, accountability and integrity, including a new law on higher education in July 2014 that sought to increase the autonomy of universities. However, its implementation was slow. Several problems hindered Ukraine's education sector. They included academic corruption, population loss, the lack of university autonomy, dated facilities and, after the annexation of Crimea, armed conflict. Ukraine's education system was among the sectors most affected by corruption and it was believed to be most rampant and quickly spreading in tertiary education, particularly in the competitive medical universities. The education system in Ukraine was affected by the rapid population decline that led to the closure of hundreds of higher education institutions. The total number declined from more than 1,000 in 1996 to 661 in the 2017/18 academic year, according to government data. (Trines, 2019) Overall, the international competitiveness of Ukraine's education system declined. While the country ranked 25th in the 2012 ranking of national higher education systems by Universitas 21, it dropped to position 38 in the same ranking in 2019 (Universitas 21, 2020).

Poland has for quite some time been an attractive destination for Ukrainian students because it provides an opportunity to pursue high-quality education, often at lower costs of study and living, and provides employment opportunities after graduation. Due to a similar demographic decline, many Polish universities successfully recruited in Ukraine because they offered a qualification in an EU member state, widening potential employment opportunities within the larger EU. It was highly common for Ukrainian international students to not return home after graduation – a trend that worsened Ukraine's brain drain.

Ukraine had a considerable number of foreign students. According to the Ukrainian State Center for International Education, there were 75,605 students from 154 countries studying in Ukraine in 2018, 41% more than in 2011. The students originated mostly from Asia and Africa, particularly among medical students, with India being the largest sending country. (Trines, 2019)

STATE OF RESEARCH IN UKRAINE (OECD, 2022)

For several years prior to the Russian invasion of Ukraine, science and research in Ukraine had been in transition, with significant structural changes taking place in the face of strong budgetary pressure. Domestic expenditure on research and development as a percentage of the GDP decreased by about one-third between 2013 and 2018 to the value of 0.47%, as opposed to the 2.49% average of OECD countries in the same year. The number of researchers shrank from over 52,000 full time equivalents in 2013, to 41,000 in 2018. This evolution was marked by a steep decrease in researchers in business and government institutions that was only partly offset by an increase of those in higher education institutions.

This reorientation towards higher education, together with an increase in international collaborations, led to an impressive rise in both the number and quality of scientific publications, from only 2% among the global top 10% most cited in their fields in 2006 to 6% in 2020. Despite strong budgetary pressures and a decrease in the total number of researchers, the structural changes in the Ukrainian science system prior to the war had contributed to an increase in its scientific publication output and an improvement in average quality by international standards. Ukrainian scientific output has showed above average specialization and expertise in areas such as computer science and energy. Although less specialized, Ukrainian scientific output also excels in the areas of earth and planetary sciences and environmental science, while engineering is the largest field in terms of total output. All these domains are closely linked to Ukrainian industry and are crucial to economic development. A significant proportion of Ukraine's scientific publication outputs have been the result of international collaborations and partnerships. Since 2013-14, Ukraine has managed to stop the progressive decline in international collaboration seen in previous years, which is likely to have played an important role in raising the overall competitiveness of its science. There has been a strategic focus on building international partnerships, as well as shifts in collaboration patterns. Russia-based scientists used to be the most frequent partners for Ukraine-based authors, while Polish-based scientists have emerged more recently as the preferred partners. Within the Danube Region, the preferred scientific partner has been Germany and to a lesser extent Czechia and Austria. (Popović, 2022)

Ukraine's association to the Horizon Europe and Euratom Research and Training programs, which provides access to these programs on equal terms with entities from the EU Member States, including in terms of access to EU funding, is proving to be a key instrument of support. The government of Ukraine does not have to contribute financially to the programs and all calls encourage the applicants to create opportunities for Ukrainian entities

and researchers. As a result, despite the ongoing war, Ukraine participates in the programs on par with the best years under Ukraine's association to the preceding EU R&I program – Horizon 2020. (ERAC, 2023)

HIGHER EDUCATION IN UKRAINE SINCE THE INVASION (GU-MOES-WB, 2022)

The full-scale Russian invasion on 24 February 2022 disrupted the organization of teaching and learning for the higher education sector, putting in jeopardy the studies and professional lives of students and teachers. However, the Ukrainian higher education sector built on its experience developed during the Covid-19 pandemic and demonstrated resilience by ensuring the continuity of the education process. Since the beginning of the war, higher education institutions have played a larger role in the community and in local administration. Many tertiary institutions have part of their premises used for purposes other than education and some have reported that almost all their infrastructure has been mobilized. These institutions now provide a variety of services to the community, including shelters for internally displaced persons, centres of collecting and sorting humanitarian aid or as shelters during air raid alerts.

Virtually all higher education institutions have relied to some extent on on-line education since the beginning of the war. On-line learning has been less effective than in-person classes. According to the survey of Ukrainian higher education institutions presented in the document *Ukraine Higher Education Needs Assessment*, the biggest barriers to the continuation of education for students are the lack of internet connection (79% of responding institutions), deteriorated security situation (46%) and the lack of technological devices for on-line learning (39%). A significant number of tertiary institutions reported that students are unable to continue studying due to the need to earn a living (28%). Some institutions also pointed to the overburden of care work and household duties as a main reason for students not to return to learning (8%). When specifically asked why some students had to terminate their studies, over 100 institutions identified the deterioration of psychological well-being as an important factor. Higher education institutions also indicated the impossibility to participate in on-line learning from the temporarily occupied territories and relocation abroad as reasons for stopping attendance at classes.

The survey showed that education staff also face significant barriers to teaching, the most important factor being the security situation in the region (60%). However, issues related to the general digitalization of the institution were also recurrent: half of the surveyed institutions indicated that a barrier

to the organization of classes was the absence of a stable and/or high-speed internet connection. Moreover, 33% reported that their staff lacked electronic devices and, critically, 17% of institutions reported that staff did not have the necessary digital skills to conduct teaching on-line. When specifically asked about the digital infrastructure supporting on-line learning, many institutions reported that they lacked key elements to provide quality remote education. While only a few higher education institutions reported not having full access/licences for online communication platforms, such as Zoom or Teams, 40% indicated that they did not use a learning management system. These findings show that universities sometimes lacked the tools to provide not only quality material and content, but also on-line classes to their students. Tertiary institutions also reported a wide range of challenges in continuing their scientific and administrative activities. The issues mentioned were: the lack of access to on-line libraries and scientific databases as well as administrative or technical barriers to financial operations, access and independent management of research grants, and difficulties of connecting to the State Treasury.

The overall impression is that the circumstances of higher education institutions in Ukraine currently vary significantly depending on their geographic location and local conditions prior to the invasion. V. P. Antoniuk has provided a detailed review of the state of higher education in Ukraine during the period of conflict. (Antoniuk, 2023)

SOLIDARITY AND INTERNATIONAL ACADEMIC COOPERATION WITH UKRAINIAN HIGHER EDUCATION INSTITUTIONS

Upon the invasion, the European academic community responded immediately with various forms of solidarity and institutional collaborations with Ukrainian higher education institutions. Universities from neighbouring countries have been especially engaged in the relief efforts. Beside humanitarian aid, placement offers for students and staff have been among the first actions undertaken by many foreign universities. National authorities have increased the number of scholarships for Ukraine. Some illustrative examples are provided below.

Under the Erasmus+ program, Ukraine became eligible for mobility and collaboration programs for Erasmus+ program countries, including staff and student mobilities (KA103). The MSCA4Ukraine scheme (MSCA, 2023), funded under the European Union's Marie Skłodowska-Curie Actions, has provided funding for 124 fellowships for researchers and doctoral candidates from Ukraine, for stays of 6-24 months in Horizon Europe countries, while maintaining their connections to academic communities in their home country.

A EUA survey of national rectors' conferences across Europe (EUA, 2022) confirmed the enhancement of existing inter-university partnerships and the development of new partnerships. The Polish National Academy's "Solidarity with Ukraine" program (NAWA, 2022) awarded **the 18 Polish universities** participating in European university alliances €3.4 million **for activities with Ukrainian partners in 2023.** 4EU+, one of the European university alliances, established the Eastern Partnership University Cluster, as a platform for cooperation with four Ukrainian universities, one Moldovan and one Georgian university (EAPUC, 2023). The UK-Ukraine Twinning Initiative, coordinated by Cormack Consultancy Group and the President's Fund of Ukraine for Education, Science and Sports with the support of Universities UK International has, so far, led to 33 partnerships. (UK-UA, 2022)

The International Science Council and the European Federation of Academies of Sciences and Humanities held two conferences in 2022 and 2023 on the war in Ukraine and how it had impacted the higher education sector. (ALLEA/ISC, 2023)

The Rectors' Conference of French-speaking Universities in Belgium (CREF) and the CIVIS alliance called on academic publishers to provide immediate assistance to Ukrainian universities and enable access to scientific publications (CIVIS, 2023).

The European University Association has been monitoring the situation continuously and has developed *Recommendations Supporting the Ukrainian Higher Education University Sector*. (EUA, 2023) The Recommendations reflect the voice of academic communities and are directed toward universities, networks, international academic and research organizations, and governments. They focus on the following issues:

- The support of Ukrainian universities through inter-institutional partnerships,
- The development of virtual exchange and cooperation, including digital infrastructure,
- Placements for Ukrainian academics and students abroad, and
- The consideration of the higher education and research sector in immediate reconstruction measures and long-term rebuilding plans.

RECONSTRUCTION OF THE UKRAINIAN HIGHER EDUCATION SECTOR

Higher education and research are indispensable for any country's development. Medium to long-term reconstruction plans should be seen as an investment in Ukraine's capacity building, to strengthen the country's resilience and further economic and social development. (EUA, 2023)

As demonstrated by the UA-MOES-WB survey results, the Ukrainian higher education system is currently under intense pressure. The combination of destruction, student displacement, limited access to quality on-line education, psychological stress and trauma, as well as the limited financial capacity of higher education institutions could significantly impact Ukraine's human capital. Learning outcomes are expected to worsen, on top of the learning losses already accumulated because of Covid-19-related closures. War and displacement are severely affecting young people's socio-emotional skills as well as their ability to focus on their studies.

While the extent of a drop in student enrolments over the next few years is currently difficult to estimate, it could seriously undermine the labour market transition. A deterioration in education quality and a reduction in the number of university graduates would have a significant impact on Ukraine's reconstruction. Ukraine will heavily depend on a skilled workforce to rebuild, but also to modernize its economy, and will face the challenge of re-pooling human capital to ensure sufficient numbers of specialists in critical sectors such as construction, infrastructure rehabilitation, the social sector, agriculture and forestry, the energy sector, the mechanical industry, security and law enforcement, finance, environmental restoration, and the mining industry. Tertiary education is critical to most if not all of these key sectors. In order to act as a catalyst for a sustainable and inclusive post-war recovery, the tertiary education sector needs to be a priority for investment already during the war. (UA-MOES-WB, 2022)

The OECD *Brief on Rights and Support for Ukrainian Refugees in Receiving Countries* highlights a need for innovative "dual intent" solutions that ensure the skills of displaced Ukrainians are not left idle and continue to be built, while at the same time not hampering a possible return to Ukraine once the war is over. However, there is a long history of academics and scientists leaving their home countries during times of conflict or political crisis and then finding it very difficult to return or contribute effectively as diaspora once the crisis is over. In an ultra-competitive international science system, many of the best Ukrainian scientists or students may be tempted to stay in their new homes rather than return to institutions that have been subject to the ravages of war. At the individual level, this would be a very legitimate and understandable choice. But what can be done now to ensure that such individual choices do not severely cripple the longer-term future of Ukrainian science?

It is unlikely that the strong historical links between Russian and Ukrainian science can survive the devastation of war. Whilst collaborations between individual scientists can be very resilient, it will take a long time for trust between research institutions in these countries to be re-established. Poland on the other hand, which was already emerging as a preferred partner of choice for Ukrainian scientists, has been a particularly welcoming neighbour.

Many refugee scientists and students have already been accepted into Polish research institutions. There is an opportunity to strengthen scientific partnerships between these two countries, with immediate benefits for Poland and longer-term possibilities for Ukraine. However, Poland will require support and solidarity from other countries and the European Union if it is to effectively perform this temporary hosting role. This includes support for those who choose to return to Ukraine to be able to do so and for new sustainable, long-term partnerships between research institutions to be maintained once the war is over. There is growing evidence that mobile scientists can play a brokering role across non-migrant colleagues and global networks. The long-term policy aim should be to support genuine brain circulation and mutually beneficial partnerships between countries rather than pursuing brain gains at the expense of each other. Digital tools and virtual open access to scientific data and publications, particularly if combined with international networks, can provide a basis for much research to continue even when research institutions are closed, or scientists are also contributing to the war effort. This, in turn, can provide a platform for re-launching Ukrainian science, which is an essential first step both for building back a better innovation ecosystem in Ukraine and for developing and implementing evidence-based policies as part of the broader recovery effort once the war is over. The Ukrainian scientific diaspora should be considered as a strategic asset both for their country of origin and their country of destination. With appropriate support, they can play an important role in brokering or building partnerships (OECD, 2022)

The total reconstruction costs for Ukraine are estimated to add up to $500 billion. Rebuilding work completed so far has been paid for out of Ukraine's cash reserves, and from an initial €600 million payment from the European Investment Bank (second package of €1.59 billion in July, 2022). (Mamo, 2023) The Education and Science Working Group of Ukraine's National Council for the "Recovery from the Consequences of the War" is developing a Ukraine Recovery Plan (first draft produced in July, 2022). For higher education, beside the necessary reconstruction of infrastructure, it emphasizes reforms to reorganize the sector, in order to enhance quality, transparency, inclusion and efficiency, as well global connectivity and European integration. At the request of the Ukrainian Ministry of Education, and the higher education sector, with the support of the World Bank, EUA's Institutional Evaluation Program is to perform a coordinated evaluation of the Ukrainian higher education system, based on audits of individual institutions (IEP EUA, 2023). Due to war, this has been put on hold.

Therefore, higher education and research must be central to Ukraine's reconstruction. Some measures will need to wait until the war ends. Others can and must take place now, to ensure the survival and sustainability of the Ukrainian higher education and research system. (EUA, 2023)

CONCLUDING REMARKS

In May 2022, the European Commission presented initial plans for support to Ukraine, which included the longer-term rebuilding. On 25 October 2022, the European Commission and Germany, as the chair of the G7, co-hosted the *International Expert Conference on the Recovery, Reconstruction and Modernization of Ukraine* in Berlin. (EC, 2022) In December 2022, the World Bank announced a *Ukraine Relief, Recovery, Reconstruction and Reform Trust Fund (URTF)*. (WB, 2022) A *Multi-agency Donor Coordination Platform* to support Ukraine's repair, recovery and reconstruction process was launched on 26 January 2023, bringing together officials from Ukraine, the EU and the G7. (EC, 2023)

It seems that an initiative of the equivalent to the Marshall Plan would be optimal for the post-war reconstruction of Ukraine. The undertaking will be a complex one with many urgent issues. In its section devoted to higher education, the Ukraine Recovery Plan emphasizes the need to reform and reorganize the sector.

The Ukrainian Ministry of Education and Science, in collaboration with the European Commission, could establish a platform for higher education reform to:

- conduct consultations and establish working groups on major reform issues, involving Ukrainian and international experts;
- develop collaboration initiatives involving the Ukrainian higher education sector and stakeholders and European and international partners;
- conduct stocktaking, monitoring and evaluation of results, and enable follow-up. (EUA, 2023)

Reconstruction will need a holistic approach, in consideration of Ukraine's needs and reform goals. The international, foremost European, academic community already does and will continue to play a very important role in supporting the achievement of these goals.

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Chapter 8

Building an Impact Ecosystem: Breaking Down Barriers to Effecting Large Scale Societal Problems

Ana Mari Cauce

Universities are amongst the oldest and most essential institutions in modern society, playing a crucial role in education, skill building, knowledge production and innovation, as well as regional, national and global economic development. Although this varies by institution, many also play a role in service delivery, especially in terms of healthcare, with many of the largest hospitals in the US attached to or affiliated with major research universities. Uniquely situated at this intersection of knowledge development, innovation and service delivery, universities were especially well positioned to play a vital role in helping our society confront the Covid-19 pandemic. Rapid discovery, development and deployment of tests, vaccines and treatments made it possible to mount a resilient response that undoubtedly saved millions of lives and allowed us to minimize economic and societal destabilization.

It doesn't take a crystal ball to predict this will not be the last or greatest challenge we will confront in the long, or even near-term, future. These challenges include new pandemics, financial crises, threats to democracy and a rapidly aging population, combined with dropping fertility rates in developed countries. They also include behavioural health challenges that are exacerbated by social isolation, substance abuse and systemic inequities, as well as climate change, with the increase in natural disasters, political

destabilization and mass migrations that accompany it. As I write this paper in early August of 2023, we have just come to the end of the hottest month ever recorded on our planet, and the UN Secretary General has dubbed this as the "era of global boiling." (Niranjan, 2023, 27 July). Research universities will be key to ensuring that we can prevent, mitigate, survive or overcome such challenges. But this will require us to work intentionally and expeditiously to make significant cultural and structural changes within both to ensure our own resiliency and that of the communities we serve.

While we are rightly chagrined by harsh criticisms of our institutions as out of touch, with change occurring at a glacial pace, universities are, in truth, complex organizations with many layers of bureaucracy than can make it difficult to make decisions quickly. In addition, too often our desire for top rankings and quest for prestige can lead us to privilege those already privileged and prioritize competition for "top" students and faculty over collaboration and service to society. Limited economic, racial, ethnic and, in some fields, gender diversity, amongst our students and especially our faculty, can also limit the range of perspectives and experiences that inform our work and its translation into all of our communities. And especially during times of economic hardship, the need for adequate resources to carry out our educational and research missions, and to compensate faculty and staff, can require universities to turn inwards, focusing on their own survival needs. As such, for universities to best serve the interests of society, so necessary at this time of rapid change and crisis, we will need to re-evaluate and re-imagine how we organize ourselves internally, how to more authentically interact with the communities we serve, and how to attract the resources needed to do both in an integrated fashion. In this chapter we use the work we are carrying out at the University of Washington as a case study in-the-making for how to make progress towards these goals, with the caveat that we are still in the early stages. Our hope is that this volume, along with the fruitful and provocative conversations we engaged in during our meetings, will provoke in other academic centres a conversation on how we can work together to realign both how we structure our universities, and the reward systems for both our faculty and our institutions that often result in perverse incentives that work counter to our lofty rhetoric and stated goals.

RE-STRUCTURING RESEARCH UNIVERSITIES TO SUPPORT SOCIETAL RESILIENCE

As a large public research university with global reach, the University of Washington (UW) is emblematic of both the opportunities and the obstacles that major research universities face in catalysing large-scale impact on the grand challenges that demand complex, multidisciplinary, multi-sector

solutions. We have deep expertise across a vast range of disciplines including environmental, social and physical sciences, engineering, computer and information science, the full range of health sciences, business, public policy and law, as well as strong programs in the arts and humanities, including on-campus museums and arts and performance venues that serve the public. We have a strong track record of engagement with external partners including community groups, the business sector and Native American tribes and we're home to more than 40,000 undergraduates and 17,000 graduate and professional students across three academic campuses, including a large one in Seattle (apx. 45,000 students) and moderate-sized ones in Bothell and Tacoma (apx. 5,000 students each). We also operate a major healthcare system that includes four hospitals and dozens of clinics throughout the state.

The potential power of such a wide-ranging and deep-rooted organization animated by a mission of public service is obvious. Effectively harnessed the singular collection of assets that comprise research universities like the UW could drive change at a local, national, even global scale. But doing so requires taking a hard look at the barriers – some systemic, some cultural, some haphazard – that stand in the way of synergy, efficiency and true collaboration.

Perhaps the most central barrier to such work, and it is almost solely self-imposed, is what many have referred to as the "siloed" way in which universities operate and are structured. The sheer size and breadth of research universities requires a certain level of hierarchy, as does the nature of our work, which is highly specialized. For example, academic departmental structures facilitate the hiring, promotion and evaluation of faculty whose work would be very difficult to judge by those outside the discipline. Academic departments also support the effective development and delivery of the coursework and experiences necessary to prepare the next generation of scholars. Yet, conducting scholarship and education within such structures can also lead to an insularity that stands in the way of the interdisciplinary collaboration necessary to solving society's big challenges.

Over the last decade, the UW has worked hard to develop internal structures that reward comprehensive, interdisciplinary approaches to problems, without constructing another layer of what can often be duplicative, and just as rigid, interdisciplinary structures that often mimic and compete with departmental ones. The model for this structural re-wiring grew out of our Population Health Initiative (PHI), launched in 2016, with a mission to address the most persistent and emerging challenges in human health, environmental resilience and social and economic equity. This initiative, which we presented at the 2021 Glion Conference (Cauce, Fulwiler & Mokdad, 2022) while it was still in its early stages, was created as a way to organize and harness our institution's deep and well-established strengths in research, teaching and workforce development, as well as the advantages of our

geography and rich network of local and global partners, to serve the public good and tackle the big challenges that confront our society.

Now that it is mature, we can look back and see that since its inception the PHI has engaged more than 15,000 students and 1,300 faculty, funded 364 student awards and 180 faculty projects, spawned engagement with nearly 200 unique community-based organizations and realized a return on investment of more than $4:1 from projects in which it has invested. But it's about much more than numbers and dollars. All of the PHI's projects are evaluated for degree of community engagement, how effectively they incorporate collaboration from all possible disciplines, and their application in real-world settings – the most critical metrics of successful impact. Drawing upon its success and lessons learned along the way, we are now developing a framework we are calling University Initiatives (UI) to further this transformational work and build a university-wide "impact ecosystem" that can serve as the foundation for a more broad-scale cultivation of the systems and supports needed to realize greater impact on grand societal challenges that can only be solved through interdisciplinary collaboration and deep, authentic community involvement.

UNIVERSITY INITIATIVES

University Initiatives (UI) is guided by a committee of the Board of Deans and Chancellors (BoDC) facilitated and staffed by UW Advancement, which brings together development, alumni and stakeholder engagement and marketing and communications, and works in partnership with the UW Foundation and the UW Alumni Association. BoDC is chaired by the Provost and made up of all the academic deans on our Seattle campus, including those of large Schools or Colleges which comprise a broad range of disciplines such as the College of Arts & Sciences and College of the Environment, to more focused units large and small like the College of Engineering, Foster School of Business, Evans School of Public Policy & Governance or School of Law, to those that blend research and education in the health sciences, such as the School of Pharmacy, School of Public Health, and School of Medicine. It also includes the Chancellors and Vice Chancellors of UW's campuses at Bothell and Tacoma. Our Vice Provosts and Vice Presidents of Global Affairs, Planning and Budgeting, Advancement and the Office of Minority Affairs & Diversity are also frequent participants in BoDC. We believed it was crucial to involve our highest and most engaged leadership in this work as a re-wiring of this significance cannot be successful without buy-in from a broad swath of leadership at the highest level. Consistent with the overarching theme of collaboration and engagement, UI leadership have worked to identify opportunities for working jointly across disciplines and with external partners, creating new interdisciplinary programs and case studies and leading strategic planning efforts within the University Initiatives framework.

POSITIVE IMPACT AS OUR NORTH STAR

The UW's impact ecosystem is grounded in our larger university vision — to be the top public university in terms of impact. This focus on impact, which I have been articulating as our goal throughout my eight years as president, is not in opposition to our deep commitment to basic research and discovery. Universities are virtually the only institutions in the world where such activities take place, and they are key to future innovations and applications. It would not have been possible to so quickly produce tests, vaccines and treatments for Covid were it not for the many decades of investment in basic research from the National Institutes of Health, the National Science Foundation, other public and private foundations, as well as universities themselves. Indeed, if we are successful, a key outcome of the development of an impact ecosystem will be creating and sustaining the conditions that will more quickly allow the discoveries coming from our basic research to be used in the creation of innovative products, policies or procedures that will help us tackle the problems of today and tomorrow. Too often basic and applied research are pitted against each other, creating a false dichotomy when, in the ideal world, today's basic research will become, or at least inform, tomorrow's applications, policies or products. Our goal, simply stated, is to create the conditions that will allow this to happen more elegantly, efficiently and quickly. The urgency of the moment demands it.

We strive to infuse this focus on impact into all aspects of our mission of teaching, research and service. Creating synergies between the various components of our mission allows us to not only focus our energies, but also provides important feedback loops that lead to new ways of framing issues and identifying potential solutions, with a greater focus on society. For example, as a faculty in child/adolescent clinical psychology, the literature reviews I conducted for grant writing served as a source for readings in the courses I taught. Because my research was community engaged, mostly conducted in partnership with local schools, mental health or social service agencies, I was also able to create service-learning opportunities for my students in these same settings, so that students in these placements provided important critiques of the work and new ideas and insights. The research I conducted to better understand how adolescents entered the mental health system was, in fact, sparked by a question from an undergraduate who noted that while readings in the course focused on treatment outcomes, we all knew that only a small subset of those with needs ever entered into treatment and this didn't just happen by chance. Subsequent work coming out of this student's astute observation, led to a clearer understanding of just how the inequities in our mental health system started even before treatment began.

I often tell students at convocation, a ceremony for first-year students that welcomes them and their parents to our university community, that one of

the advantages of getting an education at a research university is that students not only are learning from faculty adept at teaching about the latest analyses, research or discoveries in textbooks, they are working with the faculty whose work is cited in the textbooks. And even more importantly, they are learning about the discoveries that will be in the textbooks of the future. They will also be shaping what those discoveries will be. And when that research is community involved, they can also shape how it is applied.

THE UW'S IMPACT ECOSYSTEM

Figure 1 illustrates the impact ecosystem we are developing at the UW. We begin by identifying grand societal challenges on a broad level and move very quickly to convening key stakeholders, both inside and especially outside the university. This is critical to ensure that we understand the issues as they affect diverse individuals or communities in context and ensures that from the very start, we are co-defining the challenge and/or area in need or change or intervention with those who will be most affected.

Figure 1 – Impact Ecosystem

We then co-create pilot programs to test solutions, which we can then accelerate by bringing in appropriate supports and resources, leading to positive impact. When the solution is an intervention, program or policy that

can launched within the affected community or communities, we continue the research after it is launched with an eye both on documenting impact, and what led to it. By continuing the research past implementation, we can identify and mitigate or prevent negative unintended consequences that too often occur when interventions or policies developed in more controlled laboratory settings are transplanted into communities (Merton, 1936).

COMMUNITY ENGAGEMENT AS THE FOUNDATION

Community engagement is an essential component to any project that aims to benefit that community, and effective engagement arises from investing in building strong community partnerships from the start. A good example of this is the work led by the UW College of Education (CoE). UW faculty, staff and healthcare providers have a long and rich history of working with families and community groups in the Rainier Valley, a culturally and economically diverse neighbourhood on the south side of Seattle. And, beginning in late 2018, the CoE began to convene early learning researchers, early childhood program providers and community leaders in the Rainier Valley to identify challenges, design solutions and imagine the best environment that would result in success for children, families and communities. Between 2019 and Spring 2020, they convened monthly brainstorming sessions to develop a shared vision and explore community interest, continuing on-line when the pandemic hit. Regular zoom-based meetings were also conducted between UW Real Estate, the Seattle Office of Housing, UW Office of Regional and Community Relations, the Seattle Department of Education and Early Learning and CoE representatives and advocates. By the summer of 2020 a small workgroup developed concept papers and collaborated with the Seattle Office of Housing to coordinate broader community engagement.

Deep and broad community engagement began in earnest in Fall of 2020 with the convening of an advisory group of community leaders and CoE stakeholders. This advisory group met weekly to guide community engagement and overall project development and a community engagement team was brought on board to lead the outreach effort. This was followed by a series on online listening sessions across south King County. Individual discussions with community leaders and organizations were also conducted and will continue across the life of the project.

These meetings led to the vision of a Rainier Valley Early Learning Campus to provide expanded access to family support services including both the early childhood education programs, which was the original focus, but also childcare, before-and-after school programs, and parent and caregiver resources. The Learning Campus will also serve as an incubator for restorative curricula and programming that centres the lived experiences of BIPOC (Black,

Indigenous and People of Color) children, families and educators. Work at the Learning Campus will be guided by a justice-oriented framework, grounded in the ideology of empowering people and communities, and bolstering their sense of human agency and the disposition to use it, in service of pro-social community and civic goals.

Because of the chronic workforce needs in this area identified, it will also provide affordable, relevant and innovative professional development and degree-completion programs to early learning professionals including childcare providers, teachers, infant mental health specialists, early-learning policy-makers and others. Programming is intended to support emerging leaders to develop and hone the skills needed to run high quality early learning programs and the skills needed to access business resources, grant development and learning optimization tools. The partnerships forged between childcare and higher education at the Learning Campus will help launch careers in education, ensuring that from the very start, Seattle's children will have teachers who look like them, understand their communities and speak their language, while also advocating for the working conditions and compensation that recognizes the essential role that early educators play in the region's health and in families' well-being.

Consonant with our university vision to have large scale impact, the plans for the Learning Campus are ambitious, both in serving our community, but also having national reach. We will use this comprehensive approach to incubate and disseminate culturally-sustaining, evidence-based early learning practices to early childcare education programs in the state and to every Head Start and Early Head Start program in the country. We believe this unique partnership between community-based teachers and their university scholar partners will provide the framework needed to share breakthroughs in real time.

Finally, it is worth adding that because of its planned location adjacent to affordable housing and to a light rail station, it is an ideal location to serve as a hub for workforce development training and access to higher educational credentialing and completion programs through UW's Continuum College. We envision a true living-learning community built around children and families, weaving in playful learning landscapes that spark interactions between children and adults while they walk through the green spaces, ride the elevator in their building or wait for a train at the light rail station (see https://playful landscapes.com/). Learning isn't contained solely in the classroom or Learning Campus and the whole space is designed to give families tools and information to both support and empower them (Tuan & Danielson, 2023).

Another advantage of this deep and broad community engagement is the way it is resourced as a partnership among sectors. In addition to significant funds contributed from major philanthropists and community foundations,

the City of Seattle, King County and the State of Washington invested public resources and we are now partnering with the City of Seattle and community members on pre-design and construction. Indeed, the Rainier Early Learning Campus' design, development and implementation will serve as a proving ground for how public and private resources can work together to impact the public good.

One clear lesson from this project, as well as from other work that is now taking place under the UI banner, is that genuine community engagement takes time, often much longer than the tenure of a graduate student carrying out a dissertation project or the work of a professor funded by a five-year grant. For this reason, we are now working on developing a more robust infrastructure for community engagement to help faculty members or students looking to engage with local communities and to ensure that these engagements go beyond a one off for a specific project. We are presently in the process of developing shared principles, practices and accountability for those conducting this work. Universities are often rightly critiqued for doing things to communities, rather than with communities, a narrative that plays a role in the growing public scepticism about institutions of higher education. While our intentions may be good and our goals lofty, we often act in ways that make us appear extractive rather than generative, a narrative that we must change.

LEARNING FROM PRACTICE THROUGH CASE STUDIES

Building an impact ecosystem requires concerted, intentional, systemic and cultural change. To kick-start that process, the BoDC University Initiatives Committee (UIC) is guiding an effort to design and field test case studies for the co-creation of big ideas with internal and external partners. The UIC work is multidisciplinary in nature, and is engaging faculty, staff and community partners across disciplines and sectors to tackle grand challenges. Some of these challenges — such as the Climate Change Action and Adaptation case or the Rainier Early Learning Campus just described — are "verticals" — topical in nature and involving more limited units or disciplines. Others are "horizontal," such as the ongoing work of our Race and Equity Initiative, which was folded into the UIC's through the theme of Equity and Belonging and must be fully advanced by each of the UW's campuses, schools and colleges, school and which must inform all our community engagements. Another, our Behavioral Health case study, which was prompted by community and donor interest, is an amalgam of each; vertical in its topical focus but involving a very broad array of units in the School of Medicine, Social Work, Nursing, Psychology, Sociology and Public Health to name a few.

By purposefully choosing a diverse array of case studies, we expect to learn a variety of lessons that will allow us to develop more integrative solutions. For example, we now realize that it's very, very important to give "credit" for philanthropic gifts to the multiple units working together to seek funding for an initiative. Deans and their leadership teams, including advancement officers, are judged by their fundraising totals and so, at best, are understandably reluctant to put time and energy into an effort they will not receive formal credit for. At worse, it can make them compete for donors in a manner that, in fact, can alienate the very people we are trying to cultivate. Control over resources also matters, so we are working on better structuring funding agreement for shared projects, better ways to share indirect cost returns. We are also working on developing policies that will better enable us to streamline joint and/or cluster hires in key areas related to grand challenges. And I am certain that other areas of "re-wiring" within the UW will emerge as we continue to design and implement our work on University Initiatives.

As this work progresses, it is also becoming more and more evident that for change to truly take hold it cannot take place entirely within an institution. The silos within universities are either reflected in, or are a reflection of, compartmentalization across the wide arrays of structures that support and reward the academia and academics. Federal funding agencies, and often foundations, which provide the critical support for our research efforts, especially those that involve the sciences, are often themselves narrowly focused. For example, my primary research interest is in broad based normative, or healthy, development amongst low-income Black and/or Latino youth. And, in part, because such youth are often viewed through a lens of deviance and deficit, I would have very much liked to focus my funding efforts on the National Institute for Child Health and Human Development. But their yearly budget is about US$1.7 billion, compared to $595 million for National Institute for Alcohol Abuse and Alcoholism, and since you need to ask about alcohol and drug to understand healthy development, I often focused on this aspect of the work when grant-writing. While, in theory, this did not have to affect the work itself, over time I found myself publishing in journals focused on such outcomes and while this isn't how I describe my area of expertise, I have been described as an addictive behaviour researcher by others, which I dislike because of the implications it can carry for the youth that I work with and study.

Similar issues came up for me when I was a junior faculty member. My work focused on youth in "at risk" environments, rather than on "at risk" youths, because I very much wanted to show that the very real problems these youth were experiencing were a function of the difficult environments they experienced living in low-income neighborhoods often characterized by crime, poorly resourced school systems and lack of access to a host of other resources

from recreational spaces to social services. For that reason, my outlet of choice for publication was the "American Journal of Community Psychology (AJCP)" with its focus on health promotion and community development. However, that was not an "American Psychological Association" journal, which are considered the premier journals in my field. So, I worked on putting together a methodological article, which was not especially central to my interests, or that would be of interest or relevance outside of academia, with the express purpose of proving that I could publish in a top journal when I came up for tenure (Cauce, 1987). While I have no doubt this article helped to quiet critics concerned that the scholarship was too applied and focused on a narrow population, indeed I've known some who have described it as "me-search" instead of research, looking back several decades later, this top tier journal article has been cited 144 times, while some of my most widely cited articles have appeared in the more impact oriented, community focused AJCP (Cauce, Felner & Primavera, 1982, cited 732 times; Cauce, 1986 cited 438 times).

To counteract these systemic issues in faculty evaluation, especially during all important tenure decisions, requires intentional efforts to have tenure review committees recognize and reward interdisciplinary and/or community-engaged research. So, we now offer workshops for junior faculty on how to present interdisciplinary/community-engaged work in their tenure portfolios and to faculty serving on review committees about the importance of value of such work and acknowledging it as true scholarship, not just service. In evaluating scholars whose work bridges several fields, we also encourage chairs and/or deans to put together review committees with faculty in disciplines that many be outside the department or college, as well as engaging outside peer reviews from those outside the discipline. Still, all too often junior faculty are told by their senior peers to steer clear of conducting research that is difficult to publish in top tier journals in their discipline until after tenure. And after having become accustomed to, and rewarded for, conducting a specific type of scholarship, and developing habits and expertise about where to publish and obtain funding, there is little incentive to change that trajectory just because you have been promoted (Fisher, 2023). Moreover, publishing in top tier journals, that are so often narrowly focused, is not only rewarded at tenure but at the next stage or promotion and by recognitions and awards from disciplinary organizations. It is important to acknowledge that the barriers to true culture change go beyond those that any one university can change or control. But it is just as important not to let that discourage culture change within your university.

CONCLUSIONS AND NEXT STEPS

In order to create and support a resilient society, universities can and must create a culture that supports and values engaged research and outreach by its faculty, staff and students. This will require greater university investment in building partnerships with local communities, government agencies, non-profits and other organizations and working with them on developing common goals, initiatives and programs from the very start, even before the problem or project has been conceptualized.

Just as importantly, it will require us to look within and break down barriers to working across disciplines, departments and colleges. If we want our research and scholarship to translate into maximal impact in the world, we must work harder to identify and streamline bureaucratic processes that disincentivize or impede cross-college collaborations and university-community partnerships. We must also re-align our reward systems to match these goals.

We must work together and make this a priority across our universities, especially in these days when faculty, and even leadership, is more and more mobile. And we must work with disciplinary organizations where so much of the faculty and graduate socialization takes place, where journals are often housed. Faculty often consider these organizations their "homes" as much as they do the universities they reside in, and they are often the locations that determine faculty award and recognitions that are important to career advancement and prestige.

Universities must also work with public agencies, philanthropic foundations and individual donors to create funding opportunities that can support public engagement and impact-oriented research and discovery. Fortunately, given the immediacy of the crises we are confronting, from climate change to threats to democracy, this type of change is already in the making. As I was editing what I thought would be the final draft of this paper to meet my 9/1/23 deadline, an article came out in *The Chronicle of Higher Education* which is widely read by a broad swath of university leadership, including deans and department chairs in the US, making the case for why more community-focused scholarship would help to build the public trust in higher education which has been eroding over the last decade (Fischer, 2023). They note that there are a number of other type research universities in the US, mostly public but some private, that are also committed to finding ways to better encourage and support community engaged research, using many of the same strategies we have described and potentially others that we hope to learn from. It also notes that outside groups that are pushing for this chance, such as the Carnegie-classification for community-engage institutions, a designation earned by all three of our campuses. Some foundations, like the W. T. Grant Foundation, which funded some of my community engaged work early in my career, and even the federal agencies like the National Science Foundation and National Institutes of Health are incentivizing work that

seeks community impact. These changes may not seem quite as monumental for universities outside the US, many of which have strong ties with their national governments, but they represent a true sea change for this country.

We are still in the early stages of creating a truly supportive environment for interdisciplinary community engaged work focused on our society's most vexing problems. But the depth of commitment we have seen on our campuses from students, faculty and administrative staff has been truly inspirational. We look forward to continuing to learn from our Population Health Initiative, and the programs led by our BoDC as part of University Initiative and the work of our faculty leadership, including our faculty senate, and to share those lessons with others. We also look forward to partnering with other universities seeking to do the same. Together we are stronger.

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Chapter 9

Community Science for Collective Action

Nathalie Drach-Temam & Guillaume Fiquet

Community science holds great potential as a vector of resilience and a new road to success, far under-used by universities and public authorities. Despite its deviation from the conventional way universities usually operate, community science should be seen as an academic opportunity rather than a threat. Indeed, community science acts as a powerful mechanism to enhance knowledge and promote awareness of the scientific approach by associating participants from outside universities, who then become stakeholders.

The lessons drawn from the pandemic and ecological crisis, but also from the social and democratic crisis we are currently facing, have highlighted the utmost importance of confidence. With the involvement of citizens and stakeholders in research through community science, we can rebuild trust in science. Moreover, by engaging this collective action, universities are involved in promoting cohesion within society. This is how community science truly acts as a vector of resilience.

Through community science, universities can fulfil their fundamental mission of generating and disseminating knowledge, in a way that is adapted to contemporary times. These inclusive and open collaborations enable science to regain a central position at the heart of society in this era of open science. It is a promising solution for the future and a breath of fresh air for democracy.

DEFINING COMMUNITY SCIENCE

Let us first examine the origins of community science. Throughout history, natural science and astronomy have been the fields most affected by this phenomenon. Starting in the early 20th century, citizens have contributed to the study of species and nature, as exemplified by the renowned *Christmas Bird Count* in North America. The classification of galaxies also heavily relies on the participation of amateur enthusiasts.The emergence of community science in medical research gained significant momentum with the outbreak of AIDS. This early development highlighted the major role it could play in reinforcing our resilience during times of crisis. The involvement of patients' associations not only expedited progress against this scourge but also proved beneficial in combatting other diseases.

This community approach first emerged due to concerns about the scientific method itself. Researchers needed to include sources of knowledge existing not only within the walls of the university but also outside them. They understood the importance of engaging a variety of non-academic partners. Community science therefore led scientists to take a new angle in approaching their research work, seeking out sources, data and knowledge beyond the traditional academic sphere.

The participation of citizens in science is now widespread and exists in various fields due to the progress of digital technology. It is structured via several large-scale collectives and observatories associating necessarily professional scientists. Such extended access to sources has enabled a collective production of knowledge and methods. The sharing of fragmented contributions from citizens, socio-economic stakeholders and academics enables the construction of this knowledge. Partners operating outside the realm of universities contribute valuable insights to the questions researchers are raising.

What does Community Science look like Today?

The surge in community science has given rise to a multitude of initiatives involving researchers, students, citizens and socio-economic partners. Many research projects today involve people who may not hold an academic position but nonetheless contribute to the production of scientific knowledge recognized by the peers. Participation is included in most disciplines, such as literature, in addition to artistic and cultural creation.

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Institutions have now fully committed to this approach, as shown by the position held by the League of European Research Universities (LERU, 2016), the programs launched by the OECD, the European Commission as well as national approaches to research.

However, there is still not standardized terminology to define these processes precisely. For example, *community science* and *citizen science* are not interchangeable terms, despite the attempt to use *citizen sciences* in a global approach in the 2010s. Indeed, *citizen science* is partly controversial because it does not necessarily include professional scientists, and in some cases, deliberately excludes them in an attempt to establish itself as an alternative to science. The situation is further complicated by the fact that *citizen science* is subject to a variety of interpretations, with the American approach focusing on surveys and data collection (the Bird Count) while the British approach encompasses a broader scope of citizen engagement prior to research projects. *Community science* seems now to refer more specifically to the involvement of the public in research activities, globally and in its several stages, although other terms do exist (*collaborative science*, *participatory research*).

This is how François Houllier, based on Muki Haklay's work (2013), has attempted to specify the different extents of citizen participation:

Participation	Associated term	Role of citizens
level 1	Crowdsourcing	Citizens contribute as data sensors
level 2	Distributed intelligence	Citizens help to interpret data
level 3	Community science	Citizens contribute to the definition of the problem and the collection of data
level 4	Full partnership	Collaborative research throughout the different phases (definition of problems, data collection, analysis)

The concept of community science therefore encompasses a different level of engagement, ranging from level 3 in the participation table to level 4 described as "full partnership" which may include analysis. Participation therefore now works both ways: researchers no longer solely rely on sources from civil society, but rather civil society that engages throughout all stages of the scientific process.

The term *community science* underwrites this approach. As François Houllier points out in his report and article (2016, 2017), it encompasses diverse ways in which scientific knowledge is produced, with the active and intentional participation of partners from civil society alongside professional researchers. The FRIPON Science Project (Fireball Recovery and Inter-Planetary Observation Network) is a good example of such an interaction. This project is a worldwide network designed to study extraterrestrial matter by detecting and characterizing fireballs (their orbit, trajectory and size, etc.) and to recover fresh fallen meteorites to be analysed in university laboratories. In

France, the program was conceived in symbiosis with the program Vigie-Ciel, designed to raise public awareness about observing the sky, and searching for and recognizing meteorites. The project's primary objective is to develop participatory science programs by providing accessible tools to encourage and broaden public participation (Colas, 2020).

All scientific fields can be concerned by this participative approach, instances of which have increased exponentially since the early 2000s, although the phenomenon was probably underestimated prior to that period due to a lack of specific references.

Despite this dizzying rise that confirms the role of community science, it still lacks precise positioning: should scientists assume the responsibility for this approach? Or should it be the domain of university institutions? Or civil society? In any case, it is a construction situated at the interface between these three realms, with knowledge and sciences at its core.

A Vector of Projection and Resilience

The dynamic of citizen participation is an underlying trend that is being strengthened continually, alongside societal developments. The emergence of new technologies, including advancements in artificial intelligence, has profoundly transformed knowledge production, accessibility and the relationship between citizens and knowledge.

Community science emerges as a solution to adapt the way research is carried out with regard to these developments, while maintaining methodological fundamentals and integrity. It is not just a question of reinforcing knowledge by drawing on more complete sources but, most of all, promoting scientific rigour, logical reasoning and cultural openness.

By its very nature, community science is future-oriented: partners and citizens engaged in participative research contribute to the permanent work in progress that is science, through data exchange, method sharing, diverse perspectives and critical questioning. Community science therefore becomes an approach that strengthens resilience: it provides a means of overcoming fear when facing crises and changes. Thanks to their involvement, citizens can now envision the road that needs to be travelled together, through science, to confront the challenges we encounter.

Beyond *resilience*, by which organizations try to remain without necessarily addressing their shortcomings, community science goes further: it makes societies more *resistant*, with the capacity to withstand challenges by engaging citizens in questioning, understanding and addressing changes. Participation strengthens societies' very ability to evolve, to collectively chart a course, rather than to simply survive without self-examination. In this approach, citizens and researchers share observations and options available for tackling

challenges, and this is an important lever for making informed, long-term decisions. Community science therefore acts as a true transformative force, instilling a sense of confidence in society's own future. By making science accessible to all, community science is both a means of building the future of societies and for helping research universities gain a better acceptance and integration in the local and regional communities.

COMMUNITY SCIENCE AS A WAY OF RESTORING TRUST

The resilience of society is founded on trust, and community science possesses several elements that make it commendable in pursuit of this objective.

Community Science helps to Restore Trust in the Scientific Approach and in Science

Mistrust toward scientists is a pressing issue that we need to confront. This lack of trust is a major obstacle to the resilience of societies, which are fragmented and subject to a crisis of confidence. In France, only half of all citizens currently believe that we can trust scientists to be transparent regarding their research work; this proportion varies across different fields of research. There is uncertainty among the public regarding the independence of scientists, as only 35% of French citizens perceive them as independent, but 66% of the same population trusts them to adhere to the regulations and laws governing their research. In general, a fortunate paradox emerges wherein citizens express scepticism toward scientists while simultaneously holding high expectations for science (Ipsos, 2020).

The Covid-19 pandemic was a striking example of this contradiction. Factual information and groundless opinions became entangled and unfortunately amplified through the prism of the media, assisted by certain scientific and political figures who compromised research ethics. It results that healthy scientific debate is widely misunderstood, a part of the population confusing disagreements between scientists, which are part of the research process, with the defence of financial interests. The lack of trust extends beyond the specific context of the pandemic, encompassing broader perceptions of the scientific community.

In major scientific public debates and challenges such as climate change, mistrust has also increased among citizens. For instance, climate change has been subjected to a long scientific process under the authority of the IPCC, leading to a consensus confirming that ongoing global warming is a consequence of human activity. The scientific debates are still vigorous, but today they are focused on the underestimation of certain factors. Surprisingly, a

survey carried out in 2022 (Obs'COP, 2020) revealed that 37% of the global population across 30 countries remains unconvinced that climate change is a result of human activity. This is, for the first time in many years, the current level of scepticism in Europe, Africa and Asia. A lower level of doubt than those in the United States or the Gulf States, whereas populations in Central and South America show a higher level of awareness regarding this scientific knowledge.

Given the lack of trust in scientific work, should we hesitate in confronting the environmental challenge – one of the most significant challenges humanity faces this century? Although populations currently have doubts regarding scientists, these doubts are also, according to the public itself, a result of its own difficulty in grasping scientific subjects.

Thus, as universities, the responsibility lies with us to address this challenge concerning trust! By sharing what science is and what the scientific method is, community science serves as a powerful lever to restore confidence in science. The great strength of this participative approach is that it creates a way for citizens to take ownership of and become invested in science. It can completely overturn this trend towards mistrust.

With this in mind, let us rely on the success of community science in a field that profoundly impacts all of our daily lives: health. A compelling illustration is "The University of Patients" at Sorbonne University, founded in 2010 by Professor Catherine Tourette-Turgis (2013). This initiative utilizes patients' experiences of illness as the foundation for diploma courses and action-research. Given our awareness of the growing global health challenges, ranging from ageing populations to environmental diseases, it would be highly beneficial to replicate and generalize this type of approach.

More than just Restoring Trust in Science, Citizen Participation Restores Confidence in Society, via the Scientific Approach

With community science, citizens assume the role of active partners in science, from the outset and throughout the scientific process. They are involved and share in the methods employed. This fosters a profound sense of belonging to a single human community, which trusts itself to take on the challenges that society is facing. In essence, community science acts as a source of cohesion for a society, as each citizen involved in this process rediscovers the power to act for the common good.For citizens, engaging in community science comes down to re-appropriating the basis of their environment and of the world and its complexity, while removing all the preconceived judgements of passive onlookers. Furthermore, it is a way to help science to progress, by each citizen at their own level, and to shake off the feeling of powerlessness in the face of

science and contemporary problems. Citizens thereby regain confidence via the scientific approach.

This confidence extends even further when we consider the re-appropriation of techniques that community science provides. In the context of the digital age and the prevalence of artificial intelligence, but also regarding legitimate ethical questions around technology, it becomes essential to ensure that citizens have some control over the tools that are so widely available to us. Community science is an emancipating factor that should not be neglected, particularly in the face of threats to the fundamental liberties of citizens. Weakly regulated digital applications compete for our attention every day, defying the barriers of our vigilance, our ability to concentrate, to reason, and even the capacity of citizens to live together, due to algorithms that promote isolation and futile conflicts. At this digital tipping point we are living in, it is time to revisit the initial open-source mindset, associating the power of citizens. Community science indicates the road forward, the one on which society regains control via the scientific approach: our universities must help to amplify this movement.

Choosing Community Science is the Way for Universities to Strengthen their Role in Conveying Knowledge to Society

Universities were founded with the core mission of "conveying knowledge", to produce knowledge and to breathe life into it. Their primary role is to promote the transmission of knowledge and the results of research.

In order to be heard and to rebuild this trust, universities still need to make an effort to open up, to convey the scientific approach to citizens, regardless of their scientific background or knowledge. Integrating a participative dimension and acting as a mediator between science and society is a top priority for research universities, and probably an evolution of their role. This is the thrust of the *Sorbonne University for a New Deal (SOUND)* project, which aims to mobilize the Sorbonne University academic community around three major societal challenges. The goal for Sorbonne University is to promote a long-term transformation in the way public and private stakeholders and decision-makers are addressed, achieved through supporting researchers with the necessary tools to share their expertise. These tools include a community science platform, a dedicated engineering unit, and support for participative research projects.

This transformation is not straightforward. What we are talking about here is the very way in which research is carried out and therefore the working practices of researchers and their training: it is not easy to convey and popularize knowledge to the general public while remaining a guardian of scientific rigour! This is precisely the objective of the SOUND project, which offers

researchers with projects aimed at society with specialized training opportunities. Researchers become proficient in science popularization, public speaking, dealing with the media and mediation. This mission of sharing and disseminating knowledge to society at large is no longer on the "side-line" with regard to research: it is now at the heart of the university's mission.

Community science is also part of the profound change in the way research is organized to promote *open science*, which requires a considerable change in culture. At Sorbonne University, the concept of "trustworthy science" now includes support for open science, integrity and ethical considerations as part of a unified and cohesive framework. This structured approach seeks to lead the university community towards a shared cultural foundation with the aim of carrying out research under the aegis of this integrated approach.

ADDRESSING CRISIS SITUATIONS WITH COMMUNITY SCIENCE: UNIVERSITIES AS A STAKEHOLDER IN THE SOCIETY, ENABLING TRANSITIONS

With trust and confidence levels restored through community science, society can rely on a scientific approach, the fundamental bedrock for overcoming crises. Now more than ever, in order to build resilient societies, the world requires a combination of sense and science!

Contemporary Transitions and Challenges call for the Scientific Approach and Research-Based Education: Universities are in Prime Position to Assist these Transitions

In order to deal with contemporary issues and overcome crises sustainably, it is necessary to call on comprehensive and interdisciplinary approaches, where research intersects with popularization and education. This ability of universities relies on fundamental, long-term research in addition to the education they provide, these are the essential cornerstones regarding the quality of projects.

With a continuum spanning research, education, innovation and engagement with civic society, universities are well-positioned to address the challenges posed by contemporary crises. They serve as open places where a comprehensive understanding of crises can be developed and solutions can be co-constructed. Interdisciplinary Institutes dedicated to pivotal themes, innovation hubs and shared laboratories constitute integral components of this framework, including international reach, partnerships, cultural and mediation-based actions.

By developing community science, universities actively contribute to resilient solutions from a scientific and creative approach. Collaborative platforms, whether hosted by universities (Portail, no date) or external entities, play a crucial role in this process. There are many vehicles: digital platforms where expertise is shared between universities and socio-economic stakeholders to facilitate transfers, open and collaborative resource centres, autonomy clinics that integrate patients and the everyday situations they face…

If we look at the environmental challenge, innovation in sustainable, low-tech and less-expensive solutions is at the heart of resilience. The upscaling of community science would allow these solutions that are slowly emerging to be disseminated more widely, by uniting the capabilities of research and operators. On the same environmental challenge, marine ecosystems are one of the key factors in our future on Earth: the exploration of planktonic life, which generate half of the planet's oxygen, support marine life and regulate the climate, is only just beginning. In order to protect this ecosystem and draw inspiration from marine life, we need to know more about it. In this way, the global participative project Plankton Planet, is working with both citizens and maritime professionals to provide essential knowledge to scientists, citizens and decision-makers via direct use of oceanography instruments.

Community science also has a role to play in meeting the challenge of conveying knowledge. With the emergence of a society in flux, professional career paths are ever more diversified and mobile: empirical transmission of knowledge within companies is reaching its limits. Paradoxically, despite the continuous growth of total knowledge and people's increasing levels of education and training, conveying knowledge and skills has become increasingly challenging. This means that the method of knowledge transmission needs to be renewed! Community science and the development of collaborative centres both have a role to play in ensuring that skills are passed on and in lifelong education.

Community science thereby leads universities to fully embrace their role as innovators. In association with open science, they are the key to sustainable development in order to ensure the transfer between research and the economic and social fabric. They breathe new life into knowledge sharing, helping us to move on from a system whereby knowledge was reserved for a limited number of stakeholders.

Assisting and Associating Citizens, the Cornerstones of Transitions

The rise in community science correlates to a much wider movement towards *participative democracy*. With new technologies, citizens have access to a vast range of data, information and bypass traditional forms of authority. Although

lack of regulation has caused serious issues (fake news, arbitrary online judgements), it is pointless to pretend turning the clock back on this vast movement. It is far more useful to focus our energy on ensuring that science helps society by promoting knowledge and critical ability.

After all, contemporary challenges are those that citizens are currently facing; they are the ones who need to take on these challenges. Their involvement upstream of the public decision-building process alongside researchers has proven fruitful, and it provides an ability to overcome the democratic crises. The aim is to breathe new life into democracy by repositioning citizens to be as close as possible to expertise and decision-making.

With regard to this model, France has recently held two citizens' conventions: one on the climate issues and one on end-of-life care. Two central transitional subjects. It is remarkable to observe how a representative panel of citizens was trained, in a dialogue with scientists over just a few weekends on these complex subjects. The results provided a great deal of hope: the citizens involved had a unique experience; they overcame their prejudices and grasped the subjects, they had a constructive dialogue getting to the heart of the arguments; they found ambitious consensus that they had never imagined at the start of the process. All of this in a country that is well known for its confrontations.

With this type of community science, we are currently seeing real repositioning of science as a way of inculcating rigorous analysis and reasoning as close as possible to decision making, by associating citizens in this process.

It is essential to bear in mind that there may be a representation bias in community science initiatives, as citizens who are inclined towards participating in such projects are likely to be those already interested in research or technology. Some of them may possess higher education degrees. However, we firmly believe in the potential to attract individuals with less formal education into the realm of participatory science. Our goal is to engage all citizens to ask relevant questions and actively contribute to the scientific process, making them the primary agents in this virtuous circle of community science.

The participative approach as applied to science and public debates provides a way of overcoming the crisis. Our democracies would be well advised to include the dialogue between science and society prior to the formulation of political, societal and economic choices that will impact main challenges, such as climate change and biodiversity, worldwide health, social cohesion, education, economic prosperity in a world with limited resources and an ageing population. Community science is a major key for resolving these issues and must have a place in the public decision-making process. Finally, it concerns and helps decision-makers, who need to be close to science and citizen expertise to guide crucial public choices.

Community Science does not just make Societies more Resilient, but also makes Organizations more Resilient – Including Universities!

Community science also prompts questions regarding the way universities operate. Just like any other stakeholder in society, they have been impacted and need to display resilience when faced with a changing world and a fragmented society.

Universities have an ability to mobilize their communities in order to provide answers to crises. They led the way in the huge efforts made in research, solidarity and adaptation during the Covid-19 crisis. They steered action plans aimed at sustainable development by calling on the involvement of their members.

Universities, like any employer, must adapt to the new challenges in employment attractiveness. Given the growing demand for work to be meaningful, universities have a major advantage. Future generations of citizens are created at universities, as are many of the solutions of tomorrow. If we want this promise to endure, we need to renew certain content constantly. Community science provides a new type of learning and research methods at universities, by improving them and by working with external experts. Turning towards community science also means breathing new life into university missions, by setting out to engage with knowledge and skills held within society, in order to prepare for the future.

By integrating the participative approach into the way they work and by applying community science to themselves, universities can provide themselves with a way of underwriting their own resilience.

Universities would be wise to integrate community science into their research and educational missions. With the growing accessibility of tools and information for citizens, the issue at stake here is quite simply whether universities will continue to be the recognized bodies who will transmit knowledge that comes with academic and methodological guarantees as well as critical thinking.

The formalization of the role of community science touches on public authorities in general. In order for our societies to become more resilient, they are adopting this approach in the decision-making process. Community science therefore leads to more resilient societies that are better able to meet the challenges they are facing by placing knowledge and the scientific approach at their very heart.

Considering the prevailing circumstances, societal developments and the results attained, all argue in favor of community science. There is little doubt that both scientists and citizens are ready to capitalize on this. The current task for institutions is now to integrate this approach fully. This is the project that universities and public authorities need to work on: making community science a systematic tool that is used to meet the challenges of our time.

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Chapter 10

Healthy Davis Together: a Model for Town-Gown Collaboration and Sustainable, Resilient Communities

Gary S. May

Town-gown collaboration is more important than ever. Higher education – and particularly public research universities – can no longer operate with university-centric visions. The pandemic showed us that local problems can quickly become global problems that impact every corner of the world. The world's greatest challenges are complex. Consider the environment and global warming, food production and natural resource depletion, public health and the threat of the next global pandemic. These challenges are not constrained by the borders of a university campus, city or country, and solving them will require many different stakeholders working together.

In this context, universities have important roles to play as neighbours, partners and benefactors. Indeed, public universities have a *responsibility* to their surrounding communities. One of the greatest values a public research university can offer is its ability to leverage scholarship and research in ways that can benefit surrounding communities and far beyond. These benefits might include economic development, public health and medical care, environmental protection, housing and transportation improvements and better overall quality of life. Through cultivating collaborative strong town-gown relations, public research universities can help to ensure that neighboring communities are resilient, sustainable and ready to respond quickly when the next major challenge emerges.

This paper focuses on "Healthy Davis Together", a successful town-gown collaboration between the University of California, Davis, the city of Davis and Yolo County. Healthy Davis Together was conceived as a comprehensive pandemic response program, designed to identify cases of Covid-19, prevent its spread, facilitate the coordinated and gradual return to city activities and reintegrate UC Davis faculty, staff and students back into school and community life. The program was hailed as a national model for collaboration and innovative problem-solving. According to a February 2021 *New York Times* article: "Public health experts say the initiative is the most ambitious program of its type in the country and could be a model for other universities" (Hubler, 2021).The city and university received a number of awards for Healthy Davis Together, including a Presidential Excellence Award from the International Town Gown Association and an inaugural Research Response to a Community in Crisis Award from the Association of Public and Land-Grant Universities. The city of Davis also received a Beacon Leadership and Innovation Award from the Institute for Local Government for cross-agency collaboration on Healthy Davis Together.

What follows is a description of the program and its results, an in-depth look at how the program was conceived and implemented, and some lessons learned that might help other institutions use a similar town-gown approach to address a wide range of issues and emerging problems.

UNCERTAIN HOURS

To tell the story of Healthy Davis Together, some context about UC Davis, the city of Davis and the times we found ourselves in when the state of the world began to change in early 2020 is necessary. The city of Davis, population 66,799 as of 2021, is located about 15 miles (24 km) west of Sacramento, the capital of California. It is known for its agricultural setting and is largely surrounded by fields and arable land. UC Davis is a defining element of the city and key employer for local residents. As of fall 2022, the university's total enrolment was 40,772 students.

Rewind the clock to early 2020. A sense of uncertainty was looming, but there was little information about the mysterious illness appearing in news headlines and video streams coming from China.

According to the Centers for Disease Control Covid-19 timeline (CDC, 2023):

- On 12 Dec. 2019, the first cluster of patients with a pneumonia-like illness was identified in Wuhan, China;
- On 7 Jan. 2020, public health officials in China identified a novel coronavirus as the causative agent of the outbreak; and

- On 20 Jan. 2020, the CDC reported the first laboratory-confirmed case in the US from samples taken in Washington state.

The whole world took notice the following week, when, on 30 January, the World Health Organization declared a global health emergency after thousands of confirmed cases (WHO, 2020).

It was a tenuous situation for decision-making, as UC Davis, like other universities around the globe, considered how this global health emergency could impact university operations. The World Health Organization and Centers for Disease Control, along with public health agencies and health care experts, were learning more about SARS-CoV-2. In those early days, information was scarce and often conflicting, and the information received from public media would often change quickly, sometimes hour to hour. UC Davis Health created its first working group on 22 Jan. 2020 to begin planning for patients and management of this unknown infection. Shortly thereafter, on 26 February, UC Davis Health diagnosed and treated the first case of community spread Covid-19 in the United States (UC Davis Health, 2020). The case received immediate national attention and indicated the virus was already spreading widely and a global pandemic was likely.

Just weeks later, on 19 March, California Governor Gavin Newsom issued a stay-at-home order for the state's 40 million residents (Newsom, 2020). In conjunction with that order, UC Davis suspended operations, with the exception of certain critical functions (May, 2020). Little did anyone know that the majority of the UC Davis community would continue to work, teach and learn remotely for another 17 months.

While much activity on campus – and on campuses and streets around the world – eerily came to a halt, the university's work and the mission continued. In fact, experts from across the university were highly motivated to find solutions to the novel coronavirus. UC Davis boasts strong infection disease expertise, including zoonotics, in our schools of veterinary medicine and medicine. In our top-ranked School of Veterinary Medicine, one researcher had been studying coronaviruses in cats for more than 20 years. Researchers from a wide variety of disciplines came together virtually to look for solutions to the urgent problems that were emerging, including our schools of medicine and veterinary medicine, Genome Center, Center for Immunology and Infectious Diseases, and California National Primate Research Center. By mid-April, our researchers were testing vaccines that would prevent the most serious infections from the disease. Our College of Engineering worked with School of Medicine researchers to make technological innovations for producing ventilators and 3-D printing of test swabs. Communication experts were analysing millions of social media posts to identify emerging outbreaks. In April 2020, the university held its first multidisciplinary Covid-19

symposium. UC Davis is the most comprehensive campus in the University of California system, with more than 100 undergraduate and 100 graduate degree programs. Led by Walter Leal, distinguished professor in molecular and cellular biology, these virtual symposia brought together experts in infectious diseases, epidemiology and emergency medicine, public health officers and elected officials. Together, they educated the public and dispelled misinformation about Covid-19.

In those early weeks, UC Davis was leveraging its greatest assets – its expertise and inclination toward problem-solving. Six months later, there were still few options for communities trying to stay healthy and information was still developing. That was the state of the world when we launched Healthy Davis Together in September 2020.

THE UNIVERSITY AND COMMUNITY CREATE A BUBBLE

Many universities implemented broad measures to prevent the spread of Covid-19, but very few extended those measures into their surrounding communities. Healthy Davis Together, unique in that aspect, aimed to prevent and mitigate SARS-CoV-2 transmission across the university and the entire city, where students comprise nearly 30% of the population.

Healthy Davis Together began with a short phone call in early June 2020. Tom Nesbitt, emeritus associate vice chancellor for Strategic Technologies and Alliances at UC Davis Health, called Brad Pollock, distinguished professor of epidemiology and chair of the Department of Public Health Sciences in the School of Medicine. Nesbitt said a potential donor might want to help fund a project in a college town to lower the occurrence of Covid-19 in the community. Pollock went to work and over one weekend developed a plan that combined epidemiologic infectious disease control measures with health behaviour change interventions, and involved the university and the city of Davis as partners. He presented this plan to a donor group on the following Monday and later in the week he received word that they wanted to go forward with the project.

Nesbitt then called me for my approval to reach out to Davis City Manager Mike Webb to discuss the opportunity to work together on this initiative. A small executive committee led by Pollock was formed. The Healthy Davis Together plan aimed to prevent the spread of Covid-19 at a time when 40,000 students were due to return to campus and resume in-person classes and other activities, both on campus and in the city. “The idea was to take the best available Covid interventions and apply them all at once to a whole community,” Pollock said (Fell, 2021).

UC Davis is fortunate that Provost and Executive Vice Chancellor Mary Croughan is a highly regarded epidemiologist, having received her initial training at the UC Davis School of Veterinary Medicine, followed by The Johns Hopkins University School of Hygiene and Public Health. She also has 30 years of experience in higher education administration with the University of California and nearly three years at the University of Nevada, Las Vegas. Her expertise was invaluable as she provided guidance to help inform the university's decisions and those of Healthy Davis Together. An advisory committee was created to oversee program administration and activities between the campus and the community. Croughan and Davis City Manager Webb served as co-chairs of that committee, which included students, campus faculty and staff, local business owners, clergy, school and community leaders from a broad range of organizations, and associations in the city of Davis.

Many people contributed to the program's success. Kelly Ratliff, UC Davis' vice chancellor of Finance, Operations and Administration, was instrumental in securing funds and overseeing facilities and logistics. She also worked closely with city and county leaders. Cindy Schorzman, UC Davis Student Health and Counseling Services Medical Director, was key to ironing out the logistics necessary for launching the testing program on campus and in the community. She coordinated with many others to establish the infrastructure for sample collection and to develop the resources to support individuals with positive results. Yolo County Public Health Officer Aimee Sisson, a UC Davis alumna, provided valuable insights. Regional leaders were enthusiastic supporters, including then-Davis Mayor Gloria Partida, former Mayor Brett Lee, then-Yolo County Supervisor Don Saylor and Supervisor Jim Provenza and then-Supervisor-elect Lucas Frerichs.

Healthy Davis Together implemented a multifaceted approach, with free saliva-based asymptomatic testing, environmental wastewater monitoring, student public health ambassadors and partnerships with businesses, school districts and others. The program also launched a communications campaign with unique branding to promote healthy behaviours, including wearing face coverings, social distancing and taking part in free Covid-19 testing at least once a week for everyone living or working in Davis.

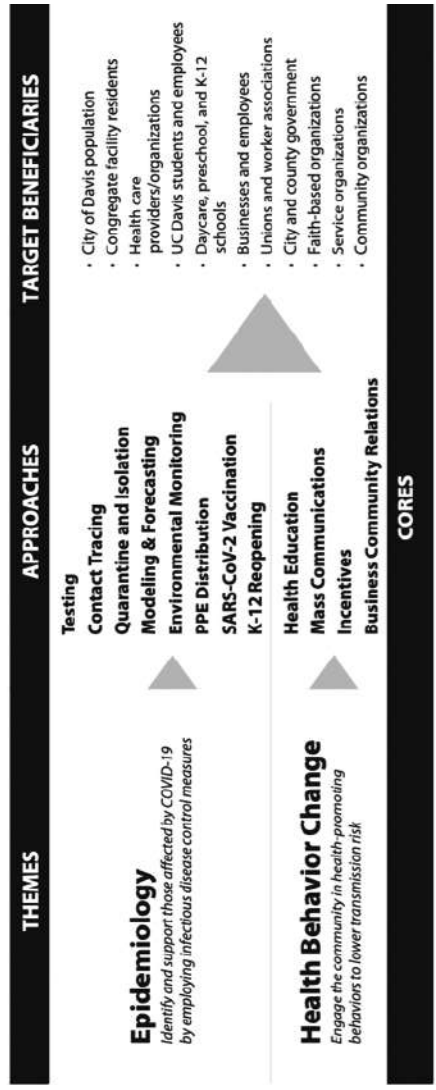

Figure 1 – Healthy Davis Together Program Organization

Note: Each overarching theme (epidemiology and health behavior change) includes several approaches. Seven enabling cores provide support across the project. The targeted beneficiaries represent components of the Davis community. (Credit: Brad Pollock et al, 2022).

Free Saliva-Based Testing with Rapid Results

Developing a rapid saliva-based test in August 2020 was a critical first step and became the centrepiece of Healthy Davis Together. Regular, asymptomatic testing was central to the program's success. Early in the pandemic two things were clear: Widespread testing would be vital to control Covid-19 and keep the campus open, and commercial testing options were unsustainably expensive. A campus-based test for university students, faculty and staff was essential, and under the auspices of Healthy Davis Together, the campus testing program could be extended to residents throughout the city of Davis and eventually Yolo County. The program operated multiple sites for symptomatic and asymptomatic testing on campus and in the community. Free weekly testing was offered to anyone living or working in Davis seven days a week and was also available to family members of all UC Davis employees.

The UC Davis Covid test put existing technology to work in a new capacity – to conduct rapid, widescale, efficient and relatively inexpensive Covid-19 saliva testing. UC Davis is home to a world-class Genome Center, which uses state-of-art-technologies to understand how the heritable genetic information of diverse organisms functions in health and disease. The university leveraged the established infrastructure, technology and expertise of the Genome Center's world-renowned faculty to quickly develop a protocol capable of processing large numbers of saliva samples accurately and quickly. Director Richard Michelmore and his team at the Genome Center had the idea to repurpose for Covid testing a machine already used in agricultural genetics, specifically, the IntelliQube automated Polymerase Chain Reaction (PCR) instrument. This array-tape machine can run thousands of tests per day, far more than machines built specifically for medical diagnostics. Lutz Froenicke, who manages the DNA Technologies Core at the Genome Center, developed an ingenious method to use saliva directly, and UC Davis engineers built a custom machine necessary to help process the samples.

This saliva-based testing provided rapid results in 24 to 48 hours, and, beginning in 2021, all positive samples were typed against known variants of concern and later subvariants. UC Davis began offering tests to students in mid-September and to the local community in November 2020. In its first year of testing, the Genome Center processed more than 800,000 tests and found 4,444 positive cases. At its busiest, the Genome Center was processing more than 11,000 samples per day to accommodate the full opening of campus in August 2021. In total, the Genome Center processed more than 2.1 million saliva tests, including for Healthy Davis Together, on campus and in the county. Screening those who were symptom-free helped with early identification and tracking of Covid-19 cases on campus and in the broader community. Also important in the earliest days of the pandemic were extensive efforts to investigate cases and trace contacts when positive test results were identified.

Vaccination

Once vaccines became widely available, they became a big part of the Healthy Davis Together program. The program partnered with Yolo County Public Health, health and community-based organizations to provide vaccinations throughout the county. This included operating vaccination sites, supporting mobile vaccination services, and outreach to migrant farmworkers, unhoused community members and homebound individuals. The program also helped to provide transportation to vaccination sites.

Environmental Monitoring

Environmental monitoring was another key component of Healthy Davis Together. Researchers conducted regular testing of city and campus wastewater, as well as experimental sampling of indoor air and certain surfaces in K-12 schools. Wastewater testing proved to be an effective way to track and learn more about the levels of infection in communities and has played an increasingly important role over time as individual testing has decreased. Heather Bischel, assistant professor of civil and environmental engineering, led efforts to set up wastewater testing on campus. In collaboration with the city's public works department, this effort was expanded to Davis neighbourhoods. A public web dashboard allowed anyone to view up-to-date results of wastewater testing by neighborhood, and data at the campus and city levels continue to be publicly available to this day (Healthy Davis Together, 2023).

Public Health Ambassadors

Student employees were also integral to Healthy Davis Together. In fall 2020, when the university was planning for more students, faculty and staff to return to campus, the university's Department of Public Health Sciences hired more than 200 student employees ("Aggie Public Health Ambassadors"), who were initially stationed at high-traffic locations on campus and in the city. They helped raise awareness about the Healthy Davis Together program, provided free face coverings and encouraged healthy behaviours, such as hand washing, social distancing and vaccination. In addition to serving in paid positions with the university, these students received training, academic course credit and, as the pandemic unfolded, they received real-world experience in health education and public health practice. They also took coursework related to Covid-19, pandemics and global health.

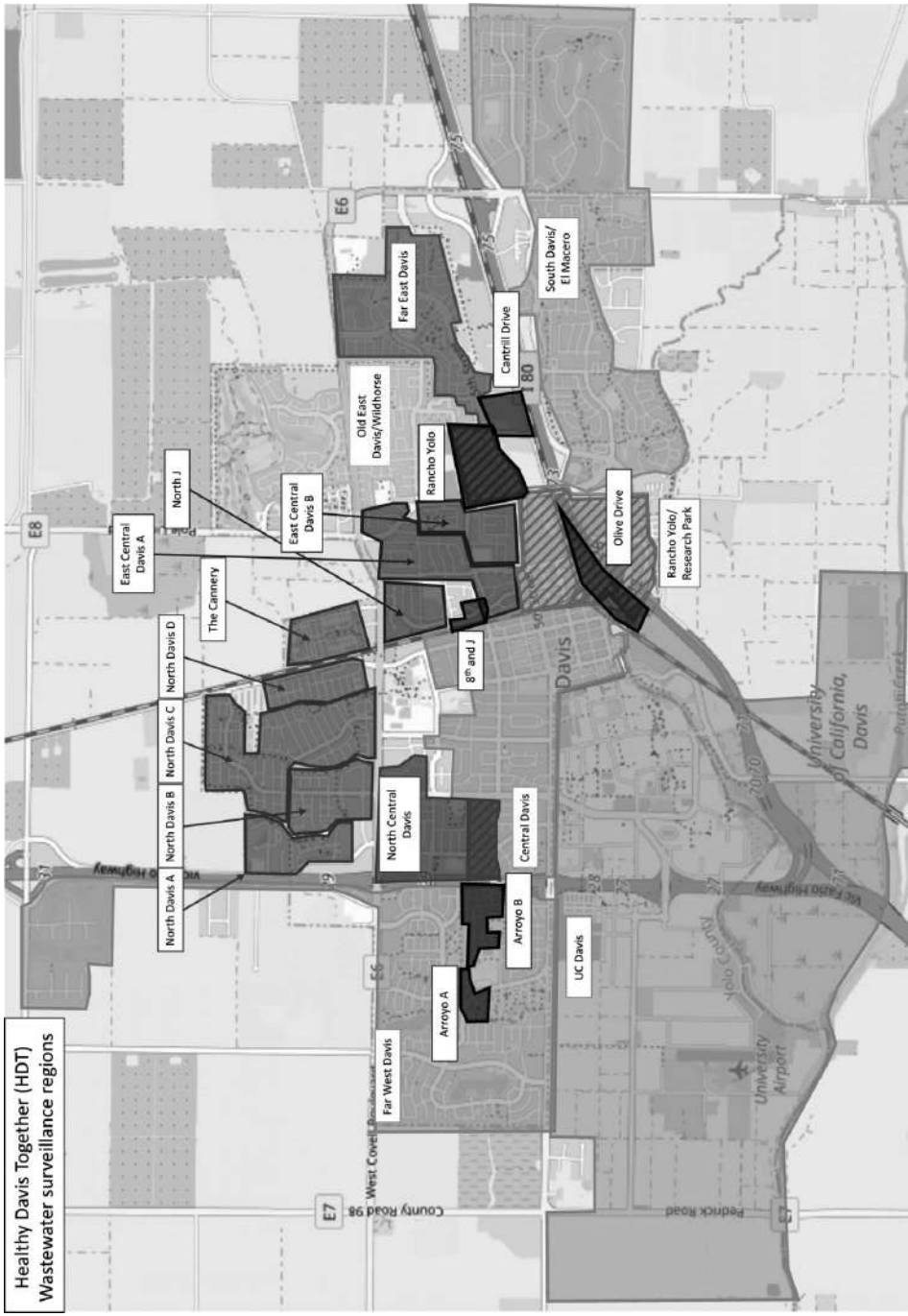

Figure 2 – Healthy Davis Together Wastewater Monitoring

Partnerships

Given the scale of the effort and numerous components of the program, the university and city could not accomplish everything alone. This is where partnerships came into play. More than 420 local businesses partnered with the program. Supporting the local economy was a priority for Davis city leaders, and business partnerships were a focus from the very beginning. With the Chamber of Commerce and the Downtown Davis Business Association, Healthy Davis Together delivered face masks, hand sanitizer and other personal protective equipment to local businesses and advised them on social distancing and other precautions. The program distributed US$365,000 in grants to enable Covid-19-safe business practices, and local businesses could sign up to be on a list of those practising good Covid-19 safety precautions. The program also purchased $480,000 in gift cards from downtown businesses, a move that retained spending in the local community. Gift cards were given as incentives for people to get tested and as rewards at testing sites. School partnerships were also key. Healthy Davis Together began with the Davis Joint Unified School District and eventually expanded to include four additional cities and five additional school districts. Healthy Davis Together leveraged these collaborations to safely reopen schools, through required weekly testing and eventual vaccination. Many other public and private partners supported Healthy Davis Together. Primary partners included the county of Yolo, California Department of Public Health, Davis Chamber of Commerce, Davis Downtown and Davis Joint Unified School District. Additional partners included the Yolo County Food Bank, First 5 Yolo, Deloitte, The Weiss Group, Mathematica and GMMB. The program also worked with more than 25 faith-based and community-based organizations.

Program Costs

Operating a comprehensive pandemic response program has its costs. Arguably, however, the costs associated with failing to take preventive measures are much higher. Treating a greater number of infections has potential to overwhelm health care systems and reduce economic productivity, not to mention the immeasurable cost of lives lost. Much of the success of Healthy Davis Together can be attributed to its approach to using resources for prevention and keeping positivity rates low. Healthy Davis Together was funded with a mix of university funds, state and federal grants, and philanthropy. The university was very fortunate to have philanthropic gifts fund the majority of the effort. In the early days of the pandemic, an anonymous donor approached the university with a desire to give toward what they believed would help make UC Davis a model for pandemic response. Overall funding for Healthy Davis Together totalled approximately $50 million. About 80% of that – $40

million – came from philanthropic gifts. The rest came from in-kind contributions from UC Davis – such as administrative functions, utilities and custodial services, which the campus valued at $5.7 million; in-kind contributions from the city of Davis; $1.5 million in American Rescue Plan money allocated to the city; and other state and federal funding.

The chart below shows the estimated public benefit return on investment. The program costs are shown on the left. The estimate savings are shown on the right. The combination of the first two bars in the right panel represent the highly significant savings in direct health care costs alone. The third bar includes the incremental return from life years saved.

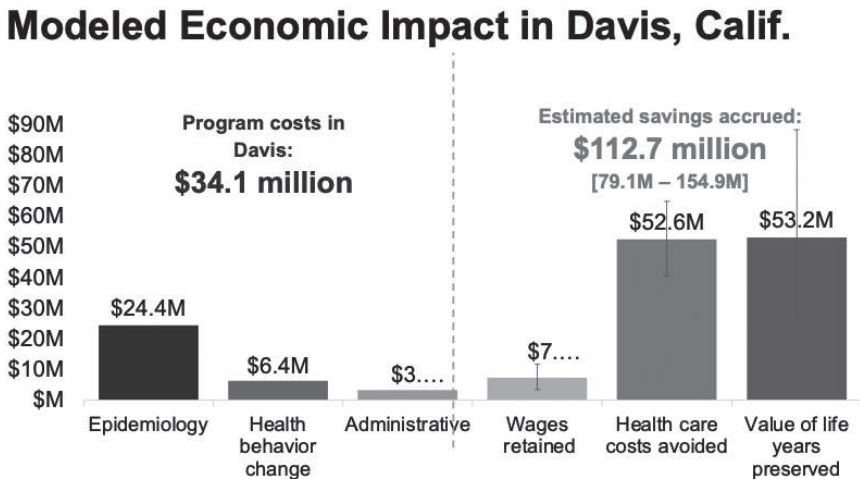

Figure 3 – Modeled Economic Impact
(Credit: Brad Pollock, 2022)
Note: because stimulations were conducted for category-specific and overall savings, total does not nexessarily equal the sum of its components.

ACCOMPLISHMENTS

Healthy Davis Together, along with its partners, played an integral role in the health and safety of students, faculty and staff who continued to live and work in town throughout the pandemic and then helped to successfully reintroduce in-person instruction at the university and secondary schools throughout the county. The campus and city of Davis maintained very low infection rates compared to California's rate overall. The test positivity rate peaked at 2.7% in early January 2021 in the city of Davis, compared to 17% statewide at the same time. For most of the pandemic, the test positivity rate

was well below 2%, and the vaccination rate was 98% in the city of Davis and at the university.

In its nearly two years of operation, from September 2020 through 30 June 2022, Healthy Davis Together had broad impact. The program:

- Conducted more than 871,245 Covid-19 tests;
- Detected 15,825 positive cases;
- Administered 16,000 Covid-19 vaccines;
- Collected more than 10,200 environmental samples, including from air filters and wastewater;
- Provided free testing, grants and other resources to help keep over 400 Davis businesses open; and
- Supported more than 50 K–12 county schools with testing and education materials.

RESULTS TELL THE STORY

As the months of the pandemic wore on, the numbers recorded by Healthy Davis Together began to tell a story of success. Through our combined efforts, we not only slowed the spread of Covid-19, but we also saved lives. Two studies highlight the effectiveness of Healthy Davis Together in keeping positivity rates low, preventing illness and saving lives. While other college towns and communities across the nation saw their Covid-19 positivity rates spike, Davis saw low positivity rates – often well under 1%.

One study published in the *American Journal of Public Health* looked at the period from 18 November 2020, when Healthy Davis Together launched its first testing site in the community at the Davis Senior Center, through 30 November 2021. It assessed health behaviour change and compared the test positivity proportion between the city of Davis and the rest of California. The results pointed to a community whose residents were vaccinated at a higher rate and received Covid-19 testing more frequently than non-residents. "Building partnerships with organizations, government and key stakeholder groups, while combining epidemiological and health behaviour change approaches was achievable and likely generalizable to other college towns and to other types of communities. Our multimodal Covid-19 community intervention program resulted in favourable changes in key self-reported health behaviours (e.g., asymptomatic testing and vaccination). Case positivity proportion was much lower in Davis compared with other areas" (Pollock *et al.*, 2022).

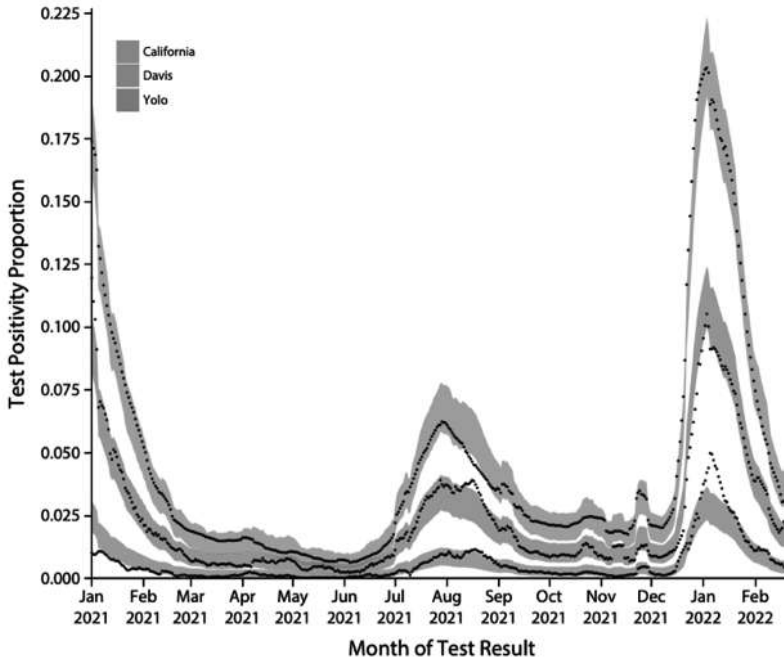

Figure 4 – Comparison of Test Positivity Proportion

Note: Comparison for the State of California, Yolo County and the City of Davis for the period from January 1, 2021 to February 23, 2022. The 95% colored confidence bands were estimated from a beta-generalized linear mixed effects model regression of seven-day moving average positivity proportions. State of California data exclude all Yolo County residents, however, Yolo County data include Davis residents. (Credit: Pollock et al, 2022)

An independent evaluation from Mathematica concluded that Healthy Davis Together reduced Covid-19 case counts by 60% in the city, in addition to avoiding 4,144 cases of Covid-19 and 275 Covid-19-related hospitalizations. The analysis also estimated the program averted 35 Covid-19-related deaths during a 16-month period from October 2020 through January 2022 (Mathematica, 2022).

LESSONS LEARNED: REPLICATING A SUCCESSFUL MODEL

Healthy Davis Together offers a successful town-gown model that can be replicated to address any number of issues or emerging challenges. This model can be generalized to other similar communities and individual components

can be generalized to even broader types of communities. Indeed, over the course of the program, the team shared best practices and lessons learned in the hopes that other institutions, college towns and communities might replicate all or portions of the program. At UC Davis, we are already working to apply this model to other issues. We're partnering with the city of Davis and Yolo County on a new initiative called "Hate-Free Together", which is asking our communities to take action against the rise of hate incidents by joining together to condemn hate and cultivate change. In this case, rather than Covid-19, hate is the virus we are trying to eradicate.

Following are five suggestions for how to put this model to work.

1. Communities must be integral partners. UC Davis is increasingly focused on engaged research, with an approach that is guided by co-creation, shared knowledge, reciprocity and mutual benefit. The best community-university partnerships will leverage these kinds of values to achieve the greatest gains. In small university towns like Davis, our local communities are inextricably connected and represent one of the greatest opportunities for innovation and positive steps forward. UC Davis created the Office of Public Scholarship and Engagement three years ago for this exact purpose – to support community-university partnerships that further our mission of research, teaching and learning. This means we're dedicating the necessary resources to support collaborations. Through internal research at our university and taking part in national conversations with engaged scholars, UC Davis has developed several new faculty, student and community-focused programs and policies that support mutually beneficial partnerships. Strong and productive community-university partnerships must be part of the equation if we wish to create resilient, sustainable communities. These partnerships help universities advance their missions, address challenges and imagine a better future for everyone.

2. Communication is key. UC Davis benefited from having well-developed relationships and established collaborative efforts with the city of Davis and Yolo County. All three organizations entered into a memorandum of understanding in 2018 to further shared commitments to build more housing and make traffic improvements, among other things. As part of this effort, all three institutions were communicating regularly and taking part in annual town hall meetings, as stipulated in the agreement. This provided a framework for the university, city and county to have ongoing discussions and be proactive in matters of mutual interest. Because of the good relations that existed before the pandemic, UC Davis was well positioned to take action. Leveraging this existing framework helped us get up to speed quickly and mobilize our collective resources to jointly address the crisis through Healthy Davis Together.

3. Town-gown relations are just the beginning. We must explore many mutually beneficial partnerships. Higher education is increasingly being called upon to partner other institutions of higher education, government, business and nonprofit organizations to coordinate our responses to emerging problems. To address the immense challenges facing the world today, we'll need new perspectives and visionary action. We will need to redefine the relationship between science experts and other community members. We will need to rethink how we can leverage scholarship and research in partnership with others. UC Davis is doing just that with a new initiative we call "Grand Challenges". It was created with the understanding that the limits of expert knowledge to tackle grand challenges underscore the need for greater and more reciprocal engagement between the public and different sectors, including institutions of higher education. The idea is to bring a holistic approach, to draw upon our institutions' greatest strengths, innovative spirit and collaborative culture. It's important to note that UC Davis shared expertise and approaches with other universities early in this process. When developing the rapid saliva-based test, the university needed test samples for validation. The University of Illinois and Arizona State University provided samples. We're stronger when we harness our collective knowledge, resources and action in pursuit of a common goal.

4. Look for ways to leverage university capabilities and expertise to benefit neighbouring communities and far beyond. Like many universities around the globe, UC Davis has a strong inclination toward multidisciplinary collaboration and bringing together world-renowned experts across a range of fields. Research universities have a critical role to play in the face of a society overwhelmed by a new problem. This applies not only to research with long-term goals, but also to immediate actions that can bring creative solutions to critical problems, and doing so with local, regional and global partners. Healthy Davis Together was a natural collaboration for our university because it aligned with our public service mission.

5. The time for planning is now. Sustainable, resilient communities must plan *before* the next crisis occurs, whether for the next pandemic or any number of other challenges we cannot yet imagine. In the early days of the pandemic, there was a missed opportunity for greater organization and collaboration among research universities. Doing the advance work to forge the appropriate mechanisms that will ensure good communication and partnership between the great research universities of the world will go a long way to ensure future resiliency and a prompt, coordinated response.

Collectively, these steps will help us prepare for – not if, but when – the next local or global problem emerges. This is how we ensure that our universities and our surrounding communities are sustainable, resilient and ready to respond to any new challenge on the horizon.

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Chapter 11

How do Universities Serve Societies to Improve their Future Resilience? Higher Education Revisited

Kerstin Krieglstein & Nadine Krolla

GLOBAL CHALLENGES AND THE MEANING OF FUTURE RESILIENCE

Social challenges and crises have undoubtedly increased rapidly and in complexity in recent years. The Corona pandemic virtually paralysed social life worldwide for years. Climate change is becoming progressively noticeable – even in Europe. The developments in Syria and Afghanistan, the war in Ukraine, challenge democratic and peaceful values. They are causing suffering, insecurity and economic inflation worldwide. What these crises have in common is that they – from a European perspective – affect society much more directly and personally: The consequences of the Corona pandemic have massively restricted our freedom of movement, our social interaction with each other, ultimately also personal rights. In Germany, in particular, it has brought the entire school and university system to unimagined limits, the consequences of which are still being felt today, especially by children, adolescents and young adults. The confrontation with climate change is no longer taking place somewhere on a distant continent but virtually on our doorstep, through flood disasters, forest fires and young

people gluing themselves to the street. The war in Ukraine, under the heading of "energy crisis", has not only made us freeze in winter, but has also made us acutely aware of our dependence on Russia and other states. This may be one of the main reasons why these global crises became much more prominent in the media and in public awareness, at least in Germany. In addition to widespread attention in Internet platforms, television programs are filled with talk shows that bring politicians, journalists and scientists to the table. Central questions and developments of the crises are discussed here in continuous loops, the most diverse positions clash, and finally hardly any clear answer is found. In some broadcasts, citizens can voice their concerns and questions, in which mostly politicians have to answer. Although the scientist is often the only person with truly sound expertise, this no longer has to mean that he or she is believed or trusted the most. The winner is the one who sells his opinion best in terms of communication. In this way, scientific facts run the risk of being perceived only as "one" opinion. Even if the scientist speaks in this panel discussion, one can hardly speak of science communication here. Whether television is a suitable medium for knowledge transfer in these formats remains to be questioned. Because it is up to the viewer which "opinion" he follows. Particularly during the Corona pandemic, scientists and scholars increasingly became involved in these formats. An impressive example of how scientists can also come under personal pressure from the media and society and be discredited in the public eye was something I demonstrated at the last Glion Colloquium for the renowned virologist Christian Drosten (Krieglstein & Gerenstein, 2022). The global challenges of our time are no longer a matter of foreign policy, no longer a mandate for science, but belong to the discourse of society. The intertwining of socially pressing issues, political leadership and scientific facts has rarely been as complex as it is today. I will come back to this later. What is clear, however, is that society expects answers to the current challenges of our time and to the pressing questions for a more resilient future. Not only from politics, but also from science. Of course, research has always borne responsibility for its actions, its results and for society. But it is only in these times that it is becoming more and more of a request. A recent trend study by the Zukunftsinstitut gets to the heart of it: "Der Modus der Krise [ist] zum festen Bestandteil einer neuen Normalität geworden." *Translation: "The mode of crisis [has] become an integral part of a new normality."* (Zukunftskraft Resilienz, 2021; p. 12) .Societies are thus increasingly facing massive challenges, geopolitical risks and changes that will require fundamental transformation processes, radical redirections and structural changes. For many aspects of life, "clinging to the status quo" must give way to "embarking on reinvention". For some time now, the term "resilience" or "future resilience" has been used to describe the process of successfully facing social or global challenges and crises. Resilience of a society

is characterized by the recovery from significant and most likely unknown risks and/or by adjustment to crisis situations. Today – it seems – the crises and the associated challenges in society have more and more led to insecurities, fear of change, fear of the unknown. Globalization issues are being renegotiated: The Corona pandemic and the Ukraine war have highlighted massive dependencies in import trade. Trust in other countries and societies is declining. Increased production in "one's own country" is supposed to bring solutions. Citizen-science, conspiracy theory and right-wing extremist currents are on the rise, the space for alternative facts has never been greater in modern times. It is already clear here that facts and knowledge alone cannot be the key to future change and resilience. Climate change is a key example of how scientific findings, economic and political interests and societal demands can drift so far apart that they obstruct each other from finding solutions. Rather, knowledge must be significantly linked to proper communication and trust-building, in order to lead to necessary changes.What has become clear from the public debates on the current crises of the last few years: lack of or wrong communication is one of the central problems. The uncertainty of society is largely based on the feeling of unclear, non-transparent or unreliable communication.

THE ROLE AND TASK OF UNIVERSITIES

Now, which role should universities play in securing society's future?

Comprehensive universities are undoubtedly among the hot spot of knowledge that should be able to provide insights to many if not all relevant topics our societies are built or rely on: public health, economics, inequality, climate chance, agriculture and challenges of global order. The Federal Government of Germany has identified research as an important strategic cross-cutting issue for a "defensible democracy and an open and diverse society" (Zukunftsstrategie 2023, p. 74: "wehrhafte Demokratie und eine offene und vielfältige Gesellschaft").

They see a "successful contribution of science to societal resilience and development capacity [...] in the successful transfer of scientific insights to society and politics [...] and in societal discourse." (Zukunftsstrategie 2023, p. 74: "Ein erfolgreicher Beitrag der Wissenschaft zur gesellschaftlichen Resilienz und Entwicklungsfähigkeit setzt einen gelingenden Transfer von wissenschaftlichen Erkenntnissen in Gesellschaft und Politik wie auch einen Austausch über die Implikationen dieser Erkenntnisse und gesellschaftliche Diskurse voraus.")

In his keynote presentation "The Social University in a Scientific Society: an appeal for interspaces" at the LERU rectors' assembly in May, Peter-Paul Verbeek impressively illustrated – using the example of the Corona pandemic

– that global challenges have also significantly changed the role of universities in recent years.

The global crisis "has intensified a process that had already been long underway. Science and society are becoming increasingly intertwined; as science focuses more on society, society is becoming more scientific. Politicians can no longer make well founded choices without science and research. […] The valorizing university has become a socially engaged university" (Verbeek, 2023).

Professor Verbeek shows three developments in which arise new spaces where universities can connect with society in a meaningful way.

First: Science is playing a more central role given the enormous challenges society is facing.

Secondly: Scientific knowledge is no longer generated by universities alone. Non-university research institutes have become much more important, especially in the Corona pandemic. (In Germany, for example, the Robert Koch-Institut [RKI] and the Paul-Ehrlich Institut [PEI].) Universities need to define their position in this new landscape of scientific research.

Thirdly: "Science itself has become more accessible to society and more transparent in recent decades […] Society is no longer simply the recipient of scientific knowledge: society is now an active participant in the practice of science."

It is all the more astonishing that the already cited and comprehensive trend study Zukunftskraft Resilienz names and expands "the spheres of resilience" with planet, people, society and economy, but does not mention science or research. Doesn't science in particular also have to develop and reinvent itself here as a central element for "resilience as a force for the future"? Is science not also to think in larger contexts of nature, human and society? Why is science not being considered here? Have we failed to properly communicate our contribution to the future?

Universities therefore have to establish themselves proactive as a reliable institution of knowledge transfer for the public and especially for all decision-makers, e. g. politicians.

SCIENCE COMMUNICATION

Providing information, building trust and explaining knowledge are best done by science communication.

In 1999, the German science organizations, together with the Stifterverband, recognized that science had to step out of the ivory tower. In the declaration *Public Understanding of Sciences and Humanities* (PUSH-Memorandum), they advocate new communication structures that enable citizens to actively participate in scientific discussions, recognize the cultural

achievements of science and reduce reservations about scientific achievements. Compared to other countries such as England or the US, however, Germany is rather a latecomer in this development.

In the sequel political initiatives were also taken at the federal level to better understand the interactions and exchange between science and society in view of the great challenges of our time, to strengthen them structurally and to promote them in a targeted manner (for example, the establishment of the #FactoryWisskomm forum, which developed recommendations for science communication in 2022).

In a position paper of the German Council of Science and Humanities on "Science Communication" published in 2021, this is examined from various perspectives. With regard to the question discussed here: How can universities contribute to resilient societies, I would like to summarize the following theses:

In a society based on the division of labour, trust is a central prerequisite for the acceptance of highly specialized knowledge that cannot be verified by the individual (Vertrauen in die Wissenschaft / Wissenschaftskommunikation, 2017, p. 28). This is primarily, but not only, about transparency and compliance with good scientific practice. Especially in the field of new technologies or questions of artificial intelligence, science must also convince that its work and its results are carried out independently of third-party funding sources.

But this is not the only prerequisite for successful knowledge transfer. Science communication must also be able to express its content in a way that is understandable to a lay person or to specific target groups. In their disciplines, scientists usually had to first acquire a technical language, which they ultimately have to translate back into a comprehensible language for society. In future, this aspect should already be taken into consideration during studies. Today, the training of a scientist should also include communicating the contents and results of his or her work in a way that is understandable to society. (Wissenschaftskommunikation, p. 41)

Science communication must also deal with the fact that topic-specific reservations about science in particular can exist where they may conflict with social identity concepts, personal convictions or the direct concern of the individual (Wissenschaftskommunikation, p. 33). Science communication can reach its limits here and must be aware of its limiting factor. (Wissenschaftskommunikation, p. 34 / FactoryWisskomm, p. 57).

This limitation can certainly be countered with the recommendation to involve society in the question of what science communication should be. (FactoryWisskomm, 2021, p. 53ff.) But is this sufficient to convince of the state of scientific knowledge in individual cases?

A particularly striking example is the vaccination debate surrounding the mRNA vaccine in the Corona pandemic. Again, I can only speak from

a European or German perspective: The Corona pandemic swept through Europe in waves and zoomed upwards the mortality rates in all countries. Not only hospitals, medical staff and funeral homes, but also society as a whole was helplessly exposed to the death-dealing violence of this virus.

In this atmosphere of fear, salvation was promised by the rapid development of a vaccine against the SARS-CoV-2 virus, with the help of a completely new immunization technology based on the mRNA principle, which was already known from cancer research.

mRNA vaccines contain gene segments of the SARS-CoV-2 virus in the form of mRNA. The mRNA can be read inside body cells after vaccination. This produces proteins (e.g. the spike protein of the SARS coronavirus-2), but not the whole virus. The finished proteins are then shown to the immune system, which reacts with targeted antibody formation against the SARS-CoV-2 protein and cellular defence against SARS-CoV-2 infected cells. mRNA-based vaccines have the advantage that they can be adapted very quickly to new variants of a virus and produced in large numbers within a few weeks. (Robert-Koch-Institut)

While the scientific community – via podcasts or the previously mentioned media – tried to convince people of the benefits of the vaccine, the fear, held by many citizens, of this novel type of vaccine opened the door not only to understandable reservations and anxiety, but also to the most abstruse conspiracy theories.

Understandable reservations were: the novelty of the technology, in which trust could not yet be built up (lack of studies and empirical values); lack of validating clinical studies parallel to the rapid development of vaccines; lack of knowledge about possible over-reactions and long-term consequences after vaccination, the lack of knowledge about what exactly happens in the body with this new type of vaccination.

It was not helpful that the Ständige Impfkommission (Standing Commission on Vaccination) for one thing often took a long time to make its recommendations. This only fuelled existing uncertainties. On a different note, it shows once again the strong responsibility that the commission had to take on.

The credit of trust in science and an innovative technology here had to be immensely high. And this applies to researchers from outside the field too.

The reliability of (communicated) knowledge has rarely been more important than here. This also and once again leads to the question: How can the lay person know that he or she is dealing with serious knowledge transfer? How does one make oneself more credible than others? And this especially in times when any lay person can generate texts by means of ChatGPD that can appear completely serious at first glance?

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So, what can we contribute to a better and more resilient future for society?

What is particularly evident in the current crises is that the delicate moment is where change becomes necessary. Especially in Western democratic societies, the fate of the individual is much more central than in other societies. Changes here need persuasion, not only from science, but above all from politics. Knowledge transfer reaches its limits where it is supposed to lead to rethinking and structural changes.

But, without mass vaccination, a virus like Covid-19 cannot be contained. Climate change cannot be stopped without reducing waste, methane or CO_2. A return to the status quo is not possible for a more resilient future. For a better future, the only way is adaptation and adjustment, even if it means profound changes.

So how can science, how can universities contribute to not only transferring knowledge to society, but also to launching the necessary changes resulting from it in the long term? Shouldn't science already have a stronger influence on politics? Is this a question of governance of science (communication)?

However, I suggest that universities have a much broader responsibility for society, explaining science by means of science communication should not only be a service but should develop towards a trust-based relation between university and society.

Society rightly expects answers and solutions for the pressing challenges of our time.

The relation between university and society should develop in both directions, meaning universities have to listen to individuals, families and society, should sense their needs, their sensitivities and their potential existential threats. "Universities are places where critical and independent thinking can coexist with engagement, without one dimension having to overshadow the other." (Verbeek, 2023).

With this information, particularly in crisis situations, universities may serve as more suitable knowledge- and advice-providing institutions.

To really serve as a valuable and sensitive sensor for society, universities should translate the needs of the individuals and the society in opportunities of higher education.

This may range from development of future skills, such as data literacy, or more global oriented study subjects as public health or sustainability management, city development or mobility management overcoming disciplinary and national borders.

Universities have their long-standing responsibility in research and teaching and in future responsibility for a resilient society.

Science communication is one more key to better understanding this society and finding the right solutions for its future. However, this can only lead to solutions for a more resilient future on the basis of a trusting, transparent and mutual relationship.

SUMMARY/CONCLUSION

The global challenges of our time are no longer a matter of foreign policy, no longer a mandate for science, but belong to the discourse of society.

Society expects answers to the current challenges of our time and to the pressing questions for a more resilient future. Not only from politics, but also from science.

Central questions and developments of these challenges are discussed in the media in a wide variety of formats with politicians, journalists and scientists, giving the impression that the scientist's expertise is only perceived as one opinion, not as the result of years of research.

Consistently the public debates on the current crises of the last few years make this clear: The uncertainty of society is largely based on the feeling of unclear, non-transparent or unreliable communication.

The global challenges of recent years have also significantly changed the role of universities. The responsibility we bear for research, teaching and transfer to society has not only become more tangible, but universities have become socially engaged and involved places.

In this new context, universities have to establish themselves as proactive as a reliable institution of knowledge transfer for the public and especially for all decision-makers, e.g. politicians. Science communication is one key to this aim.

Universities should not only be mediators of knowledge, but should also be able to initiate necessary processes of adaptation and change for a more resilient future in an advisory capacity.

To this end, the criteria for sound and serious science communication should be made more transparent and accessible to lay persons.

Even though the importance of science communication as a key to dialogue with society has been recognized, it can only make a limited contribution to overcoming social polarization (FactoryWisskomm, 2021).

To really serve as a valuable and sensitive sensor for the society, universities should translate the needs of the individuals and the society in opportunities of higher education.

In the sense of a "governance of science", it must be important in the long-range to become even more aware of the responsibility of science and to find a relationship with society that is based on trust.

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Chapter 12

Developing a Global Brand for Excellence

Michael Spence

In referring to the issue of "recognizing" the value of different types of university work, the questions raised in this section of the Colloquium program remind us of an important fact. That is, that universities, as well as being primarily involved in the business of talent management, are equally involved in reputation management. Michael Spence (not the author) was awarded the Nobel Prize for the insight that a college education (and, by implication, a college education to different degrees, depending upon the reputation of the college), signals value to prospective employers in an employment context of information asymmetry, and does so independent of any evidence that the college education actually adds value to the skills and knowledge of the prospective employee. What is true for the individual is *pari passu* true for the institution; a university's capacity to attract talented staff and students, funding, philanthropy and so much more, depends upon its ability to develop a reputation for "excellence" and even better "global excellence".

A significant difficulty is immediately apparent. The notion of "excellence" in university performance partly depends upon which of the various social goods to which an institution might be committed it chooses as its focus; whether it is research, education or community engagement, each itself a diversely understood and contested concept.

For a small number of institutions, this represents little difficulty. These tend to be of two kinds. First, there is the handful of institutions that by reason of age, resources and a long process of the development of social capital (particularly in jurisdictions that have been internationally politically,

economically and culturally dominant) have entered the global premier league of universities, the names of which are synonymous with generic excellence. For these institutions, their reputations are extremely resilient; it would take decades of underperformance for Harvard to stop being Harvard or Oxford to stop being Oxford.

Second, there are the specialist institutions, the unique offering of which permits them to develop a strong brand for excellence within a given field (though again, of course, age, resources and location in a current or former imperial power help in the development of that brand). Into this category of institution, one might put Caltech or the LSE.

But this problem is more acute for large comprehensive, research-intensive universities outside a handful of global household names, particularly those that aspire to more than local recognition and particularly those in the majority world.

This is, of course, what has fuelled the rise of the so-called leagues tables. A simple ranking, a grade if you like, allows what might otherwise be a generic brand to attract the prestige of global recognition. Indeed, it does so with some false precision; it places a university at a particular point on a scale of institutions apparently sufficiently homogenous in their missions to be able to be compared. The absurdity of the rankings in their assumption of comparability means that they are treated with some contempt; but their enormous utility for the comprehensive research-intensive institution that aspires to global recognition means that they have enormous power in our sector, power with prospective students, with staff, with governments and with other funders. It means that they have evolved from being special features in trade journals to major businesses, creating, in their turn, activities in universities devoted to improving the rankings performance of the institution. The global investment in the rankings industry must be very significant indeed. But there must be a better way for universities to promote their reputation for "excellence", however that elusive concept is understood.

This paper explores the problems associated with developing a brand for a comprehensive research-intensive institution not in the tiny global number of household brands, and asks how, aside from through the rankings, such a university may approach the question of global recognition. It suggests that there might be a particular role for the university president in that work. In doing so, it is helpful to begin with a comparison of reputation management at my former university, the University of Sydney ("Sydney"), and my current institution, University College London ("UCL").

In many ways, the Sydney and UCL share similar foundational stories and, in marketing terms, similar "value propositions".

UCL was founded in 1826 as the third university in England, after Oxford and Cambridge, at a time when it was necessary to sign the 39 Articles of the

Church of England to study at either of the existing institutions. The new university, founded as the London University, was to be open to all (men) and to have a distinctive mission. Contrasting its purpose with what they regarded as the "polite learning" of the ancient universities, UCL was to pursue "useful knowledge" in both its activities of knowledge production and knowledge generation.

So scandalous were these twin goals at the time that UCL was unable to acquire a Royal Charter establishing the institution and giving it degree-granting powers, and King George IV, the Bishop of London and the Duke of Wellington established the King's College in competition with UCL by a Royal Charter of 1829. UCL persisted in its campaign for a Charter. Thus in 1836, the government established the University of London with degree-granting powers, changed the name of London University to University College, London, and UCL and Kings became the two founding constituent colleges of the University of London on the Oxbridge model. Over time, however, the University of London has become a looser and looser association of institutions, and most of its colleges, including UCL, have degree-granting power and the status of independent universities. UCL is now the largest (save for the Open University) and most comprehensive university in the United Kingdom.

Perhaps more importantly, the twin foundational commitments of UCL to openness and to the production of "useful knowledge" remain core to our self-conception. A solutions-focused, multidisciplinary approach to our work has proved remarkably resilient in the life of the institution; UCL remains a university that prides itself on its close and open engagement with the communities that it serves in work around problems important to them. This claim can be instantiated in many examples. But asked to describe our "brand" or our so-called "USP", at the highest level, and we would reach for something around this foundational narrative.

The University of Sydney was founded in 1850 as part of the same social movement for public secular education that inspired the establishment of UCL. Like UCL, it was to be a university open to all (or, at least, to all non-Indigenous men), and the University still proudly points to a speech made by one of its founders in the NSW (New South Wales) Legislative Council declaring that the gates of the new university would be "open to all whether they are disciples of Moses or Jesus, of Mahomet, of Vishnu, of Buddha". The founding legislation of the University, the University of Sydney Act 1850 (NSW), made it clear that a core purpose of the new institution was to be "the promotion of useful knowledge". Like UCL, Sydney has clung to a narrative about openness, about a tendency to disruption, and about a desire to bring useful change, as its birthright. It has grown to be large (73,000 students to UCL's 44,000) and comprehensive (at one point Sydney would

proudly claim that it was more comprehensive than any other institution in the top 200).

Despite these similarities, there is a difference between these two institutions that ought to make reputation management easier at UCL than at Sydney. UCL is invariably ranked in the top 10 institutions globally (at least in those rankings we most like to cite), while Sydney is ranked in the top 50 (in those of which they are most fond). UCL has a number of individual disciplines ranked in the top handful in the world, including, for example, Education, which, as far as we know, is the only discipline at a university that has ever been ranked in the QS Subject Rankings as first in the world 10 years running. The QS top 10 is littered with global household brands of the likes of Harvard, Cambridge, Oxford and Stanford. If the rankings reflect the quality of a university's work and if reputations were built on quality, then my current work in promoting the reputation of UCL ought by rights to be easier than the task I had in promoting the reputation of Sydney.

But university reputations are built on far more than the actual quality of an institution's work. A reputation for quality takes a very long time to build, so an institution can be doing excellent work and its reputation lag. For established institutions, their reputation often takes a long time to dilute, even when the quality of the institution's work in particular disciplines, or perhaps overall, is not what it once was. Moreover, the reputation of a university is affected by all sorts of extraneous factors. One in-house brand survey among prospective students, for example, showed a strong preference for studying Agriculture at UNSW in Sydney ("UNSW"), over studying it at the University of Sydney, even though Sydney has been teaching and researching agriculture for longer than any other institution in the country, and UNSW does not offer any teaching in the field at all! This is presumably because in local lore UNSW is a "technical" and "scientific" university, while Sydney is a "medical" and "humanities" university, though both are fully comprehensive.

As a result, it is perhaps less surprising than it might otherwise be that my task in promoting UCL is actually far more difficult than was my task in building the reputation of Sydney. Just as, at least by institutional folklore, more people in India knew of the Oxford Dictionary than of Oxford University, so Sydney enjoyed an enormous spillover effect from its position as the civic university of a globally recognized and admired city. On announcing that I was from the University of Sydney, people who knew nothing of the institution had a sense that they ought to know the institution, and that its work must be excellent, because of the brand association with an attractive city in a developed economy. By contrast, UCL often seems to be the best university of which no one has ever heard. Our three-letter acronym is poorly recognized outside the United Kingdom and is easily, and often, confused with UCLA in California. Our fuller name, University College London, does not read

as the name of the civic university of London as a city, not least because of the confusing semantics of the word "college", and because of the odd use of "university" as an adjective. Moreover, the University of London has long run a global extension education activity, relying on the teaching of the constituent members, and so the brand "University of London" has some international currency that renders the promotion of our distinct brand all the more difficult. These confusions occur even within the local market: there is a story in the institution, too good to be wholly apocryphal, of a Radio 4 debate between two academics, one said to be from "University College London" and the other said to be from "UCL"!

On one level this may not matter. UCL produces first-class work and has no difficulty attracting outstanding staff and students. There is a passion for excellence in the place that drives performance and a commitment to impact that means our research and teaching genuinely make a difference to the communities that we serve. Our peers and those with whom we work know the quality of what we do and are very loyal.

But at another level it does matter. Academics develop their careers not just through the development, but also through the dissemination and promotion, of their research, and the stronger the brand of their institution, the easier that is to do, particularly for junior researchers. Donors and others like to be associated with the strongest brands. Generous American supporters of UCL recently told me that the most common question that they get in the United States in relation to their United Kingdom giving is why they give to a university of which no one has ever heard and not to Oxford or Cambridge. In their case the answer is because of the strength of our work in a particular field, but for every donor that takes the effort to identify premium quality, there will be one that simply opts for premium brand. The same can be true for governments and corporates. Moreover, if this is true for UCL, how much more must it be true for excellent universities in the majority world, keen to develop a global reputation for the quality of their work.

Even if the strength of a university's brand does matter, the tendency among many university leaders is to shrug and to point out that the household names have history, money and usually imperial power on their side, and that the process of developing a university brand is difficult to short circuit. But, as custodians of institutions quite so dependent upon the cultivation of our reputation, there is a strong argument that a university ought consciously to work to promote its brand, and there is evidence that doing so can yield results. Moreover, it is arguable that the most senior university leaders have a particular role in this task.

It is my experience from Sydney (and increasingly from UCL) that four relatively routine aspects of brand management, which are very complex in their application to the university context, do help build local and global

reputation if they are rigorously pursued. None of these four aspects of brand management answer questions concerning the modalities or geographies through which a university's brand ought to be promoted, but each is something important to get right prior to answering such questions.

ARTICULATE A CLEAR INSTITUTIONAL IDENTITY

We have all been given this challenge. But at this point, most university leaders roll their eyes and wonder why they paid the brand consultants! How can a complex institution be reduced to a single identity, far less one that is somehow distinctive, when most universities pursue very similar purposes? And how can that identity be made attractive or relevant to stakeholders as diverse as governments and potential undergraduates?

At this point, I think it is crucial to distinguish an important and difficult task, from an impossible one. A university identity needs to be authentic. When it is embodied in various ways, people within the broad community of the university need to recognize it as something that they can own, as something true to their values and, perhaps, to their history. It needs to be something for which, without much thought, members of the broader university community can produce "roof points" of various kinds in the life of institution either now or in the past. Similarly, it needs to be something that has enough "bite" so that people within the institution itself can use it to commend, and to critique, aspects of the university's life and work. It needs to reflect something "real" about the institution, and also to help shape that reality.

However the articulated identity of a university does not need to be "unique". To find a unique identity for a large, comprehensive, research-intensive university would be almost impossible. The Sydney and UCL foundational commitments to access and to useful knowledge are interesting examples of the distinction between authenticity and uniqueness. It is not merely that these two institutions share similar foundational stories, diversity and impact are ubiquitous university commitments in the modern world. There is not a university in the Western world that does not lay claim to those attributes. But at Sydney and UCL those foundational commitments continue to have a powerful identity shaping force, they are a part of the account of the institution that staff and students give when they explain why they enjoy working for the university and when they explain to others what makes those institutions "different", even if that claim to difference is somewhat overstated. They are also, in each, foundational to a claim of a distinctive culture of multi-disciplinarity.

Authentically articulating the identity of an institution is difficult for two reasons. First, the many different parts of an institution, particularly if they have strong brand histories of their own, may have difficulty articulating a

shared identity at all but the most general level of abstraction. This is especially so because that identity must be given expression in narratives that speak into very different stakeholder communities. The identity of a university must be capable of expression to policymakers and high school leavers, to doctors, artists and engineers. Rare are the comprehensive universities that are able to find an identity narrative of the specificity of, for example, James Cook University in Australia, that has carved out a place as a "university of the tropics" and been able to use its geography to shape its identity narrative and to use that narrative to shape the focus of its research and educational offerings. Most comprehensive universities lack so clear an opportunity for positioning.

But, second, while the claimed identity of an institution need not be unique, it cannot be wholly generic, it needs to be sufficiently specific to be meaningful. Much of this will come in the power of the proof points that can be offered. For example, a university may claim to be at its core a place of free enquiry, but, if its academic departments are marked by a certain ideological homogeneity, this identity narrative will be difficult to sustain. If it is always causing scandal through the radical, and radically varied, speakers that it hosts, the claim will have much more authenticity. If a community perceives the variety of voices on that campus to be genuinely more varied than those at similar institutions, a generic claim can become quite a powerful and authentic identity positioning. The importance of these proof points is why "living the brand" and letting the identity narrative shape, as well as reflect, institutional practice, is so important. That is a particular challenge for university leaders who need to use the brand as a guide for decision-making.

TO BUILD THE BRAND OF A RESEARCH-INTENSIVE UNIVERSITY, INVEST IN RESEARCH OUTCOME FOCUSED BRAND CAMPAIGNS

A quick scan of university websites will notice that identity narratives tend to fall into one of two types. They either send the message that the institution does a great job of looking after students or is changing the world through its research. Given the ubiquity of the Humboldtian vision of the deep nexus between research and teaching in the modern university, this may be surprising, and institutions often attempt to bridge this divide by focusing on attributes that researchers and students are supposed to share such as "passion", "creativity", "curiosity" or the like. But these attempts almost always fall flat as simply too generic and too difficult to substantiate.

Moreover, a tension between a desire to market specific educational offerings, on which the finances of most universities depend, and to promote research outcomes, confronts marketing departments in almost every

institution. Every dean or head of department wants someone to produce marketing collateral (often a brochure that ends up being pulped or a website that no one visits) to promote their favourite course, and when a university's marketing team questions that use of resources, the local academic leader hires their own local marketing person or engages an external agency to do it for them. Every principal investigator believes that their research finding, important in its field but utterly beyond the comprehension of the average non-specialist reader of a broadsheet, should be splashed onto billboards, and not infrequently uses money that could otherwise be spent on research to engage in locally designed promotional activity, much like the frustrated dean or head of department. These tensions lead to problems with consistency of identity, discussed below, but they can also lead to considerable waste of resources on reputation-building activity of varying quality, the impact of which is rarely measured.

There is a considerable literature on the marketing that most successfully builds brand equity for universities, and to some extent the answer to that question must depend on the identity narrative of the particular institution. But in universities such as Sydney and UCL, research-intensive comprehensive public institutions, the biggest measurable shift in reputation that I have seen has come from campaigns that focus on the outcomes, whether in real world impact or an evident increase in human understanding, of research, especially research the results of which are counter-intuitive. Prospective students, partners, governments, even academics, all want to be part of an institution that is making real advances in human understanding, and they will choose an institution that they think is producing quality work and having an impact before they begin to think about the specifics of a particular course, or partnership, or gift. The important thing is that an institution has the aura of being a place where "exciting things are happening", with specific and memorable proof points.

At this point, it is worth noting the real importance of comprehensive brand campaigns that focus on research, even if there is a constant stream of media stories emerging about the research findings of people at a particular institution. It is one of the frustrating realities of university media and communications that a story announcing a particular exciting medical, or other, breakthrough is a story focused on the breakthrough itself and the institutional affiliation of a researcher is really of secondary interest. This is true even where the affiliation is correctly attributed and the principal investigator is not, for reasons explored below, identified as coming from some obscure department or research institute within the university. Occasionally, the name of an institution can be so associated with a treatment – such as the Oxford-Astra Zeneca vaccine – that an individual announcement will have positive institutional brand impact. But not even this always yields the results

that it might; few know that the Lidcombe Programme, the most widely used and successful treatment for stammering in young children, is called the Lidcombe Programme because Lidcombe is the location of the allied health faculty of the University of Sydney. It is not possible, therefore, simply to rely on a stream of outstanding research outcome announcements to build the brand of an institution. It takes institution-focused brand campaigns that tell the story of multiple exciting breakthroughs, even ones which have already been widely celebrated, to build the connection between a university's brand and its institutional reputation.

The fact that many universities engage in similar research outcome-focused campaigns makes the shaping of a distinctive brand in this way more difficult, but it is the challenge of the comprehensive university that it needs to choose some things for which it will really be known, above and beyond a general reputation for "excellence" or for "impact". The choice of proof points in a brand campaign becomes, therefore, an important strategic leadership question, that needs to match emerging areas of investment and established or growing academic strength. Moreover, it is crucial that the format of a research outcomes-focused brand campaign tells the story of the institution's research success in ways that reflect the brand identity that the institution seeks to establish. In the case of both Sydney and UCL, the claimed positioning builds on an origin story about disruption, about their establishment as radical institutions. For Sydney this is a more difficult story to maintain given the establishment connections that it acquired over the long period in which it was the only university in the city, but for UCL it sits easily as a 200-year-old challenger brand, defining itself against Oxford and Cambridge. In any case, both the Sydney *Unlearn* campaign and the UCL *Disruptive Thinking* campaign, built on these identities as radical institutions. In the Sydney case, the *Unlearn* concept drew fire from the right-wing commentariat as a sign of the radical nature of the university, helpfully underscoring the desired brand positioning.

DEVELOP A COHERENT BRAND ARCHITECTURE

Every university leader knows the extent to which academics often regard themselves as sole traders peddling their own academic reputations, and their institution as at best the reputational and infrastructural backdrop against which they offer their wares. External members of our UCL Council were recently surprised to hear academics on the Council affirm that they regard themselves as working *at* UCL, but in no sense *for* UCL. Moreover, it is the bane of professional staff in a university that many academics regard themselves as armchair experts in areas of professional practice far outside their academic competence, particularly areas regarding which they may be

sceptical of any underlying art or science, such as marketing and communications.

For these twin reasons, many academics will go to the barricades to protect local brands or "sub brands" within an institution without any regard as to the extent to which splintering the brand impact of the university damages the whole. This may have to do with history, where the brand is associated with a once independent institution that has merged with the university. The Sydney Conservatorium of Music had acquired an international reputation as a music school between its establishment in 1915 and its joining the University of Sydney in 1990. Drawing the brand of the Conservatorium into the university family of brands was a process reflective of the complex process of transitioning the institution itself. UCL is full of such stories as the university has grown by absorbing hitherto independent colleges of the University of London. The power of sub brands may also reflect reputation within a very particular field of professional practice. The Slade School of Fine Art and the Bartlett School of Architecture are both brands with enormous draw in their respective fields. They have both, from their foundation as brands, in 1872 and 1919 respectively, developed such independent reputations that surprisingly few people know that they are, and always have been, constituent parts of UCL. It is sometimes the case that sub brands emerge because a particular centre or program, while housed within a given university, involves collaboration with researchers at other universities, and the claim is made that those other institutions do not want the activity to be too closely aligned with the host. But it is often the case that local commitment to a sub brand reflects nothing more than the affection of a group of staff, often a particular principal investigator, who may have designed a logo of some sort on their kitchen table. It was always slightly amusing during my time as Head of the Social Sciences Division at the University of Oxford, to hear how many directors of tiny centres known as the "Oxford Centre for X or Y" believed that the brand power of their centre resided in the words "Centre for X or Y" and not the word "Oxford" that preceded it.

In whatever way a plethora of sub brands, and associated visual representations, might emerge, a survey of the websites of most large comprehensive universities will reveal literally hundreds of names, logos, visual representations and the like, that have little or no reference to the overarching brand of the university of which they are a part. Indeed, so much is this the case, that many institutions still have teams of people who scour the principal research databases looking for work primarily attributed to an investigator at the "Centre for X or Y" so that it can be reattributed to the university for the purposes of proper attribution in rankings and research assessment exercises and the like.

Developing a coherent brand architecture can be a difficult and sensitive task. This is because it makes explicit issues of institutional affiliation that

many would prefer to leave ambiguous. In contexts of merger, for example, they reflect the extent to which a merger is seen as a "formality" or a "take over". They also become proxy conversations about the autonomy that principal investigators so prize. The "National Centre of the Interdisciplinary Study of X or Y" is much more clearly "mine" than the "UCL Centre". Indeed, while the "National Centre' might reside *at* UCL while an investigator works *at* UCL, the assumption is often that it can move when they work somewhere else. In highly decentralized institutions, such as are many large comprehensive research-intensive universities, resisting the development of a coherent brand architecture is usually a way of resisting a broader agenda involving the implementation of more rational university-wide structures and processes.

But the development of a coherent brand architecture is crucial. It is simply the case that a strong institutional brand has important spill-over effects for all its sub brands, and that strong sub brands can build institutional brand in a virtuous cycle. A splintered family of brands dilutes an institutional brand to the same extent. Moreover, as universities are increasingly looking to capitalize on the economies of scale entailed in more institution-wide services and processes, a conversation about brand architecture can often be helpful precisely because it forces the conversation for which it can serve as proxy. At Sydney the development of a coherent brand architecture was an important part of reminding a highly decentralized university that, while polycentricity of decision-making is essential in an institution involved in disciplines as diverse as veterinary science, astrophysics and Celtic studies, it is important that that decision-making takes place within a coherent university management structure, in which the right decisions are taken at the right level, and in which the relationship between different parts of the institution was clearly understood.

HIRE WINSOME BUT EFFECTIVE ENFORCERS

This is the crucial, but less pleasant part, of the whole exercise. Once a clear identity has been articulated, effective university level campaigns run that focus on research outcomes, their effectiveness in shifting perceptions measured and celebrated, and a clear brand architecture developed, it might be imagined that the whole university would fall into line. But unfortunately, that is rarely the case. We have eleven faculties at UCL. One has just three people with marketing and communications in their job title, but another has 30, another 29, and the other eight some number in between those extremes.

Eventually we plan to rationalize these very large numbers, but in the meantime all those people feel the need to keep busy. And nothing quite tickles the vanity of an academic leader like the opportunity to demonstrate their taste and style by dabbling in marketing. For this reason, polycentric

institutions will remain impossibly brand polyvocal without a team of winsome but effective enforcers who ensure that the brand book is observed with the rigour with which it is observed in companies that deal in fast-moving consumer products (while even the mention of that comparison would put a shiver down the spine of most academics).

Once again, this issue of compliance with the brand all too often becomes a proxy in the battle against the "corporate" university. The academic freedom to engage in curiosity-driven research and to pursue a line of enquiry wherever it might lead is often understood to be also the academic freedom to design the logo for a research centre, or to style my presentation in ways that do not use the university templates. To some extent it is hard not to have sympathy with this position. Many academic publishing contracts give exclusive rights to determine cover design and marketing to the publisher. When I worked in a free copyright law advice service, I had to disappoint many academics with my advice that what they regarded as the wholly inappropriate cover of their work was within the choice of the publisher. They were sometimes genuinely distressed as they felt that the cover presented a type of hermeneutical filter on their work that was not faithful to its scope and purpose. It may well be that individual academics object to the brand positioning of the institution of which they are a part on similar grounds.

But the failure to build a coherent university brand has enormous costs, not just for the institution as a whole, but for every academic who might otherwise benefit from the spillover effects of a stronger university brand. For that reason, brand enforcers need to have the capacity to work with academics to distinguish situations in which some exception to the university brand rules ought appropriately to be made, and those in which someone merely has a preference for a difference aesthetic. This is not an easy role, and it requires people who understand both brand discipline and also the distinctive nature of academic work.

CONCLUSION

Of course, none of this is startling advice. And none of it will equate to the effect of a hundred years of the development of a premium brand. None of it answers questions about the relative importance of earned media, owned media and paid media, about the balance of social and traditional media, or the like.

But I emphasize these four things for two reasons. First, it is my experience that together they are an important part of shifting the potentially generic brand of many large, comprehensive, research-intensive universities. A clearly articulated identity, a focus on research outcomes, a strong brand architecture and smart brand enforcers are an absolute *sine qua non* to building the brand

of any institution. Second, many of the questions about the modalities and geographies of university promotion are technical and best left to marketing experts, but these four require real academic leadership from people such as university presidents and faculty deans because of the important interplay between brand and reality; a brand can only speak if it reflects the life of an institution, and it will only do that if it is allowed in some ways to shape important decisions that are made.

Moreover, besides the reputational payoff of a university president investing their time in these aspects of developing their institution's brand, it is my experience that in different ways they also help to build a stronger sense of institutional identity and thus help presidents attempting to increase their institutions' capacity to make and to implement

decisions at the institutional level about university-wide initiatives and structural and process reforms. The stronger the sense of institutional identity, and the more people that have been engaged in the conversation about what that identity might be, the higher the chance that more academic staff might feel that they work, if not *for* the university, at least more than *at* the university. And it is my conviction that a university's capacity to operate effectively as a single institution and not simply a loose federation of schools, departments, centres and institutes, is going to be crucial as many of us navigate choppy financial, social and political waters in the decades ahead.

A focus on brand management is not only desirable, but an essential part of the day job of any effective university president, however elusive the task of building a global reputation for excellence may seem to be. It is my experience that as well as being necessary, it is also rather good fun, and that within a relatively short period of time measurable differences in reputation can be achieved.

Chapter 13

Climate Crisis: Are Universities Set Up to Rise to the Challenge?

Martin Vetterli

Climate change is real, demonstrated by the undeniable rise in global temperature and the accelerating pace of extreme climate events. According to the Word Meteorological Organization, the past eight years have been the hottest eight years on record, driven by increasing greenhouse gas concentrations and accumulated heat. And, with an El Niño event, typically associated with higher-than-average global temperatures, ending a "cooler" three-year La Niña episode, it's likely that the next three years will see more climate records shattered as extreme temperatures, heavy rainfall events and droughts become both more frequent and more severe. Experts are categorical: there is only very little time left to drastically change our behaviour and reduce emissions if we want to avoid dramatic and irreversible consequences on the planet. According to the Intergovernmental Panel on Climate Change, climate models that cap global warming at 1.5°C above pre-industrial levels, the target set during the 2015 COP21 conference in Paris, saw global CO_2 emissions peak before 2025 (WRI, 2023). This would require transforming entire industries – decarbonizing electricity, cement, aviation and transportation, adopting more sustainable agricultural practices – and the broad adoption of more sustainable behaviour. Each of these require urgent action starting today. Still, society, politics and the economy are struggling to deviate from their current practices.Universities have a vital role to play in shaping how we address the global climate crisis. At their

foundation, universities have as their mission to train the next generations of scientists and leaders, and to carry out the highest quality research that is relevant to humankind. And, as a public service, it is their duty to think about the climate crisis in depth and pave the way for adequate solutions. But their duties don't end there. Largely perceived as guided by scientific facts and reason, universities are much observed bellwethers that shape public opinion. Fulfilling their responsibilities in the light of a strong scientific consensus over the causes of the climate crisis will require them to act from within a comfort zone – through teaching, research, development and technology transfer, and from outside it – by demonstrating their unwavering commitment through strong statements, bold actions and, when necessary, audacious advocacy to challenge the very societies they serve.

But are the institutions ready to rise to the challenge? Leading by example and using their expertise to develop solutions that could contribute strongly to tackling the situation should become a highest priority. Initiating this momentum is, however, not easy. It requires leadership, funding, good governance and intelligent collaboration among all key players. Taking sides in a charged political debate and challenging governments, populations and economic interests takes a clear sense of mission and courage. As hotspots of technological and cultural innovation, universities can and must take on these challenges head on, while at the same time exploring ways to shift the culture towards one emphasizing energy sufficiency and sobriety. Contributing to managing the transition to a sustainable and respectful world could become their most thrilling and impactful project.

UNIVERSITIES ARE NATURAL VENUES FOR INNOVATION

Universities campuses are constantly bubbling with ideas, the feedstock of research and innovation. Take EPFL, where we recently had to expand our Innovation Park to meet growing demand for space to host the 30+ spin-offs to emerge from our labs every year. Today, much of that innovation is related to sustainability, which is hardly surprising considering that over one hundred labs present on our campuses work in areas that intersect with topic – in energy, chemistry, construction, health and more.

But the "wicked" nature of the problems posed by sustainability – their inherent complexity, non-linearity, ambiguous causality and interconnectedness, and tendency to give rise to solutions with negative unintended consequences – have changed the boundary conditions surrounding innovation (Terra Institute, 2023). While it used to be sufficient to have the genius and perseverance to pursue a new idea through to completion, today, researchers

need new skills to think well beyond their innovation and consider the often elusive environmental, social and economic implications that it might lead to. This will often require them to reach across the aisle and collaborate with people in fields that they are less familiar with, including in the social sciences.

FUTURE-PROOFING RESEARCH AND INNOVATION IN SUSTAINABILITY BY UPDATING THE CURRICULUM

Like other leading universities, EPFL is replete with top-notch laboratories that have proven themselves through their scientific output. Only, the researchers that make up these labs are not yet systematically trained to think about wicked problems in which no single technological solution will solve sustainability problems once and for all, but in which a wealth of contributions can collectively interact to alleviate them over longer time scales. Training students early on and instilling in them the skills and mindset they need to tackle wicked problems will orient innovation towards the interdisciplinary, holistic and long-term thinking required to successfully address sustainability challenges.

To drive this change in mindset and prepare the next generations of graduates to succeed in a world in which wicked problems are more prevalent, first-year EPFL students in all faculties will be required to take a core class in sustainability as of 2024. In addition to teaching the basics of sustainability, the course will highlight the value of systems thinking and cross-disciplinary approaches. Moreover, each department will introduce one class in the Bachelor's cycle and one in the Master's cycle introducing sustainability skills that students will need later in their careers. And finally, the entire curriculum will be enhanced with additional sustainability content when relevant (EPFL, 2023).

Imagine replicating this approach in universities around the world and fast-forward a decade into the future: Today's students will have become decision-makers in key positions in public service, business, politics and society, and their thinking will be guided by their core training in sustainability. Similarly, the products, services and policies they dedicate themselves to will reflect these new values. It's hard to imagine these graduates devoting their careers to maximizing corporate profits at the expense of the environment. While their impact will come with a considerable time lag, teaching initiatives such as the one outlined here will no doubt become academia's contribution with the greatest transformational impact, not in the form of a technological fix, but in the dissemination of a way of thinking, essentially a security patch for our cultural software.

Unfortunately, we can't wait for the next generation of students to rise to the occasion in the distant future. The good news is that we don't have to. Innovation into sustainable solutions is already well underway at universities around the world, including at EPFL, where technologies that optimize renewable energy production and distribution are being developed to help us reduce our reliance on fossil fuels. Research in nuclear fusion could, if successful, usher in a new era of energy abundance. The development and commercialization of sustainable chemistry and materials could help decarbonize the 300,000 chemicals produced by Switzerland's chemical industry, 95% of which are fossil-fuel derived. And innovative formulations of cement, such as the limestone calcinated clay cement developed at EPFL, could help reduce cement-related CO_2 emissions by 40%.

INNOVATING IN INNOVATION

While we are well aware that no technological silver bullet will solve the climate crisis, there's no doubt that technologies, many of which will emerge from universities like our own, will be fundamental components of a holistic global solution. While national science foundations and traditional funding mechanisms are doing their part to direct the focus of research and innovation towards goals that are relevant to the public, there is clearly room for innovation when it comes to developing funding mechanisms to cut the time it takes for innovation to make a tangible impact in the real world.

EPFL's Solutions4Sustainability (S4S) initiative was designed to precisely this end, bringing multiple innovations in how to fund innovation. The initiative, launched by the school's leadership, broke new ground in challenging all members of campus – students, researchers, professors, but also the technical and administrative staff – to develop projects promoting sustainable solutions, some within two years, others over the course of up to six years. Another innovation was its focus on demonstrability: Once completed, the projects will have to be implemented as demonstrators on campus. If successful, the demonstrators could later be replicated and scaled up to serve society at large.

Internal funding to the tune of 20 million Swiss francs – another of the initiative's differentiating features – shortened the time it took to fund ideas that passed an initial evaluation round to just a few months. The initiative's evaluation committee judged submissions based on their scientific merit, their potential to contribute to carbon neutrality, their potential to be implemented on campus, their capacity to create new ties with startups and external partners, and their ability to federate researchers from EPFL's various labs, faculties, and campuses. When Solutions4Sustainability was announced, it was welcomed by a campus clearly yearning for an initiative of its kind to come its way.

The two long-term projects financed by the initiative tackle two major sustainability challenges. The first offers solutions to decrease the growing carbon footprint of data centres. Working on EPFL's data centre, it aims at developing and implementing an on-chip cooling system to extract heat generated by the CPUs and supply it to the school's district heating system. Additionally, it uses recovered heat to generate electricity and seamlessly integrates the data centres' power flows in the campus's overall power network relying on, among others, coordination with the local PV infrastructure, energy storage and heat demand.

The second long-term project spawned by the S4S initiatives seeks to develop and deploy cost-effective demonstrators of carbon capture, utilization and storage (CCUS) solutions. Using CO_2 captured from a waste incineration plant used to heat the EPFL Valais campus, it aims at producing methane that will be fed to the natural gas grid and used as a feedstock for the chemical industry. Once proven technologically and ecologically viable on campus, the project will lower barriers to adoption and could make important contributions towards meeting agreed-upon CO_2 emissions reductions goals.

Over the years, demonstrators like these have been central in our efforts to lead by example. Recently, researchers at EPFL developed a solar hydrogen production system that uses sunlight to convert water into hydrogen, oxygen and heat that is being demonstrated right on campus. And on a larger scale, the Energypolis campus in Sion shared between EPFL and the HES-SO uses a unique CO_2 distribution network to heat and cool its buildings.

EPFL ASPIRING TO BEING A MODEL FOR SUSTAINABILITY

Today's university campuses are increasingly morphing into small cities in their own rights. The analogy – and let's be clear, it's becoming less and less of an analogy – holds not only in terms of the infrastructure and logistics they require, but also in terms of cultural and societal phenomena: As in cities, campus culture evolves in response to bottom-up drivers – in this case students, student associations, the staff and other employees, top-down drivers – the school's leadership, and external boundary conditions – local and national laws, the geographical setting, etc. And, like forward-thinking cities, campuses can lead by example, inspiring others to emulate their successes.

From its very inception, the EPFL campus has been a role model for sustainability. The campus's future-focused architecture and, in particular, its visionary heating and cooling system that draws thermal energy from Lake Geneva were developed with the scare of the 1970s energy crisis still fresh on people's minds. EPFL has been issuing a greenhouse gas report since 2012, the same year that it unveiled the EcoCloud centre to develop sustainable

computing systems. Energy and sustainability were named as one of the school's strategic focus areas in 2017 and a sustainable food services strategy was presented in 2019. 2021 saw the creation of a new Vice Presidency for Responsible Transformation, focused on sustainability as well as the issues of respect, equality, diversity and inclusion. And, earlier this year, the school began mapping – with great precision – the power use of energy operations and research, accompanied by measures to meet and exceed national energy reduction goals.

In 2023, EPFL released its first climate and sustainability strategy, spelling out the school's commitments to the community, society and the environment. Far from being dictated from the top down, the strategy draws on inputs from all key constituents of the campus and, in turn, challenges the entire EPFL community to contribute through concrete initiatives. Student associations have been instrumental in putting environmental issues on the table, at least since the founding of Unipoly, an association dedicated to raising awareness on societal issues related to ecology in 2002. These clubs and associations have made important contributions that have shaped EPFL's actions with regard to sustainability, including not only the creation of a vice presidency devoted to sustainability mentioned earlier, but also working groups such as the Climate and Sustainability Task Force and the carbon-emissions calculator for research labs.

CONTINUALLY EARNING AND UPHOLDING THE REPUTATION AS A ROLE MODEL

The label of a role model is never a permanent accolade, but rather one that must be continually earned and upheld. EPFL's Climate and Sustainability Strategy will be essential in ensuring that the school lives up to expectations it set with the development of the avant-garde heating solution in the 1970s. In addition to laying out the tactics to reduce its CO_2 footprint and energy requirements to meet and exceed national targets, the strategy outlines how the school can make the most of its position at the forefront of education, research and innovation to drive change. By expanding the university curriculum to train students in dealing with new challenges stemming from sustainability and orienting R&D such that its fruits in terms of innovation and technology transfer positively impact the challenges we face today, the strategy aims to establish EPFL as a leader in sustainability – one that leads by example and invites others to emulate its success.

The objectives have been clearly established. In terms of numbers, they involve, among others, cutting energy-related carbon emissions by 50% compared to 2006 levels, travel- and commuting-related carbon emissions by at least 30% compared to 2019 levels, food-related carbon emissions by at least

40%, all by the year 2030. Additionally, the campus and its operations will be enhanced by adopting green IT practices, increasing the canopy index to 30% to mitigate heat islands, promote biodiversity and improve overall wellbeing, and by cutting waste (by 30%) and increasing the recycling rate (to 80%). Finally, all EPFL tenders will be subject to ambitious sustainability criteria starting 2025 and a transparent policy on sustainability and third-party funding will be introduced.

The action plan laid out in the strategy is agile, intended to evolve as the school moves towards meeting its targets, which are unlikely to remain static. Because you can only improve what you can measure, data will play a central role throughout this process. To this end, we have kicked off efforts to obtain a comprehensive overview of our research-related carbon emissions by 2026, drawing on insights obtained from a carbon emissions calculator for research activities at all EPFL schools and colleges. These efforts will be accompanied by the appointment of sustainability coordinators at the faculty level and contact people within the labs to effectively disseminate best practices, as well as extensive training on sustainable lab practices, both for existing staff and newcomers. These initiatives build on past achievements, including a green lab pilot project carried out in 2020, which saw the development of green lab guidelines for life sciences, lifecycle assessments for the animal facilities, and a first iteration of the carbon emissions calculator by the Zero Emission Group student club.

Following the 1970s oil crisis, EPFL underscored its commitment and investment in sustainability through its visionary, energy efficient heating system, which, in 2022, was upgraded to make the campus 100% oil free. Fast-forward to today, and EPFL is working to forge a sustainable solution for data centres, which are responsible for an ever-growing share of the world's CO_2 emissions. Through the EcoCloud R&D center, which unites 27 labs from four EPFL schools, 12 large IT companies including Microsoft, IBM, Meta, HPC and Intel, and several EPFL spinoffs, EPFL will promote the development of cloud-computing and artificial intelligence technology that can help save energy, preserve natural resources and protect biodiversity.

The EcoCloud project will benefit from internal funding through the Solutions4Sustainabilty initiative and see the implementation of a full-scale demonstrator on campus by 2026. Additional objectives will include developing less energy-intensive machine learning systems to train artificial intelligence models, the launch of experimental facilities to test sustainable computing systems, the operation of sustainable digital twins for smart cities and transportation systems (in partnership with ETH Zurich), and awareness-raising and outreach activities.

With travel making up more than a third (35%) of EPFL's CO_2 emissions, it, too, will be an area of focus towards achieving CO_2 emissions reductions

goals. Long-haul flights account for 95% of travel-related emissions. Several action items have, therefore, been proposed to disincentivize travel. These include a new business and student travel policy, improved travel planning and booking processes, state-of-the-art videoconferencing facilities, and efforts to position the SwissTech Convention Center as a centre of excellence for hybrid events.

Commuting to and from campus is another major source of CO_2 emissions addressed in the sustainability strategy. To reduce emissions due to commuting by 30% by 2030, we will make public transportation, walking and cycling more attractive, and launch initiatives such as car-pooling, off-campus co-working spaces, and public-transportation ticket subsidies, while discouraging the use of personal motor vehicles through a new parking policy that respects individual needs.

All in all, the objective is to instil an attitude of sobriety or sufficiency across all activities on campus, including in procurement. Specifically, this involves challenging the impulse to purchase new equipment by first assessing whether equipment offering the same functionality is available elsewhere on campus. Similarly, regular maintenance and repair can extend the lifespan of existing research equipment. In the School of Life Sciences, for example, we have evolved our repair workshop into a maintenance workshop, extending the longevity of our equipment by 30-50%.

Unlike the actual cities that they model, university campuses provide ideal test benches for technological, infrastructural and social solutions to address aspects of the climate and sustainability crisis. A collective recognition of the pressing nature of the crisis diminishes political hurdles that stand in the way of progress elsewhere, paving the way for the rapid implementation and evaluation of bold approaches to promote sustainability and meet climate targets. After demonstrating their benefits on campus, real-world cities will be able to replicate these approaches – some technological, others social – with confidence in the value that they offer. In this way, universities like EPFL have the potential to lead the way in addressing the climate crisis, not solely through technological fixes but rather by instilling an updated value system, fostering a mindset oriented towards energy sobriety and sustainability, and reassessing lifestyle choices.

INITIATING THE MOMENTUM TO PRIORITIZE SUSTAINABILITY

Prominent universities around the world are embarking on a similar path as EPFL to prioritize sustainability, lead by example and develop technological and societal solutions that, if scaled up, will move the needle closer to the agreed upon target of limiting global warming to 1.5°C. Nonetheless, moving

in the right direction continues to be an uphill battle, amid well-intended but ill-advised policies, political taboos and societal mores that slow progress. Fortunately, universities benefit from an indefatigable motor driving change: their student body. By setting up structures capable of tapping into the students' drive for change, the collective intelligence and technical knowhow of the labs, and the executive power of the leadership, universities can succeed in initiating the momentum to put sustainability front and centre.

But first, what are some of the impediments that stand in the way of change? Some are political. Despite the scientific nature of the climate crisis, the political responses to the crisis are often at odds with science. This puts universities in a difficult position. Take the simple act of offsetting CO_2 emissions abroad, mandated by the state: Our own experts have shown that the prevalent approach of preventing deforestation abroad to offset carbon emissions at home does not hold up to scientific scrutiny, yet we remain bound to it. (E4S, 2023; Guardian, 2023). With the public and the media incessantly observing the actions of universities – assumed to be guided by scientific facts and reasoning – they can only conclude that offsetting CO_2 emissions abroad must be the right thing to do. Were it not, why would universities, with their deep understanding of the scientific evidence, do it? In the same vein, until universities demonstrate the level of urgency that they attribute to the climate crisis by abandoning business as usual and taking drastic action to substantially curb CO_2 emissions, the public will have to be forgiven for concluding that the situation is not as dire as some "alarmists" make it out to be.

Unlike students, who have full freedom of expression and action, university leaders have their hands bound, at least to some extent, by political taboos and societal mores. It would, for example, have been considered an incursion into the political freedom of students for the school's leadership to encourage the entire student body to vote for the new climate law in June, 2023, despite the recognition of the urgency to take drastic steps to mitigate CO_2 emissions. Meanwhile, calls from student associations would be considered acceptable. Similarly, should professors of a Swiss federal academic institution – employed by the state – question the democratically agreed upon decision to ban the construction of new nuclear power plants? Encouraging and listening to a vibrant, vocal student body with close ties to the university leadership is vital to remaining on the cutting edge of societal demands in general. This is as true for sustainability and the climate crisis as it is for social issues such as diversity and inclusion.

It was, after all, the student body that, through EPFL's general student association, called for the creation of the Vice Presidency for Responsible Transformation, devoted to sustainability, among other topics. This new role has proven to be instrumental in translating calls for change from all

members of campus – from students to the presidency – into concrete actions. The mere fact of having a VP allows to rapidly sign off on initiatives that otherwise could have taken years to approve. Moreover, because promoting sustainable practices typically involves extra work, for example, to catalogue purchases in order to monitor the CO_2 emissions of a research group, some labour-intensive sustainability initiatives are most likely to succeed when they are driven from high up in the hierarchy.

Rather than doing it alone, universities can amplify their forces by acting together. The International Sustainable Campus Network, created in collaboration with ETH Zurich in 2007 and chaired by EPFL since 2016, provides a forum for over 100 academic institutions through which they can exchange information, ideas and best practices promoting sustainability. ISCN holds yearly international conferences, including the 2021 edition titled "Accelerating Climate Action and Sustainability in Education." The EuroTech network, which includes six European technical universities, another coalition of universities to include EPFL, seeks to build a strong, sustainable, sovereign and resilient European society, with an initiative dedicated specifically to "Sustainable Campus Development". And at the national level, EPFL has been a member of Swiss universities' sustainable network committee since 2020, and part of its travel, procurement, carbon neutrality and green lab sub-groups.

A THRILLING AND IMPACTFUL PROJECT FOR YEARS TO COME

The climate crisis presents an unprecedented societal challenge. As expressed in an article by the Geneva Graduate Institute, "its causes are multiple and complex, its impacts are uncertain and interrelated, and potential solutions to climate change might well cause further problems." (Graduate institute, 2023). As such, it will only be addressed collectively, not with a silver bullet, but through myriad technological, political, economic and societal contributions. And, while it will require the involvement of stakeholders from across society, universities will have a key role to play. Fortunately, many of the world's leading universities are aware of their role and setting themselves up in such a way that they will be able to rise to the challenge. Others will be able to follow their lead.

For universities, which have long led the charge on societal, cultural and environmental issues, this role is not new. In the past, it has led to movement such as the Archimedean Oath, introduced by EPFL students in 1990, which offers an ethical code of conduct for engineers, similar to the older Hippocratic Oath that medical professionals bind themselves to. But to rise to the unprecedented challenges posed by today's crises, of which the climate

crisis is but one example, they will have to step out of their comfort zone and assume a more assertive posture. Bold action, not incrementalism, will be required of universities seeking to maximize their impact on society.

We'd be remiss to count on technosolutionism to save us. Still, the role of EPFL and universities like it will be to deliver technological solutions that interact with others to address ecological, political, societal and behavioral issues. By joining forces with other academic institutions and, when necessary, with the private sector, they will be optimally set up to address these wicked problems that, more often than not, demand holistic solutions. To universities and the students, researchers and staff that populate their campuses, addressing the climate crisis by leading by example will be a thrilling and impactful project for years to come.

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Chapter 14

High-Quality University Education Safeguards the Success of Societies of the Future

Sari Lindblom, Susanna Niinistö-Sivuranta & Auli Toom

Universities educate academic experts for an unknown future. Rapid societal changes and unforeseen global challenges set high demands for the quality of university education. To meet these challenges and demands, university education of the future requires more and more multi-disciplinary and multi-stakeholder collaboration and learning environments where creativity and technology play a major role. The previous few years have really tested the resilience of modern societies as well as universities as they have been confronted with several chronologically overlapping severe global challenges: Covid-19, Russia's attack on Ukraine, an energy crisis and biodiversity loss. How can universities prepare their staff and students for such global turbulences? How can we lead hope to strengthen resilience?

Research on surviving and recovering from crises shows that recovery can only begin when the crisis is over. It is uncertain how individuals can endure without healing processes after each crisis, even being in the middle of the next crisis when recovering from the previous one. We predict that it takes years for universities and individuals studying and working in them to recover from stress and high workload during the many challenges.

However, crises that have arisen outside universities can also enhance cohesion of the academic communities. Even though experiences and

reactions to crises vary among individuals, the experience of belonging to the community has become stronger. The community and its members can learn to support each other socially in a variety of ways: academically, informatively and emotionally (Väisänen, Pietarinen, Pyhältö, Toom & Soini, 2016). The individuals provide and receive social support from each other. Through this, individuals can learn strategies for maintaining cohesion and well-being as well as tackle influences of the crises. This is extremely important for future academic experts already during their university studies, since these experiences can protect individuals from severe stress in a variety of contexts and throughout their professional and personal lives.

FUTURE ACADEMIC EXPERTS NEED A SOLID SCIENTIFIC KNOWLEDGE BASE AND VERSATILE SKILLS

The capabilities of the future world are difficult to predict, but the skills acquired through university studies will remain critical and relevant in the future. The demand for collaboration skills is unlikely to diminish as solving complex problems requires a wide range of skills and smooth interaction. Students need to grow up in communities where different skills are valued, where they can reach across boundaries, where they can be impressed by what others do and enjoy shared learning experiences.

Providing university students with research knowledge of their own disciplines is not enough. Instead, we need to focus on providing the graduates with versatile generic skills (Tuononen, Hyytinen, Kleemola, Hailikari, Männikkö & Toom, 2022) and high-order academic thinking skills, such as analytical and critical thinking and problem-solving skills. Key elements of expertise also include a sense of values, a sense of responsibility, the ability to reflect on issues that affect society and the world, and continuous reflection on one's own thinking, actions and relationship with nature (Wiek, Withycombe & Redman, 2011.) These skills are essential for student learning during university studies, but they especially play a pivotal role in solving great challenges of the future. This is important because evidence shows that higher-order thinking skills develop during university education. In addition, we need to support students to reflect on their roles as academic experts and as actors in solving sustainability issues, and to prepare them to work in multidisciplinary teams to solve global problems.

Supporting the development of a strong disciplinary expertise and versatile generic skills as well as new demands regarding use of digital pedagogies challenge university teachers' pedagogical expertise as well as program leaders' expertise in building curricula for the study programmes (Tuononen,

Hyytinen, Kleemola, Hailikari & Toom, 2023). At the program and curriculum level, it is necessary to ensure the coherence of the degree programs and courses as well as constructive alignment between the intended learning outcomes, teaching and learning methods, and assessment methods (Biggs, 1996; Hyytinen, Toom & Shavelson, 2019). Constructive alignment means that curricula and courses are planned so that all learning and teaching activities address the intended learning outcomes in a very systematic manner. This assumes that teachers have strong scholarship of teaching and pedagogical expertise beyond their discipline-specific knowledge and skills (Boyer, 1990). At the individual teachers' level, it is essential that teachers can support student learning of discipline-specific and generic skills sustainably and throughout the various courses. While learning discipline-specific knowledge and skills, it is necessary that students are challenged to solve problems, think critically and create robust arguments, and that they are exposed to a variety of group work and collaborative knowledge creation (Tuononen, Hyytinen, Hailikari & Toom, 2020; Tuononen *et al.*, 2022).

STRONG PEDAGOGICAL LEADERSHIP SUPPORTS TRUST IN COMMUNITY

One of the biggest current challenges for pedagogical leadership in higher education is to critically analyse how the pandemic changed learning cultures and how the changes in teaching and learning practices during the pandemic should inform the future of university education. The distance-learning years during the Covid-19 pandemic revealed a strong polarization. This polarization is evident in the experience of learning in crisis as well as in the success and stress and strain experiences. Some students made excellent progress, but others suffered extensively and dropped out altogether (Asikainen & Katajavuori, 2022; Juntunen, Tuominen, Viljaranta, Hirvonen, Toom & Niemivirta, 2023).

From a leadership perspective, the pandemic period particularly challenged interaction and people-to-people interactions and encounters. It also challenged the sense of community. Community is crucial to reflect values and interaction. Interaction in the community and in leadership is important and continuous interaction is needed to maintain trust and shared understanding. (Weick, 2001; Yammarino, 2013; Dirks, Sweeney, Dimotakis & Woodruff, 2022; Parpala & Niinistö-Sivuranta 2022). The relationships between the individuals in the community are reciprocal and constantly changing, and balancing the changes in the community requires constant discussion and interactions.

At the University of Helsinki after the pandemic, we wanted to reflect on the future of learning and teaching by allocating time for analysing the

experiences of old and new teaching and learning practices. During the pandemic, we learned that our university's pedagogical capacity to adapt to the crisis was at a good level: teaching could be delivered online despite the limitations. However, it is clear that the future may still bring many uncertainties and we wanted to reflect together more deeply on the meaning of university education. In the academic year 2022-2023, we celebrated the centenary of teaching and during the academic year we carried out an extensive teaching future scenario exercise and updated our teaching philosophy. This work highlighted the importance of community, student inclusion, sustainability and diverse pedagogies, for example. These themes were also highlighted in our updated teaching philosophy. (https://teaching.helsinki.fi/instructions/article/starting-points-teaching)

The pandemic understandably – but also unfortunately – forced individuals to concentrate on themselves and their loved ones to survive and to deal with the stress in the novel situation where face-to-face interaction was not possible. Everyone stayed at home and took primarily care of their own and closest ones' everyday life, work and well-being. There were not many resources left to help and support others at the workplace, studies or in the neighbourhood. Now it is the time to focus on the individuals as members of university communities and to strengthen the experiences of belonging, trust and inclusion. It is extremely important to rebuild the university community and think primarily about the needs of those students and colleagues who have suffered most during the recent crises and provide collegial support. With help from the colleagues and peers, it is possible to recover and strengthen. Caring and supporting in a variety of ways among both students and colleagues are highly important. University staff members have a responsibility to take care of each other, but also students as part of the academic community need to contribute through rebuilding the community. It is essential to be able to perceive the needs of peers and provide help and support. It is necessary to revitalize concretely the collegiality and collectivity even in Western democracies. It is not possible to recover and rebuild with focusing only on oneself, or with too individualist ways of action.

RESILIENCE IS THE KEY TO SUCCESS ON INDIVIDUAL AND INSTITUTIONAL LEVELS

Resilience can be explored at two levels: institutional and individual. Institutional resilience is defined as the ability of an organization to absorb and recover from external shocks and demands, while positively adapting and transforming to address long-term changes and uncertainty. To foster

institutional resilience, an active role by the leadership of the university is not enough. The whole academic community needs to be involved and committed to adapt to changes and in transforming practices. Only by working together is it possible to enhance resilience and sustainable well-being at the institutional level.

The university of the future must increasingly seek to create opportunities for collaborative reflection and understanding. As the world changes and the environment becomes more complex, a sense of community and hopefulness is needed to build trust for the future. The leader thus encourages his or her community to strengthen interaction with the surrounding society, but also to focus attention on taking time for reflection of the future rather than just on everyday performance (Bryman, 2007; Yammarino, 2013; Dirks *et al.*, 2022.)

Understanding of the changes in university education is strengthened by a common language and concepts of learning. An understanding of the role of research in society is strengthened by encouraging the presentation of results from different disciplines in a variety of ways. Discussions and shared reflection also build community resilience to face difficult situations together. In times of crisis, trust and interaction are developed and strengthened to build for the future. Having such difficult conversations is also important in various exceptional situations, when there is often a risk that discussions, and especially informal joint discussions, will diminish and conversations will focus only on everyday matters. (Parpala & Niinistö-Sivuranta, 2022; Ripatti-Torniainen & Stevanovic, 2022.) To maintain the community discussion on the development of learning and teaching, and on the meaning of research, leaders must enable various encounters and arenas for interaction.

The resilience of an organization is also demonstrated by its ability to maintain a sense of purpose in the face of change. When individuals have a sense of meaning and value for their work, even in the face of critical change, community resilience is strengthened, and difficult issues can be dealt with. A resilient community not only adapts to change but is also proactive (Annarelli & Nonino, 2016.) From a management perspective, the ability to deal with the future in a strategically relevant way and to make choices is also part of resilience.

One example of a strategically important change in learning is digitalization and its use in universities. Without investment, digitalization is at worst a threat to traditional teaching and at best it brings learners into university education in an increasingly broad and open way. However, the relationship between digitalization and pedagogy must be steered in a coherent way. In the previous strategic period of the University (2016 – 2020), we organized an extensive university project to strengthen digital pedagogical competences, during which programs received funding to develop the digital aspects of their teaching. Some of the programs ran MOOCs, some used virtual reality and

some simply invested in enhancing teachers' digital skills. In the current strategic period (2021 – 2024), we have launched a project called Global Campus to continue reinforcing the digital learning environment for teaching at our university. The resilience of an organization must be strengthened in concrete terms by ensuring that it has the skills to meet current and future challenges.

To foster individual resilience of students is more difficult because resilience needs to be learned by the individuals themselves. The resilient academic community supporting students' versatile resilience development is essential since the relationship between institutional and individual resilience is often reciprocal. However, students can be supported in developing good academic thinking skills. In addition, good study skills, such as self-regulation, time-management and being organized in studying, can also be learned, and rehearsed.

Students can also be supported to practice and develop their emotion regulation skills, which play a central role in individual resilience. To foster resilience the most important and the most difficult is to help students in strengthening their self-efficacy beliefs, in other words individuals' beliefs in themselves and their capacities to tackle any problem they confront, are the most important and decisive factor to be resilient at the individual level.

Self-efficacy beliefs cannot be purely taught because they originate from individuals' view of themselves, their self-confidence and their previous experiences. This requires psychological work by the students to evaluate themselves, their skills and knowledge in a way which promotes motivation to strive forward and to gain a deeper understanding of oneself. This gives strength to put effort to one's own development. However, universities can help to develop students' metacognitive skills to realistically evaluate their own skills and capabilities to tackle different tasks and problems (Trede, Macklin & Bridges, 2012). In addition, low-threshold guidance and support must be systematically available to students in a timely manner at different stages of the study process imbedded in the curriculum.

For both levels of resilience, it is important to acknowledge that resilience cannot be given, it needs to be created by institutions or individuals themselves. Therefore, universities need to take an active role in creating resilient and sustainable societies. Strong self-efficacy beliefs are the most important and decisive factor to be resilient and to maintain and monitor one's own well-being is the individuals' beliefs in themself and their capacities to tackle any problem they confront.

LEADING THE UNIVERSITIES OF THE FUTURE SUSTAINABLY WITH HOPE

The leadership of higher education is facing not only qualitative but also quantitative objectives at an accelerating pace. From a management perspective, monitoring learning outcomes and the effectiveness of university education has become increasingly important and has a direct impact on the funding of higher education. This is critical from the perspective of strategic choices, as at the same time, the quality of education and the well-being of the community must be ensured within existing resources (Bottery, 2016; Lindblom-Ylänne, Haarala-Muhonen, Postareff & Hailikari, 2017; Doyle & Brady, 2018).

This means that especially pedagogical leadership must focus on developing and enabling sustainable competences in the higher education community and in higher education teaching. Sustainability in higher education should be based on the premise that caring for the well-being of nature also increases human well-being. This understanding can emerge through systemic thinking, as we learn to examine the interactions between nature, people and society. The aim of sustainable pedagogical leadership at the teacher-student interface is to ensure that learners have the knowledge, skills and motivation to build a sustainable future (Wiek *et al.*, 2011; Niinistö-Sivuranta & Mäki, 2023).

Broadly interpreted, pedagogical leadership involves not only managing teaching, making decisions and choices, but also comprehensively guiding and directing educational resources, coordinating and organizing activities as well as building the community and collective efforts (Yammarino, 2013; Quinlan, 2014). Leadership also has an impact on the culture of learning. It is important to align objectives with strategy so that teaching and learning can result in high quality, deep learning, and competences for the different needs of society (Ripatti-Torniainen & Stevanovic, 2022). The way that a leader creates space for open communication is crucial. It also needs structures at all levels of the organization.

The pedagogical development of education and the effective leadership of education therefore requires structures and resources, but also a strong culture of interaction and a commitment to long-term action, the results of which can sometimes only be seen over time – as knowledge in society (Yammarino, 2013; Quinlan, 2014).

It takes time to grow as a student in a university community. The universities' role is to provide the students with time and support to grow and develop to their full potential. The role of the teacher is to understand the potential of the student, identify the competences and learning goals to be achieved, and create the conditions for high-quality learning (Trede, Macklin & Bridges, 2012; Tirri & Toom, 2020).

STRENGTHENING INTERNATIONAL UNIVERSITY COLLABORATION AND ALLIANCES

In the current global situation and after many consecutive crises, it is necessary to enhance international collaboration of academic institutions and to join forces to develop sustainable and resilient societies. In this demanding journey, research is the key to finding solutions to tricky problems. Now it is the time for universities to act to increase our societal impact and to help societies to overcome crises. Universities bring hope to societies by educating academic experts in various fields and by producing innovations through research.

The University of Helsinki has very positive experiences of international collaboration to advance higher-education policy and the quality of both research and university education. We have been active in LERU, i.e. League of European Research Universities, and in one of the EU's university alliances, namely in UNA Europa.

Values are at the core of international collaboration. It is important to mirror the values of one's own University with the values of international collaborators. Shared or similar values strengthen the base for collaboration and enhance sustainable cooperation.

The University of Helsinki bases its activities on its four values: *bildung, freedom, inclusivity*, and *truth*. These values steer everyday work from teaching and learning to research and to societal interaction. *Bildung* guides the University on the right path and serves as the moral conscience as well as cultivates stability and open-mindedness. *Freedom* encourages creativity and underlines the autonomy of the University. It also refers to freedom to research. Inclusivity springs from democratic empowerment as it safeguards equality and translates into diversity and respect for others. In addition, inclusivity supports and promotes openness and collaboration. Truth leads us to pursue new knowledge. It requires critical thinking and promotes high-quality research and teaching.

It is difficult to create reliable criteria to measure the success of universities. Evident criteria are the quality of expertise of alumni and quality of research outputs. However, it is often the case that the actual impact can only be assessed years later. Effectiveness is reflected in society's ability to face crises, create new skills and care for the most vulnerable. In Finnish, this is called *sivistys* (*bildung*). The consecutive recent crises have shown that one important criterion could be the agility of universities to adapt to constant changes but yet maintaining the high quality of research and education. Universities have for centuries relied on traditions and have remained quite unchanged until the recent decades. The Covid-19 crisis was the final pulse that forced all universities to adapt to the unexpected global crisis. The pandemic showed that universities can change and develop under pressure from the outside.

At university, individuals should also have time to grow. A young student's professional growth to becoming an expert, researcher and contributor to society always requires the development and support of professional identity (Trede *et al.*, 2012). This growth requires time and versatile community with multiple interactions, which university studies should provide. Universities have a role to play in strengthening a sustainable and hopeful future, of which a prosperous human being and a sustainable planet are an essential part (Weick, 2001). Elements of growth require community support and a sense of belonging. Strengthening the individual's sense of self-efficacy within a social context is essential. While universities offer opportunities to update skills throughout a career, it is important to remember that a completed degree also builds permanence into a young person's life. Competences cannot be a fragmented sum of parts but must be sustainable as a whole now and in the future.

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Chapter 15

W(h)ither Global Research Collaboration: the End of the Open Model?

Meric S. Gertler

INTRODUCTION

The global research community is emerging into a post-pandemic era in which unprecedented global challenges such as climate change and refugee migration are already transforming our world. The latest report of the Intergovernmental Panel on Climate Change (IPCC) has underscored the urgency of climate action, describing "a rapidly closing window of opportunity to secure a liveable and sustainable future for all" (IPCC, 2023, p. 24). Meanwhile, the United Nations High Commissioner for Refugees (UNHCR) reported in 2022 that we had passed a dreadful milestone: 100 million people were forcibly displaced from their homes, more than a third of them for reasons having to do with climate or war (United Nations, 2022). By 2050, the International Organization for Migration (IOM) estimates that climate-related events *alone* will force 216 million people to become refugees (IOM, n.d.). That's roughly the population of France, Germany, Switzerland and Italy combined. Such unrest on an unprecedented scale will create heightened instability of a humanitarian, economic, political, social and military nature.

Faced with such challenges, it seems self-evident that the global research community must work together to mitigate or avoid the worst outcomes and identify solutions. This will take ingenuity, innovation and – most of all

– collaboration. And yet, at a time when it is most badly needed, international research collaboration appears to be under significant threat. How can such collaboration be sustained and supported, in order to promote resilient and equitable societies?

This chapter offers an assessment of the present state of international research collaboration, highlighting two powerful and opposing trends currently re-shaping the global research environment.

First, it notes that international research collaboration has been rising steadily for at least a generation. By some measures, international collaboration produces especially impactful research with far-reaching and profound impact. This was strikingly on display during the global response to Covid-19. Indeed, an open science paradigm, of which international collaboration is an important part, continues to gain momentum, yielding dramatic and transformational results.

A second trend threatens this emerging paradigm. An unstable geopolitical landscape is undermining international research collaboration and fracturing the global research mission. Economic rivalry, political schisms and military conflicts are re-casting one-time collaborators and partners as rivals and foes. The profound restructuring of globalization currently underway seems destined to reshape the global research enterprise in fundamental ways. If the open science movement fragments into blocs of like-minded partners, "us" and "them", then perhaps the days of wide-open global research collaboration may well be behind us.

This somewhat bleak assessment constitutes a wake-up call for universities. The world is changing in profound ways. Universities need to acknowledge this explicitly, recognizing the threats to the global research enterprise, stepping forward to defend it at a time when few others will do so and seizing emerging opportunities arising from the new geopolitical reality. Despite many challenges, the global research community can – and must – defend the collaborative and open science enterprise upon which global well-being depends.

A TALE OF TWO TRENDS

Part One: the Growth and Power of International Collaboration

The growth of international research collaboration, as measured by academic publications with authors from more than a single country, has significantly outpaced the growth in total publications. This has been particularly dramatic among the traditionally well-established leaders in scientific research. For example, as seen in Figure 1, since 2000 the number of academic publications coming from OECD member countries has more than doubled, while

the number of international collaborations involving OECD members has increased more than five-fold through 2020. Even among BRICS nations, as seen in Figure 2, where the meteoric rise in Chinese academic publications dominates the picture, the pace of growth in international collaboration still exceeds the pace of growth in all academic publications.

This growth in international collaboration has been enabled by greater research integration and openness, and driven by the recognition that international collaboration – the mixing of diverse ideas, perspectives and complementary research strengths – produces exceptionally impactful research. For example, in the past five years, publications that involve international collaboration account for more than half (55%) of "hot papers" identified by Clarivate's Web of Science – those papers that rapidly accumulate significant numbers of citations; this despite the fact that international collaborations represent less than a quarter (23%) of all publications over the same period. And publications with authors from three or more countries have a normalized citation impact of more than twice the overall global average (see Adams, 2013).

Another factor driving the growth of international research collaboration is the formalization of "open science" as a global norm. The ideas behind open science – sharing scientific data, methodologies, results and facilities freely and openly – were enshrined by UNESCO in 2021:

> **Open science** is defined as an inclusive construct that combines various movements and practices aiming to make multilingual scientific knowledge openly available, accessible and reusable for everyone, *to increase scientific collaborations and sharing of information for the benefits of science and society*, and to open the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the traditional scientific community. (UNESCO, 2021a, emphasis added)

Notwithstanding this recent formalization, the ideas underlying open science have been circulating for many years. The goal of the open science movement is to advance the entire research enterprise by opening it to global collaboration, sharing papers, discoveries, data, protocols, tools and infrastructure. For those countries engaged in the task of developing their nascent national systems of innovation, an intentional embrace of this model has long been viewed as a way of accelerating their scientific progress.

Scientific and technological cooperation has also been used as a tool for advancing diplomacy. For example, the United States and China forged their first Science and Technology Agreement (STA) in 1979, following the formal diplomatic recognition of China by the US under then-President Nixon. The STA has been renewed every five years since then, fostering

collaboration in fields such as agricultural science, atmospheric science, physics and chemistry. For reasons that are spelled out below, it is not clear at time of writing if this Agreement – most recently renewed in 2018 – will be extended in the future (Martina, 2023).

Moreover, as the challenges we face have become increasing global in nature, global collaboration is the most effective way to seek their solutions. The global response to Covid-19 provided striking evidence of the power of international collaboration. Bibliometric indicators revealed unprecedented and growing levels of international co-publication on Covid-19 in the early months of the pandemic (Duan & Xia, 2021). Researchers collaborated across international borders in developing vaccines, formulating diagnostics and therapeutics, tracking variants and designing and evaluating public health policies. The scientific community shared data and best practices far more readily than did governments (many of which resisted openness, both nationally and internationally). Preprint servers facilitated the rapid exchange of ideas. International teams collaborated on global infectious disease surveillance projects. The GISAID database, to take one remarkable example, provides public access to (at the time of writing) fifteen million hCoV-19 genome sequences collected by scientists from 210 countries and territories. GISAID continues to play a vital role in tracking, monitoring and sharing "clinical and epidemiological data associated with human viruses … to help researchers understand how viruses evolve and spread during epidemics and pandemics" (GISAID, n.d.). This is the sort of global collaboration that rarely makes the news, but represents an essential part of the global scientific effort to advance human knowledge in the face of grand challenges.

It is worth noting that while such international collaborations constitute an important part of the open science movement, they are not to be confused with the related concept of open *access* – another aspect that is also gaining momentum. According to UNESCO, roughly 70% of scientific papers published in the past decade are owned by publishers, institutions or governments and protected by subscription services or paywalls. In contrast, during the pandemic, 85% of papers related to Covid-19 were made publicly and freely accessible, massively facilitating international collaboration (Nair-Bedouelle, 2023).

The extraordinary speed and effectiveness of the global response to Covid-19 owes a great deal to the way in which the global biomedical research enterprise collaborated openly. It is a powerful model, and a dramatic and compelling instance of a larger trend. The research community, and the global community, more generally, have seen the benefits of international collaboration and open science. Building on this momentum, the White House Office of Science and Technology Policy designated 2023 the Year of Open Science.

Part Two: Geopolitical Instability Threatens the Global Scientific Enterprise

However, despite its remarkable successes, the future of the global research enterprise appears to be increasingly in doubt. Geopolitical rivalries and outright conflicts are undermining the global research mission and threatening the principle of open science, with profound effects on the pace and direction of scientific advances, the geography of international co-operation and the openness upon which a sustainable, inclusive and prosperous global future depends.

The Russian invasion of Ukraine provides the most obvious example. The human cost of the invasion has been appalling. And its toll on higher education and advanced research – and international research collaboration – has been immense.

Ukrainian research capacity has been decimated. According to one estimate, more than one-quarter of Ukrainian scholars fled the country following the Russian invasion, though some have since returned (see Gaind *et al.*, 2022). Hundreds of thousands, perhaps millions, of Ukrainian students have been internally displaced or are studying in foreign countries, dozens of which have opened their doors. Critical infrastructure, to say nothing of sensitive research infrastructure, will take years to rebuild, once such reconstruction is even possible.

Meanwhile, Russian researchers are facing boycotts, sanctions and restrictions in many countries around the world. Collaborations involving Russian scientists or agencies have been cancelled or suspended in western countries. The 1.3-billion-euro ExoMars project led by the European Space Agency severed its ties with the Russian space agency Roscosmos, imperiling its future until a last-minute investment from European member countries saved it. CERN has barred Russian institutions from participating in its experiments, and more than 70 papers resulting from experiments at the Large Hadron Collider languish unpublished because of disputes over to how to cite or credit Russian contributions (Petrakou, 2023).

In Canada, federal research funding agencies are pulling back from funding collaborations involving Russian institutions. The Canadian government has committed to "refraining from entering into agreements with Russian research institutions" and "to ensur[ing] that no new collaborations with individual Russian researchers are established in areas that advance the interests of Vladimir Putin's regime." Likewise, the United States government has announced that it will "wind down institutional, administrative, funding and personnel relationships and research collaborations in the fields of science and technology with Russian" government-affiliated research institutions (Office of Science and Technology Policy, The White House, 2022). Other G7 nations have acted similarly.

These measures have doubtless encouraged an exodus of talent from Russia. Hundreds of thousands of educated professionals, including many researchers, scientists and students, have fled Russia since the invasion of Ukraine, especially since the country's partial mobilization in September (Carl, 2023). A PONARS Eurasia survey found that Russian migrants since the invasion are younger, better educated and wealthier than the general population. More than 80% of Russian migrants have degrees in higher education compared to a general population average of 27% (Kamalov *et al.*, 2022). The Biden Administration is moving to recruit Russian scientists and engineers to the United States and the UK has made similar overtures, though it is still unclear how successful these measures have been (see: The Editors, 2022; Benner, 2022).

In addition to the war in Ukraine, the increasingly strained relations between China and the West are further destabilizing the global geopolitical environment, leading to a fragmented "tri-polar" or "multi-polar" world. Spheres of influence are shifting and evolving. And international research collaboration is one indicator of this. China-US co-publications declined in 2020 for the first time since the early 1990s (Figure 3). Meanwhile, co-publications between Chinese and Russian scholars continued to grow, seeing a particularly steep rise in 2021. (One should be mindful of differing base-rates: the United States and China still collaborate on far more publications than do China and Russia. But the shift underway is nevertheless striking.)

It is hard to overstate the importance of these trends. Propelled by successive Science and Technology Agreements, China and the United States remain the largest international research collaborators and the world's leading sources of high-quality collaborative research as measured by the *Nature Index*. But the marked recent decline in co-publication activity could hold dramatic implications for the advance of knowledge in many fields.

The geopolitical tensions between China and the US show no signs of abating. Immigration and visa challenges for Chinese students and scholars in the US, together with the Trump Administration's "China Initiative", have had a chilling effect. The Biden Administration cancelled the most stringent components of the China Initiative, but left others in place and added new measures. The *CHIPS and Science Act*, signed into law in August 2022, contains provisions to enhance research security in direct and explicit response to allegations of Chinese spying and intellectual property theft. It also bans participants in programs like China's Thousand Talents plan from receiving federally funded research grants.

Indeed, a 2022 analysis of faculty members reporting affiliations with both Chinese and US institutions on their publications shows a decline of more than 20% in the past three years, even as, overall, the number of authors reporting multiple affiliations has continued to rise. This undoubtedly reflects the changing geopolitical environment.

These developments carry overtones of Great Power rivalry, with the United States seeking to entrench its position as the world's leading superpower in the face of a rising challenger. "Full of Cold War mentality and ideological prejudice", is how China described the *CHIPS and Science Act* (Sharma, 2021).

Whatever one might think of the allegations of "ideological prejudice", real prejudice against Chinese students and scholars has been on the rise in the United States, Canada, United Kingdom and elsewhere (Eligh, 2021). The pandemic played a significant role in the rise of anti-Asian racism, and geopolitical tensions have amplified it. Strict export controls coupled with massive investments in local US R&D and friction over Taiwan, Hong Kong and the South China Sea have contributed to a growing culture of mistrust and hostility that is sure to impede international research collaboration (see Ruiz *et al.*, 2021).

The culture of mistrust pervades all aspects of US society, including higher education and advanced research. Findings from recent surveys of Chinese Americans and Chinese students and scholars at US institutions are alarming. Consider:

- A 2021 survey of some 2,000 scientists reported in *Nature* found that more than half of the scientists of Chinese descent reported "'considerable' fear, anxiety or a mixture of both that they are being surveilled by the US government" (Subbaraman, 2021).
- According to the same survey, 42% of scientists of Chinese descent felt racially profiled by the US government.
- A 2021 survey by the American Physical Society found "[a]pproximately 43% of international physics graduate students and early career professionals currently living in the United States perceive that the United States is an unwelcoming country for international students and scholars" (American Physical Society, 2021).
- The same survey found that the recent US emphasis on research security led 40% of international early career professionals and 45% of international graduate students to say that they were "less likely or much less likely" to stay in the United States over the long term.

These data testify to the pronounced deterioration of what is arguably the most important relationship in the global research enterprise. Predictably, the chill in collaboration between Chinese and American institutions and scholars is also reflected in student enrolment trends. According to *Open Doors*, international student enrolment in the United States has continued to rebound after several years of pandemic and nationalism-induced decline: overall international enrolment was up 3.8% in 2021-22. But international

enrolment from China *declined* by 8.6% – the second consecutive steep decline (Open Doors, 2023).

Canada appears to be following a similar pattern. International student enrolment has recovered to pre-pandemic levels, but 2021 saw a nearly 10% decline in Chinese international students at all levels (ICEF, 2022). In the UK, visas issued to Chinese students have fallen by 2% since 2019, and in 2022, for the first time the UK issued more visas to Indian nationals than to Chinese nationals (McNamara, 2022). As today's international students are tomorrow's international partners and collaborators, this is a troubling sign for the future.

In the face of these striking shifts, there is some evidence to suggest that global research productivity, as measured by publications and patents, has stalled or even declined (Silver, 2022; Astvansh *et al.*, 2022). And there is growing evidence that the international research community is fracturing into partisan blocs of like-minded partners.

Indeed, it would appear that a fundamental shift in the geography of global research collaboration is underway, one that follows the current restructuring of globalization itself. Major economies are now "re-shoring" (repatriating overseas production activity) and "friend-shoring" (limiting supply chains to trusted, "like-minded" or friendlier partners). Global research collaboration seems to be following suit, splintering into blocs of "like-minded" partners.

Consider the following recent developments by way of illustration. During Chinese President Xi Jinping's state visit to Moscow in mid-March 2023, China and Russia pledged to "significantly increase" bilateral trade by 2030 (Magnier, 2023). The two nations reconfirmed an economic and political alliance based on a common desire to resist US power and influence. Notably, this agreement takes its place alongside the agreement between the China National Space Administration and Russia's Roscosmos for a joint International Lunar Research Station. These developments mirror the steady rise in co-publication activity between scholars based in China and Russia documented in Figure 3.

At the same time, the Biden Administration has focused its attention on cultivating new international partners – signalled most vividly by the launch of its US-India Initiative on Critical and Emerging Technologies (iCET) in May 2022. Indian Prime Minister Modi's state visit to the United States in June 2023 signified a major step forward in promoting closer research ties between the two nations.

For its part, the United Kingdom, fresh off signing the New Atlantic Charter with the United States in 2021, denied entry to a record 1,104 Chinese researchers and postgraduate students in 2022 on the grounds of "national security". As *The Guardian* notes, that's up from 128 in 2020 and 13 in 2016 (Devlin, 2023). In the face of this rising backlash, some leaders

of British universities are speaking out to draw attention to the unintended consequences of "hawkish" science and technology policies with regard to engagement with China. UCL's Michael Spence (2023) has noted in a recent essay in *The New Statesman*,

> Collaborative research with China is of substantial and growing importance. As a rising research and economic power, China, like the UK, has excellent research institutions. Both countries' universities can achieve more if they learn from each other, and we get back as much as we give in these relationships. … [W]e must continue to work with Chinese partners on pressing global challenges where co-operation is essential, in ways that benefit us all, and which increase our shared intercultural understanding with the Chinese people.

Others contend that the measures the West has implemented to contain a rising China may have had other unintended consequences. Beijing's 2015 "Made in China" policy called on China to develop advanced technologies, materials and processes domestically in response to – and anticipating – restrictions imposed by foreign countries. President Xi doubled down on this strategy in 2021 at an address to a joint assembly of the members of the Chinese Academy of Sciences, the Chinese Academy of Engineering and the national congress of the China Association for Science and Technology. He called for "resolute efforts to achieve breakthroughs in core technologies in key fields" and emphasized that "Sci-tech self-reliance and self-strengthening should always be considered a strategic support for national development" (Xinhua, 2021).

The strategy may well be working. China is now among the world leaders in solar and battery technology, artificial intelligence, quantum computing, advanced manufacturing and space exploration among many other fields. Emily Weinstein, a Research Fellow at Georgetown's Center for Security and Emerging Technology, is quoted in *World University News*:

> In the US there are really strong export controls and regulations on interactions between NASA and Chinese scientists. But now we can see that China is all over space and they're relatively self-sufficient. And that came from being cut off (Sharma, 2021).

Far from containing a rising China, Western measures designed to limit China's scientific and technological advances may have inadvertently spurred China's rise. It remains to be seen whether China can continue its impressive progress in an era of stronger barriers to research collaboration with Western research institutions.

QUESTIONS FOR GLOBAL RESEARCH COLLABORATION AT A CROSSROADS

The two trends I have described – the growing importance of international research collaboration, and the growing challenges to international collaboration – pose important questions for leaders in the worldwide research community.

Should we really be Asking 'Which Side are you on'?

The major protagonists and supporting cast in an emerging "tri-polar" or "multi-polar" world are well known. However, many countries and regions of the world remain largely unaligned. Asking them – or coercing them – to choose sides may not produce the results political leaders want, sowing resentment rather than fostering cooperation. Regional, cultural, ethnic, economic and other associations make local calculations complicated. Many nations will not want to be put into such positions: China is the largest trading partner for over a hundred countries.

Moreover, advancing the idea that there is an "us" and a "them" undermines the advantages that make open, inclusive societies successful, especially in research and innovation. The survey results reviewed earlier should sound alarm bells. The reputation of the United States – and Canada, the UK, Australia and others – as welcoming and equitable countries with opportunities for all, has attracted thousands of talented people and driven scientific, economic and social progress for generations. More than international collaboration is at stake if we sacrifice those reputations.

And when it comes to the future of international collaboration in a polarizing world, prospective partnerships with research institutions in the "unaligned" countries represent an important opportunity for advancing open science and reaping its benefits. By way of example, the University of Toronto has recently launched an African Health Collaborative network in partnership with eight universities across five African countries. We have also recently inaugurated a research centre in Mumbai, with the goal of supporting collaboration with Indian research institutions, local governments and private sector partners tackling urban sustainability and quality of life.

Along similar lines, the Association of American Universities recently created a Task Force on Expanding US-India University Partnerships, leveraging the Biden Administration's initiative to build stronger economic ties with India (AAU, 2023).

WHERE ARE WE HEADED?

A multi-polar world with factions vying for geopolitical, scientific or military supremacy is highly reminiscent of the Cold War. The "Space Race" and the "Arms Race" pitted the superpowers against each other in an existential struggle, consuming resources that may have been better spent elsewhere. The Cold War was predicated on a zero-sum approach to the global order, with scientific communities in the United States and the Soviet Union harnessed to advance geopolitical goals.

Is this our inevitable trajectory again? Writing recently in *Foreign Affairs*, Jessica Chen Weiss puts the point succinctly:

> Where the current trajectory leads is clear: a more dangerous and less habitable world defined by an ever-present risk of confrontation and crisis, with preparation for conflict taking precedence over tackling common challenges (Weiss, 2023).

In other words, current conditions will not only undermine the global open science paradigm, they will also distort the trajectory and direction of the scientific research that is performed in each of the poles. Instead of addressing global challenges like climate change or pandemics, the global research enterprise will be focused on "preparation for conflict".

I would submit that the global research community is uniquely placed to alter this trajectory and show the value of positive-sum international engagements, as it did during the pandemic. Tackling common challenges is the lifeblood of international collaboration.

How can we Build the Future we want?

The 2021 UNESCO Science Report asks, "Are we using science to build the future we want?" (UNESCO, 2021b). As rival nations raise barriers to international research collaboration, impede the progress of open science and retreat into like-minded adversarial factions, we are increasingly at risk of building the future we fear rather than the future we want.

The unrelenting global challenges we are confronting today – such as climate change, pandemics and refugee migration – simply cannot be met effectively by a "decoupled' or fragmented global community. It will take international collaboration, scientific as well as political. Take the aforementioned IPCC as a case in point. The large team of scientists, authors and editors contributing to its most recent *Synthesis Report* was drawn from an astonishing 52 countries across the Global North and South – including

both China and Russia. This kind of collaboration will be essential if we are to tackle today's grand challenges successfully.

As the most natural advocates for the cause, it falls to universities to resist the balkanization and polarization of international research collaboration. We must work closely with governments to help them understand the value of international collaboration and academic freedom – including the freedom to determine one's research partners. We must also help governments understand the risks of inflammatory rhetoric and strenuously resist it on our campuses. At the same time, we must work within our academic communities to ensure we have the tools necessary to protect research and intellectual property from genuine risks of theft or misuse.

And, finally, university leaders, together with individual researchers and students, must model global collaboration and champion the tenets of open science as a means of building knowledge and mutual understanding. The U7+ Alliance, formed in 2019, provides a striking example. The U7+ is an alliance of universities from across five continents dedicated to the common goal of addressing global challenges. At their Presidents' Summit in March 2023, the alliance noted in their *U7+ Tokyo Statement on Peace and Security* that "[u]niversities are uniquely positioned to innovate for peace and security through research, education, and international exchange. The U7+ Alliance, with its strong multilateral ties between top research universities in both G7 and non-G7 nations, can generate new solutions across traditional geopolitical barriers" (U7+ Alliance of World Universities, 2023). Ultimately, such open collaboration is the best path to global prosperity, security and well-being.

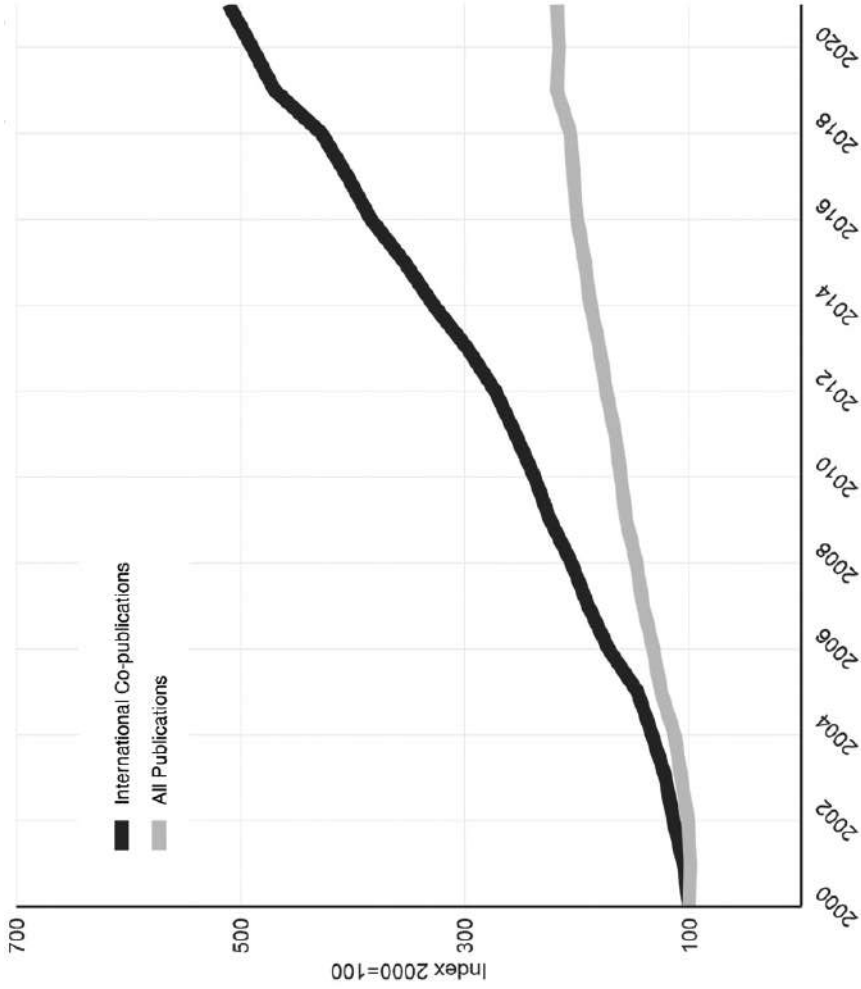

Figure 1 – OECD Publications and International Co-publications
(year-over-year change)
Note: certain data included herein are derived from Clarivate Web of Science

Analysis from the University of Toronto.

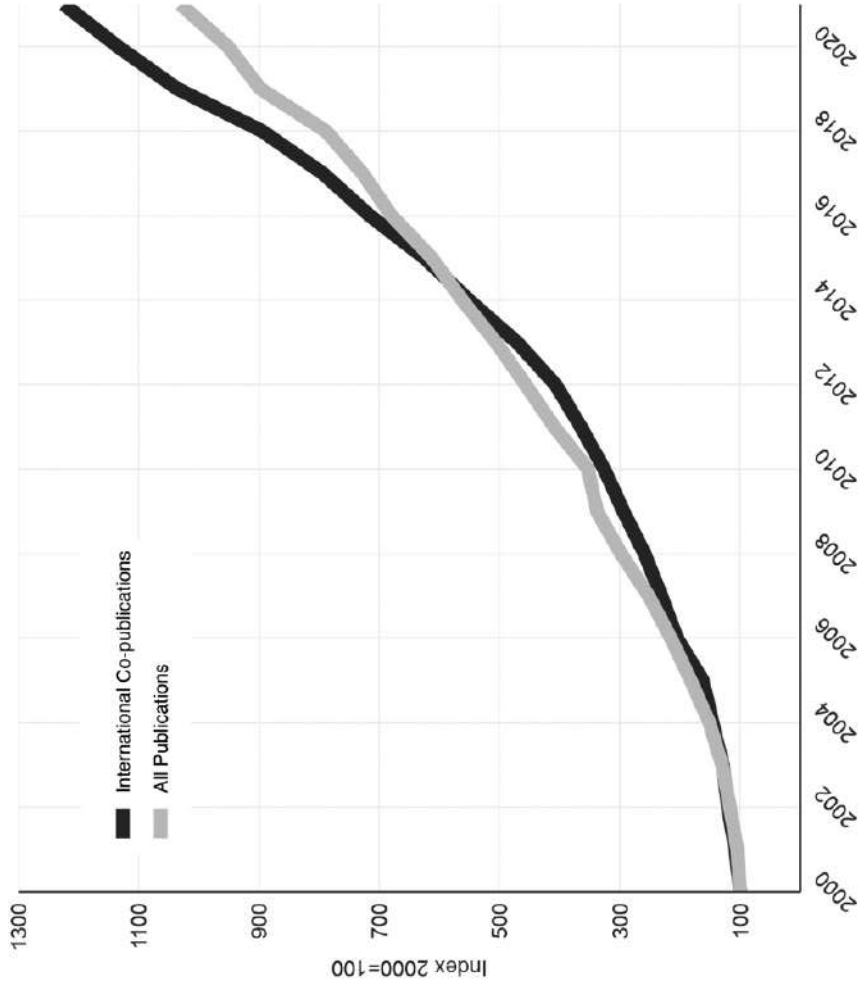

Figure 2 – BRICS Publications and International Co-publications
(year-over-year change)
Note: certain data included herein are derived from Clarivate Web of Science

Analysis from the University of Toronto.

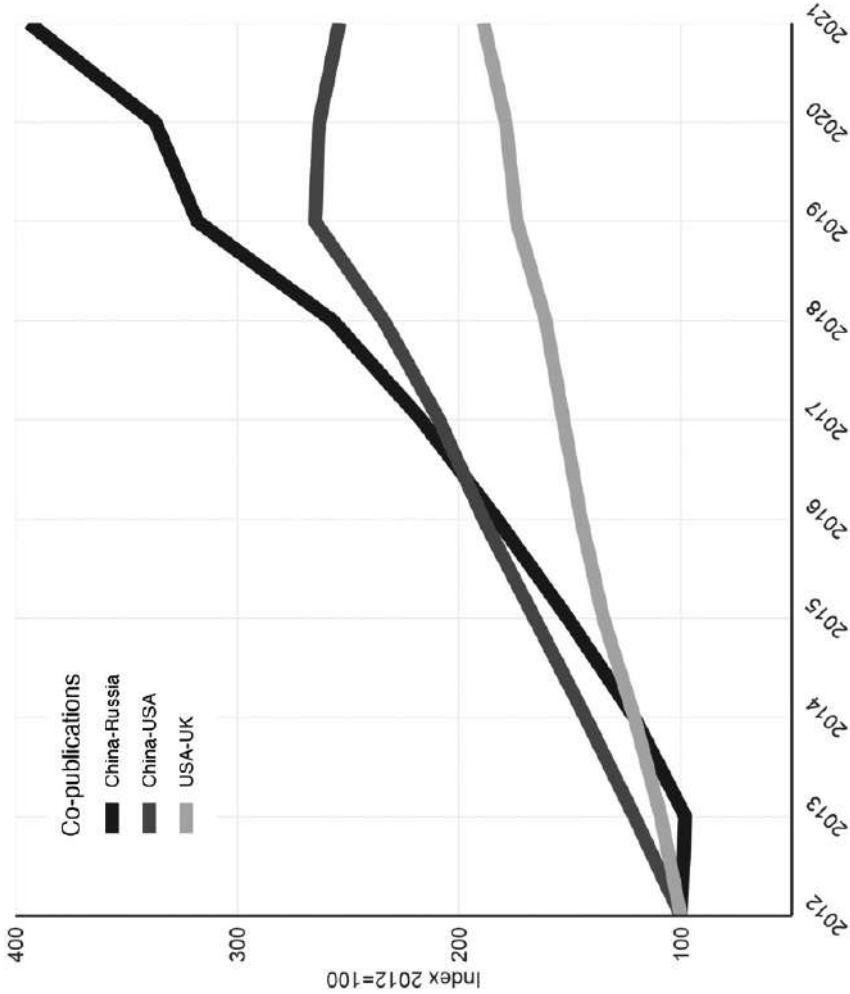

Figure 3 – A sea change in International Co-publications
(year-over-year change in co-publications, select countries)
Note: certain data included herein are derived from Clarivate Web of Science

Analysis from the University of Toronto.

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Chapter 16

Equitable Collaborations: Key to Sustainable Futures

Nana Aba Appiah Amfo & Gordon A. Awandare

INTRODUCTION

The challenges that face societies today are, to a large extent, global, ranging from the climate crisis, food insecurity, health, to terrorism and conflicts. Efforts towards addressing these challenges, which have the tendency to affect the quality of life of global citizens, have to be concerted, consistent and global in nature. This is because an event happening in one part of the world often has ripple effects and no one or group of persons can assume they are totally protected and cannot be affected. The recent Covid-19 pandemic remains a vivid example. We can also cite the Russian-Ukraine war and Jihadist movements in the Sahel, and the effect of these on nations both near and far afield. In spite of increased globalization, it is impossible to ignore the cultural and context-specific idiosyncrasies when seeking to address challenges of even global nature. In effect, global challenges require local solutions. To achieve maximum results, solutions to the difficulties that confront us have to be contextualized and culturally sensitive. Collaborations are most effective when there is the recognition of local expertise, in the context of external funding, and projects are co-created by all who are involved, including south and north collaborators. This is essential for achieving more targeted, beneficial and sustainable outcomes.

In what follows, our aim is three-fold. First, we examine how collaborations among research universities and funding agencies in the global south

and north can be equitable and targeted towards sustainable results. Second, we consider how south to south collaborations among universities/institutions have played significant roles in resolving the developmental and social challenges of our communities. Finally, we will examine the community impact and involvement of research projects. We do so by mainly examining activities of three World Bank African Centres of Excellence (ACEs) at the University of Ghana (UG). These are the West Africa Centre for Crop Improvement (WACCI), West African Centre for Cell Biology of Infectious Pathogens (WACCBIP) and the West African Genetic Medicine Centre (WAGMC).

UNIVERSITY OF GHANA WORLD BANK AFRICA CENTRES OF EXCELLENCE (UG ACES)

The World Bank Africa Centres of Excellence (ACEs) project is deemed to be the first large scale World Bank sponsored higher education project in Africa. It started in 2014, and it is aimed at addressing gaps in higher-skills development in the continent's priority areas of science, technology, engineering and mathematics (STEM), agriculture, health, environment, applied social science and education (cf. worldbank.org). Out of the over 80 Centres in 50 Universities across 20 countries, the University of Ghana is host to three of these centres – The West Africa Centre for Crop Improvement (WACCI), West African Centre for Cell Biology of Infectious Pathogens (WACCBIP) and the West African Genetic Medicine Centre (WAGMC).

The West Africa Centre for Crop Improvement (WACCI)

The West Africa Centre for Crop Improvement (WACCI) was established in 2007, as a partnership between the University of Ghana and Cornell University, US, with an $11.4 million grant from the Alliance for a Green Revolution in Africa (AGRA). The objective for its establishment is to train African plant breeders and seed scientists in Africa for Africa. The need for such scientists to help resolve issues of food insecurity in Africa was clearly identified. It was also recognized that training on the continent will better benefit the continent, and there will be more contextualized curricula. Additionally, retention of graduates on the continent will improve with such a program that trains people on the continent for the continent. These plant breeders and seed scientists are expected to develop superior varieties of crops and seeds for improved yields within their local communities. This is expected to enhance food security and "spark a green revolution" (Danquah *et al.*, 2023: 1).

The objective of WACCI, together with its track record, put it in good stead to compete as a World Bank ACE. Thus in 2014, with a grant support of $8 million, WACCI joined the first set of World Bank ACE.

West African Centre for Cell Biology of Infectious Pathogens (WACCBIP)

WACCBIP was established in 2014, with an $8 million grant, as part of the initial set of World Bank ACE. The grant application was led by faculty at the University of Ghana's Department of Biochemistry, Cell and Molecular Biology and the Noguchi Memorial Institute for Medical Research. The Centre aims at becoming a major hub for biomedical research training in Africa, producing high-quality home-grown African biomedical scientists. As a result, its training programs are targeted at producing masters and doctoral graduates, as well as post-doctoral fellows. Another key objective of the Centre is to conduct applied research into the biology and pathogens of tropical diseases. Finally, it seeks, through its research and training programs, to enhance collaboration between biomedical scientists and industry leaders. (cf. waccbip.org).

West Africa Genetic Medicine Centre (WAGMC)

The West Africa Genetic Medicine Centre (WAGMC) was established through funding from the World Bank in 2019. Its main research focus is sickle cell disease genomics. The funding provided is intended to assist the development of a regional centre of excellence in genetic medicine. The Centre aims to "foster a culture that integrates research, teaching and learning, service and community and public engagement to advance knowledge of human genetics, and to further the ability to overcome genetic disorders to promote health" (wagmc.org). The Centre's objectives are to introduce programs in genetics, conduct innovative research on common genetic disorders and engage its communities and publics. Like the other two World Bank ACEs at the University of Ghana, the Centre believes that offering training on the continent for Africans will build capacities and competences in its people, thus bridging major skills gaps in the area of genetic medicine in Africa. The Centre has since its set-up established the first genetic counselling program in sub-Saharan Africa.

EQUITABLE PARTNERSHIPS, SUSTAINED RESULTS

The Centres we have described above have their own unique set-up stories. While WACCI was established prior to it being designated as a World Bank

ACE, the other two started as World Bank ACEs. WACCBIP was one of the initial World Bank ACEs and WAGMC came on board five years later. However, what is common among all of these centres is that they leveraged on initial funding to become multi-source funding centres. They have also created curricula relevant for the continent's needs, and are well on course to create on the continent a critical mass of scientists who are poised to address our agricultural and health needs.

WACCI

This original initiative and collaboration between an African University and an American University has been highly successful. Born out of a partnership, WACCI's continued success can be attributed to sustained partnerships and collaborations, not only with local and international funding agencies, but also with national, regional and international research institutes and Universities. Its main sponsors have been the AGRA, WA Agricultural Productivity Programme, Cornell University, German Academic Exchange Service (DAAD) and the World Bank. However, it continues to explore funding opportunities from within and outside the continent. As of March 2023, WACCI has received sponsorship support from 38 organizations to the tune of more than $44 million (Danquah *et al.*, 2023). The credibility it has built over the years through judicious use of its resources for targeted outputs has facilitated the evolution from a single-donor funded centre to a multi-donor funded one.

As a result of effective collaboration, students trained at WACCI have access to world-class facilities in a local context. For example, students have access to a reference library at UG, The Essential Electronic Agricultural Library (TEEAL) and Global Online Research in Agriculture (AGORA). In addition, they have electronic access to the Albert R. Mann Library at Cornell. Students from all over Africa benefit from guest lecturers from collaborative institutions from both the global north and south. Their research work is in their respective countries as they aim to address specific national crop production challenges. Their supervisory team is made up of faculty from UG and their home countries, as well as experts from international Centres.

WACCBIP

WACCBIP has leveraged on initial funding and has since its establishment attracted over $45 million in funding from science funding agencies and philanthropic organizations in the global north to enable research and training in West Africa. Among its key funders are the Wellcome Trust, the National Institutes of Health (NIH), US, the Royal Society, UK, National Institute of Health and Care Research (NIHR), Global Challenges Research Fund,

UK, DANIDA, Denmark, Rockefeller Foundation, US, and the UK Foreign Commonwealth and Development Office. WACCBIP has subsequently become a globally competitive Centre and the preferred African partner for many international research consortia and industry entities.

WAGMC

The West Africa Genetic Medicine Centre (WAGMC) was established through a $6.4 million grant from the World Bank in 2019. In addition to funding from the World Bank, it has received considerable funding from the NIH. Its Sickle Cell Genomics of Africa (SickleGenAfrica) project is a $5.4 million project from the NIH. Sickle Pan-African Research Consortium (SPARCO) is a $1.1 million NIH funded program. Through the University of Pittsburgh, WAGMC is part of the $2.8 million Therapeutic targets of acute chest syndrome project. The mid-term review of the World Bank ACEs rated WAGMC as the highest performer of the new ACEs as far as the implementation rate was concerned. The ability to leverage on the original funding for further funding may have played a significant role in this favourable rating.

SOUTH TO SOUTH COLLABORATIONS

The Centres have stayed true to their mandates and names as regional training hubs and have extended their services to countries in the West African subregion and beyond.

WACCI

In training plant breeders and seed scientists, WACCI has collaborated with over 20 National Agricultural Research Institutes (NARIs), the Biosciences of East and Central Africa (BecA), International Institute of Tropical Agriculture (IITA) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) of the Consultative Group on International Agricultural Research (CGIAR). These collaborations have permitted several cohorts of students to use molecular markers to genotype their varieties using the genotyping platform of LGC Genomics, UK and ICRISAT, India. Funding from the Bill and Melinda Gates Foundation (BMGF) also provided the facilitation for the development of a functional gene discovery platform for sorghum development. Students have developed skills and knowledge in genomics and bioinformatics for crop improvement.

Since its establishment, WACCI has produced 105 PhD students and 40 MPhil students from 19 African countries in West, Central and East Africa. The Centre projects to graduate 160 plant breeders and 90 seed scientists by

2026. The programs at WACCI take into consideration the linguistic situation on the continent. Apart from six African countries that are Lusophone, the rest of the countries in Africa are either Anglophone or Francophone. Even though the curriculum is delivered in English, francophone students have the opportunity of an intensive eight-week pre-enrolment intensive English language proficiency course, delivered by the Language Centre of the University of Ghana. Throughout their first year, they continue to receive language proficiency lessons to help them cope with the taught courses.

WACCBIP

The Centre has built a robust and extensive research ecosystem in Africa; which includes state-of-the-art research infrastructure, a complete research training pipeline within sub-Saharan Africa, and an extensive collaborative network of both global and regional partners.

Currently, the Centre has established a world class research facility at the University of Ghana, with wide ranging applications and technology platforms, each led by a scientist with specific expertise, including Flow Cytometry, Next Generation Sequencing, Protein Expression, Advanced Microscopy and Imaging, High-Performance Computing, Bioinformatics and Data Management. This has facilitated the sharing of resources, access to specialized equipment and the mobility of students and faculty across various partner institutions in the sub-region to study and conduct research.

Through our partnership networks, our trainees have access to the best expertise and technology platforms for globally competitive research. For example, the Centre is part of Sickle cell Genetics (SickleGen) Africa, Hearing Impairment Genetics Studies in Africa (HI-GENES Africa), Tackling Infections to Benefit Africa (TIBA) program, the NIHR-Global Health Research Programme for genomic surveillance of malaria in West Africa project, Crick African Network, and West African Network of Infectious Disease ACEs (WANIDA). All these consortia, which WACCBIP leads or is co-lead, have conducted impactful research into the thematic areas of WACCBIP and trained many young African scientists.

WACCBIP has positioned itself as a major hub in Africa for training young African scientists. Over the last nine years, the Centre has produced 148 master's students and 50 PhD students. It has trained 40 postdoctoral fellows. Altogether, over 300 young African scientists have benefitted from the Centre's long-term training programs and over 2,500 health professionals have benefited from various short courses offered by WACCBIP. It has therefore contributed significantly to building a critical mass of home-grown African

science leaders by providing a full training pipeline — from graduate internships, through Master's and PhD programmes to postdoctoral fellowships and creating an environment for high quality training and development of science leaders in Africa. WACCBIP has built a pedagogic resource base comprised of local, sub-regional and international biomedical scientists working in world-class institutions across the globe who help facilitate specialized training programs in Molecular Cell Biology of Infectious Diseases at the MPhil and PhD levels.

WACCBIP has become a major hub with about 9 national, 15 regional and 15 international active partner institutions. Several faculty members in each institution have been involved in joint research projects with WACCBIP researchers, co-supervision of students, hosting of students in their laboratories, serving on thesis advisory committees and serving as external reviewers for student research proposals and theses. In addition to this, WACCBIP is leading south-south collaborations through funded research consortia in Africa. These consortia such as the World Bank ACE projects and the Wellcome Trust DELTAS program, ensure capacity transfers to other institutions in the south. In addition to collaborating with some of the most advanced research institutions in Africa (MRC Gambia, KEMRI Kilifi etc), WACCBIP has specifically identified institutions in disadvantaged countries such as Liberia (University of Liberia), where it is supporting them to build both human resource and infrastructural capacity.

A key contribution of WACCBIP to Africa's scientific capacity is its training strategy which ensures the retention of most of its trainees on the continent. Currently, 95% of the Centre's postdoctoral fellows are working on the continent. In addition, over 90% of all PhD and Master's alumni who transitioned directly into employment have remained in Africa, whilst the others are undertaking further studies in institutions across the world. To ensure the retention of the Centre's fellows on the continent, the Centre adopts the following strategies:

- Giving fellows on the continent access to global scientific collaborative networks during periods of their training;
- Fostering partnerships with the biotech industry in Africa, and giving access to fellows to intern in biotech firms on the continent. Such industrial arrangements have led to the retention of some of the Centre's fellows in these firms;
- Deliberate repatriation of talented young scientists from the diaspora back to the University of Ghana, through postdoctoral and research fellowships;
- Prioritizing alumni engagement; and
- Effective mentorship and role modelling.

WACCBIP's research has been a direct response to the present and future health needs of the continent. For example, a fellow's research work on the identification of drug-resistant strains of bacteria in Ghanaian hospitals uncovered over 500 strains of multidrug-resistant virulent bacteria circulating in intensive care units in selected Ghanaian hospitals. These findings (Abiola, 2019; Abiola & Mosi, 2020; 2021) have redefined how disinfection is done in major hospitals in the country, after engagements with the Ghana Health Service (GHS) and other relevant stakeholders.

Another study, on hearing impairment, led to the characterization of the specific genetic change (mutation) contributing to hearing loss in the Ghanaian population (Adadey *et al.*, 2020a & 2020b). To reduce the burden of the condition, the researchers have designed a diagnostic test with high sensitivity and specificity to screen new-born babies for the genetic change that causes susceptibility to hearing impairment in the Ghanaian population.

Focusing on the Covid-19 pandemic in Ghana, WACCBIP played a leading role in Ghana's response to the pandemic. WACCBIP scientists led the sequencing of the genome of the Covid-19 virus within the first three weeks of detection of the virus in Ghana. Subsequently, the team set up a nationwide surveillance effort, obtaining Covid-19 positive samples from testing labs across the country and sequencing the viruses. This has resulted in more than 4,500 viral genomes, which provided real time information to the Ghana Health Service on the circulation of viral variants in different parts of the country. Samples from arriving passengers who test positive at the airport were also regularly sequenced, which enabled early detection of new variants coming into the country. Additionally, the Centre has completed the largest Covid-19 exposure (seroprevalence) study in the sub-region with over 20,000 participants in Ghana, Burkina Faso and Nigeria, to provide critical information about the spread of the disease in West Africa. These studies have shown that vast majority of the populations across the countries had been exposed to the Covid-19 virus and helped in providing a better understanding of case numbers in the various epidemic waves.

WAGMC

In the delivery of its mandate, WAGMC has partnered with over 10 institutions in Ghana, Tanzania, Nigeria and South Africa. These include Kwame Nkrumah University of Science and Technology (KNUST), University of Abuja, University of Lagos, Bayero University and Muhimbili University of Health and Allied Sciences (Tanzania). Such collaborations with institutions in Africa have resulted in increased capacity building in these institutions.

It is in line with its objective to "build on existing relationships to create a new network focused on genetic medicine in the region, with WAGMC as the hub" (wagmc.org). WAGMC led the establishment of translational research groups at KNUST and University of Abuja. In both cases, the universities went on to develop competitive research applications to secure independent funding for sickle cell disease research. Its collaboration with Bayero University has resulted in the installation of a $30,000 echocardiography machine in the Aminu Kano Teaching Hospital of the Bayero Medical School in Kano. Subsequently, they have established the world's largest cohort study of echocardiography in sickle cell disease. At University of Lagos, this collaboration has resulted in the establishment of a vibrant community engagement unit that continues to provide critical input in design and execution of research, including clinical trials at the University of Lagos Teaching hospital.

COMMUNITY IMPACT

WACCI

Beyond the scientific publications produced by its over one hundred graduates, these alumni "are in the process of releasing new improved varieties of maize, rice, millet, sorghum, cowpea, cassava and sweet potatoes for their various agro-ecologies" (Danquah *et al.*, 2023:26). A readily cited example is the development of three yellow maize varieties by WACCI graduate Dr Mamadou Mory Coulibaly of the Institut d'Economie Rurale (IER) in Mali (cf. Danquah *et al.*, 2023). These improved varieties are expected to be adopted by resource-poor farmers, as they are developed taking into consideration major production constraints and farmer preferences. This development is considered critical in addressing the food insecurity challenges of sub- Saharan Africa.

WACCBIP

The centre regularly provided updates to the GHS, Ministry of Health, the Presidential Covid-19 taskforce, and their research data were frequently included in the regular nation-wide addresses of the President of Ghana, and led to the reinforcement of restrictions during the peak periods. The Centre has also been recognized and engaged as a key stakeholder in the government's initiative for vaccine development in Ghana.

The Centre has a dedicated Communication and Public Engagement (CPE) Unit, with the aim of improving and strengthening communication and engagement with local communities, bridging gaps in public understanding of

science, and embedding public and patient voices in the research process. The CPE Unit has continuously facilitated successful programs including engagements with schools, community interaction programs, town hall meetings, durbars, and media communication and dissemination activities. Annually, WACCBIP holds a breast cancer screening and awareness program known as "Nufu" (breast) festival, and annual community durbars to mark World AIDS Day and World Malaria Day. The CPE team has maintained a visible presence on several social media platforms which have subsequently seen an appreciable increase in terms of followership and engagement. The CPE team in collaboration with the Abibigroma Resident Theatre Company of the School of Performing Arts, University of Ghana, has led the production and piloting of a docudrama on the genetics of hearing impairment to engage communities affected by the condition in Ghana. The docudrama has since been translated into five widely spoken Ghanaian languages – Ga, Ewe, Akan (Twi), Dagbani and Gurene. Overall, the CPE unit has increased visibility of the Centre and helped researchers to address identified information gaps relating to their research into various diseases.

WAGMC

The WAGMC GHGenome project is being delivered in collaboration with traditional leaders and community youths. From August to September 2021, in commemoration of the 20th anniversary of the enstoolment of the Okyehene Amoatia Ofori Panyin (Paramount Chief of Akyem Abuakwa), WAGMC provided free screening for over 10 medical conditions for 2,500 children and adults in five towns in the Eastern region of Ghana. A component of the project focusses on public health education on the importance of genetics in well-being, health and diseases.

ENSURING EQUITY IN PARTNERSHIPS

The UG World Bank ACEs have, to varying extents, enjoyed cordial and productive research and training partnerships with institutions across sub-Saharan Africa, and the global north. These partnerships have been successful because of mutual respect on all sides, and genuine desire to work together in the best of faiths. In these partnerships, the UG World Bank ACEs came from positions of strength because they started with core strengths in the quality of the people and the environments they created, as indigenous African Institutions, created by Africans, led by Africans and for Africans. These Centres are led by world class scientists who go into partnerships as equal or stronger partners, contributing innovative ideas to project proposals and bringing their unique experiences in delivering large research projects

in the low and middle income country (LMIC) setting. The Centres have also diversified their funding portfolios, which inherently offers protection from any form of bullying by individual or group of funders or collaborators. Thus, they insist on partnerships being bound by signed agreements which are fair to both sides, including co-ownership of any resulting intellectual property and research publications. Finally, the Centres have been able to sustain and grow their funding and partnerships largely by delivering results and demonstrating high levels of transparency in financial management. This is possible because the Centres, with the support of the University, have assembled high quality talent not only in scientific faculty, but also critically, in support staff who have mastered grants management, communications and logistics.

CONCLUSION

The three World Bank ACEs at the University of Ghana, which we have described above, provide an indication of how given the right support, African institutions can lead projects which will develop expertise to address global challenges with specific focus on the continent's peculiarities.

For grants targeting global challenges, eligibility to be a Lead or Principal Investigator (PI) should be open to all individuals with the requisite expertise and track record. It should not be that the PI must be from a UK/US/EU institution. Many LMIC institutions have now demonstrated the capacity to manage large grants, including establishing robust financial management systems. Therefore, the perceived risk of mismanagement of funds should be significantly tampered.

Funding agencies should also insist on equitable partnerships, and this should be monitored throughout the life of a grant. There are instances where northern partners give the semblance of equity in the grant application, but once funded the imbalances are established during implementation, especially where they are the PI. Funders should conduct feedback interviews with LMIC partners involved in all collaborative grants that they fund to ascertain if the partnership was equitable, and, if not, the culprits should be blacklisted, with restrictions to further funding.

The lessons from these three Centres can be summed up as follows – equitable partnerships have the potential to yield desirable results, with contextual applicability. When the right partners are identified, there is a massive multiplier effect of initial funding. African institutions have the capacity to leverage on support from both the north and south, to grow expertise in the south, based on talent recognition and development programs. These result in higher retention of talent on the continent and locally tailored solutions for global challenges in our communities.

African countries have expended enormous resources on sponsoring students for higher education abroad, however, this has rather led to an increased brain drain since most of such individuals have not returned home after their training. The UG World Bank ACEs in recognition of this challenge set out to increase capacity to train highly skilled scientists locally, while promoting cutting-edge locally relevant research to provide opportunities for trainees to establish independent careers in Africa. Continued equitable collaborations appear to be the most viable route to sustainable futures of our communities.

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Chapter 17

Why 'Good' is 'Great' – Universities Leading the Way for Global Change

Linda Doyle

INTRODUCTION

The Glion conference for 2023 and this book are entitled "The New Road to Success: Contributions of Universities towards more Resilient Societies". It may be true to say that resilience is needed more than ever in the world. Our students and staff, and society at large, are living in a world in which climate change and biodiversity loss are threatening the very future of the planet, a world in which the lingering effects of the pandemic are still felt, and at a time at which many parts of the world are at war, resulting in forced displacements of large populations. Democracy is under threat, even in parts of the world where democracy has been deeply embedded in the culture. Geopolitical tensions are disrupting collaborations and cooperation between different nations and there are national security concerns driving countries to retrench and look inward. In addition, there is a cost-of-living crisis due to high inflation, though this term is very much a Global North term, so it is more universal to say there is an ever-growing gap between rich and poor. There are worldwide supply-chain issues, labour shortages in many places and lack of opportunities in even more. There are energy crisis issues, and in several countries, including my own, there are homelessness crises. The world is a very broken place and, in the face of all of this, it can be daunting to ask what can a university do to make society more resilient?

With all of this in mind, in this paper I present *one* answer to the question of how universities can contribute to a more resilient society and that answer is that we can start by being "*good*" universities.

The word "good" can come across as an unusual choice of word. The type of rhetoric we typically use when describing our institutions tends to include words such as "excellent" and "world class". Hence, the use of the word "good" can initially give the impression that ambitions are curtailed, and mediocre achievements will suffice. That is not the intention.

The word "good" as used in this paper is inspired by the work of Raewyn Connell as detailed in the book, *The Good University: What Universities Actually Do and Why It's Time for Radical Change*. This paper starts by unpacking this work and the meaning of the Good University in section 2. The paper then goes on to look at how "good" can be put into action, and to this end draws on a framework created by Kate Raworth in her work, *Doughnut Economics*. Section 3 of the paper introduces the key concepts of Raworth's framework including the concept of the *social foundation* and the *ecological ceiling*, and section 4 of the paper focuses on how this framework can be used to drive a "good" university if reframed or "downscaled" from the global to the level of the university. Section 5 of the paper circles back to the opening description of the paper – the broken world – and essentially makes the point that a good university based on a strong social floor and one that lives within its ecological ceiling can be a model for a better world. While the phrase "if you can't see you can't be it", can come across as a cliché, this essentially is the point; universities must offer a different way of being so that a way towards different and more resilient futures can be seen and used as a model.

THE MEANING OF GOOD

The book *The Good University: What Universities Actually Do and Why It's Time for Radical Change* was first published in 2019 by Raewyn Connell (Connell, 2019). Like any book, it is written from a particular political perspective and this book very much firmly sets itself in opposition to what is seen in many countries as a neoliberal agenda underpinning the development of the university system. In the book, Connell proposes that a good university is "*democratic, engaged, truthful, creative and sustainable*" and delves into exactly what she means by these terms.

While I have my own understanding of what form a good university might take, and while I believe many universities are engaged in good practice, what follows are some key points that I have taken and understood from the book.

A significant part of the book focuses on the collective labour of the university. In the book, Connell challenges some of the features that could be said to describe or be at the heart of academia. Academia is very much based around

the gifted individual or the academic superstar. This leads to individuals making incredible breakthroughs and provides inspiring teachers for students, but also leads to a system of hierarchies that can mean certain roles are not appreciated and can lead to a divide between academic and professional staff. Connell, on the other hand, emphasizes the fact the whole workforce of the university matters and she does this in a bold way, really recognizing how labour right across the university is needed to deliver research and teaching. She says,

> *''A good university is a good place to work, for all its workforce. It has job security and workforce stability. It fosters staff skills and knowledge. It values operations staff as highly as it values academics. Running a university involves a great quantity of administrative, technical and manual work; every function of a university depends on the work of operations staff. A university with high ambitions depends even more on their creativity and commitment.''*

Connell pays attention too to invisible labour and talks about such issues as "*funding for the full labour process of research*". Time and time again the role of all and every member of the university and their collective labour is emphasized. There is much too in Connell's writing that is about democracy, shared decision-making and shared responsibility, all of which contribute among other things to the essential health and well-being of all students and all staff.

Connell speaks out against an agenda that does not see teaching and research as a public good, but instead looks at everything from a purely market-driven perspective. Connell argues that the market-driven perspective allows limited or no space for academic activities that are less lucrative, and drives us all to seek one kind of success (i.e. she suggests we all aim to be like a small select number of universities) and seek short-term gains. Connell argues that the Good University is about challenging norms that universities collectively seem to just accept as "*the way it is*": *rankings, a culture of hierarchies among institutions, the world of academic publishing*, etc.

Connell encourages the pushing of boundaries in teaching and research and emphasizes that we are here "*to serve society and not agree with it*". She also speaks about who gets to access education or what kind of research should be prioritized. She says, "*In both teaching and research a good university follows principles of social justice, giving priority to the least advantaged social groups*" and goes on to say, "*Social justice is also core business for the teaching programme, both in democratizing access, and pursuing curricular justice in the courses*". Connell speaks at length too about engaged students, and, even though this was written before the pandemic and hence without the full experience of the fallout of full online experiences, Connell emphasizes the value of real places and the need for face-to-face engagement. She also makes the point that a good university is inevitably "*a bearer of oppositional ideas, an obstacle to privilege*" and talks about creating conditions for "*adventurous work*".

The book is inspiring but not without challenges. While Connell does mention that a good university will have a "*modest demeanour*", "*live at the level of its society as a whole*" and "*not build palaces for itself*", the book overall does not consider the fact that many institutions work within very constrained resources. In Ireland for example, the EUA public funding observatory report, which appears yearly, consistently places our third-level system within the group of countries whose education systems are under threat. There is also no acknowledgement of the fact that public institutions can at times be highly inefficient and hence the other side of the coin of that that comes with being treated fairly, namely accountability, is not in my opinion emphasized enough. There is also limited recognition of the notion that universities are, by their nature, institutions that should see research projects come and go. While this is not an excuse to treat any person working on such projects badly, it does mean that all staff will not be permanent and of course does call for truth and clarity about opportunities in the university. It is also worth noting that sustainability in Connell's work, tends to be about economic sustainability and the "*capacity for the university to flourish over the long run*"', rather than what we understand it to be in the context of the planet under threat (something that is missing from the book).

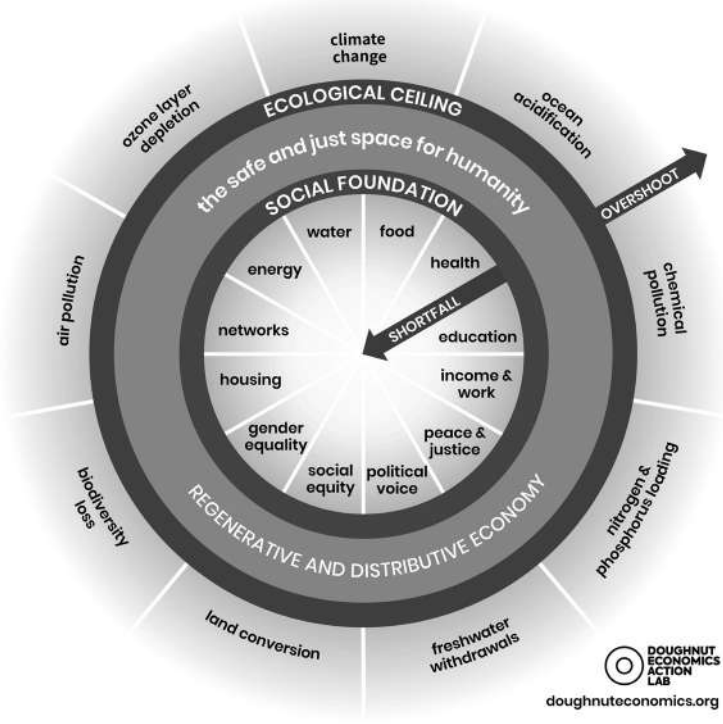
Overall however, *The Good University*, provides a way of thinking that resonates with my belief, that ultimately universities exist to make the world a "better" place and resonates with the notion of "public good" that in my opinion is an essential purpose of a university. The strongest aspects of the book, for me, are those in which Connell forces us to acknowledge the "*weave of collective labour*" that underpins all we do and encourages us not to all want to be the same. This collective weave of labour, in my reading, is not about denying the place of the brilliant individuals who break boundaries and create new knowledge, but rather about acknowledging and respecting the place of all others who make a university work. It is about being democratic, engaged, truthful, creative and sustainable (in the fullest sense). Ultimately a good university can be a model for a more resilient society.

SEEING THROUGH THE DOUGHNUT

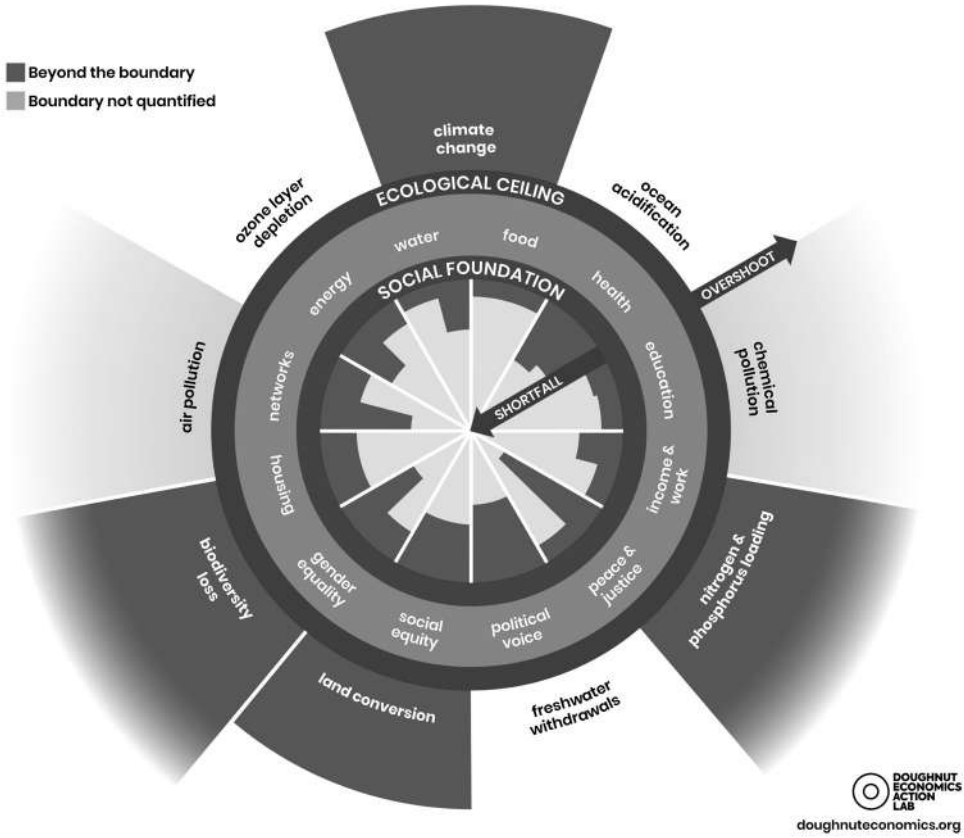
The Good University is very much about all students and all staff thriving. The question Kate Raworth asks in her book *Doughnut Economics – Seven Ways to Think like a 21st-Century Economist* (Raworth, 2017) resonates hugely with this – how do humans thrive? Raworth very much recognizes a broken world, though long before recent developments, as this book was written in 2017, and in her book she attempts to answer the question on how humans thrive through looking at things in a very different way, a way that I will later show has relevance for the Good University.

In *Doughnut Economics*, Raworth argues that the way we understand and engage with the economy is limited by narrow thinking all based on the drive for GDP growth. She very strongly makes the point that the world is based on the use of simplistic market models that do not take the wider functioning of the planet into account. This is unpacked in some detail by Raworth and as an alternative to this limited GDP-growth perspective, she offers a different model which she calls the doughnut because of its shape. The Doughnut has an inner circle that represents a social foundation, and an outer circle termed an ecological ceiling. Raworth postulates that humans thrive in the space between this foundation and ceiling.

Raworth's diagram is reproduced in Figure 1(a) and lists the elements that make up the social foundation and ecological ceiling. The elements of the social foundation have been defined through drawing on social priorities linked to the Sustainable Development Goals. They include such elements as access to water and housing, good education, fair income and more. Raworth defines the ecological ceiling based on planetary boundaries derived and defined by Johan Rockström and Will Steffen. (Rockström, 2023).



(a)



(b)

Figure 1 – (a) Kate Raworth's doughnut-shaped diagram
(b) An example of how you can map performance on the diagram showing an undershoot of the social foundation, and an overshoot of the ecological ceiling

Raworth makes the argument that if we fall short of this social foundation or undershoot, humans do not thrive. The fact the SDG goals are still aspirations shows that globally we are undershooting with many falling through that social foundation. Raworth proffers that if we overshoot this ecological ceiling, we destroy the planet and we do not thrive either. The 2023 IPCC synthesis report provides many examples of how we are overshooting the ecological ceiling with the goal of limiting global warming to 1.5 degrees now considered beyond reach. (IPCC, 2023). Figure 1(b) is an example of how the doughnut might be used to map that under- and overshooting.

Raworth looks at much more than just the diagram shown in Figure 1 in her book, and provides many more insights. Her overall belief that we need to look at the economy in a different way and the power of the doughnut diagram are the key relevant points for this paper. Others have done work that echoes this thinking. The impressive Dasgupta Review (Dasgupta, 2021), for example, looks at how we can better build biodiversity into the economic models we use. Organizations such as Natural Capital Ireland (2023) that seek to protect natural capital and ecosystems services nationally.

WHERE 'GOOD' AND 'ROUND' COME TOGETHER

We return now to the concept of the Good University and show how the ideas from Raworth can be used to put "good" into action.

The doughnut diagrams in Figure 1 are drawn at a *global* scale. Scale is an important concept. Raworth and her collaborators have developed mechanisms for *down-scaling* the doughnut to a scale smaller than the global. In particular there are movements around the world that have focused on down-scaling to the city scale (Circle Economy Foundation, 2020). This opened the question as to whether it is possible to down-scale the doughnut to the level of the university? Which in turn, led to a conclusion, that "the safe and just space for humanity" between the social foundation and ecological ceiling of the doughnut at the university scale could be interpreted as "the space in which a good university should operate".

The social foundation in Raworth's work echoes with the ideas in the Good University that call for the whole of the workforce to be valued, a focus on the well-being of all students and staff, the concern with voice, democracy and inclusion among other things. Connell does not deal in depth with sustainability issues (as mentioned she uses the term more in the context of financial sustainability) and hence Raworth's work provides a stronger mechanism for including the sustainability of the planet and its people within a definition of a good university.

In essence the doughnut framework can provide a more meaningful and practical way to put the Good University into action, and a way that updates the thinking around the Good University to more substantially take sustainability issues into account. Figure 2 captures this thinking, using the doughnut shape, and also with the "unrolled" doughnut for ease of viewing. In the Figure 2, I use the phrase social "floor" to better pair with the ecological "ceiling".

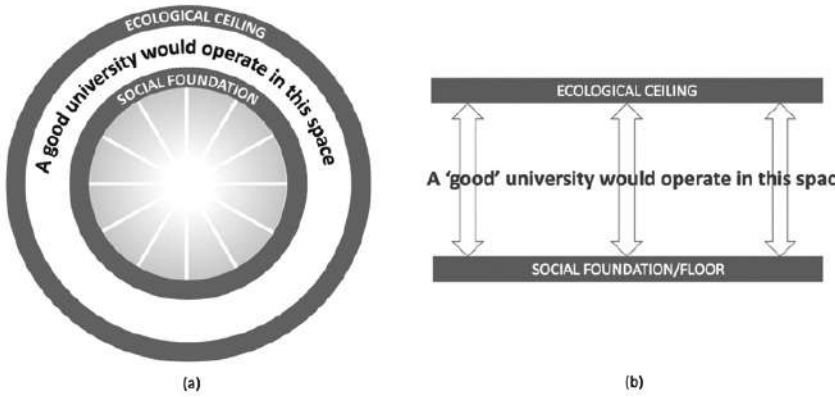


Figure 2 – Bringing the Good University and Doughnut Economics together

The challenge in down-scaling to the university scale is to take the SDG goals that Raworth used to define the social foundation and the planetary boundaries to define the ecological ceiling and transpose them to something more meaningful in day-to-day university life. Since I began work on this, Urai and Kelly (2023) have created their interpretation of this down-scaling and done so in a powerful way. Their work serves to show there is no one way of working through this process. What follows here is my approach.

The Social Floor and Ecological Ceiling at the Scale of the University

The twelve social priorities listed by Raworth as comprising the social floor are water, food, health, education, income & work, peace & justice, political voice, social equality, gender equality, housing, networks and energy. All of these priorities resonate in some way or other at the scale of the university, though some need translating to be actionable at the university scale. The process of down-scaling does not mean slavishly sticking to these priorities but using them as inspiration to understand what might be useful at the university level and using them to link back to the good university. What follows here is one attempt to map, for the purposes of providing an example.

Some of Raworth's priorities are directly usable (though defined more particularly for the university), while others need some translating for use at the scale of the university. In some cases I have grouped priorities together. Table 1 summarizes the outcome of an example process of down-scaling. It should be noted that the act of down-scaling to the university level does not imply that a university has full control over all of these priorities, but needs to work with external actors to deliver.

Raworth's Social Floor Priorities	Suggested label for a university scale social foundation	Links to the Good University and additional comments
education	**access to education**	Of course, a university is about education. Interpreting education in the context of a strong social foundation means providing access to education irrespective of social status or background or physical ability and includes access to all that goes with learning including extra-curricular activities that are so important to student development. As the Good University emphasise, 'giving priority to the least advantaged social groups' is key. This social priority can also be seen through the lense of lifelong education – lifelong access to education is even more crucial as AI platforms rapidly redefine the meaning of work.
income & work	**fair income and conditions**	Translating this priority to the university implies that universities should never employ anyone who does not receive at the very least a liveable wage, and for example that there should be fair stipends for researchers. While Connell in the Good University seems to suggest that all employment in a university can be of a permanent nature, as mentioned already her work does seem to fully recognise the finite duration of research projects or other such work that is project based. Recognising the reality of the flow of staff to and from a university, however, does not negate our obligation to ensure that staff are employed under fair conditions and a university with a strong social floor will avoid creating precarious working conditions for positions that are not project based. Marie Curie Fellowships and other awards for researchers are flagships of best practice (e.g. maternity leave for researchers and other rights are conditions of accepting grants).
food **water** **energy**	**adequate resources to do your job**	The three basic resources for life that Raworth prioritises can be mapped to the 'basic' resources at the university scale you need to do your job (e.g. space, infrastructure, research funding, time). If research and teaching are properly considered to be a public good - they should be adequately resourced. Of course, any resources we have need to be responsibly used. The Good University in fact speaks to the responsibility to use resources well – hence the sharing of space and infrastructure, , the wise use of resources, the conservation of energy and other resources all fall within this priority area.

gender equality social equality	EDI	There are a number of terms in Raworth's priorities that relate to equality and for us in the university are best grouped under EDI. Strides have been made on this front in various jurisdictions around the world, though in many countries we see significant erosion two examples being Afghanistan in very extreme ways, and USA as a result of the most recent supreme court rulings.
political voice	academic freedom	For the down-scaling to the university level one mapping of political voice is to academic freedom, again something that cannot always be taken for granted, and in need of constant defence. The other side of academic freedom, however, is about openness to and exposure to different and conflicting ideas and debate. It is about inclusive curricula protection from interference from the state and others on what can and cannot be taught. It is about freedom to do research and openness in sharing research outputs.
Peace & justice	accountability	Accountability may on the face of it look like an odd mapping to peace and justice, but it is meant to be understood as a crucial part of what it means to a just place of work. Initially I had included accountability with academic freedom but ultimately kept it separate to emphasise that accountability is required from all staff and indeed students, for all we do as part of a university, and not just our academic endeavours.
social networks	belonging	Belonging in a university is crucial – for example it matters when it comes to access to education that people feel the right to be there in the first place. It matters that all staff feel they – as Connell points out about the full workforce - A university with high ambitions depends even more on their creativity and commitment. This creativity and commitment can only be built on a strong social foundation of belonging.
housing	housing	This is essence is a direct mapping. It is increasingly the case that students and staff struggle to find housing near universities, making it harder for those with lower means to fully avail of education. Students who commute long distances do not get the full university experience.
health	health	In this case there is a direct mapping when down-scaling as a strong and vibrant university will consider the health and wellbeing of staff.

Table 1 – Down-scaling to the level of the university – the social floor

We now turn to the ecological ceiling. The nine planetary boundaries Raworth mentions are of course very valid boundaries, but are complex and technical to action at the scale of the university, and at the scale of the individual in the university. In fact in looking at them in our university, we found individuals considered planetary boundaries to be too abstract and distant. Learning from this and working with our Vice-President for Biodiversity and Climate Action, our down-scaling is focusing on an ecological ceiling defined by *net zero emissions* and becoming a *nature-positive* university. Nature-positive is the term used to describe a world where nature – species and ecosystems – is being restored and is regenerating rather than declining. There are many resources available internationally to help understand the local ecological system in which a university is located. This allows an institution to better understand how it should fit within its local environment, develop its biodiversity within that context and mitigate and adapt to climate change with the local conditions in mind, deploying technical and nature-based solutions as appropriate to the local system. The ecological ceiling is impacted through the operation of the university (e.g. in how we use resources, travel behaviours, running green labs, controlling greenhouse gas emissions, refurb rather than new build etc.), through teaching (e.g. embedding sustainability elements in all courses), through research (pushing boundaries of understanding and finding solutions through research projects of scale), and through partnerships (collaborating with key partners so that system change is possible).

The Reintroduction of the Global

Crucially the down-scaling process does not eliminate the global. While down-scaling does call for a re-conceptualization of what the social floor and the ecological ceiling mean at the chosen local level (such as the level of the city in the examples referenced above and the level of the university in our case), there is a direct connection to the global. This is because the down-scaling process is also framed through a matrix of questions as listed in Table 2 that in essence asks us to consider the global consequences of how we live locally.

	Local	Global
Ecological Ceiling	What does it mean for the university to thrive within its natural habitat or ecosystem?	What does it mean for the university to act in a way so that the whole planet thrives?
Social Floor	What does it mean for all students and all staff in the university to thrive?	What does it mean for the university to respect the wellbeing of people worldwide, so others thrive too?

Table 2 – Local and Global concerns

This linkage is particularly important. What it means in practice is that as we go through the priorities for the social floor and ecological ceiling, we need to consider not just how our choices impact our own students and staff, but also how they impact the rest of the world. This is essentially about taking a much more systems-thinking approach to all we do, which of course is challenging. This link with the global reminds us it is not good enough for our students and staff to thrive but that we need to think about how humanity thrives. As mentioned already, in the *Good University* Connell encourages universities to have a "*modest demeanour*", "*live at the level of its society as a whole*" and "*not build palaces for itself*", which reflects some of the local-global perspective. Many institutions depend on international students for financial sustainability – however, thinking globally, we need to balance this perhaps with how we act as universities of sanctuary, deal with scholars at risk, partner with others and support the growth of universities in other locations. However, it is not enough to make up for ills and hence the phrase climate justice comes to mind too in how we understand the local and global, especially as we see certain parts of the world pay heavily for the choices of other parts of our world.

For me, the great value of opportunity of the university to link the local and global is in the fact that we are here to do teaching and research. Very many of our institutions aim to be universities of global consequence – there is no better way to be of global consequence by educating the next generation with that systems thinking perspective to understand that local-global link and to do research that has global impact, whether through the outcome of the research itself or through open practices that ensure knowledge is shared.

CONCLUDING THOUGHTS

The framework presented in this paper – the idea of a Good University being a university that builds a strong social floor and lives within its ecological ceiling – is presented as a framework that will allow all staff and all students in that university to thrive.

There are multiple ways of translating at Raworth's twelve social priorities and nine planetary boundaries to the university level and this does warrant more work than has been carried out here. It is worth noting that practices have been developed to down-scale, especially in the context of downscaling to the city level, and are typically based around dedicated workshops.

Whatever the approach to adopting these ideas, thriving staff and students do great work – so from goodness comes greatness. Hence, creating a stable, inclusive, respectful environment that recognizes and supports the full weave of collective labour will ultimately benefit, as will living within our ecological ceiling.

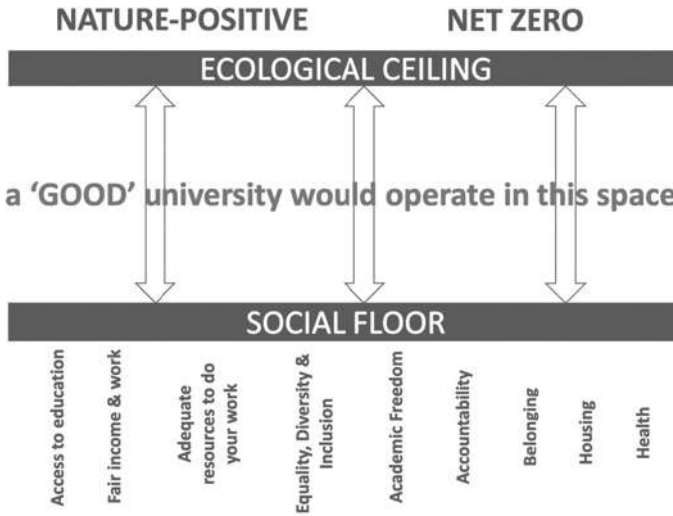


Figure 3 – The floor and ceiling reformed for the university scale

Some of this is within the complete gift of the individual institution while other aspects require government and other support to be able to realize the full vision – especially in cases where resources are limited within the institution.

More importantly though, this kind of "good university" is a university that can be the bedrock of a resilient society. A good university will be properly pluralistic in thought and what it teachers, ensure that the transformational nature of education reaches a diverse population, drive social cohesion, be a leader in systematic change for the planet, individually and as part of a wider international partnership, embrace evolving economic models that recognize the natural capital and ecosystems of the world, and treat all its staff and students with the dignity and respect that we would like to see widespread across the world. A "good university" will ask to be evaluated and ranked under these terms, under the terms of what it does with its resources and not just how many resources it has.

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Chapter 18

Enhancing Learning Outcomes for Impact at Scale

Subra Suresh

The shock and trauma from the sudden onset and protracted staying power of the Covid-19 global pandemic altered the daily lives and livelihoods of billions of people over the past several years. The perspectives derived from the experiences during the pandemic have also led to an indelible influence on careers and personal lives. These factors have also catalysed efforts to effect transformative and permanent changes in how we learn, live, work and engage with one another.

Educational institutions, which at the epicentre of resilient societies are cultivating the inspiration, imagination and innovation to prepare citizens and the workforce for a lifetime of inquiry, productivity and service, are re-examining and re-assessing their strengths, financial models and roles that have been refined over thousands of years through many crises. At the same time, they are also confronting new challenges and threats. They are faced with global and local trends that inevitably call for new approaches, infrastructure, policies and business models for better engagement with and impact on society.

Some of the global megatrends emerging in the aftermath of the Covid-19 pandemic are poised to severely disrupt how universities serve society (see Fig. 1):

- Ever-accelerating pace of not only the development, but the adoption and deployment on a global scale, of new technologies that are further propelled by developments in: artificial intelligence (AI), machine learning, large language models, computing, massive data

(from the internet of everything, everywhere, all the time) and the unprecedented scale of convergence of the digital, physical and biological worlds.

- Rapid globalization, arising from instant connection of every corner of the globe to information,
- And, at the same time, rapid de-globalization from geopolitical tension and polarization.
- Growing inequality within and among countries and peoples in access to information, education, healthcare and opportunity. Consider this. When hundreds of millions of school and university students had to take classes online during the pandemic because of public health safety concerns, technology was the enabler to deliver courses to learners of all ages and backgrounds. At the same time, about half of the global population of 8 billion people did not have access to the internet and hence access to education and learning. Similarly, in parts of both developed and developing countries, the underprivileged and under-represented were disproportionately affected by job loss.
- During the global pandemic, the important role of universities, as pillars of resilient societies, that partner with governments, industry and non-profits in developing solutions to the global crisis, was decisively demonstrated. At the same time, public trust in universities as impartial facilitators of deep intellectual thought and discourse for the betterment of humanity continues to be eroded in many key regions of the world.
- Although scientific research and development delivered clear solutions (as in the case of vaccines to fight against Covid-19) with unprecedented speed and efficacy, public trust in science remains low across geographical regions and political spectra. Universities have a critical role in nurturing and maintaining this trust for resilient growth of societies at a time of multigenerational challenges posed by complex issues such as aging populations, environmental sustainability, threat of rapid climate change in this century, and the potential for devastation from the next pandemic.
- Hybrid environments for learning, work, human interactions and social events, continue to define how people use physical and digital infrastructures.

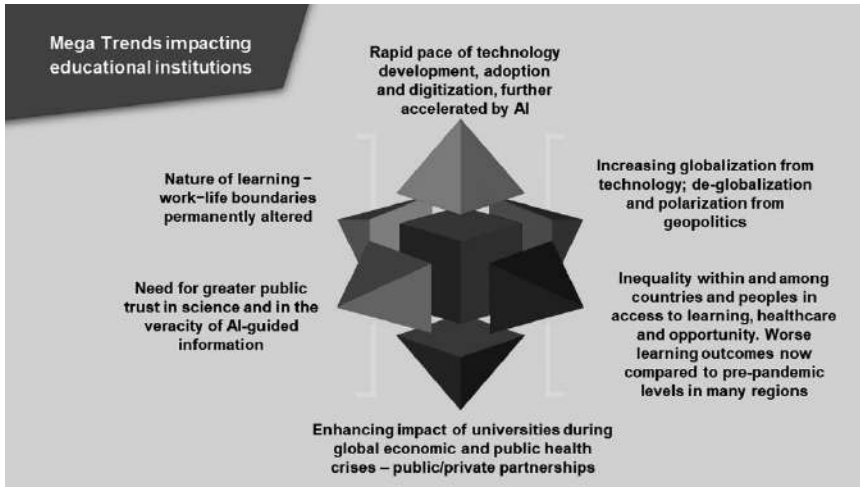

Figure 1 – Some global megatrends impacting the future of educational institutions.

Many organizations around the globe have initiated new activities, or have refined their mission, scope and focus, to address the rapidly evolving changes to the learning ecosystem.

The Global Learning Council (GLC) was established in 2013 as a virtual international network to connect thought leaders engaged in the use of technology and science of learning to improve learning outcomes for university students. GLC and its international team of Advisory Board members have led activities and efforts through offices at Carnegie Mellon University (2014-2017) in Pittsburgh, PA, and at the Leibniz Association in Berlin, Germany (2017-2022). In the aftermath of the global pandemic, GLC was reconstituted with a renewed focus, scope, vision and mission. It has been re-launched as a special Council, with a formal secretariat, as part of the recently created Villars Institute in Villars-sur-Ollon in Switzerland. The Villars Institute was established in January 2022 as a Swiss, non-profit foundation dedicated to accelerating the transition to a net zero and nature positive economy through intergenerational collaboration, interdisciplinary knowledge and systems leadership. It is based in the alpine village of Villars-sur-Ollon which has a long history of intercultural education. The Institute's partners include leading secondary schools and research universities from around the world. Its foundation board also has extensive experience in secondary, tertiary and executive education.

In view of the megatrends summarized in Fig. 1, GLC is reimagined to address the promise and challenges of the next wave of learning revolution, that serve to contribute to the resilience of local and global society. Here the expectation is that the ever-accelerating pace of development and adoption

of technology is poised to further disrupt and transform education and learning for people of all ages and backgrounds. Its work is based on the notion that access to content alone does not directly translate to effective learning, particularly in a world that is being reshaped by complex systemic changes, such as climate change and biodiversity loss, impacting multiple generations.

As noted on its website (www.globallearningcouncil.org), GLC is a cross-sector, interdisciplinary innovation platform, committed to advancing the use of science and technology to improve the outcomes for learners of all ages through systemic transformation**.** GLC brings together thought leaders and practitioners in the effective use of technology to discuss and address system-level pathways that enhance access to education and improve learning outcomes for people of all ages and backgrounds.

GLC has assembled a strong multi-sector group of leaders, philanthropists, policy-makers and experts who will serve as Advisory Board Members and as Members of Committee of Experts and Partners. They collectively provide significant domain expertise to help effect systemic transformation at scale in the science and practice of education and learning.

At its Annual Meeting (see program at: https://www.globallearningcouncil.org/events/glc-2023- annual-meeting) held in Villars on 27 June 2023, immediately after the Glion Colloquium 2023, GLC announced activities, initiatives and global partnerships with specific objectives and timelines for tangible outcomes in several initial areas of focus. These activities seek to address, through academia-industry-government partnerships, sponsorship and coordination of the work of post-doctoral fellows from institutions across the globe, and engagement of students and teachers in focused programs that cultivate and enhance systemic thinking. The work of the GLC also includes efforts that seek to facilitate broad dissemination of information and educational content for both teachers and learners through partnerships with entities and individuals who have had a record of effecting transformative changes at scale.

Initiatives launched in June 2023 at the GLC Annual Meeting in Villars include:

- Creation and curation of a global network and periodic gathering of post-doctoral fellows who individually and collectively develop new knowledge and perspective on the implications of artificial intelligence (AI) in such diverse areas as fundamental scientific research, education, fine arts, agriculture, healthcare, vernacular languages and social sciences.

- The HP-GLC Global Hackathons, in partnerships with local organizers in Asia, Europe, Africa and North America, for high-school and university undergraduate students, focused on the theme of "ascertaining the veracity of AI-derived information in learning". Top performers from these regional hackathons will convene at the GLC Annual Meeting in June 2024 for the grand prize.

- GLC Sponsorship of a cohort of students and teachers for summer internship at the *Conseil Européen pour la Recherche Nucléaire (CERN) in Geneva, Switzerland, in the summer of 2024. Following the internship experience, the students will devote several months working together on a group project on a theme that focuses on one of the complex challenges facing humanity, such as climate change, sustainability of energy, natural resources and biodiversity.*

- GLC will partner with HP Futures with a goal of bringing together learners and global thought leaders to discuss topics and ideas that address complex global and multi-generational issues.

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CONCLUDING REMARKS

The 14th Glion Colloquium focused on contributions of universities towards more resilient societies. The meeting naturally followed and built on the discussions of previous colloquia. Held in the backdrop of increasing conflict in the world and frequent natural disasters, many exacerbated by climate change, the Colloquium re-iterated the importance of universities actively engaging in both the grand challenges and in local community issues. The discussions reflected global and local circumstances through the contributions of participants from several continents: Europe, North America, Africa and Asia. We devoted our attention to university resilience in general terms, to specific aspects that increase resilience and to examples of individual university actions. A case in point was the response of universities to the Covid-19 pandemic. The monitoring and regulation of artificial intelligence, as well as its impact on universities, was another dominant theme in our discussions. The growing gap between the fiercely competitive AI technological race and the tedious process of defining rules at national or international levels is a subject of serious concern. Universities need to find a middle ground between restricted AI models and fully accessible AI in order to reap the benefits of AI and to minimize its negative consequences.

RESILIENCE OF UNIVERSITIES – APPROACHES AND STRATEGIES

We looked at ways for societies to absorb shocks and cope with complex crises and the role of universities in that context. Universities have shown themselves to be quite resilient in the face of socio-economic, political and technological changes.

Formally, institutional resilience refers to the ability of an organization or system to withstand and recover from disruption or crisis. This may include events such as natural disasters, technological failures or other types of shock. Institutional resilience involves having systems and processes in place to anticipate and mitigate potential threats, as well as the ability to adapt and recover quickly when disruptions do occur. During the Covid-19 pandemic, universities succeeded in being a significant part of the solution: through the rapid discovery, development and deployment of tests, vaccines and treatments, it was possible to mount a resilient response saving millions of lives and allowing for minimal societal destabilization.

Despite the undeniable contributions of universities to solving societal challenges, the success of universities depends on trust. Trust is a central prerequisite for the acceptance of highly specialized knowledge that cannot be verified by the individual. Therein lies the challenge for universities in an age of (dis)information overload. The role of science is to provide facts, point out options and translate them into understandable language. But facts do not speak for themselves. It is necessary to interpret them and think in scenarios of the advantages and disadvantages of certain approaches and the risks and opportunities they entail. Ultimately, science communicators (foremost universities) must transparently show the assumptions on which their assessments are based, clearly present what is secured knowledge and where there are still uncertainties. Further, the media must assume their responsibility to distinguish between genuine controversy and pseudo-debates, and universities must continue to take on the role of trusted custodians and disseminators of knowledge.

A "good university", as defined by Connel, strives to be democratic, engaged, truthful, creative and sustainable (Connel, 2019). It may be considered as a model for a more resilient society as it promotes a thriving environment for both students and staff. In her book *Doughnut Economics*, Raworth also focuses on humans thriving and presents her approach to the development of the global economy in tune with the goals of sustainable development (Raworth, 2017). The doughnut has an inner circle that represents a social foundation, and an outer circle termed an ecological ceiling, with the postulate that humans thrive in the space between this foundation and ceiling. This concept has opened the question of the possibility to down-scale the doughnut to the

level of the university. Further development of this approach has led to the conclusion that the optimal space of the doughnut at the university scale could be interpreted as "the space in which a good university should operate". A "good university" is a university that can be the bedrock of a resilient society. A "good university" will be properly pluralistic in thought and what it teaches, ensure that the transformational nature of education reaches a diverse population, drive social cohesion, be a leader in systematic change for the planet, individually and as part of a wider international partnership, embrace evolving economic models that recognize the natural capital and ecosystems of the world, and treat all its staff and students with dignity and respect.

Another consequence of the pandemic has been the liberation of many educational resources, supporting the democratization of education by removing some barriers to accessing documents and manuals for teachers and learners. These actions are aimed at building the education commons such as, for example, the Creative Commons licences.

As we have witnessed, universities play an important role in overcoming crises. They also play a relevant role in the aftermath, when adapting to new circumstances after a disruptive event. There are various aspects of this process: a) absorptive capacity, the ability to preserve basic infrastructure and the capacity to recover from disruptive events, b) adaptive capacity, the ability to adjust to disruptions in order to continue functioning without major qualitative changes, c) anticipative capacity, meaning the anticipation of potential threat and taking early action, d) preventive capacity, which is mainly the reduction of existing risks, and e) transformative capacity, the ability to create a totally new system if necessary.

SPECIFIC ACTIONS THAT INCREASE THE RESILIENCE OF UNIVERSITIES

While the resilience of academic institutions is paramount for their survival, the resilience of students is crucial for the future of society, making this topic an important discussion point at this year's Colloquium. One of the challenges for pedagogical leadership has been to critically analyse how the pandemic has changed learning cultures and how these changes could affect the future of university education. The distance-learning years during the Covid-19 pandemic revealed a strong polarization in the experience of learning in crisis, as well as in the success and stress experiences. Some students made excellent progress, while others suffered extensively and dropped out of university.

The individual resilience of a student must be learned by the individual him- or herself. A resilient academic community needs to support students to

develop versatile resilience: good academic thinking and study skills, as well as emotion regulation skills, which play a central role in individual resilience. The key factor in building resilience is to help students strengthen their self-efficacy beliefs. Self-efficacy beliefs cannot be purely taught because they originate from the individuals' view of themselves, their self-confidence and their previous experiences. This requires psychological work by the students to evaluate themselves, their skills and knowledge in a way which promotes motivation to strive forward and to gain a deeper understanding of oneself.

One of our topics of interest was how international collaboration contributed to the resilience of universities. Complex geopolitical circumstances, the effects of climate change and an increasing number of armed conflicts, both causing massive migrations, are a source of instability, humanitarian, political, economic, social or other. All of these developments have affected how universities approach international research cooperation. The open model of university collaborations and its role to promote resilient and equitable societies have been brought into question. On the other hand, the growth of international research collaboration, as measured by academic publications with authors from more than a single country, has significantly outpaced the growth in total publications. In the past five years international collaborations account for more than half (55%) of "hot papers" identified by Clarivate's Web of Science. We are witnessing a fundamental shift in the geography of global research collaboration, one that follows the current restructuring of globalization itself. Global research collaboration seems to be splintering into blocs of "like-minded" partners. As the most natural advocates for the cause, universities are called upon to resist the fragmentation and polarization of international research collaboration. Even though a complex issue, the global research community must defend the collaborative and open science enterprise upon which global well-being depends.

We also engaged in discussions on open science and its importance in modern society. Open science is based on the free exchange of data and knowledge. Groundbreaking discoveries may be made through the fostering of a collaborative environment. Such a complex endeavour can only flourish if we uphold freedom of thought, autonomy, integrity and other ethical considerations, such as inclusivity and reflexivity. It is important to establish a system that provides fair, empowering and sustainable rewards. Industry, academia and governments need to adjust their ways of working and communicating, and create new policies and metrics to reflect these values. One of the key enablers of open science is artificial intelligence, which brings us back to the topic of the responsible use of AI. Universities need to engage and impact AI governance through active participation in forums defining AI standards.

One aspect of open science that we also touched upon was community or citizen science. Despite its deviation from the conventional way universities

usually operate, community science may be seen as an academic opportunity. Community science may act as a powerful mechanism to enhance knowledge and promote awareness of the scientific approach by associating participants from outside universities, who then become stakeholders. Community science leads to more resilient societies that are better able to meet the challenges they are facing by placing knowledge and the scientific approach at their very heart. Community science helps to restore trust in the scientific approach and in science.

Another way of increasing the resilience of universities is by increasing their global recognition by building a brand of excellence. This is a serious and long-term process requiring a well-defined strategy and committed leadership. A clearly articulated identity, a focus on research outcomes, a strong brand architecture and smart brand enforcers are an absolute must when building the brand of any institution.

The role of universities in dealing with the climate crisis has been the topic of several Glion Colloquia, also of this one. Universities play a vital role in shaping how societies address the global climate crisis. Academic institutions, as a public service, have a duty to analyse the climate crisis in depth and pave the way for adequate solutions. Largely perceived as guided by scientific facts and reason, universities are much observed bellwethers that shape public opinion. It is not enough for universities to engage through classic academic activities, they must be staunch advocates and demonstrate their unwavering commitment through strong statements, bold actions and, when necessary, audacious advocacy to challenge the very societies they serve. Universities must lead by example. Taking sides in a charged political debate and challenging governments, populations and economic interests takes a clear sense of mission and courage.

EQUITABLE COLLABORATIONS FOR BUILDING RESILIENCE

Our general discussions inevitably led to the sharing of good practices, of which a few are highlighted below.

The World Bank Africa Centres of Excellence project was discussed with a special focus on Ghana. The project is aimed at addressing gaps in higher-skills development. Of the over 80 Centres in 50 universities across 20 African countries, the University of Ghana is host to three. The results show that equitable partnerships have the potential to yield desirable results, with contextual applicability. When the right partners are identified, there is a massive multiplier effect of initial funding. African institutions have the capacity to leverage on support from both the North and South, to grow

expertise in the South, based on talent recognition and development programs, resulting in a higher retention of talent on the continent and locally tailored solutions for global challenges in local communities.

Through cultivating collaborative strong town-gown relations, public research universities can help to ensure that neighbouring communities are resilient, sustainable and ready to respond quickly when the next major challenge emerges. The *Healthy Davis Together*, a successful town-gown collaboration between the University of California, Davis, the city of Davis and Yolo County, was conceived as a comprehensive pandemic response program, designed to identify cases of Covid-19, prevent its spread, facilitate the coordinated and gradual return to city activities and reintegrate UC Davis faculty, staff and students back into school and community life. The program was hailed as an American national model for collaboration and innovative problem-solving. *Healthy Davis Together* offers a successful town-gown model that can be replicated to address any number of issues or emerging challenges.

The reorganization of Kyoto University, part of a national initiative, is aimed at enhancing its research capability and contribution to social innovation. The driving force for change is the outdated organizational structure of the University. Fundamental reforms will be implemented to revitalize university functions for the future, while maintaining the hallmark pioneering spirit and original principles of the University. The plan consists of three pillars: 1) active investment in human capital and the University's research environment to strengthen research capabilities, 2) the establishment of a mechanism to realize the social value of research results, and 3) a new style of governance and management enabling autonomous and self-reliant University operations. The plan represents a radical reform of the current organization of national universities in Japan in the coming decades.

As war is the ultimate test of the resilience of a society and its institutions, an assessment of the higher education sector in Ukraine before the war and since the invasion was made. The post-war reconstruction of Ukraine is expected to require an initiative of the equivalent to the Marshall Plan. The Ukraine Recovery Plan, in the section devoted to higher education, emphasizes the need to reform and reorganize the sector. *Reconstruction will need a holistic approach, in consideration of Ukraine's needs and reform goals*. The international, foremost European, academic community already does and will continue to play a very important role in supporting the achievement of these goals.

All in all, this year's Colloquium enabled us to have lively discussions and fruitful debates in formal and informal settings. Our exchanges were additionally enriched by the special guests of the meeting. In a nutshell, the outcome of our discussions was straightforward: In order to create and support a resilient society, universities need to create a culture that supports and values engaged research and outreach by its faculty, staff and students.

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RECOMMENDATIONS

As we met in Glion, the world appeared to be coming out of the Covid crisis. Covid was beginning to be viewed less as a pandemic and more like a seasonal communicable disease to be managed through vaccinations and medical treatments. As already noted, this was nothing short of a resounding success for scientific research and our ability to quickly put it into practice, and we were all feeling justifiably proud that universities led the way. At the time, public opinion polls showed that after many years of declining trust in universities and in science, there was a small, but clear, upward trend in both. But, in our discussions, it was obvious that we feared it would not last, which, as we write a year later, proved to be prescient. Trust in our institutions is back in decline and there is much work ahead of us if we are to lead the way towards resilient societies.

The crises we face today, and that we will continue to face for the foreseeable future — climate change and the natural disasters, human suffering and migration that accompanies it, wars between nations, threats to our democratic governance and geopolitical instability across the globe; computing advancements, including AI, and their moral consequences; as well as growing socioeconomic inequality within countries, and between the global north and south to name a few examples — are both immense and existential. The role that universities can play in bolstering both the resilience of our institutions, those who study and work in them, as well as that of society at large presents a huge challenge. But with challenges also come opportunities. Next, we briefly present some key areas that came out of our discussions that will help us mitigate the threats and seize the opportunities.

BUILDING STRONGER COLLABORATIONS BETWEEN UNIVERSITIES

Despite the size, breadth and reach of our largest research universities, not one president believed that their university alone could solve, or help society adapt to, the many crises that we face or will face. We all believed that it was only by working together, across nations and continents, that universities could play a lead role in building a more resilient society, while also providing tremendous benefits to our faculty and students. As the Covid crisis made clear, we are living in a truly global society where boundaries between nations mean little when it comes to the crisis before us. To take climate change as one example, it affects us all and the actions of one country impact that of not just another country, but of all other countries.

Examples of productive research collaborations, both across universities in the same country, and across universities in different countries, and on different continents, abound. Several studies have found that about 20-25% of all articles published in science and engineering journals included co-authors from different countries. As several presentations made clear, open science is essential for facilitating such collaborations as it allows universities to build upon each other's knowledge more rapidly, accelerating innovation. There is little question but that open science played a key role in the rapid and effective global response to the Covid pandemic.

Despite clear acknowledgement of its importance, threats to open science are also real and universities must work collaboratively to develop and implement best practices, ethical guidelines and secure infrastructure that balance the benefits of open science with the protection of intellectual property, privacy and data security. Additionally, university leaders need to engage in discussions with stakeholders, including policy-makers and funders, to create an environment conducive to open and responsible research practices.

It is also crucial that open science goes hand-in-hand with open access. Not all researchers and institutions have equal access to the necessary technology and infrastructure for open science. This digital divide, which is especially strong between the global north and south, can hinder equitable participation and collaboration in open science efforts. For collaboration across universities to enhance equity and sustainability across our globe, which is a pre-condition for societal resilience, they too must be built with equity and sustainability in mind.

Open access also underscores the importance of improving science communication, a subject that we kept coming back to in our discussions. Clear and effective communication of our research findings is critical, as it allows us to shape policy debates in a fact-based manner and is key to building trust in science. Effective science communication will be increasingly important in this "click-based society" where it is all too easy for the public to get

the impression that there are two equal sides to every debate, even when the scientific evidence almost uniformly supports one position, as with climate change, where the role of human activity and industrial practices in its acceleration is exceedingly clear. There was a lot of apprehension that the increasing accessibility of Artificial Intelligence (AI) would add to the spread of fake news and fake science. How the rise of AI might affect universities more generally, in terms of education, research and community engagement was the subject of many dinner-table conversations. It will surely continue to be an issue for all of us.

Another issue that we will likely continue to deal with is how geopolitical instability will affect both open science and collaboration across universities and their scholars. As one very clear example, the strain on relations between US and China poses a threat to both open science, open access and scientific innovation more generally, given the importance of this relationship to the global research enterprise. We all agreed that we need to find ways to maintain scholar-to-scholar collaborations, and student-to-student exchanges across countries where political tensions are real. Centres for such collaborations that may rest outside universities are one avenue worthy of further exploration since such collaborations are not only important to the research enterprise, but also to our educational and civic missions.

ENHANCING COMMUNITY ENGAGEMENT

Community engagement is of paramount importance if universities are to help our societies become more resilient. As described in several presentations, community engagement provides a platform for the exchange of knowledge and expertise between universities and local communities. Universities can share their academic knowledge and research findings, while community members can contribute their local knowledge and experiences which, in turn, shape that knowledge and how it is applied. This two-way exchange, where universities not only teach and serve, but learn from communities in ways that shape their service, not only enriches both parties, but is an absolute pre-condition to healthy partnerships.

As noted in our discussions, universities also promote cultural exchange and enrichment by supporting arts and cultural events, preserving local traditions and facilitating cultural understanding. Moreover, universities not only have expertise in health-related fields, but especially so for those with medical schools and/or hospitals and healthcare networks, they provide healthcare services, ultimately improving the health and well-being of the community.

When universities make serving the public a central mission, when we are not only great but "good" universities , we not only build trust with surrounding communities, but they also provide important learning opportunities for

our students as part of workforce development. We can also encourage civic engagement and social responsibility among our students and staff by involving them in community projects. This promotes a sense of belonging and shared responsibility in the community. It also provides hope. Community engagement is both a responsibility and an opportunity for universities to make a positive impact on the local, national and global national level.

RE-STRUCTURING OUR UNIVERSITIES FOR TACKLING SOCIETY'S GRAND CHALLENGES

As discussed throughout, in the face of an uncertain and ever-changing world, the grand challenges before us touch every corner of society. For universities to support societal resilience, it is critical that they be structured in a manner that allows them to be adaptable, flexible and able to respond rapidly. One of the strengths of research universities is that they house a broad array of expertise on topics ranging from philosophy to physics. However, to best utilize this expertise to address the complexity of our current challenges, it will first be necessary to break down, or build bridges across, disciplinary boundaries that are often too rigid and impermeable.

Re-structuring, or building additional multidisciplinary structures, may be necessary to more quickly move the theory and research we produce into venues that lead to the development of products or policies, cures, solutions or programs that can be implemented within our communities and then reproduced at scale. Several presentations at the conference, and hence chapters in this volume, discuss this problem and potential solutions that have either been piloted or proven successful in their universities. While each is different, some commonalities include a focus on multidisciplinary collaboration across the university, a focus on translating research into policy, and on the successful implementation of technology transfer. The breakdown of multidisciplinary silos is also important to developing new curriculum and areas of studies that will better prepare our students for positions of leadership. Although each of our universities is different and unique, it will be important to assess these initiatives and share results across our universities so that we can learn from each other. There is no question that we are united in our goal to be nimbler and more adaptive in responding to crises.

FACING THE FUTURE

Despite a rather celebratory mood at our conference, as many engaged in their first travel abroad and first in-person meetings with no or minimal masking, there was also clear uneasiness about the future we were facing, as universities,

and as a society. Geopolitical instability and volatility were affecting us all, if not directly, in terms of our research collaborations, partnerships and ability to recruit international students and faculty from certain parts of the world. Some countries were also dealing with refugee crises, driven both by politics and climate change. And as we write these recommendations, the war between Russia and Ukraine continues to rage, jihadist insurgencies in the Sahel are on the rise, and conflict in the Middle East is becoming more heated in the aftermath of the terrorist attack by Hamas on Israel, and Israel's response in Gaza that is claiming the lives of civilians. And these are but a few of the more volatile regions in the globe. But the instability doesn't end there as many, if not most, countries are experiencing a more polarized internal political landscape than has been the case for decades, making it hard to come to consensus on a range of issues, including the importance of higher education, and a belief in the power of science to lead us to facts and truth. Even vaccination became a polarized topic during the pandemic, and vaccination hesitancy is still a threat, now not only in terms of Covid, but also RSV, the flu and even polio.

While universities alone cannot solve the world's problems, we can lead the way towards building more resilient societies by collaborating together and leveraging our many resources, including our convening power, in the name of mitigating or overcoming today's crisis and those of tomorrow. In order to be maximally effective, such collaborations, and indeed, all of work, must be actively informed by robust community engagement. This will require us to re-think and re-structure ourselves to enhance our own ability to work across disciplines, and to be able to adapt more quickly to address crises with urgency, moving from theory and research to action. By actively working across disciplines, boundaries and borders, and actively engaging with and participating in local and global communities, universities can enhance their own academic missions and contribute to the resilience and well-being of the societies we serve. In the process we begin to build trust in our institutions and in science, so critical to our shared future.

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This 14th volume of the Glion Colloquia provides an insight into resilience and how universities can enhance it for the benefit of society. Universities seek solutions that contribute to a globally resilient society by promoting policy decisions based on research evidence. This volume discusses how universities should engage with society and what collaborations might look like, using our many resources, including our convening power, to mitigate or overcome the crises of today and tomorrow. Suggestions range from strong community engagement to rethinking and restructuring universities to improve their own capacity to work across disciplines and adapt more quickly to urgent crises, moving from theory and research to action. The contributors propose models for how universities can work across disciplines and contribute to the resilience and well-being of the societies they serve. In doing so, universities begin to build the trust in their institutions and in science that is so essential to their shared future.
In this context, different forms of collaboration are discussed: Multidisciplinary, Interdisciplinary and Transdisciplinary Collaboration; Sustainable Local, National and International Collaboration; Multistakeholder Collaboration; Equality and Mutual Respect in the context of Sustainable Higher Education Collaboration.

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