



GFCC

Global Federation of
Competitiveness Councils

Optimizing Innovation Alliances

A report by the GFCC University
and Research Leadership Forum

Optimizing Innovation Alliances: A Report by the GFCC University and Research Leadership Forum

© 2018 Global Federation of Competitiveness Councils

The Global Federation of Competitiveness Councils (GFCC) is an international network of leaders, non-profit organizations, government agencies, universities and companies working collaboratively to build sustained prosperity through innovation. The GFCC develops initiatives and tools to better understand and navigate the complex competitiveness landscape, and disseminates best practices.

This report was written and produced by:

Roberto Alvarez

Executive Director

Global Federation of Competitiveness Councils

Maria Olivares

Head of Innovation

University of Zurich

Yasmin Hilpert

Director of Policy and Engagement

Global Federation of Competitiveness Councils

Mahmoud Samir Abdulwahed

Director Strategic Initiatives, College of Engineering

Qatar University

This publication may not be reproduced, in whole or in part, in any form beyond copying permitted by sections 107 and 108 of U.S. copyright law and excerpts by reviewers for the public press, without written permission from the publishers.

The Global Federation of Competitiveness Councils (GFCC) is a nonprofit, 501(c)(3) organization as recognized by the U.S. Internal Revenue Service.

The GFCC's activities are funded by contributions from its member organizations.

Global Federation of Competitiveness Councils

900 17th Street, NW, Suite 700

Washington, DC 20006

USA

T +1 202 969 3382

www.thegfcc.org



GFCC

Global Federation of
Competitiveness Councils

Optimizing Innovation Alliances

A report by the GFCC University
and Research Leadership Forum

Table of Contents

A Letter from the GFCC President and the University and Research Leadership Forum Chairman	6
A Letter from the Task Force Chairs	7
Acknowledgments	8
Foreword	10
1. Introduction	11
2. Innovation Alliances: A Global Snapshot on Frameworks, Tools and Best Practices	15
3. The Framework	23
4. GFCC University Practices for Innovation Alliances	26
4.1 Summary of Universities' Practices	26
4.2 Analysis of University Practices that Enable or Implement Innovation Alliances	27
4.3 Trends Among GFCC University Members	46
5. Optimizing Innovation Alliances	52
5.1 Developing a Framework to Optimize Innovation Alliances	52
5.2 Conclusion	53
Appendix A — Universities That Contributed to This Report	55
Appendix B — Three Generations of University Innovation Alliance Practices	56
Appendix C — 2018 Members of the University and Research Leadership Forum	62

A Letter from the GFCC President and the University and Research Leadership Forum Chairman

Around the world, universities are expanding their roles in innovation ecosystems. They are enhancing their capacity to move scientific discoveries and new technologies to the marketplace by engaging in a range of innovation initiatives, involving students and faculty in entrepreneurship experiences, sharing their innovation infrastructure with others in the innovation ecosystem, and building academic-industry partnerships to accelerate technology commercialization. They have adopted, modified, and developed a wide range of practices to drive innovation.

The Global Federation of Competitiveness Councils' University and Research Leadership Forum established a Task Force on Optimizing Innovation Alliances to lead an effort to increase understanding of these university practices. We are pleased to present the Task Force's report, *Optimizing Innovation Alliances*, which provides an expansive review of university practices to make innovation a reality, identifies trends in their use, and discusses implications for universities that

seek to adopt them. We are grateful for the GFCC member universities that provided information on their practices for this report, and the Task Force co-chairs and members who guided this effort.

The GFCC is dedicated to sharing knowledge and best practices on innovation, economic development, growth and prosperity. Amplifying this mission, the Forum was formed to identify, analyze, and disseminate best practices in universities and research institutions that can scale up globally. With the release of this report, we have strived to help fulfill the GFCC mission by developing a compilation of tools that we hope will be useful to universities in increasing returns on their research and investments in innovation infrastructure, serving the learning needs of their students, supporting the efforts of companies and start-ups to grow and compete, and increasing their contribution to local, regional, and national economies and their global competitiveness.



The Hon. Deborah L. Wince-Smith
President, Global Federation of Competitiveness Councils
President and CEO, Council on Competitiveness



Dr. Pradeep K. Khosla
Chairman, GFCC University and Research Leadership Forum
Chancellor, University of California San Diego

A Letter from the Task Force Chairs

Innovation is the key driver of socio-economic development and an important factor in competitiveness. It is a necessity for any nation seeking to stimulate economic growth and find solutions to societal challenges. Knowledge production and knowledge diffusion are at the heart of innovation, which leverages universities in a central role to serve socio-economic development.

In addition to education and cutting-edge research, today's universities are expected to fulfill a "third mission": the transfer of scientific breakthroughs and technologies into the marketplace. In other words, universities become critical components of regional, national, and global innovation ecosystems. They are powerful generators of scientific and technological knowledge, and have an innate ability to link vast areas of expertise and activities across society. This is true especially in light of the wide range of activities through which universities interact with industry, the political arena, and the wider society (e.g., technology transfer offices, incubator and accelerator programs, spin-off companies, and science and technology parks).

To optimize the university's role in innovation and maximize its outputs, academic-industry collaborations, networks, and innovation alliances are vital. In this context, in May 2017, the GFCC University and Research Leadership Forum

established a task force on "Optimizing Innovation Alliances," which emerged from the GFCC community discourse at the Forum's inaugural meeting in London in 2016. It has been a pleasure to lead this task force, jointly chaired by the University of Zurich and Qatar University. We are grateful for the effort and intellectual contributions of the task force members since then, which were explored during our meeting at the GFCC 2017 University and Research Leadership Forum in Kuala Lumpur, Malaysia. The insights from that meeting have been included in the final report to provide a clearer understanding of what needs to be put in place for establishing successful innovation alliances.

This final report of the task force aims at being an inspiring read for anyone in this arena, showing the variety of practices universities employ to foster innovation and entrepreneurship activities. The report follows the threefold purpose of the task force: to identify, understand, and systematize best practices for innovation alliances; to create a toolkit for innovation alliances; and to create a framework to exchange and promote innovation and entrepreneurship activities within the University and Research Leadership Forum.

We would like to thank all members who contributed, facilitated, analyzed, and/or developed this

final work. We hope the task force outcomes will become a seed for sharing cutting-edge innovation practices and encouraging their implementation specifically among the GFCC members, but also globally among other academic institutions and partners.



Prof. Christoph Hock
Former Vice President for Medicine
University of Zurich



Dr. Hassan Al-Derham
President
Qatar University

Acknowledgments

We would like to express our deepest appreciation to all those who enabled us to complete this report. A special thank you goes to our members and their partners, whose written contributions and long phone interviews were crucial for the completion of this report. In addition, we would like to thank the individuals listed below for their information, inspiration of new ideas and relevant insights.

Dr. Mahmoud Abdulwahed
Director of Strategic Initiatives
Qatar University

Dr. Wolfgang Bauer
University Distinguished Professor
Senior Consultant
Office of the Associate Vice President
for Administrative Services
Michigan State University

Michael Bernstein
Senior Policy Director
Council on Competitiveness

Dr. Ahmet-Hamdi Cavusoglu
Director, Academic Venture Exchange
Director, Innovation Accelerator
Foundation

Kitty Chen
Event Manager, Global Events & Network
Office of International Affairs
National Taiwan University

Chad Evans
Executive Vice President
Council on Competitiveness

Linda Foster
Director of Technology & Innovation
Lockheed Martin Corporation

Aspyn Fulcher
Program Coordinator
Center for Entrepreneurial Studies
University of North Carolina at Chapel Hill

Prof. Colin Grant
Vice President (International)
Queen Mary University of London

Dr. Michinari Hamaguchi
President
Japan Science and Technology Agency

Chad Hardaway
Director, Technology Commercialization
Office
University of South Carolina

Dr. Matthew Johnson
Partnership Manager
King's College London

Dr. Stefanie Kahmen
Head of Research
Innovation and Academic Career
Development
University of Zurich

Nafiz Karabudak
Corporate Global S&T/University
Engagement Lead
Lockheed Martin Corporation

Wendy Kerr
Director, Centre for Innovation and
Entrepreneurship
University of Auckland

William Kirkland
Executive Director, Office of Economic
Engagement
University of South Carolina

Drew Knight
Director of Global Research & Strategic
Alliances
University of Waterloo

Osamu Kobayashi
Director, Department of International
Affairs
Japan Science and Technology Agency

Adriana Kuiper
Director, Office of Knowledge Enterprise
Development
Arizona State University

Kristen Lantz
CTO Operations Lead
Lockheed Martin Corporation

Paul Levins
Chief Strategy Officer
Xinova

Prof. Jim Metson
Deputy Vice Chancellor (Research)
University of Auckland

Prof. Steven Miller
Vice Provost (Research)
Singapore Management University

Constanze Multerer
Policy Officer, President's Office
Ludwigs-Maximilians-University Munich

Alastair Nuttall
Executive Officer to the President
Imperial College London

Dr. Maria Olivares
Head of Innovation
University of Zurich

Samantha Petrie
Innovate Carolina Student Leadership
Team
University of North Carolina at Chapel Hill

Prof. Noorsaadah Abd. Rahman
Deputy Vice Chancellor (Research &
Innovation)
University of Malaya

Pasi Rautiainen
University Cooperation Expert
University of Helsinki

Sophia M. Rester
Executive Assistant
College of Engineering
Ohio State University

Deanna Rockefeller
Global Science & Technology Engagement
Engagement Senior Program Manager
Lockheed Martin Corporation

Gianna Sagazio
Director of Innovation
Confederação Nacional da Indústria

Dr. Lawrence Schuette
Director of Global Science & Technology
Engagement
Lockheed Martin Corporation

Prof. Peter Smith

Pro Vice Chancellor of International
Projects
University of Southampton

Dana Sprehe

Coordinator, Office of the President
Webster University

Prof. Elizabeth Stroble

President
Webster University

Dr. David Williams

Dean of the College of Engineering
Executive Dean of the Professional
Colleges
Ohio State University

Dr. William Wescott

Managing Partner
BrainOxygen LLC

Elke Zappe

Program Director, BioEntrepreneurship
& Innovation
Institute for Regenerative Medicine IREM
University of Zurich

Dr. Ted Zoller

Director, Center for Entrepreneurial Studies
University of North Carolina at Chapel Hill

Foreword

This report is a direct outcome of the conversations held during the inaugural meeting of the GFCC University and Research Leadership Forum. On that occasion, university leaders from 20 nations reviewed the initiatives their institutions have across the globe as part of their innovation agendas. They decided to continue the work in 2017 and established the "Optimizing Innovation Alliances" task force.

GFCC university members contributed information, insights, and comments to the work of the task force. Through a series of teleconferences and a survey in which universities were asked to submit information about their practices, according to an original framework developed in the context of the task force, information was gathered and analyzed by the authors.

The global innovation landscape is changing — technology growth, new organizational and business models, globalization, and the emergence of new global players are democratizing, decentralizing, and reconfiguring innovation processes and ecosystems. Universities are following suit by updating and reconfiguring their toolkits. In this report, the authors capture some of the

transformations in the university realm, leveraging the rich experiences of GFCC members.

The project that led to this report aimed at mapping the innovation toolkits of GFCC university members and identifying some of the new generation practices they have in place to drive innovation and/or engage in innovation initiatives. This report summarizes the information received and the insights obtained. A detailed map of initiatives submitted is available upon request for GFCC members.

Building on the information gathered and the analysis performed, the report presents a conceptual framework for universities to enhance their innovation footprint and elements for an operational model that could enable the dissemination and scale up of practices within the GFCC membership community.

This report is organized in five sections:

- Section 1 outlines the scope of the study project and defines key concepts used in the report.
- Section 2 provides a snapshot of the basic types of models of innovation, tools, and governance and organizational models that are the subjects of study.

- Section 3 introduces the specific framework developed for the information collected, systematized, and analyzed to generate this report, including the categorization of numerous practices carried out by universities participating in and creating innovation alliances, and a broader taxonomy for grouping these practices.
- Section 4 reviews the practices in effect within GFCC member universities, and identifies the evolution of these practices and emerging key trends.
- Section 5 analyzes the implications the trends identified in the report have for universities; it also elaborates on potential next steps for the initiative and the work of the GFCC University and Research Leadership Forum.

1. Introduction

Universities are at the heart of innovation. They create and disseminate knowledge, develop human resources, influence policy, invest in and operate critical research infrastructure, do business with government and the private sector, and, increasingly, create new ventures. Innovation can be seen as a contact sport. It flourishes in environments that better resemble a rainforest than a plantation. Innovation cannot be promoted, spurred, or achieved from a distance; it requires engagement and joint work. Innovation depends on alliances, and happens when different stakeholders collaborate.

Universities and research organizations are key components of innovation ecosystems. In industry and technology clusters, regions, economies, and countries, they engage and partner with other academic institutions, industry, start-ups, government, labs, innovators, media, investors, and other stakeholders in a variety of ways. They follow different strategies and use a variety of tools to pursue these partnerships. This report sheds light on the toolkits that GFCC university members use to catalyze innovation and entrepreneurship, by both partnering with outside stakeholders and activating internal resources.

Innovation is About Value Creation

Innovation differs from research, the systematic investigation of an issue, and invention, the creation of a new technical solution, artifact, method, process, etc. Innovation is about creating value recognized in the marketplace and value for society. Innovation depends on commercialization, and is a source of competitive advantage.

While universities do play a pivotal role in education and research, this report focuses on the so-called third mission of universities—the innovation and entrepreneurship-related initiatives in which they are involved, and how they contribute to economic and social impact for the wider society. Nevertheless, there are multiple and expanding connections between education, research, and innovation. While there is not a linear path connecting research, education, and innovation, a variety of university practices integrate these missions.

Universities and research organizations play central roles in innovation processes. They are a fundamental source of scientific and technological knowledge. They educate and train innovators,

What do we mean by innovation?

Innovation is the transformation of knowledge into new products, processes, methods, business models and organizational solutions that create economic and societal value.

makers, future business leaders, and personnel for all sectors and industries. They increasingly take an active part in innovation and business, and engage in manufacturing efforts, venturing, commercialization, industry joint ventures, and other endeavors. But universities' strength in innovation lies not only in the scholars they hire, the technology they create that underpins new products, or the science they perform that leads to new cures. Universities innovation-accelerating power is strengthened by the alliances they build with outside stakeholders.

Innovation Requires Engagement With Internal and External Stakeholders

Innovation thrives in diverse and interaction-rich environments, in which stakeholders connect systematically and continually, routinely co-create and originate new initiatives and ventures.

Universities' potential to drive innovation is strengthened when they engage with outside stakeholders such as corporations, start-ups, government, research organizations, entrepreneurs, local communities, etc. Different types of relationships enable this engagement, from technology

Innovation alliances

Innovation alliances are engagements with outside stakeholders that spur innovation and create economic and social value, taking new products, processes, methods, business models, and organizational solutions to market.

commercialization, joint ventures, and one-time initiatives and collaborations, to long-term contracts, partnerships, and joint investment. There is a wide range of models, programs, and initiatives for these innovation alliances; in other words, a variety of "practices."

Innovation alliances have important internal implications for universities. They depend on strategic decisions and internal partnerships within the university system, require commitment, and are normally built on top of other programs, solutions, and infrastructure. For instance, venture building and acceleration programs normally require entrepreneurship education. In many cases, innovation alliances result in new programs and enrich the academic ecosystem.

Universities Have a Constellation of Initiatives to Promote Innovation

There is no such thing as the "one best solution" and the "one size fits all" program or initiative for universities to be effective in driving innovation. A variety of "practices" is normally required.

What is meant by "practice"?

In the context of this report, a "practice" is something that a university intentionally implements to enable or perform its third mission and drive innovation. A practice can be a program, an initiative, an office, a center, an infrastructure, a team, a model, or process for collaborating internally, and for engaging and working with outside partners, and thereby making innovation happen.

In fact, universities that are pushing the boundaries and recognized as innovation powerhouses have large portfolios of programs and initiatives. And they seek internal cohesion and integrate these efforts (see Section 4. in this report for details).

In this report, we regard any innovation-related university programs and initiatives as a "practice." GFCC university members were asked to provide information on their practices for the preparation of this report.

Examples of practices include:

- A study program, course, or seminar to empower students with an entrepreneurial skill set;

- A program to train faculty as entrepreneurs;
- An office that connects the alumni network with the university community;
- A research center designed, implemented, and/or managed in partnership with industry;
- A structured and expedited process for technology commercialization;
- A challenge in which faculty and students collaborate to solve industry problems.

As universities implement different practices, they face the simultaneous challenge and opportunity of integrating them. Different types of stakeholders involved in these practices also require different frameworks that universities need to develop for the cooperation to be successful. Nevertheless, the practices, frameworks in which they are integrated, and relationship models are not static; they are in constant change.

Universities Have Been Expanding Their Toolkits for Innovation

The economy is becoming more complex and sophisticated, innovation interdisciplinary, competition fiercer, technology democratized, and societies

demanding—for growth, opportunities, better living conditions, and positive outcomes for public investments. In response, universities have been evolving their innovation-related strategies and practices.

Universities that are leaders in engaging with industry and society keep adding new initiatives to their portfolios. Universities that are now connecting with industry and becoming more innovation-oriented are replicating proven solutions and devising new models. New-generation practices emerge in two forms: first, as new things, unseen so far; second, as new ways of implementing existing models and initiatives.

For example, when first launched, both technology transfer offices (TTOs) and university business accelerators were typical examples of the first case. That is, they were new solutions to transfer cutting-edge research and technology with commercial potential into the market. However, TTOs have been around for decades. In contrast, "Integrated Knowledge Companies," established as separate ventures or offices, represent a new model; they serve to systematically explore the possibilities to create value by deploying the university knowledge portfolio via multiple channels (commercialization, venturing, etc.).

The identification of new ways to implement existing models requires a deeper understanding of what universities are actually doing, and how their programs and initiatives are institutionally set up in comparison to other universities. For instance, it is commonplace for universities to have entrepreneurship training programs. But it is a different institutional setup to have those managed by the President's Office, rather than the business school, and delivered by professors of practice or experienced entrepreneurs, instead of academics.

The task force developed a framework to organize the practices that universities have in place (more details are provided in Section 3). The framework includes a taxonomy composed of eight dimensions and 52 archetypes of university practices.

Universities submitted information on their practices according to the taxonomy. The cross analysis of the inputs received showed a variety of practices and revealed evolutionary patterns for the different archetype practices. New-generation practices are those identified as the adoption of new models, concepts, and institutional solutions.

Cutting-edge practices

These are innovation-related practices that universities have in place that include elements of novelty. They represent the most updated stage of evolution within an archetype practice category of the framework used to analyze the practices informed by GFCC university members.

The knowledge and insights gained through the analysis of the whole set of practices, and the new-generation practices in particular, are an important asset. The intent of the project that led to this report was not just to identify what is new or emerging, but also to catalyze learning about them and their dissemination among the GFCC university community.

How Can We Accelerate Dissemination of New-Generation Practices?

Being a membership organization, the GFCC's focus is primarily on supporting its members and helping them understand and implement new solutions to drive innovation. Therefore, this report concludes with ideas for a potential "operational model" for disseminating practices within the GFCC community (see Section 5.).

What is an operational model?

It is a representation of how the GFCC could work with its members to disseminate new-generation practices identified in this report and/or others. An operational model should be organized in a series of critical decision areas such as strategic goals, organizational structure, processes, IT systems, and funding.

2. Innovation Alliances: A Global Snapshot on Frameworks, Tools and Best Practices

The frameworks and models to understand the participation of universities in innovation systems, the toolkits they have to engage in innovation and the governance and organizational solutions they adopt are in constant evolution.

Since Schumpeter's seminal work, it is clearly established that innovation is the centerpiece of long-term growth and economic competitiveness. It can hardly be overestimated — according to the OECD, as much as 50 percent of long-term economic growth in its member countries can be attributed to innovation, and this contribution is expected to grow.

Vannevar Bush envisioned, conceptualized¹ and implemented a system of institutions that articulate the research and education enterprise with industry and the national economy in the US. His model — sometimes mistakenly dubbed as "linear" — made an unequivocal case for investments in science and technology as drivers of economic

growth, security and prosperity. Universities are central in those efforts and absolutely critical components of national innovation systems, as later conceptualized.²

A more elaborated framework linking government, academia, and industry to boost innovation emerged in the 1990's: the "Triple Helix". Interactions are central to the model and give origin to new organizations and institutions³ — for instance: tech transfer offices, incubators, tech parks etc. The framework used in this report to identify the practices universities have to catalyze innovation — see section 3 for information — including some of these new "organizations and institutions" as archetype practices.

Building on the triple helix concept, expanded frameworks such as the "Quadruple Helix"⁴ and the "Quintuple Helix"⁵ have been suggested recently. They include and highlight the roles of additional significant stakeholders in innovation ecosystems and

express the growing importance that it has for universities to engage across all sectors and segments of society. These concepts are also linked to two aspects reflected in the framework used in this report: (i) the linkages between innovation and global/societal grand challenges⁶ (ii) the emergence and dissemination of models that mobilize resources outside of the traditional boundaries of research organizations and companies, in society at large.

The interest in innovations systems has grown in recent decades and the knowledge content of the economy intensifies. Universities are increasingly required to play different roles and build alliances with outside partners: "...the rise of a global knowledge economy has intensified the need for strategic partnerships that go beyond the traditional funding of discrete research projects⁷..." In the UK, NESTA⁸ has suggested that universities should actively build

1 England, J. Merton. "Dr. Bush Writes a Report: "Science-The Endless Frontier"." *Science* 191, no. 4222 (1976): 41-47.

2 Lundvall, B.-Å. (1988), 'Innovation as an interactive process: From user-producer interaction to the National Innovation Systems', in Dosi, G., Freeman, C., Nelson, R.R., Silverberg, G. and Soete, L.(eds.), *Technology and economic theory*, London, Pinter Publishers.

3 Etzkowitz, Henry. "University-Industry-Government: The Triple Helix Model of Innovation". *Newcastle University Business School*.

4 Monteiro, Sara, Carayannis, Elias G. (Eds.). *The Quadruple Innovation Helix Nexus: A Smart Growth Model, Quantitative Empirical Validation and Operationalization for OECD Countries*. Palgrave MacMillan : 2017.

5 Carayannis, Elias; Barth, Thorsten; Campbell, David. The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. *Journal of Innovation and Entrepreneurship - A Systems View Across Time and Space*. Springer, August 2012.

6 Innovation is key to address global challenges and impact communities around the globe. On their turn, such challenges create big opportunities for innovation.

7 Science-Business Innovation Board (2012). *Making Industry-University Partnerships Work: lessons from successful collaborations*. Brussels.

8 NESTA (2009). *The Connected University Driving Recovery and Growth in the UK Economy*. London.

networks with firms at the local, national and international level; they should also recruit, develop and promote "...people whose experience encompasses both public and private sectors who can build links between them", a recommendation much in line with the conclusions of the inaugural meeting of the GFCC University and Research Leadership Forum.

This evolution of expectations on the roles and participation of universities in innovation ecosystems originates a variety of models and additional frameworks.

New models have emerged detailing more internal dimensions and dynamics of innovation alliances (e.g., talent mobility, curriculum, entrepreneurship, engagement in local and regional economic development, etc.), such as the University Business Cooperation (UBC) framework which was conceptualized after a large-scale EU study covering 33 countries, and survey responses from more than 6,000 academics and higher education institutions.⁹ Other examples include the "Innovative and Entrepreneurial University

Framework" conceptualized by the U.S. Department of Commerce,¹⁰ and the OECD Entrepreneurial University Framework.¹¹

The framework used in this report (see Section 3) recognizes the centrality of the academia-industry-government partnerships expressed in the Triple, Quadruple and Quintuple-Helix models. It also builds on the various dimensions, components, and attributes identified in the UBC, the OECD framework and others. An original contribution of this work is to add an evolution perspective in the way in which innovation alliance practices are categorized into classic, contemporary, and cutting-edge. In doing that, once again, we must recognize that innovation systems and institutions that regulate and shape them are continuously evolving — GFCC university members are embedded in different realities across the globe.

A recent example about institutional changes comes from Brazil, a country that, considering the size of its economy, has a relatively poor performance in innovation, according to

analysis¹² based on the GFCC Competitiveness Decoder®. It was just recently that it became legally possible for Brazilian government-owned universities to launch activities that are the standard practice in most nations, such as concede land to companies and tech parks or co-invest in joint ventures. A new legislation piece, extensively supported by GFCC member National Confederation of Industry, has the potential to unleash academia-industry-government collaborations.

Transformations in ecosystems, frameworks and toolkits are also happening at a fast pace in countries that are leaders in innovation — and universities are fundamental players in this process. In the United States, the National Science Foundation commissioned the GFCC member Council on Competitiveness to research the new innovation landscape that arises from changes in the economy, the nature of innovation itself and the toolkits to materialize and/or promote.

9 Davey, T., Baaken, T., Muros, V. G., & Meerman, A. (2011). The state of European University business cooperation: Final report—study on the cooperation between higher education institutions and public and private organisations in Europe. Science-to-Business Marketing Research Centre Germany: Muenster.

10 OIE, 2013. The Innovative and Entrepreneurial University: Higher Education, Innovation & Entrepreneurship in Focus. *Report by the Office of Innovation & Entrepreneurship, US Department of Commerce, United States.*

11 OECD, 2012. A Guiding Framework for Entrepreneurial Universities. *Report by the OECD and the EU.*

12 <http://www.thegfcc.org/wordpress/wp-content/uploads/2017/01/2017-GFCC-Decoding-National-Innovation.pdf>.

Country Perspective: Brazil

New Legal Framework for University-Business Cooperation in Innovation



In 2016, Brazil approved a new legal framework for innovation, applauded by the National

Confederation of Industry (CNI) as a remarkable improvement in the institutional and regulatory environment for research, development, and innovation in the country. This new framework is the result of a supra party effort that involved the scientific community and entities representing the national business community in several public hearings over four years of legislative procedures.

This legislation revisited and expanded essential mechanisms in the Brazilian system of science, technology, and innovation, especially those regarding cooperation between public and private sectors. The most important changes include:

- Facilitation of strategic alliances and cooperation between companies, research institutions, and private non-profit entities through, for example, sharing public facilities for R&D; public universities can share facilities, laboratories, and equipment with business entities;
- Public universities can concede the use of land and facilities to technology parks, incubators, accelerators, and similar entities;
- Simplification of company-university joint initiatives, including civil servants can be remunerated for their research activities outside of the university (even under a regime of exclusive dedication of their time to this specific initiative), and the facilitation of technology transfer;

- Clearer guidance for using public procurement to promote innovation;
- Import tax exemption for acquisition of feedstock and equipment for research, development, and innovation projects carried out by companies; and
- Public universities can have equity (minority stake) in new companies.

It is expected that, once in force, the new legal framework will boost research activities, and facilitate the integration between industry and research institutions, strengthening the competitiveness of the Brazilian economy. One of the new framework's most important goals is providing legal certainty for the science, technology, and innovation agreements signed between entities in the Brazilian innovation ecosystem.

However, despite this significant progress, industry voices recognize that it is still necessary to change the Brazilian mindset towards innovation, minimize bureaucracy, improve the business environment, and increase investments in innovation.

Country Perspective: United States



The **Council on Competitiveness Exploring Innovation Frontiers Initiative (EIFI)** is a national, public-private effort to accelerate over-the-horizon, transformative innovation models to drive U.S. competitiveness in the coming decades.

Undertaken in conjunction with the National Science Foundation's Directorate of Engineering, Office of Emerging Frontiers of Research and Innovation, EIFI is a qualitative and quantitative effort among active innovation practitioners to:

- Craft with stakeholders a transformational agenda, positioning the United States as a global innovation leaders for decades to come.
- Catalyze a larger movement to enhance U.S. competitiveness and economic growth by accelerating knowledge creation and the transfer of science and engineering research into market reality.
- Expand and improve public and private sector engagement in the innovation process.

Key initiative findings, recommendations and in-depth analysis can be found in *Transform: A New Agenda to Boost U.S. Innovation-Driven Competitiveness in the 21st Century* at www.compete.org.

Transform makes clear the United States has the world's greatest collection of innovation assets and resources, but it also uncovers many areas where America's stock and flow of innovation resources can be leveraged more effectively. Five quick keys to leveraging a nation's assets for long-term competitiveness:

- Embrace diversity. Applying different perspectives to difficult problems enhances problem-solving abilities.
- Make education accessible. Cultivating a broadly and inclusively skilled populace capitalizes on the potential of a nation's talent and workforce.
- Invest in technologies underpinning future competitiveness. Moving first on nascent and developing technologies representing the foundations of a future economy draws specialized talent and allows nations to set global standards for their use.
- Support technology commercialization efforts and entrepreneurs. Capturing value from technology investments, and creating economic and productivity growth only happens when ideas reach the market.
- Increase exposure across disciplines and domains. Breaking down silos widens the tools and experiences available to overcome challenges inherent to an ever-evolving, turbulent innovation environment.

Recently, several tools and approaches have emerged to assist universities in understanding and updating their approaches and toolkits to build alliances with industry, steer innovation and develop entrepreneurship capabilities. Different attempts to systematize the practices associated to that have been made, particularly in Europe.

Examples of such models include the "Entrepreneurial and Engaged Universities Accreditation" framework, which sets standards for academic institutions¹³ across five dimensions — "orientation and strategy," "people and organizational capacity," "drivers and enablers," "education, research, and third stream activities," and "innovation and impact" — and OECD's online innovation assessment platform "HEInnovate."¹⁴ More broadly, the European Union has identified the development of entrepreneurial capacity as a key policy objective and created an "Entrepreneurial Competency Framework,"¹⁵ which can "...be used as a basis for the development of curricula and learning activities fostering entrepreneurship as a competence".

Country Perspective: Japan

Center of Innovation Program



Japan's Center of Innovation (COI) is one of the main funding programs under the Center of Innovation Science and Technology-based Radical Innovation and Entrepreneurship Program (COI STREAM), launched in 2013 by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The COI

program aims to establish an innovation platform through industry-academia collaboration, and to advance radical innovation that is difficult for industry and academia to accomplish on their own. The Japan Science and Technology Agency (JST) supports COI sites at universities for nine years. COI sites are expected to become self-sustaining, industry-centered innovation platforms at the end of the R&D period. R&D funding for a COI site is not expected to exceed 1 billion yen per year, including overhead expenses.

The COI program sets three high-risk visions:

- Secure sustainability: Challenge: advanced aging population and declining birth rate. Key concepts include physical and mental health, motivation, sports, food, ties, and the realization of happiness.
- Create a living environment within a prosperous and reputable country, creating a high quality of life. Key concepts include innovative, intuitive and active thinking, serendipity, and employing the six senses.
- Establish a vital, actively sustainable society. Key concepts include personalization, resilience, sustainability, functionalization, and flexibility while reducing waste, thereby creating a durable society.

13 ACEEU, 2016. Accreditation Standards of Engaged and Entrepreneurial University. *Standards by the Accreditation Council of Entrepreneurial and Engaged Universities*.

14 <https://heinnovate.eu/en>.

15 Bacigalupo, M; Kampylis, P; Punie, Y; Van den Brande, G. *EntreComp: The Entrepreneurship Competence Framework (2016)*. Joint Research Center, European Commission.

The evolution of toolkits is also driven by industry and, especially, funding agencies. An example of that can be found in Japan, where GFCC member Japan Science and Technology Agency (JST) is pushing the implementation of a new program to advance radical innovation.

Toolkits for universities to engage in innovation evolve based on the combination, hybridization and dissemination of models emerged in the university domain itself, catalyzed by changes in institutions and legislation (like the Tech Transfer Offices), suggested by industry and pushed by funding agencies (like the i-Corps). GFCC's framework, presented in section 3, includes archetype practices originated in all those sources.

It is also important to recognize that university models evolve as well. New organizational and governance solutions are being explored and implemented. For instance, universities such as KAUST, Georgia Tech, and Arizona State have established organizational structures in which the majority of innovation and entrepreneurship activities are coordinated through one unit

directly under the supervision of a Senior Vice-President, the President or Provost. In some universities, new funding solutions and financial tools are specifically engineered to support university-initiated innovation initiatives.

Other realities reveal cases in which university operations and governance structures are combined with other universities, local/regional economic development players and industry, particularly in regions or metropolitan areas in which innovation- and knowledge-intensive universities are at the core. These include the well-known and hyped Silicon Valley (with Stanford), but also, in a different extreme, new developments such as the King Abdullah Economic City in Saudi Arabia (with KAUST University), Qatar Foundation and Education City in Qatar (with several branch campuses, a technology park, R&D funds, and several socio-economic development entities), and the knowledge village in Dubai (with several branch campuses located there). In those cases, the participation of universities in regional governance can be an important focus area for university management.

Other practices include forming regional technology transfer centers and research corridors as an alliance for solving regional problems. Examples in the US can be found in the states of Texas, Utah, Massachusetts, North Carolina and others; in Europe, university technology transfer alliances (TTAs)¹⁶ are common across the continent. As a result of that, in many cases, it becomes hard to clearly identify what is and what is not a university initiative — actually, this kind of “blurring” is one of the trends identified in this report (see more on section 4.3).

The national and local realities in which universities are inserted vary. As seen in the initial part of this section, institutional realities can limit what universities do or are allowed to do. As innovation is also being globalized, they can limit what global companies do and how they engage with universities across geographies.

16 Add reference: http://www.solvay.edu/sites/upload/files/P_Dekie/WP_002-2013.pdf.

Industry Perspective: Lockheed Martin Corporation

Global Innovation Engagements at the Frontiers of Technology



Lockheed Martin is the world's largest Defense Contractor with four primary business areas:

Aeronautics, Missiles

and Fire Control, Space, and Rotary and Mission Systems. With product lines and fielded systems in undersea, sea surface, ground, air, space and cyber domains, Lockheed Martin finds it essential to maintain a significant presence in Science and Technology (S&T) educational environments to ensure the viability of current and future systems. For example, this includes sponsoring research and student participation in International Competitions. Lockheed Martin's research interests align with the US Department of Defense portfolios including broad areas of research such as Advanced Electronics, Autonomy, Structural, Thermal and Informatic Materials. With its strong engineering competences, Lockheed Martin has a presence in more than 15 countries around the globe.

Lockheed Martin employs senior scientists who are recognized leaders in their fields to assist soliciting, sponsoring, and managing basic research efforts. Their role is to engage with the University, and to support the Lockheed Martin engineers in

achieving their goals from the academic research program. Results can include peer reviewed academic journal articles and reports tailored to the needs of the Lockheed Martin customer. Typical efforts can last anywhere from one to three years with opportunities to participate in reviews, follow-up meetings, and hiring interviews for the students.

LM currently sponsors research in North America, Europe, Asia, and the Middle East. Each effort requires an understanding of the academic expertise present in the region, the needs of the Lockheed Martin Regional Director, as well as the potential needs of the Business Areas. This might include high temperature materials for advanced aviation needs, or advanced wind turbine blade designs for next generation windmills. In all cases, Lockheed Martin has an opportunity to work with academia to create unique capabilities by combining expertise, mentorship and real-world scenarios.

The framework presented in the next section covers a variety of possibilities, but the balances between internal or external focus for the development of university practices to engage in

innovation certainly depends on local realities. As different trends in university toolkits were identified (see Session 4), it can be expected that the adoption of cutting-edge practices can create new

opportunities for universities, not just to partner and drive innovation locally, but also engage with global players.

Industry Perspective: The Innovation Accelerator Foundation (IAF) and the Academic Venture Exchange (AVX)



Innovation is the process of conducting research and development (R&D) and bringing discoveries it to market. The National Science Foundation (NSF) estimates that the U.S. federal government contributed over \$122 billion for R&D in 2016, much of that being conducted at U.S. universities and institutions. Because of this research funding, U.S. universities and institutions have generated over 25,000 invention disclosures and have filed over 16,000 U.S. patent applications for the intellectual property (IP) developed by these R&D funds.

Over the past decade, there has been a significant uptick in the number of IP licenses to start-ups and spin-offs. The Innovation Accelerator (IA) was founded in 2008 as part of a public-private partnership with the Small Business Innovation Research (SBIR) Program at the NSF to facilitate the commercialization efforts of high-technology small businesses funded by grants from the NSF

SBIR program. IA-supported companies have exited, forged significant strategic partnerships, and raised substantial private financing in the last nine years. In 2012, IA launched a not-for-profit Innovation Accelerator Foundation (IAF) as an extension organization to provide additional tools in supporting IA's mission of promoting America's economic competitiveness in the global economy by promoting American innovation.

In 2016, IAF launched the Academic Venture Exchange (AVX) to match new ventures from top universities with fundable entrepreneurs. Their hypothesis is that this can all be done better by pooling deals and entrepreneurial relationships along with guiding sensible introductions. Over two years, AVX has facilitated over 850 introductions between entrepreneurs and spin-offs, with nine matches and 30 more pending. The work by IAF and AVX has inspired and supported a range of sister and partner networks, including the following: the New York Life Science Exchange, the New York State CleanTech Venture Exchange, the NYSERDA EIR Program, the Southeast XOR Program and the Midwest XOR Program.

3. The Framework

One of the key goals set for the task force was to identify, understand, and systematize information on best practices. The discussions with GFCC members suggested a focus on the new-generation practices. To identify such practices, it was necessary to collect and analyze information on the initiatives that GFCC university members have in place.

Development of a framework to collect, organize, and analyze information was one of the original contributions made in the project that produced this report. The framework is organized in two axes: thematic categories (types of practices) and evolutionary stages.

In the first axis, the taxonomy for university practices covers eight dimensions: students, faculty, infrastructure, business offices, agreements, platforms, alliances, and organization. Each dimension includes a series of archetype practices. In total, 52 archetypes were defined. The dimensions are labeled according to the focus of the practices they include, serving to organize the archetype practices and help "users" navigate the taxonomy.

The task force team developed the taxonomy, taking into consideration literature in the field, inputs and examples discussed during the Forum's inaugural meeting, and insights

that emerged from calls with GFCC university members over the course of 2017. The taxonomy was submitted to the GFCC member community and adjusted according to the inputs received.

Dimension 1: Students

Students are crucial for universities, not just because education is a core university mission, but because developing innovation, entrepreneurship, and business skills in the next generation is a fundamental enabler for innovation and creates opportunities for engagement with outside partners. The dimension includes archetype practices on entrepreneurship education, experiential and service learning programs, as well as collaborations with industry to empower students.

Dimension 2: Faculty

A key finding from the discussion during the 2016 Forum's inaugural meeting was that faculty should be prepared with an entrepreneurial mind and skillsets to boost universities' innovation potential. This dimension includes practices related to the development of faculty's entrepreneurial and business skills and capabilities via training, mentoring, and industry-engagement such as faculty experiences working in industry as well as the appointment of industry experts as faculty members.

Dimension 3: Infrastructure

State-of-the-art laboratories and equipment, manufacturing, campuses, and other facilities are key assets that universities can and should leverage to engage with outside partners and boost innovation. Programs and initiatives organized around university infrastructure are therefore an important aspect of innovation alliances. The dimension encompasses practices such as global campuses, campuses in innovation hotspots, research centers, and academic-industry joint ventures.

Dimension 4: Business Offices

University business offices are organizational structures within university systems that manage specific processes and perform tasks directly related to innovation. It includes units such as technology transfer offices, knowledge companies, venture capital and seed funds, business incubators, and accelerators.

Dimension 5: Agreements

Legal and organizational solutions, formalized by agreements, speed up the development of relationships with outside partners.

It is important to note this is not just about templates for documents, but also internal resources and processes to disseminate and support their use. Included in this category are practices such as joint research agreements, expedited IP agreements, and others.

Dimension 6: Platforms

Platforms are university initiatives and programs that connect and mobilize internal and external resources, directly exposing, nurturing, and requiring university teams to work together and collaborate with outside partners. Archetype practices such as innovation competitions, open innovation arenas, and others are included in this category.

Dimension 7: Networks

External networks are multi-stakeholders initiatives in which universities actively take part, such as advocacy and economic development coalitions. This dimension includes practices such as regional economic development alliances, innovation clusters, alumni networks, etc.

Dimension 8: Organization

Organization refers to how the university innovation effort is organized and managed. It encompasses strategic management, funding and human resources practices, as well as organizational structures to manage relationships with outside stakeholders. Practices include global benchmarking, alumni offices, university bonds, etc.

Furthermore, each of the archetype practices was labeled as an "enabler" or a "vehicle for implementation." In other words, the archetype practices were classified as to whether they create conditions that foster innovation alliances, or actually create them. For instance, if a university establishes an "office in a global innovation hotspot" (archetype 3.b), it is enabling the creation of new partnerships with industry. Instead, when a university hosts an "industry research center" (archetype 3.f), it is actually implementing an alliance with industry (see the analysis of university practices in Section 4.2).

The second axis in the framework (see Figure 1) relates to the evolution of university practices. The analysis of inputs received from GFCC university members points to three generations of university practices: Classical, Contemporary and Cutting-Edge. (Full Framework can be found on pages 56–61.)

Descriptions characterizing the generations were developed for each of the 52 archetype practices. All archetypes have contemporary practices, but not necessarily classic or cutting-edge practices relating to them (see the trends of university practices representing cutting-edge generation practices in Section 4.3).

In general, practices become more sophisticated and interconnected over time. The underlying concept of this three-generation scheme is to go beyond simply classifying practices and show they are dynamic in nature.

Figure 1. Three Generations of University Practices

	GENERATION 1	GENERATION 2	GENERATION 3
	Classical	Contemporary	Cutting-Edge
1 Student	<p>This first generation of practices includes models and initiatives that were pioneered by universities for each one of the archetype practices. In general, while many universities have already evolved their programs and portfolios, classic practices still are in operation across the university landscape.</p>	<p>These practices characterize the most frequent case observed for each one of the archetype practices in the taxonomy and reveal their "state of practice." Contemporary practices were not necessarily preceded by classic practices.</p>	<p>This third generation includes new developments, and practices that include clear elements of novelty in relation to what the majority of universities in the sample have adopted.</p>
2 Faculty			
3 Infrastructure			
4 Business Offices			
5 Agreements			
6 Platforms			
7 Networks			
8 Organization			

4. GFCC University Practices for Innovation Alliances

4.1 Summary of Universities' Practices

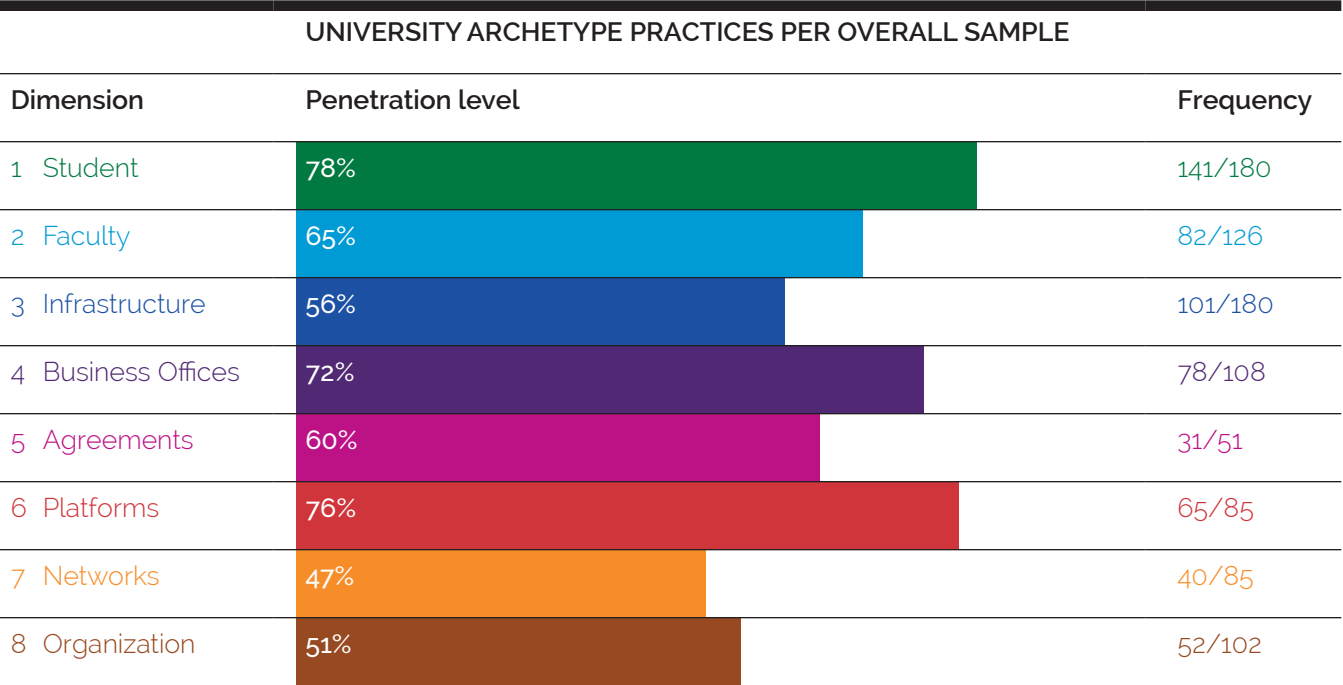
Overall, 18 universities that participate in the GFCC University and Research Leadership Forum provided information on their innovation and entrepreneurship related practices¹⁷ that was processed and analyzed according to the framework described in Section 3. This information served as the basis for the analysis included in this report. As such,

the report's analysis is drawn from a small sample study, which could be further enriched by extended research on the broader university landscape, and the identification of new-generation or cutting-edge practices.

Figure 1 shows the overall degree to which the 18 GFCC sample universities have reported on the archetype practices to promote innovation and entrepreneurship for each of the eight dimensions.¹⁸ For example, Dimension 1 —

Students — includes ten archetype university practices. If all ten archetypes were present at all 18 universities, the frequency for the overall sample per practice would be 170 instances, meaning a penetration level of 100 percent. Given Figure 1, this study identified 121 instances of for student related university practices among the 18 universities, a penetration level of 71 percent.

Figure 1: An Overview of Archetype Practices and Their Application in the University Sample



17 A list of these universities can be found in Annex 1.
18 Detailed inputs provided by universities are available to GFCC members upon request to the GFCC head office in Washington, D.C.

Our analysis reveals that the 18 GFCC universities deploy a range of practices to enable and implement innovation alliances, with the most common practices involving students and agreements, followed by platforms and faculty as seen in Figure 1.

For example, for students (Dimension 1), the most common bundle of practices involves training and mentoring programs. The second most common set of student-related practices includes incorporating industry partners in education programs, and promoting student clubs and networks.

For agreements (Dimension 5), the most common practices involve research collaboration agreements with public and private partners and open-ended research agreements jointly with partners from academia, industry and the public sector. Some of the universities combine several practices related to agreements to expand their interaction with external partners.

For platforms (Dimension 6), the most common practices include funding platforms to support university-industry collaborations, followed by innovations platforms to increase the entrepreneurial engagements between students, faculties as well as business and industry experts. Furthermore,

universities use publicly funded programs to foster the transfer of basic-research into the market, focusing on both the commercialization of technologies and entrepreneurial training.

For faculty (Dimension 2), the most frequent practices involve incentive mechanisms to encourage faculty to undertake innovation and entrepreneurship activities, followed by faculty engagement with industry experts, and the involvement of university faculty in executive education programs. Leaves of absence to work with industry or industry internships for university faculty are rare practices in the 18 GFCC universities that provided information for this report's analysis.

4.2 Analysis of University Practices that Enable or Implement Innovation Alliances

A more detailed exploration of practices is presented as a summary for each dimension's archetype practices in the following sub-chapter.

Each of the archetype practices have been classified here as either **enablers** or **vehicles for implementation**. Practices that enable alliances to create

the framework and conditions for innovation at the universities, whereas vehicles for implementation are practices that actually create and leverage university innovation alliances.

STUDENTS

1.a Entrepreneurship Training

Integrated entrepreneurship program bundling different practices such as industry mentoring, seed funding, leaves of absence for students to run start-ups, business support, and international experience.

✓ Enabler

Vehicle for Implementation

Entrepreneurship training has evolved from academic courses and classes to initiatives that are more integrated with industry and the outside world. One step in this direction is the involvement of industry mentors and professors of practice in entrepreneurship training. Physical spaces and campuses have been adapted accordingly and since become less classroom-oriented and more similar to real world entrepreneurship settings. Systemic approaches for entrepreneurship training are emerging, with several elements being integrated in mid-/ long-term entrepreneurship development tracks or trajectories for students. The logic of



The **Experiential Entrepreneurship Education (E3) Program** at Ohio State University is an example of entrepreneurship training tailored to the demands of a future workforce. The goal is to respond to the skills shortage and talent demand in advanced manufacturing, and to generate an interest in applied innovation. This program provides students with the opportunity to get first hand experience by working part time in industry during the course of their studies. E3 is the first program to combine product design, manufacturing, and business model learning with onsite prototyping capabilities and industry sponsored research and development projects. The E3 program also provides mentorship to students (see practice 1b), and experiential and service learning opportunities (see practice 1g).



A similarly practical and close-to-industry approach is pursued within the **Arizona State-Draper University Entrepreneurship Incubator Program**. Students participate in a four month intensive training and mentorship experience in Silicon Valley, California, learning the technical, business, and leadership skills needed to succeed as entrepreneurs. The experience gained in this program goes beyond an internship. The program includes a competition in which program participants are encouraged to submit a business plan and American venture capitalist Tim Draper commits to invest US\$1 million into the winning

business plan. The success of this program is proven: more than 280 start-ups were created that raised more than US\$50 million. Alumni of the program have joined accelerators like Techstars, 500 Startups, and YCombinator and are funded by some of the most prestigious venture capitalists.



The **Velocity Entrepreneurship Program** at the University of Waterloo is the largest and most comprehensive university-led entrepreneurship program in Canada, running programs on the university campus and in the broader Waterloo region. With a strong focus on start-ups, Velocity includes the largest, entirely free start-up incubator in the world, and features an all-round start-up ecosystem: a dormitory (Velocity Residence), a science lab for current students (Velocity Science), weekly workshops on start-up basics to support young entrepreneurs-to-be (Velocity Start), and a 37,000 square foot incubation space for software, hardware, life science, and social entrepreneurship start-ups (Velocity Garage). This exceptional environment for nurturing entrepreneurship generates a strong student innovation and entrepreneurship network (see practice 1h), supports the hipster-hacker-hustler model in science projects (see practice 1d), and goes much further than just an entrepreneurship program. With its focus on the university infrastructure and the broader Waterloo area, it is a powerful incubator (see practice 4c) and a tool to engage alumni in an alumni angel network (see practice 7e) with its successful alumni.

entrepreneurship development is also being flipped; instead of providing content, universities increasingly rely on industry to achieve this goal, engaging and making students part of industry-led entrepreneurship development initiatives.

This innovative approach is being applied in the Experiential Entrepreneurship Education (E3) Program at Ohio State University, the Arizona-Draper University Entrepreneurship Incubator Program, and the Velocity Entrepreneurship Program at Waterloo University. These programs feature comprehensive, industry-involved training, out-of-classroom experiences and engagement, business development support by faculty, and campuses that are designed for working on real world problems and challenges.

1.b Mentorship

Leverage the alumni network, outside social capital, and industry mentoring, enlisting investors, business leaders, and entrepreneurs to engage with students in a systematic way as mentors, professors of practice, and project leaders.

✓ Enabler

Vehicle for Implementation

Mentorship has evolved from sporadic meetings with industry leaders to structured programs in

which students have continuous access to mentors with industry and entrepreneurship experience, in person and/or online. Alumni networks are important providers of expertise and relationships. More recently, mentorship schemes tend to become more personalized and individual, and blended with leadership development initiatives targeting students.

1.c Global Mobility

Global mobility programs (such as classes across multiple campuses, portable degree programs, double degrees, etc.) prepare students to operate in an international environment, developing the ability to work across cultures, languages, and geographies, and creating a global network of connections as part of their education.

✓ Enabler

Vehicle for Implementation

Global mobility programs have evolved from strictly academic initiatives (e.g., study abroad and student exchange) into industry-oriented experiences. Universities are also organizing missions and immersion programs that allow students to experience different innovation ecosystems around the globe.

1.d Hipster-Hacker-Hustler Models

Programs and projects bundle science, business, and entrepreneurship skills to increase the economic impact of science.

✓ Enabler

Vehicle for Implementation

The university provides knowledge and business resources (e.g., people, expertise) to scientists and scientific projects to enable the creation of science-based business ventures. This includes engaging people with business expertise in science projects. The BioEntrepreneurship & Innovation Program (BEI) at the University of Zurich is a good example.

1.e Student Leaves of Absence

Programs that allow students to put academic activities on hold for a limited period of time in order to start up or join a new venture or company, having global experiences and developing soft business skills while pursuing their academic degrees.

✓ Enabler

Vehicle for Implementation

While universities in general allow students to interrupt and/or extend their academic studies to pursue personal endeavors outside the academic world, there is a tendency to grant formal leave to students who want to pursue entrepreneurship.



Universität
Zürich ^{UZH}

The **BioEntrepreneurship & Innovation Program** at the University of Zurich (UZH) is an exemplary case of using a systems approach to entrepreneurship. The program features in-residence

coaching by entrepreneurs, and provides support, advice, and funding to young scholars in the field of life sciences who are planning to start a company based on the research they accomplished at UZH. In the "Founders Lab," students are taught essential skills and crucial knowledge (e.g., business plan, intellectual property rights, etc.) needed to turn their ideas and research into a business operating in the marketplace. By giving students the opportunity to exchange experiences with entrepreneur coaches, students can overcome common founders pitfalls. The program uses the hipster-hacker-hustler modelⁱ with a strong focus on team building.ⁱ Course participants learn about the concept and the importance of a diverse team, which character they stand for, and how to find others to kick-off a start-up. In doing so, this program goes beyond classic entrepreneurship training programs (see practice 1a), turning into a powerful accelerator (see practice 4e) for innovative, research-driven start-ups. The program is an essential part of the UZH BioEntrepreneur-Fellowships established in 2017, which supports young researchers financially with CHF 150'000 for 18 months, who intend to start up a company based on their own research carried out at UZH.

ⁱ The approach adapted from Massachusetts Institute of Technology (MIT) is based on the idea that in order to run an efficient team, you only need three team members: a hipster (designer), a hacker (scientist), and a hustler (business)."

1.f Education Oriented to Local/ National Priorities

Education programs designed to fulfill workforce needs of local/ national economies.

✓ Enabler

Vehicle for Implementation

Degree programs are normally based on educational priorities, either expressed in government policies or market data. In some geographic areas, universities have been engaging in deliberations and initiatives led by government and economic development

agencies, and aligning education initiatives to local and national priorities. Co-operative education with industry exemplifies an additional level of coordination between universities, and industry and societal needs.

1.g Experiential and Service Learning

Learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience.

✓ Enabler

Vehicle for Implementation

Experiential learning has evolved and become increasingly oriented toward solving community and/ or societal problems, not just providing a service. Universities are creating and deploying processes and infrastructure to engage with outside stakeholders in a more continuous and integrated way by "bringing problems in." SMU-X at Singapore Management University does that by fostering interdisciplinary studies and letting students address real-world problems and challenges.



The facilities and structures of **SMU-X** at Singapore Management University catalyze connections with the outside world and serve as hubs for experiential learning. With a focus on learning, rather than teaching, the program incentivizes interdisciplinary studies. The curriculum is designed to encourage students to tackle real-world problems through interdisciplinary approaches. Industry partners and faculty who support the students facilitate this effort. With a 24/7 co-working hub, students are encouraged to collaborate with peers across disciplines. The program emphasizes project-based experiential learning with external clients, and has grown to a university-wide initiative for undergraduates, featuring a comprehensive systems approach to co-curricular activities that go far beyond classic academic curriculum learning.

1.h Student Innovation and Entrepreneurship Clubs

Student-led initiatives to exchange information, raise awareness, and promote entrepreneurship on campus.

✓ Enabler

Vehicle for Implementation

Student clubs have evolved from event-oriented communities, in which students gathered and connected with leaders from within and outside the university system, to broader platforms and initiatives that are incorporated as university-linked entities that manage funds and facilities. Student entrepreneurship and innovation clubs and initiatives are emerging as student-run services platforms to support university entrepreneurship ecosystems, offering a variety of services and programs.

1.i Industry Integrated and Co-Designed Education

Education programs co-designed and implemented in partnership with industry stakeholders.

Enabler

✓ Vehicle for Implementation

Industry participation in the design and deployment of education programs has evolved from an arms-length approach in which industry has a voice in university advisory and governance



The King's Imperial EPSRC Centre for Doctoral Training for Medical Imaging

has involved industry as part of the centre to create an interdisciplinary training approach addressed at challenges in healthcare and Medical Imaging. The goal is to improve student training and develop industry related projects, such as Collaborative Awards in Science and Engineering. The Centre for Doctoral Training has built strong relations with key industrial leaders and developed deep links with St. Thomas Hospital, where the Centre is based. Students undertake an MRes in the first year of the programme, giving students the opportunity to develop key research skills before embarking on their three year PhD projects.

structures, to a more direct engagement in program design and delivery. Programs that include activities under industry responsibility and co-education are becoming a contemporary

practice in education and curriculum design. New models include university joint initiatives, and centers and units created around industry needs with the support of industry partners.

1.j Industry-Placed PhD Programs

PhD programs that are designed to address industry needs and place candidates in industry positions.

- ✓ Enabler
- ✓ Vehicle for Implementation

PhD candidates (doctoral students) have been engaging with industry in a variety of ways, and researching industry problems, normally in combination with industry funding. In these dual assignments, PhD candidates respond both to academic and industry supervisors, and must deliver, simultaneously, sound academic research and relevant content for industry. Models such as the EngD (Engineering Doctorate) in the United Kingdom require, for example, major involvement with industry throughout the duration of doctoral research and study.

FACULTY

2.a Faculty Incubation and Acceleration

Initiatives and spaces that accelerate the development of faculty entrepreneurial skills and capabilities.

- ✓ Enabler
- Vehicle for Implementation

The initial approach to prepare faculty as entrepreneurs has been centered around courses and training workshops on business, entrepreneurship, and innovation. More recently, initiatives such as I-Corps have been disseminated in the United States and around the globe. Faculty have also been encouraged and supported to take part in business incubation and acceleration programs. New approaches that relieve faculty from academic responsibilities for a 1-2 year period and take them physically to a special environment within the university to accelerate their development as entrepreneurs (not a company they have co-founded) are now being bench-tested.

2.b Industry Internships

Structured programs through which faculty members experience industry/business life, developing their understanding of industry language, priorities, and work style, as well as professional networks.

- ✓ Enabler
 - Vehicle for Implementation
- Faculty members have traditionally worked with industry via university projects in education, research, or business. Universities are now creating programs and initiatives to allow faculty to experience industry life, develop industry relationships, and deepen their understanding of industry realities, needs, and dynamics.

2.c Industry Leaves of Absence

Industry leaves of absence for professors to have business and entrepreneurial experiences without jeopardizing their careers; industry residence for professors; circulation of professors between academia, policy, and business.

- ✓ Enabler
 - Vehicle for Implementation
- Faculty members are allowed to take leaves of absence for personal reasons. It is now becoming common for universities to grant special leaves of absence, without compromising academic trajectories and careers, and even encourage faculty to take leave to pursue entrepreneurship and work in industry, supporting them in placement.

2.d Executive Education for Industry Professionals

Executive education programs; in-company or not.

✓ Enabler

Vehicle for Implementation

Executive education is a major window to the business world and society in general. Universities have a variety of executive education programs, through which faculty have direct contact with professionals from industry and government, getting to know the realities of those domains and to develop new relationships. Executive education has spread across university units and departments, becoming part of the portfolios outside of business schools. University initiatives in which executive education is offered to faculty are becoming more common, turning this into a two-way process.

2.e Faculty Innovation and Entrepreneurial Training, and Consulting Services

Technical assistance, consultancy, and training services provided by the university to industry.

Enabler

✓ Vehicle for Implementation

Faculty consultancy and training on innovation, technology, and entrepreneurship is a

well-established practice that leads to new relationships and opportunities for innovation-oriented initiatives with industry. Universities are now investing in special consultancy units and/or training faculty to be consultants.

2.f Faculty Innovation and Entrepreneurial Incentives and Rewards

Incentive schemes (compensation and career progression) for faculty based on innovation and entrepreneurship criteria.

✓ Enabler

Vehicle for Implementation

Compensation systems for faculty have been changing to reflect an expanding focus on innovation and entrepreneurship. Typically, the first practice adopted by universities is to grant faculty intellectual property (IP) rights to technologies they invent. Building on that, faculty may receive equity in new ventures. Nevertheless, these compensation models are not fully connected to academic progression. Increasingly, universities are using metrics related to innovation, not just education and research, to advance (to tenure and beyond) and compensate faculty.

2.g Appoint Industry Experts as Faculty

Industry leaders join university faculty, typically in joint appointments, keeping their involvement and activities in business/industry.

✓ Enabler

Vehicle for Implementation

Many industry professionals teach part-time at universities around the globe. In recent decades in emerging nations, universities had to make huge investments to develop and attract talent with advanced degrees. Industry professionals engage with universities, not in substitution of academics, but rather as complementary professors of practice, bringing different types of skills and expertise. Some universities have implemented double/joint assignment schemes for industry personnel with advanced degrees and/or outstanding research track records.

INFRASTRUCTURE

3.a Global Campuses

Universities can scale up operations and leverage core capabilities via physical presence and joint operations with partners across geographies.

✓ Enabler

Vehicle for Implementation

Universities have long implemented global exchanges and partnerships in education and research. A common practice now is engaging with overseas campuses, especially in countries that want to turbocharge their education and research capabilities by partnering with leading global research universities. Also, leveraging technology and deploying digital "global classrooms" are becoming a standard for universities. A new development is the creation of joint campuses or multi-institution campuses as independent organizations.

3.b Offices in Innovation Hotspots

By setting up offices in global innovation hotspots, universities can connect with leading industry players and enable students to experience highly competitive and innovative technology business environments.

✓ Enabler

Vehicle for Implementation

Several universities have representatives and offices around the globe to recruit students, engage with alumni, and explore partnerships. This approach has evolved, and many universities now have representation offices combined with education and/or research units in specific knowledge areas that are relevant or strong in the host country. A new development is the establishment of global outposts solely dedicated to innovation and entrepreneurship, with the mission to connect and/or support students in engaging with technology and business communities in global innovation hotspots, and providing support with physical and social infrastructure devoted to this task.

3.c Flagship Global Research Centers

Universities can maximize opportunities for faculty and students by co-locating flagship research organizations on campus; institutes and others share facilities and complex equipment with the university.

✓ Enabler

Vehicle for Implementation

Many universities have independent and government R&D centers co-located on campus, and devote resources to

attract, retain, and engage such organizations with the university. While it is common to have flagship research centers sharing resources such as people and facilities with universities, it is a new practice for universities to co-invest and build global multi-institution independent flagship R&D ventures.

3.d Global Grand Challenge Centers

University centers, departments, and programs can connect more closely to social and economic realities by organizing themselves around specific global challenges, instead of by academic discipline.

✓ Enabler

Vehicle for Implementation

Multidisciplinarity (or transdisciplinarity) is being pursued in higher education through various schemes and models, initially, through multidisciplinary programs and research initiatives, and, increasingly, through multidisciplinary centers and initiatives. Today, global grand challenges (in energy, food, water, security, climate, governance, etc.) serve as a key organizing principle for multidisciplinary research and innovation centers and institutes, including ones in partnership with industry and other partners.

3.e Joint Institutes

Joint institutes with other universities and research organizations can be effective in promoting cultural change, and creating a new spirit of collaboration and risk-taking.

✓ Enabler

Vehicle for Implementation

For decades, universities have implemented joint institutes with neighbor organizations to complement their capabilities, achieve higher results, and experiment with new models, using the synergies of collaboration to drive change. Increasingly, such institutes assume a new organizational form and independent identity formed by strong partners following a joint vision, such as the Francis Crick Institute and the Wyss Zurich.

3.f Industry Research Centers

Universities perform industry R&D, under long-term agreements that define the functions to be performed, allow for the co-location of personnel, and regulate IP and knowledge sharing; centers are 100 percent industry funded.

Enabler

✓ Vehicle for Implementation

Universities provide research services (contract research) and conduct research for industry



King's College is engaged in a novel partnership with the **Francis Crick Institute**, an independent organization established by a consortium of high-impact driven scientific organizations including the Medical Research Council, Cancer Research UK, Wellcome, University College London, Imperial College London, and King's College London. The center is a biomedical discovery institute dedicated to outstanding scientific quality and emphasizing multidisciplinary research into the fundamental biology underlying health and disease. Its work is helping to understand why disease develops and to translate discoveries into new ways to prevent, diagnose, and treat illnesses such as cancer, heart disease, stroke, infections, and neurodegenerative diseases. The center is the biggest biomedical research facility under a single roof in Europe, where 1,500 scientists and support staff work collaboratively across disciplines.



The Wyss Zurich, a joint R&D center of the University of Zurich and Swiss Federal Institute of Technology–Zurich, is another example of collaboration across universities. Wyss Zurich was launched in 2014 by a generous donation from the Swiss entrepreneur and philanthropist Hansjörg Wyss,

with a vision to foster the translation of scientific discoveries into new therapies for patients and breakthrough innovations in the emerging fields of Regenerative Medicine and Robotics, and their enabling technologies. Wyss Zurich unites world-leading experts from both institutions in multidisciplinary teams, pooling their knowledge and expertise. In this unique all-in-one approach emphasizing “from invention to commercial product,” Wyss Zurich provides funding for personnel expenses; translational R&D projects, notably early phase clinical trials; access to world-class infrastructure, including dedicated facilities for production of clinical grade material and clinical trials; and support from subject-matter experts in the development of project business strategies.

through different models and approaches. A long-term research contract between industry and university labs or research centers is a common practice. An evolution of that concept is the industry research center funded by an industry partner together with the university. Such centers often develop critical knowledge for the industry partner, in areas in which the company does not have an in-house R&D operation and the host university has the needed technical capabilities.

3.g Industry Joint Ventures

Work with third party investors to build new facilities to be shared by universities, companies, and research centers; private capital investment in big facilities.

Enabler

- ✓ Vehicle for Implementation

Universities co-invest with industry partners in joint businesses. A development in that standard model is participation—with investment, and a voice in management and governance—in complex, multi-stakeholder businesses.



Rolls-Royce Plc. has developed successful long-term research partnerships with selected universities world-wide by establishing more than 30 University Technology Centers, including the Computational Engineering and Design Group (CED) at the University of Southampton. Each University Technology Center focuses on cutting-edge research in selected engineering fields. For example, the goal of the Centre for Computational Engineering at CED is to apply modern computational tools, methods, and environments to problems in aerospace engineering and related fields for the benefit of Rolls-Royce, offering expertise in design development, robustness, optimization, cost modeling, and the use of advanced geometry manipulation schemes. With its global network of research centers, Rolls-Royce benefits from outstanding scientific excellence, and access to talent and cutting-edge technologies leading the future of engineering.

3.h Mixed Campuses

Collaboration with government agencies, such as cities or local governments, to build new campuses to bring in corporate partners and incubators, establishing a mixed campus; capital-intensive ventures with industry require new governance models.

Enabler

- ✓ Vehicle for Implementation

It is common for universities to own and operate their own campuses. A typical evolution is campuses with industry and government outposts, fully managed and governed by the university. A more recent model is represented by multi-institution/multi-organization campuses created by design, involving industry and the community, with joint governance, co-investment, and shared management responsibilities.

3.i Manufacturing Centers and Facilities

University-owned or co-owned and operated manufacturing facilities that can be used by industry for prototyping, small batch production, or even full-scale manufacturing; on campus and/or off-campus.

Enabler

- ✓ Vehicle for Implementation

Universities have manufacturing and production facilities that are valuable for industry. At an entry level, universities allow industry to use space and manufacture prototypes. Evolving that model, universities can engage in the production of certain items and supply them to outside businesses. In an emerging model, universities perform contract manufacturing, and use their facilities to engage with industry via manufacturing, and product and process development functions.

3.j Joint Industry-Academia Research Centers

Industry-university co-investments in research center oriented toward developing capabilities in certain technologies and/or solving certain problems; based on long-term partnerships and well-established protocols on assets utilization and rules of engagement.

Enabler

✓ Vehicle for Implementation

University and industry partner to jointly develop capabilities and explore opportunities in a certain technology area, co-investing and co-branding the initiative; results are shared. Expanding on this model, the center can be spun off as an independent organization.



The **HIV Cure Center** at the University of North Carolina (UNC) shows an exemplary partnership between university and industry to jointly develop

capabilities for producing a cure for HIV within the next 15-20 years. The center is led by the Department of Medicine and partners with GlaxoSmithKline (GSK), pairing UNC's top talent capabilities with the development capabilities at GSK. This strategic partnership aims to accelerate the research, discovery, and development of an HIV cure. The center's approach is moving a state-of-the-art initial HIV cure method, "shock and kill" developed at UNC, beyond university labs toward an applicable cure. The "shock and kill" method uncovers persistent traces of the HIV virus in patients, and augments the immune system to target the remaining virus and infected cells. The other unique attribute of the center model of partnership is that commercial products resulting from the research will be governed, commercialized, and manufactured by the private arm of the partnership "Qura Therapeutics."

BUSINESS OFFICES

4.a Knowledge Companies

Companies with a mission to drive entrepreneurship and unleash value creation from knowledge assets created by the university, strategizing and implementing solutions to (i) develop and fund new ventures, and (ii) allocate any resulting intellectual property (IP) commercialization rights.

✓ Enabler

✓ Vehicle for Implementation

Universities can integrate technology transfer and venturing into a single operation via "knowledge companies" that decide how best to use IP, for example, whether to license the IP or build a company around it, and connect with industry, entrepreneurs, and investors. In an evolution of this model, operations run by outside partners with market reach access and leverage non-university pools of resources to unleash value creation for the university ecosystem.

4.b Venture and Seed Funds

University investment vehicles that provide capital to early stage ventures; capital can be owned by university and/or outside partners; funds can be directly managed or not.

Enabler

✓ Vehicle for Implementation

Universities have established seed and small venture funds, using their own resources and endowments. In some cases, they have partnered with other universities in creating these funds, with co-governance and joint operational rules. Further developments in this type of practice include long-term partnerships with investment and innovation companies, leveraging outside resources.

4.c Incubators

University operation/office that helps new and start-up companies develop by providing business services (e.g., finance, procurement, market development, etc.), management training, mentoring, office and manufacturing space, contacts with investors, etc.

Enabler

✓ Vehicle for Implementation

For many decades now, universities have operated technology incubators, originally as university structures. Today's generation of university technology and business incubators includes many that are independent from universities, operated by outside partners. A new model is emerging; instead of having or operating incubators, universities partner with venture companies and others that own and operate incubators, taking students, faculty, and industry partners to those facilities and environments.

4.d Technology Transfer Offices

University office that licenses IP created in university research.

✓ Enabler

Vehicle for Implementation

Technology transfer offices (TTO) that seek to commercialize IP created at the university, often through licensing, were initially implemented in several countries in the 1970s and 1980s. Many universities have expanded the mandates, structures, and functions of TTOs, turning them into integrated knowledge companies (4a), responsible for turning university IP into economic value, either through technology transfer to industry or venturing. Alternatively, universities (particularly in Europe)

have outsourced technology transfer to university associations and university-backed nonprofit organizations. The natural evolution is forming partnerships with outside businesses, as in [4.a].

4.e Accelerators

Operations/offices that enroll start-ups in 3-4 month-long programs that offer mentorship, office space, supply chain resources, and access to capital in return for equity in the start-up.

Enabler

✓ Vehicle for Implementation

Universities have replicated the (digital) accelerator model pioneered in the business sector. "Classes" of start-up companies participate in 3-month (typically) programs in which they develop prototypes, identify potential customers, and look for product-market fit. More recently, universities have founded/co-founded accelerators in partnership with local, national, and global market players, instead of building and operating their own digital accelerators. Variants of the accelerator model are emerging for specific areas such as pharmaceuticals, computer hardware, and space technologies; some universities are experimenting with this type of specialized operation, sometimes working with outside partners.

4.f Makerspaces

Facilities that have equipment available for students, faculty, and the outside community to work on their projects, try new technology solutions and design concepts, build prototypes, and even manufacture small batches. Includes training programs and tutors/mentors, for example, in CNC programming, welding, laser cutting, 3D modeling, robotics, design thinking, coding, etc.

✓ Enabler

Vehicle for Implementation

As a precursor of university makerspaces, many universities encourage students and faculty to book laboratory time to work on their own projects, and build and test new products, processes, and equipment. It is now common for universities to have dedicated makerspaces for students and faculty use, particularly facilities equipped with electronics and digital manufacturing equipment such as 3D printers, CNC mills, 3D scanners, etc. Universities are connecting these spaces in internal networks and, at the same time, using them to engage with the outside world in a variety of ways — as facilities used to attract

Imperial College London

The “**Invention Rooms**” at Imperial College London features three types of invention spaces: the Advanced Hackspace,

Reach Out Makerspace, and the Interaction Zone. The Advanced Hackspace is a cutting-edge prototyping and workshop space for faculty, students, and partners to develop ideas. The Reach Out Makerspace is a workshop and design studio for young people from the local community to get hands-on experience in making and prototyping, with equipment to make a wide range of things from wearable technology to household gadgets. Opening in Spring 2018, the Interaction Zone will host local events and activities, including science workshops and technology drop-in sessions.

outside users and connect them with the university, as revenue generators, as flagship operations to showcase university capabilities, as economic development tools, etc. The Invention Rooms at Imperial College London is an example of an innovative cutting-edge practice in the makerspaces category (4.f).

The unique feature of the Invention Rooms is the integrated ecosystem and immersive environment providing young scholars with a space to experiment, design, and innovate. There are also several funded programs operating in the Reach Out Makerspace.

AGREEMENTS

5.a Joint Research Agreements

Contract, grant, or cooperative agreement entered into by the university with one or more entities for the performance of experimental, developmental, or research work in a certain knowledge field.

Enabler

✓ Vehicle for Implementation

Processes and agreements for implementing joint research with industry represent the most basic level for this practice. In today's dominant practice, universities develop model agreements with standard provisions that are used across the university system. These templates are coupled with services that support researchers

and university units in customizing and implementing such agreements, covering compliance and business perspectives.

5.b Open Ended Research Agreements

Long-term contract or cooperative agreement entered into by the university with one external partner (industry or government) for the performance of developmental or research work in a certain knowledge field; products, resources, and deadlines are continuously adjusted, as the engagement evolves, and needs and opportunities emerge.

Enabler

✓ Vehicle for Implementation

Flexible, long-term goal-oriented (not product) contracts with industry represent the most basic level of this practice. Today, universities have templates, processes, and service structures to support researchers and units in establishing and implementing relationships based on this type of arrangement, with resources being scaled-up on demand.

5.c Expedited IP Agreements

Short and simple set-up of IP agreements to speed up projects, such as the use of templates for simple IP agreements (to which faculty must agree to

certain pre-conditions, but could otherwise adjust quickly during implementation).

Enabler

✓ Vehicle for Implementation

Universities can make available and educate internal stakeholders on the use of prepared and simple templates for IP commercialization, which can speed up IP negotiations and agreements. Universities are now automating some IP transactions, particularly for off-the-shelf IP commercialization.

PLATFORMS

6.a Innovation Platforms

Universities combine research/technology capabilities and business expertise into their entrepreneurship platforms that link students, academic mentors, and industry mentors in new ventures.

✓ Enabler

✓ Vehicle for Implementation

Universities focusing on entrepreneurship and innovation have structured calendars of events and activities to connect and engage with industry stakeholders. Building on that, universities build communities — digital and in-person — through a variety of models and activities, including membership-based

clubs and communities. We see models emerging in which universities have units devoted and professionals assigned to curate industry engagement with the university's faculty, students, centers, institutes, etc. They provide advice; help outside stakeholders navigate the university system, and access content and expertise; and design, facilitate, and create partnerships. A focus on specific and/or disruptive technology areas is emerging. Waterloo University's Global Entrepreneurship and Disruptive Innovation (GEDI) program is a prime example of the university facilitating the industry-academia exchange and thereby promoting innovation; in this case, specifically aimed at the geographic cluster of Toronto-Waterloo.

6.b Innovation Competitions

Industry, university, and government hold competitions in which teams work to solve concrete problems and can obtain funds to implement their solutions.

Enabler

✓ Vehicle for Implementation

Different types of business and technology competitions are held at universities, with business plan competitions being the most common type. In this model, university teams composed of



The **Global Entrepreneurship and Disruptive Innovation (GEDI)**

at the University of Waterloo is a gateway for industry to access the

full innovation capacity of universities in the region. Managed by the office of the president, GEDI eliminates barriers between industry, government, and universities, and bridges the innovation gap to unleash their full potential and kick-start the knowledge economy. The program is intended to encourage the growth of the Toronto-Waterloo innovation corridor, and seeks to boost innovation by providing a channel to connect start-ups, university talent, and established companies. It provides executive education and leadership training in areas including disruptive innovation, intrapreneurship, and advanced technology, and helps industries determine whether they are disruption-ready or disruption-proof. Nationally, the program helps establish Canada's leadership in the knowledge economy by becoming a single starting point to easily engage Canadian talent, research, skills, and startups.

students and/or faculty present or pitch business ideas that are evaluated by a panel and, in most cases, teams receive seed funds to continue the project and kick start business implementation. Originally practiced in business schools, this team-originated approach to solving a problem in a competition has been implemented across university units and departments. Universities now incorporate other types of innovation competitions, particularly those in which real world actors (e.g., industry, government, and communities)

bring challenges to be addressed, especially in relation to the so-called global grand challenges such as food, water, sanitation, energy, climate, etc. This second case is typically a stakeholder-originated challenge, in which university teams compete to create solutions for real world problems or needs.

6.c Open Innovation Arenas

Workshops in which industry brings problems, and university teams composed of faculty and students compete to create and present solutions. Teams can

be led by faculty or students, and have a small budget for development.

Enabler

✓ Vehicle for Implementation

Universities run events and/or processes through which teams composed of students, researchers, and faculty work together to develop solutions for concrete industry and company problems. A client or partner company brings the problem and funds the program. Teams have a short period of time (from a weekend to a few weeks) to develop and present a solution. Proposals are evaluated, and the best are selected and recognized. The "Solve It" Initiative at the University of Auckland is an example of a university partnering with industry to solve concrete problems submitted by industry clients.

6.d I-Corps™-Like Programs

The National Science Foundation (US) program prepares scientists and engineers to extend their focus beyond the university laboratory, and accelerates the economic and societal benefits of NSF-funded basic research projects that are ready to move toward commercialization.

✓ Enabler

✓ Vehicle for Implementation

University faculty, researchers, and staff participating in I-Corps™-like programs go through a seven-week curriculum in which they are introduced and experience the lean start up model in a series of hands-on engagements with potential customers and

partners, interacting with and/or interviewing a minimum of 100 people. Through that process, they are, simultaneously, trained to use the lean start up model and develop an understanding of what it will take to bring their technologies to the market.

Industry Perspective: Xinova

A Unique Innovation Partner



Open Innovation is a term that has been used for well over 15 years, and is usually narrowly defined to describe organizations that issue public challenges to generate crowdsourced solutions. Xinova is a

global network of 12,000 innovators dedicated to connecting problems to solutions and commercializing the outcomes. Xinova works with universities, governments, commercial partners such as Pepsi, Honda, EDB in Singapore, and many others.

Xinova innovates more efficiently by challenging its network of innovators to find many high-value real-world solutions. The diversity of innovators within Xinova's network allows for a multidisciplinary approach to problem solving, and provides a fertile ecosystem for ideation and collaboration. Working with our partners, we identify the best solutions, whether that is nurturing an idea from concept to market application, identifying new applications for an existing technology, or connecting a problem to a solution that previously had not been considered. Preferring to share the risk as well as the upside

of trying many different approaches, Xinova will co-invest with its partners.

Universities participate with Xinova in a variety of ways, including using Xinova to help unlock the value of their intellectual property, participating as members of the Innovator Network, and submitting solutions to open projects for Xinova's commercial partners, as well as prototyping and commercialization activity. Academia has a long history of creating valuable intellectual property; Xinova acts as a highly skilled enabler to share this value with society.

Xinova recently announced a new partnership with Helsinki Innovation Services, Ltd. (HIS), the research commercialization arm of the University of Helsinki. The partnership will use Xinova's unique innovation network to connect Helsinki University research groups and spin-outs with international investors, development experts, and commercial partners. These capabilities will ultimately provide open access to international markets for Finnish technology, while leveraging globally-tested models of commercialization.



The University of Auckland's **"Solve It"** program runs "solve for x" challenges, in which "X" is an industry or company issue. This open innovation program encourages companies to bring concrete challenges to participating University of Auckland teams, which include students, researchers, and faculty. In an award competition with cash prizes (US\$24,000 in total), teams engage in workshops and are provided office space at the Center of Innovation and Entrepreneurship, while entrepreneurs, technologists, and business experts monitor the program. In creating solutions for clients to address their environmental or business challenges and problems, students are given the opportunity to build a network with industries by presenting their own innovative ideas.

6.e Funding Platforms to Support Industry-University Collaboration:

Basic funding provided by university to accelerate the identification of opportunities, design and implementation of initial stages of industry-university joint research initiatives.

✓ Enabler

Vehicle for Implementation

An initial approach to this practice is exemplified by universities using their own resources, normally set aside for this specific purpose, to provide seed funding to start new initiatives, enabling researchers and/or faculty to visit potential industry partners, conduct an initial assessment of opportunities, take part in joint activities, etc. Expanding the model, universities can raise or mobilize external resources to implement this practice.

NETWORKS

7.a Regional Economic Development Networks

Universities can leverage regional and international connections via partnerships involving industry and government, and aiming at boosting innovation and building competitive advantage.

Enabler

✓ Vehicle for Implementation

As an initial step, universities take part in regional economic alliances that operate virtually, with resources provided by members and that function through meetings and dialogues; no physical infrastructure or independent business structures are present. Moving a step forward, economic development alliances with university participation can be incorporated as separate organizations, with their own governance and organizational structures. In this case, universities are partners in the alliance (or shareholders), co-invest, and have fiduciary responsibility.

7.b Industry University Leadership Networks

High profile leadership groups involving industry and university that catalyze collaboration, engage with government, influence the establishment of long-term, multi-layered public-private plans.

Enabler

✓ Vehicle for Implementation

The university partners with industry to form a C-level advocacy group that works at the intersection of economic development, competitiveness, and the knowledge enterprise. Such groups work to raise the awareness of the importance of research and innovation in the knowledge economy.

Imperial College London

The **Imperial Business Partners (IBP)** program at Imperial College London brings together world-class research academics with

business innovation professionals, policy makers, and business strategists. Major program purposes include: operating a corporate engagement network to provide member industries access to Imperial College expertise and assets related to technological innovation; acting as a multi-disciplinary knowledge exchange platform between the members to share their experiences; and offering a forum for academic research excellence and business innovation to find cutting-edge solutions. The IBP serves also as an example of a cutting-edge practice for organizational structures that support industry partnerships (see the “Industry relationship offices” (8a) practice category.) The IBP program is unique in its structure of enabling strong collaboration between academic researchers and business leaders, in particular in areas

7.c Economic Development and Investment Initiatives with Growth

Partnerships with government agencies for local and national economic development initiatives in which universities support investment attraction, and development of critical capabilities and infrastructure that will enable growth and create unique linkages with industry, government, and society.

Enabler

✓ Vehicle for Implementation

Universities play different roles in greenfield investment attraction efforts. As an initial step, they provide information to government

and economic development agencies working with potential investors and preparing submissions or replying to RFIs. Expanding their involvement, they can play an active role in long term initiatives that involve the development of critical capabilities to generate future growth opportunities, co-investing in new facilities, education programs, and more. Beyond that, universities can even become system integrators in the regions where they are based, and operate and coordinate investment attraction and economic development initiatives.

7.d Innovation Clusters

Agglomerations of innovative start-ups, companies of all sizes, research organizations, and universities operating in a particular sector and/or region and that collectively interact, share facilities, engage in new projects, etc. and, in many cases, are collectively governed.

Enabler

✓ Vehicle for Implementation

Universities are key players in innovation clusters initiatives. Traditionally, universities have hosted activities. It is becoming a more dominant contemporary practice to have universities play a leadership role in such initiatives, actively taking part in their governance.

7.e University Alumni Angel Networks

University-related alumni network that routinely reviews investment opportunities and allocates capital to very early stage start-ups. Network members engage with faculty and students through a variety of events and other activities.

Enabler

✓ Vehicle for Implementation

Alumni initiatives in several universities include angel investment networks. They

can have access to university-related start-ups and investment opportunities via informal meetings and a variety of university events. Several universities are now deploying processes and initiatives to connect alumni networks with the internal community in structured ways, via university programs.

ORGANIZATION

8.a Industry Relationships Office

Offices responsible for building relationships and channels with industry, preferably outside of technology transfer offices (TTOs), which can be more transaction-oriented.

✓ Enabler

Vehicle for Implementation

Industry relationships can be managed via different university units and offices, in addition to direct connections established at the department level. At the most basic level, technology transfer offices or knowledge companies [4a] manage relationships with industry. Nevertheless, universities have noticed that TTOs are normally transaction-oriented and not necessarily the best strategic weavers of long-term partnerships; they have responded to this by establishing special offices or chancellorships to engage with industry and nurture

strategic relationships. Building on the relationship-management model, cutting edge practices include quasi-clubs (industry liaison programs) that provide special access to universities, curate relationships across the whole university ecosystem, and offer special innovation-oriented services from technology foresight to consultancy.

8.b Systematic Global Benchmarking

A global benchmarking routine to systematically benchmark university practices for innovation promotion across the globe.

✓ Enabler

✓ Vehicle for Implementation

Benchmarking is a critical function for organizations and is carried out by universities in different ways. At the most basic level, it is performed when needed, and an ad-hoc practice for universities. As the state-of-practice today, universities have benchmarking as a core feature and structured step in their planning and strategy development processes.

8.c University Bonds and Concessions of University Assets

Universities can develop new opportunities for investment in their own programs and projects

via innovations in finance and mechanisms such as bonds, concessions, and funds.

✓ Enabler

✓ Vehicle for Implementation

Universities are diversifying their funding sources and exploring innovations in financial management. Bonds and long-term concessions of universities' assets are among the new solutions that universities are using to mobilize and attract private capital, enabling investments in new capabilities, infrastructure, and spaces.

8.d Private Investment in University Facilities:

Private funding for university facilities that can be leased to industry and academic partners, start-ups and other ventures; universities minimize capital expenditures, create opportunities for private sector (real estate) participation, and maximize availability and quality of high-end facilities.

✓ Enabler

✓ Vehicle for Implementation

Universities increasingly have mixed spaces — shared by students, faculty, corporate partners, start-ups, etc. — and face the need to continually expand, improve, and update



THE OHIO STATE UNIVERSITY

One exemplar practice in this domain is the **"Century Bonds"** issued by Ohio State University (OSU) in 2011. OSU became the first public university to offer a so-called century bond that pays interest only until a single balloon payment of the principal in 2111. The private University of Southern California and Massachusetts Institute of Technology have sold them as well.

OSU trustees gave authority to borrow up to \$500 million, but the university was going to sell about \$300 million in bonds this first go-round to see how markets responded. Typically, universities issue 30-year tax-free bonds with fixed or floating interest rates, and repay principal and interest as they mature. The unique attribute of this practice is that income from century bonds is taxable to the buyer, so interest rates are usually higher, but markets are such that the 4.8 percent rate was lower than three of Ohio State's last six bond issues.

such facilities. They need capital to do that and, traditionally, get public and private funding to build and expand facilities. It is commonplace for universities to raise capital, and build and pay back based on the revenue they generate from outside users. More recently, universities started to partner with real estate developers and use new models to leverage outside resources. For example, developers build areas for multiple uses and lease them to corporate partners, getting profit, and alleviating or reducing university expenditures.

8.e Alumni Offices

Offices for relationship building and to maintain strong links with graduates, parents, friends, and supporters of the university through a program of events, services, and communications.

✓ Enabler

Vehicle for Implementation

In addition to alumni clubs and societies, universities have created their own operations offices to develop and manage relationships with the alumni community.

8.f Entrepreneurship and Executives in Residence

Universities bring in accomplished entrepreneurs and executives, and give them office space and formal

positions within the university structure. They host conversations with students and small events, mentor faculty and students, are "on-call" to coach students and, on behalf of the university, can build external partnerships.

✓ Enabler

✓ Vehicle for Implementation

Business skills are critical for innovation, and universities have been working to leverage outside resources to provide business expertise to students and faculty. One practice is bringing in industry professionals, such as entrepreneurs and business executives, as entrepreneurs in residence. As an initial step, they mentor students and faculty. The roles such professionals play have expanded, and they now engage in business development and venturing activities on behalf of the university.

4.3 Trends Among GFCC University Members

The variety of practices employed by GFCC members reveal some important trends.

1. Multidisciplinary approaches, centers, and initiatives are gaining momentum.

For the past few decades, multidisciplinary (or inter- or

transdisciplinarity¹⁹⁾ has been a hot topic for research and education advancement. Establishing multidisciplinary research and education programs, centers, and institutes was and still is a popular trend in higher education.

Now, universities are creating multidisciplinary centers in partnership with industry, and focusing on global challenges instead of specific disciplines and technologies. These industry-university cooperative centers and institutes are becoming

more problem-oriented. Examples of such entities from the GFCC network include the Waterloo Water Institute, Imperial (College) Grand Challenges in Ecosystems and Environment Initiative, and University of Zurich, among others.

Waterloo Water Institute



In 2009, Waterloo University established the "Water Institute"

as a platform for bringing multidisciplinary assets and research related to water into the university (e.g., water engineering, water science, water governance, and water economics). The institute currently involves more than 150 faculty members from across university faculties and departments.

Imperial Grand Challenges in Ecosystems and Environment Initiative



The initiative aims to be an institutional hub that brings together leaders

in various inter-/multidisciplinary academic fields such as natural and social sciences, engineering, and economics, with policy makers and other stakeholders in an effort to work on integrated research programs that have real-time impact on environmental conservation.

University of North Carolina at Chapel Hill, GlaxoSmithKline, Qura Therapeutics HIV Cure Center



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Qura Therapeutics was started in a partnership between the UNC HIV Cure Center and

the pharmaceutical company GlaxoSmithKline. Established in 2015, the center provides the infrastructure that brings together the best researchers from industry and academia, and is co-chaired by both UNC and GSK, while Qura Therapeutics provides financial and material support to the HIV Cure Center. The National Institutes of Health co-funds the partnership's research.

The Wyss Zurich



Universität
Zürich^{UZH}

The joint research and development center established by the University of Zurich and ETH Zurich (Swiss

Federal Institute of Technology Zurich) focuses on translational research and breakthrough innovations in emerging fields of Regenerative Medicine and Robotics, and their hybrid technologies. The approach Wyss Zurich emphasizes is "from invention to commercial product."

19 <http://www.sciencemag.org/careers/2003/01/multidisciplinary-research-todays-hottest-buzzword>.

2. Innovation-oriented solutions and portfolios are expanding and diversifying.

Although universities already had a variety of initiatives and partnerships with industry, the relationship was boosted in the 1980s as an outcome of the U.S. Bayh-Dole Act, which allows universities to retain title to the inventions they make in the course of performing U.S. government-funded research, and patent and license these innovations. This encouraged universities to establish technology transfer offices (TTOs) all across United States. Other countries eventually followed suit and issued similar pieces of legislation, emulating the U.S. model. As a result, TTOs have become the most common tool for universities to engage with industry globally. Other practices such as business incubators and technology parks have been around since the 1950s, but gained momentum in the 1970s and 1980s. More recently, entrepreneurship education and support has become a popular practice among universities.

The toolkit universities have available to work with industry (from global corporations to nascent technology companies to small and medium-sized enterprises), governments, and other society stakeholders is expanding and diversifying. The

variety of "solutions" within the GFCC membership suggests that such variety will continue to grow. Examples of existing solutions within the GFCC community include the Helsinki Think Company and Waterloo's Velocity program.



Helsinki Think Company

The initiative brings together

future change makers and helps them use their academic skills to their full potential in solving interdisciplinary, real-world problems. This program encourages entrepreneurship, and includes an infrastructure to support this goal: free co-working spaces, workshops, boot camps, accelerator programs and other events, mentoring, and a community are provided to participants of the program. By allowing non-members of University of Helsinki to join the initiative, a broader network of alumni and young innovators is created.

3. Universities are combining practices like building bricks, giving origin to new models.

As innovation toolkits continue to diversify and the economy becomes more complex, universities are increasingly combining different practices to be more effective in their innovation (and education) initiatives, amplifying impact.

For internal stakeholders, such as students and faculty, it is about having access to coherent, mid-to long-term paths and tracks to follow, and experiences to gain. For instance, instead of just taking an entrepreneurship course, students may have contact with mentors in a different context, or be exposed to industry challenges via other programs and initiatives. Some universities are offering students the possibility of engaging in trajectories or programs that include all these elements.

For external stakeholders, it is about curating the relationship with the university, and access to programs that combine different elements — for example, access to facilities, IP, training, contract research, and consultancy — and can lead to long-term engagements. This trend toward combining practices into new solutions is likely to become more prominent in the years to come. Examples of such new extended models from the GFCC network

include the OSU Experiential Entrepreneurship Education (E3) Program and the University of Zurich's BioEntrepreneur and Innovation Program (BEI) and new Entrepreneur-Fellowships (see section 4.2).

4. The most innovative and innovation-oriented universities increasingly leverage outside resources

Traditionally, universities mobilized their own resources (e.g., equipment, capital, faculty, etc.) to provide services to internal and external stakeholders. For instance, university faculty would deliver entrepreneurship programs, professors would mentor students, students would use university facilities to build prototypes, university employees (not venture capital firms) would support fundraising for technology spin-offs, etc. This is changing.

Increasingly, universities are using, leveraging, and embedding outside resources into their practices. This opens new opportunities to change the relationship between capital expenditure and university impact. By investing in relationships and external connections (mostly operational expenses), universities create not only new opportunities, but also become more effective, extend their reach, and lower capital expenditure needs.

Imperial Innovations



Imperial Innovations is a subsidiary of IP Group plc,ⁱ and has exclusive access and rights to commercialize intellectual property generated at Imperial College. Its portfolio includes venturing, and it can mobilize resources from external sources to fund Imperial College spin-offs.

UZH Life Sciences Fund



**Universität
Zürich** ^{UZH}

The UZH Life Sciences Fund was established in 2017, and financed by equal contributions from the University of Zurich's UZH Foundation and the Novartis Venture Fund. The fund invests in UZH spin-offs with the goal of accelerating the transfer of research findings into practice, focusing on early stage companies in life sciences and biotechnology with business ideas based on research performed at the university. Three such investments have been made to date.

A committee comprised equally of representatives from the UZH Foundation and the Novartis Venture Fund makes investment decisions, following a matching approach: the UZH Foundation's share of the funding comes from donations, while the Novartis Venture Fund matches the contributions raised by the UZH Foundation. Any revenues flowing back from the spin-offs remain in the UZH Life Sciences Fund for investment in further spin-offs.

ⁱ IP Group PLC.

This approach is still new and not widely understood for most universities, including those in the GFCC member community sampled for this study. However, this trend is likely to grow in the future. Examples of such leveraging from the GFCC network include the University of North Carolina,

Waterloo University with networks of mentors and angel investors; Imperial Innovators; the University of Zurich Life Sciences Fund; and the Arizona State University-Draper Entrepreneurship Incubator Program (see 4.2).

5. The boundaries between universities and the outside world are becoming blurred.

Universities used to engage with industry, governments, and other partners in a more transactional way with well-established boundaries. This relationship has changed significantly.

University campuses now host a variety of players, such as corporate research labs, government labs, start-ups, etc. But the frontiers still are visible and clearly identifiable. In an advanced degree of engagement and mutualism, there are university-industry joint ventures and initiatives in which resources and initiative ownership can hardly be associated to one party or the other, and lines are crossed the whole time. Examples include professionals co-located and with double assignments, resources with joint ownership and management, value creation in the two (or multiple) sides of the relationship, with joint investment and returns.

Such practices will become more common as universities further connect with society, also in response to the emergence of new organizational models in general. Universities are the latecomers in adopting new organizational models with business having the lead, but they are catching-up.

Rolls-Royce's Technology Center at the University of Southampton



The goal of the center is to apply modern computational tools, methods, and environments to problems in aerospace engineering and related fields for the benefit of Rolls-Royce. It is fully funded by Rolls-Royce and integrated in the company's global network. The center is organizationally integrated in Southampton's Computational Engineering and Design Group (CED).

University of North Carolina at Chapel Hill, GlaxoSmithKline, Qura Therapeutics HIV Cure Center



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Qura Therapeutics was started in partnership between the UNC HIV Cure Center and the pharmaceutical company GlaxoSmithKline. Established in 2015, the center provides the infrastructure that brings together the best researchers from industry and academia, and is co-chaired by UNC and GSK, while Qura Therapeutics provides financial and material support to the HIV Cure Center. The National Institutes of Health co-funds the partnership's research.

University of Malaya Centre for Innovation and Commercialization (UMCIC)



UNIVERSITY
OF MALAYA

In an effort to create an entrepreneurial ecosystem at the University of Malaya, the Centre for Innovation and Commercialization strives to convert scientific findings into market-driven solutions, emphasizing both high impact values and social innovation. Through this facility, a wide array of inventions, e.g. industry-focused hardwares, sought-after formulations, effective medicines and so on, have been produced

Examples from the GFCC network in which universities are involved in hybrid university-industry initiatives include the Rolls-Royce technology centers, a model the corporation now has operating in different countries,²⁰ as well as the University of North Carolina at Chapel Hill HIV Cure Center, a joint venture with GlaxoSmithKline.

6. Universities now do a variety of things that most people would not have expected a few years ago.

There are different university models around the globe, and further diversification is expected in the years to come. Above all, universities are expected to increasingly do things not commonly associated with them, such as manufacturing, real estate development, economic development, event production and management, vocational training, technology venturing, and even regional or city coordination.

To partner with industry, attract students, and become or continue to be relevant in a rapidly changing world, universities are assuming new roles. They are also developing new business capabilities, creating new organizational units, and establishing new infrastructure and

physical spaces to manage and operate an extended portfolio of services and activities.

7. Entrepreneurialism is a fundamental characteristic of universities that drive innovation.

Universities are institutions with strong foundations in tradition. An entrepreneurial mindset is required to drive and accelerate transformation, coping with changing and increasingly sophisticated business and societal landscapes. Universities are required to be entrepreneurial themselves, not just to prepare students to be entrepreneurs.

Initiatives to prepare faculty to be entrepreneurs have grown more important, and there will likely be a growing interest in university entrepreneurship and entrepreneurialism. This requires leadership, new organizational, management and governance models.

20 <https://www.rolls-royce.com/about/our-research/research-and-university.aspx>

5. Optimizing Innovation Alliances

5.1 Developing a Framework to Optimize Innovation Alliances

What does it mean?

The trends identified in this report have some important implications for universities around the globe. Such implications assume different levels of relevance across geographies, as challenges and institutional realities are different country to country.

This report organizes implications for universities in two groups: internal and external. The two groups need to be connected to achieve effective results and efficiency.

The external perspective

Resources

Universities increasingly leverage outside resources — professionals, capabilities, infrastructure, and capital. They need to have in place the processes, protocols, legal frameworks, and templates needed to make that possible. They also need to overcome a variety of internal barriers that hinder the mobilization and integration of external resources into university initiatives and activities, from mindsets to language.

Community

The boundaries between universities and the outside world are becoming more fluid or, as stated earlier, blurred. The outside community is a massive source of intellectual resources, relevant problems to address, capital, etc. To harness such potential and maximize benefits, universities need to be able to build and organize communities.

Engagement

Outside relationships are essential for universities, and they need to be prepared to develop and implement engagement strategies and initiatives in a consistent way over time. Entrepreneurs, investors, alumni, local businesses, global businesses, government agencies, and other stakeholders should be involved, recognized, get visibility, and allowed to build reputations based on their involvement with the university. From an internal point of view, a relationship manager, community organizers, events, and platforms for engagement are needed.

Technology

The world is being digitalized and industries transformed by digitalization. Curiously, there were few examples of digital solutions, strategies, tools, or platforms being used by universities in the context of innovation alliances, although they are being applied

for education. This is a clear gap that universities will be challenged to overcome.

The internal perspective

Autonomy

Entrepreneurial behaviors require autonomy and flexibility. To drive innovation, universities need autonomy as a key characteristic at two different levels: internally, as a guiding (and practical) principle for faculty and university leaders to organize and implement multidisciplinary initiatives that do not align with formal structures; and, most importantly, universities as organizations need autonomy to operate as entrepreneurial organizations, take risks, and manage their resources, for example, defining compensation levels, hiring personnel, entering into agreements, investing, etc. This last aspect is a particularly critical issue for public universities.

Organization

Universities need new functions, research, innovation and partnership areas, and capabilities. As they endeavor in new areas and types of activities, they need to have the types of structures and resources required to work with industry, governments, start-ups, the media, etc. As multidisciplinary areas, institutes, and initiatives emerge, a variety of business services structures and quasi-business units are also expected to emerge. Increasingly,

universities will need community managers, storytellers, digital strategists, industry liaison executives, business development professionals, technology evangelists, global scouts, project managers, social media experts, knowledge managers, and so on. Also, as organizational structures evolve into more complex networks, universities will increasingly need connectors and brokers to work with internal and external stakeholders.

Design

Pathways to integrate different practices and solutions do not emerge spontaneously; they need to be designed, especially if different players within and/or outside the university ecosystem provide the various solutions. Such paths need to be designed and purpose built.

More generally, there is a growing need for universities to bring design thinking, approaches, and methodologies to their strategic toolkits. It will become increasingly important for universities to use contemporary approaches to conceptualize, prototype, test, improve, and scale up practices across their units and society. They will be expected to create such new solutions by design, in meaningful and purposeful ways. University leadership will be much about ecosystems design and architecture.

Metrics

To amplify their engagement with the outside world and become more effective in the innovation enterprise, universities need to adjust their performance metrics and compensation systems. Innovation-related attributes and types of activities should be valued and rewarded, and performance evaluation systems for faculty and non-faculty members alike should be adjusted accordingly.

Building on that, universities could be expected to collect data and build technology-enabled dynamic scorecards to keep track of their impacts in the communities in which they are present, at the local and/or global levels. IT solutions could help universities better understand and manage their multiple connections (the networks in which they are present), resources, and activities.

5.2 Conclusion

Universities have long played a vital role in innovation by generating new knowledge, advancing technology, and training the next generation of scientists and engineers. However, for the past several decades, universities have been expanding and diversifying their roles in the innovation ecosystem.

In fulfilling these new roles, they are adopting, modifying, and creating a host of practices that: involve students and faculty more deeply in a greater spectrum of innovation activities, leverage university infrastructure to engage outside partners, and build more lasting linkages, networks, and relationships with stakeholders in parts of the innovation ecosystem outside of the university.

These university practices are generating benefits. They are increasing returns on the research universities perform and their investments in innovation infrastructure, such as laboratories and equipment. Students are being exposed to richer learning environments and experiences, and developing innovation-related knowledge and entrepreneurial skills they can exercise in the real world, generating career building and, potentially, economic benefits to the individual. Companies are tapping a wider array of research, talent, and technical capabilities enhancing their capacity for innovation. And, universities are increasing their contributions to the communities in which they are involved, and to their local, regional, and national economies.

The landscape for universities' participation in the innovation ecosystem is evolving, and the boundaries between universities

and the outside world are becoming more blurred. This is a positive sign that these critical science, technology, talent, and innovation assets are becoming more fully integrated into innovation ecosystems, their networks, and processes of innovation.

There remains significant opportunity to further enhance many universities' role in the innovation ecosystem, and carrying it out more efficiently and effectively. This includes institutionalizing the policies, processes, and protocols needed to make innovation-related practices an integral "way of doing business," while retaining the flexibility and agility to seize new opportunities as they arise and try new practices as they emerge. Performance evaluation and reward systems should recognize the importance of innovation activities, and metrics should gauge the university's impact

in the innovation ecosystem. Universities should make greater use of digital platforms in carrying out innovation activities. And they need to devote the resources, personnel, and funding to fully engage in the innovation ecosystem and its processes.

Finally, university leaders must assume the mantle of agents of change, and address stubborn barriers that often arise when organizations with strong and long-held traditions are adopting new ways of doing business. Barriers can involve organizational forms, embedded processes and systems, management structures, comfortable routines, and the roles of people and their power in the organization. Adopting a mind-set for change is just the beginning; then, the real work of transformation begins.

APPENDIX A

Universities That Contributed to This Report

Ohio State University

University of South Carolina

University of Auckland

University of Helsinki

University of Waterloo

King's College London

LMU Munich

Webster University

Arizona State University

University of Southampton

University of Malaya

UNC Chapel Hill

University of Zurich

Singapore Management University

Qatar University

Imperial College London

Michigan State University

National Taiwan University

APPENDIX B

Three Generations of University Innovation Alliance Practices

	GENERATION 1	GENERATION 2	GENERATION 3
Emerging Practices	Classical	Contemporary	Cutting-Edge
1. Students			
1.a Entrepreneurship Training	<p>Courses and classes are taught by academics</p>	<p>Programs have industry mentors and professors of practice, working in combination with academics.</p> <p>Programs are delivered and leverage specially-designed facilities with layouts that encourage collaboration and where participants can stay, connect and continually work together.</p>	<p>Entrepreneurship training is a systemic, long-term and integrated effort across courses and university activities.</p> <p>Students engage in long-term entrepreneurship tracks, not in isolated one-time training programs or courses.</p> <p>Programs are jointly designed and deployed with industry.</p> <p>Industry has leadership in program design and implementation and university provides specific content.</p>
1.b Mentorship	<p>Students can have contact and get input from industry leaders & alumni during university events, in a non-structured way.</p>	<p>Students have access to mentors with industry experience on a regular basis.</p> <p>Alumni networks are leveraged to mentor students.</p> <p>Online communities are available to support students.</p>	<p>Students are assigned individual industry mentors throughout their education.</p> <p>Leadership development is included as an integral and structured component of education programs.</p>
1.c Global Mobility Programs		<p>Study abroad and student exchange programs.</p>	<p>University offers industry internships abroad.</p> <p>University organizes entrepreneurship study missions to foreign countries.</p>
1.d Hipster-Hacker-Hustler Models		<p>University provides knowledge & business resources to scientists who create science-based ventures.</p>	—
1.e Students Leave		<p>Students can interrupt and return to academic studies on their own.</p>	<p>University has structured program/ process to concede leaves to students who want to pursue entrepreneurship journeys.</p>
1.f Education Oriented to Local/ National Priorities		<p>Degree and non-degree programs are informed by national priorities, strategies and policy statements, but not coordinated.</p>	<p>Degree and non-degree programs are designed in coordination with government agencies and business, in the context of national priorities, strategies and policies.</p> <p>Cooperative education for grad and undergrad levels.</p>

	GENERATION 1	GENERATION 2	GENERATION 3
Emerging Practices	Classical	Contemporary	Cutting-Edge
1.g Experiential and Service Learning	Students enroll in experiential and service learning programs.	Students take part in university-organized community and society-oriented problem-solving programs and initiatives.	Universities have facilities and structures to catalyze connections with outside world and serve as hubs for experiential learning and problem-solving activities.
1.h. Students Innovation and Entrepreneurship Clubs and Networks	Clubs and societies exist and host entrepreneurship and innovation events.	Clubs and societies are incorporated as university-linked independent organizations. Clubs and societies organize innovation, startup and entrepreneurship competitions. Clubs and societies have/manage seed or VC fund.	Student-run initiatives include service platforms to support university entrepreneurship ecosystem.
1.i Industry Integrated and Co-Designed Education	Industry has a voice in university affairs and programs via board participation.	Education programs are designed and delivered with industry participation. Cooperative education.	Multi-institutional education programs are designed and implemented in partnership with industry.
1.j Industry-Placed PhD Programs	PhD students are sponsored by industry for industry-related research.	PhD students develop industry-related research under joint oversight of industry and academic supervisors.	University-industry partnership PhD program, with PhD students placed and working in industry research, under joint supervision of industry and academic supervisors.
2. Faculty			
2.a Faculty Incubation and Acceleration	University offers entrepreneurship workshops for faculty.	University offers opportunity for faculty to take part in i-Corps. Faculty projects are accepted in university incubators and accelerators.	University has special faculty acceleration infrastructures and initiatives, with faculties lifted from academic responsibilities for 1–2 years in order to be fully dedicated to the development of her/his entrepreneurship skills and journey.
2.b Industry Internships	—	Faculty work with industry and in industry activities as part of university projects.	Faculty have s period/time assigned to be in industry with the purpose of understanding industry reality and processes.
2.c Industry Leaves	—	Faculty take leaves for personal reasons and engage with industry.	University has initiative or program to help faculty to connect and be placed in industry.
2.d Executive Education for Industry Professionals	—	Faculty design and lecture at executive training programs, getting to know and developing relationships with industry.	Executive education programs are offered across university units & departments for faculty to take part together with industry leaders.

	GENERATION 1	GENERATION 2	GENERATION 3
Emerging Practices	Classical	Contemporary	Cutting-Edge
2.e Faculty Innovation and Entrepreneurial Training, and Consulting Services	Faculty develop relationships and understanding of industry through training and consultancy activities to industry.	Faculty are trained to engage with industry.	Faculty are trained by industry professionals to engage with industry.
2.f Faculty Innovation and Entrepreneurial Incentives and Rewards	Faculty shares IP resulting from research in which he/she took part.	Faculty has equity and is involved in the operation of companies that take to the market IP developed as part of academic research.	IP generation and innovation track record are taken into account for faculty tenure and promotion.
2.g Appoint Industry Experts as Faculty		Industry professionals teach classes as adjunct faculty.	University has special type of assignment for industry professionals as professors of practice. Industry professionals have joint appointments — industry (or research organization) and university.
3. Infrastructure			
3.a Global Campuses	University has global exchange partnerships that allow for students to take courses across geographies.	University has campuses overseas and students can enroll in courses and activities across geographies. Universities have virtual classrooms with students globally distributed.	University pools resources with others to implement multi-institutional campuses as independent organizations in third countries.
3.b Offices in Global Innovation Hotspots	University has representation offices abroad for student recruitment and business development.	University has global hubs, houses and facilities abroad for academic activities.	University has outposts in global innovation hotspots solely dedicated to innovation and entrepreneurship.
3.c Flagship Global Research Centers	Independent and government R&D centers are co-located on campus.	Independent & government R&D are co-located on campus and jointly use university facilities and resources.	University has equity and is involved in activities of multi-institutional, independent flagship R&D ventures.
3.d Global Grand Challenge Centers	University has multidisciplinary research initiatives.	University has multidisciplinary research centers and institutes.	University has multidisciplinary centers and institutes in partnership with industry and other players.
3.e Joint Institutes	—	University has joint institute with neighbor organizations.	University has equity in multi-institution research institute involving other academic partners. University has equity in research institute in a different country.
3.f Industry Research Centers	University provides research services (contract research) to industry.	University provides research services to industry on a continued basis, based on long-term contract.	University owns/operates an exclusive R&D center for industry, which concentrates at the university its R&D capabilities for a selected technology area.

	GENERATION 1	GENERATION 2	GENERATION 3
Emerging Practices	Classical	Contemporary	Cutting-Edge
3.g Industry Joint Ventures		University co-invests — shares investment and risk — with a industry partner in a joint business.	University co-invests — shares investment and risk — in a multi-stakeholder businesses with industry.
3.h Mixed Campuses	University owns and operate its campuses, fully dedicated to academic activities.	University campus includes industry and government outposts. Campus is managed by university.	University operates in multi-institution campus with joint governance — investment & management responsibilities are shared among partners.
3.i Manufacturing Centers and Facilities	University facilities can be used by industry to build prototypes & perform R&D fabrication in the context or research projects.	University facilities can be leased by industry, to build prototypes & perform R&D fabrication.	University offers specialized manufacturing services to industry — contract manufacturing.
3.j Joint Industry-Academia Research Centers	—	Centers are university units.	Centers incorporated as independent organizations.
4. Business Offices			
4.a Knowledge Companies	—	University-owned knowledge companies.	Knowledge companies owned/operated by outside partners with extended market reach.
4.b Venture and Seed Companies	University owns/ manages venture and seed funds.	University has joint venture and seed funds with other universities and organizations.	University integrates and leverages outside resources for venture and seed funds via 3rd party-owned, university-linked knowledge company.
4.c Incubators	University owns and operates incubators.	University-related incubators are operated by outside partners.	University partners with existing technology/venture company-backed incubators.
4.d Technology Transfer Offices	University Tech Transfer Office licenses IP.	Technology Transfer Office includes venturing and becomes university knowledge company [4a].	Technology Transfer Office is an independent company, outsourced.
4.e Accelerators	University owns and operates accelerator.	University-related accelerators are operated by outside partners.	University partners with existing technology/venture company-backed accelerators. Thematic (health, hardware, education) accelerators run by specific units (pharmaceutics, engineering, etc.) and/or outside partners.
4.f Makerspaces	Students use university laboratories and facilities to make prototypes for new products.	University has specific makerspaces available for students.	University maker facilities are open to the community, serving as a platform to engage outside innovators with the university community.

	GENERATION 1	GENERATION 2	GENERATION 3
Emerging Practices	Classical	Contemporary	Cutting-Edge
5. Agreements			
5.a Joint Research Agreements	—	University has structured model for research agreements with industry.	University has a structured and ready to use template, internal outreach initiative and services to support units in implementing agreements with industry.
5.b Open-ended Research Agreements		University has structured model for open-ended research agreements with industry.	University has a structured and ready to use template, internal outreach initiative and services to support units in implementing agreements with industry.
5.c Expedite IP Agreements		University has templates for expedite IP agreements available for use across units.	University has a fully automated process to implement expedite IP agreements with industry partners.
6. Platforms			
6.a Innovation Platforms	University hosts entrepreneurship and innovation events that mingle internal and external stakeholders.	University actively builds an extended community of innovators via events and other initiatives that connect internal and external stakeholders.	University provides to external stakeholders curated access to its internal research and innovation ecosystem. University uses foresight and events on future-looking disruptive technologies to create connections with leading industry stakeholders.
6.b Innovation Competitions	—	Business plan competitions. Competitions in which problems are simulated or brought by competitors or faculty.	Competitions in which real world actors (industry, government, community) bring challenges to be addressed by university teams.
6.c Open Innovation Arenas	—	University runs "solve for X" initiatives.	University partners with industry to run "solve for X" initiatives, addressing concrete industry problems; teams work to develop real solutions for industry.
6.d iCorps-Like Programs	—	iCorps programs implemented.	—
6.e Funding Platforms for Support Industry-University Collaboration	—	University provides seed funding to kick-start new initiatives with industry — project discovery and design.	University works with external partners to provide seed funding and expertise to kick-start new initiatives with industry — project discovery and design.

	GENERATION 1	GENERATION 2	GENERATION 3
Emerging Practices	Classical	Contemporary	Cutting-Edge
7. Networks			
7.a Regional Economic Development Alliances	—	University takes part in specific economic development initiatives.	University co-invests and takes part in the governance of long-term, multi-stakeholder economic development platforms.
7.b Industry University Leadership Alliances	—	University is a member of a leadership alliance.	—
7.c Economic Development and Investment Initiatives with Government	University takes part in initiatives to attract investments as a knowledge provider.	University plays active role to attract investments and commits financial resources to the initiative. University invests in critical assets (labs, test facilities etc.) for investment attraction and the development the local talent pool.	In addition to investing in facilities and talent, the university works as a system integrator or coordinator of the investment attraction initiative.
7.d Innovation Clusters	University takes part in cluster activities.	University plays leadership role in cluster governance.	—
7.e University Alumni Angel Networks	—	University alumni invest in university spin-offs to which they connect through events and ill-structured opportunities.	University alumni angel network is embedded in university entrepreneurship initiatives and programs, having direct, structured and preferred access to the university spin-off pipeline.
8. Organization			
8.a Industry Relationships Office	—	Industry relationship management is a function of Tech Transfer Office (4e) or knowledge company (4a).	Industry relationship management is performed at a strategic level by a specific office, not the Tech Transfer Office (4a) or knowledge company (4e).
8.b Systematic Global Benchmarking	—	University performs benchmarking on innovation on a project basis, as needed.	University has in-house strategic unit that regularly performs benchmarking on innovation as a core function.
8.c University Bonds and Concessions of University Assets	—	University implements new financial instruments to monetize its assets and release capital for investment in strategic initiatives.	
8.d Private Investment in University Facilities	—	University raises private capital to invest in facilities and returns capital over time.	University partners (joint-ventures) with private developers to build facilities for university and industry use.
8.e Alumni Offices	—	University has office to engage and manage relationships with alumni.	
8.f Entrepreneurship and Executives in Residence	—	Entrepreneurs and executives-in-residence engage and mentor students.	Entrepreneurs and executives-in-residence are professors of practice and develop new businesses for university.

APPENDIX C

2018 Members of the University and Research Leadership Forum

Australia
Aikenhead Centre for Medical Discovery
Bond University
Monash University

Brazil
Pontifical Catholic University of Rio Grande do Sul

Canada
Western University
University of Waterloo

Finland
University of Helsinki

Germany
Ludwigs-Maximilians University Munich

Greece
American College of Greece

Hong Kong
University of Hong Kong

Italy
University of Bologna

Malaysia
Universiti Teknologi Petronas
University of Malaya

Mexico
Monterrey Institute of Technology and Higher Education

New Zealand
University of Auckland
Portugal
Catholic University of Portugal
University of Minho

Qatar
Qatar University
Weill Cornell Medicine – Qatar

Saudi Arabia
King Abdullah University of Science and Technology

Singapore
Singapore Management University

Switzerland
University of Zurich

Taiwan
National Taiwan University

United Kingdom
Imperial College London
King's College London
Queen Mary University of London
Ulster University
University of Southampton
University of Warwick

United States of America
Arizona State University
Georgetown University
Michigan State University
Northeastern University
Ohio State University
Purdue University
University of California San Diego
University of Chicago
University of North Carolina at Chapel Hill
University of South Carolina
Webster University

.....
For more information
on GFCC members,
please visit our website
at thegfcc.org.



GFCC

Global Federation of
Competitiveness Councils

**Global Federation of
Competitiveness Councils**

900 17th Street, NW, Suite 700
Washington, DC 20006
USA
T +1 202 969 3382
www.thegfcc.org

