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Ideation Center insight

Beyond bricks

Building a high impact research ecosystem in the GCC

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The Ideation Center is the leading think tank for Strategy& Middle East, part of the PwC network. We aim to promote sustainable growth in the region by helping leaders across sectors translate socioeconomic trends into actions and better business decisions. Combining innovative research, analysis, and dialogue with hands-on expertise from the professional community in the private and public sectors, the Ideation Center delivers impactful ideas through our publications, website, and forums. The end result is one that inspires, enriches, and rewards. The Ideation Center upholds Strategy&'s mission to develop practical strategies and turn ideas into action. At the Ideation Center, we enjoy the full support of all practices in the Middle East. Together we bring unsurpassed commitment to the goal of advancing the interests of the Middle East region. Find out more by visiting www.ideationcenter.com.

Executive summary



Gulf Cooperation Council (GCC) countries¹ are investing heavily in research infrastructure, but less on high-quality research and development (R&D). At present, private-sector-led and academic research is limited. Local universities have few channels for collaboration with international universities, the private sector, or the government. This reduces the output and quality of their research, and precludes innovation and any meaningful input into social and economic policy. A further deterrent to leading-edge R&D is that the region's legal system does not effectively protect researchers' intellectual property (IP) and does not provide them with commercialization support. Consequently, GCC countries pay a high price to import knowledge, an unsustainable solution that does not always answer their specific needs.

Instead, GCC countries need to put more effort into fostering the research ecosystem so that they produce high-quality research that can lead to innovation and that can inform public policy. By carefully moving part of their spending from facilities to R&D, and by creating incentives for high-impact, practical research, they can facilitate the transition toward a diversified economy, better manage an array of societal challenges, and reduce dependence on imports generally. There is empirical evidence that a 1 percent increase in R&D can boost economic growth by 0.6 to 2.2 percent.

GCC governments must focus on improving research capabilities and the quality of output. Governments should create national research frameworks, invest in building their local talent, and fund research on a performance basis. They should also encourage research in high-priority socioeconomic sectors through collaboration with enterprises. Finally, they should establish an effective intellectual property (IP) framework and provide support in prototyping and commercialization. Research collaboration amongst GCC economies can also help foster innovation in the region.

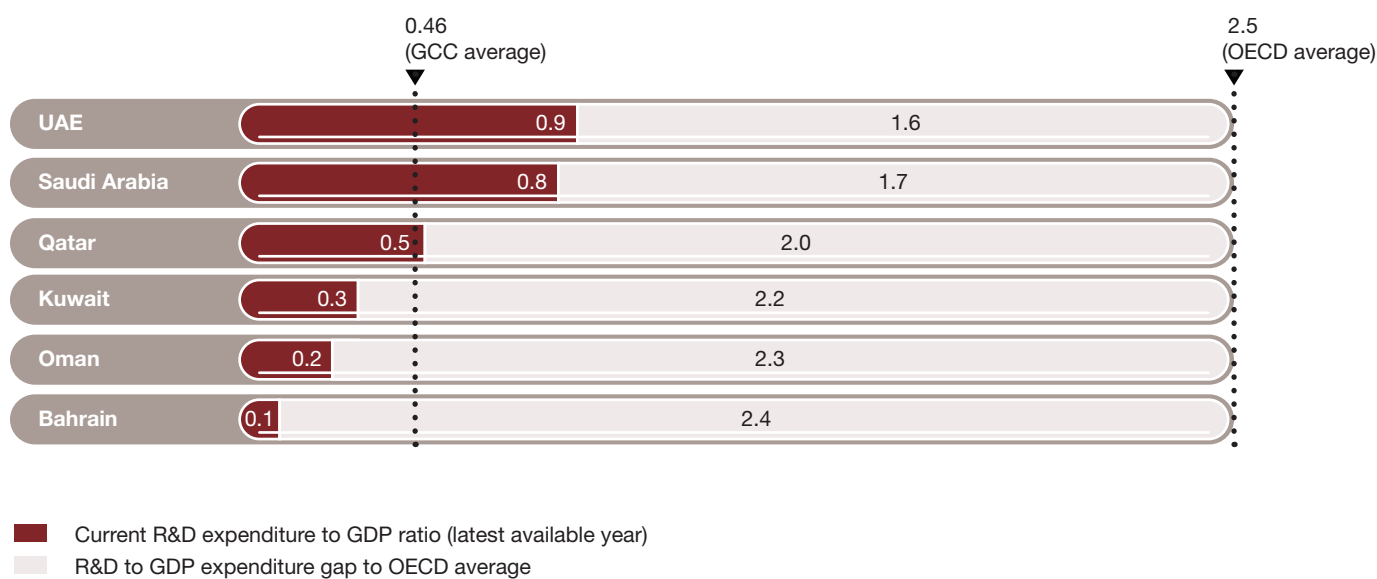
GCC countries have limited research output

GCC governments are making significant investments in building infrastructure and equipping their institutions with state-of-the-art facilities. For instance, they are allocating large shares of their budgets to building labs, and infrastructure for universities; constructing new schools; and renovating existing ones.² Yet these countries currently do not allocate enough to high-quality research. R&D spending³ (including capital expenditures) is between 0.1 percent of GDP in Bahrain and 0.9 percent in the United Arab Emirates (UAE) — compared to an Organisation for Economic Co-operation and Development (OECD) average of 2.5 percent (*see Exhibit 1*).

Exhibit 1

The ratio of R&D expenditure to GDP is low in GCC countries compared to global peers

Research and development expenditure as a percentage of GDP (latest available data)



Source: World Bank; Strategy& analysis

Consequently, GCC countries are forced to import knowledge. They currently run a trade deficit when it comes to knowledge-intensive services — which include R&D, professional, and technology-based services. In 2015, the deficit reached 4.0 percent of GDP in Oman, 1.3 percent in Kuwait, and 0.8 percent in Saudi Arabia. This compares to surpluses of 1.3 percent and 0.2 percent in the U.K. and U.S., respectively.⁴ Additionally, imported knowledge, especially science-based knowledge, may be difficult to adapt to the GCC's specific context or may not even be available.

The result is that the GCC countries are forgoing an important growth opportunity. Numerous academic studies have quantified the impact of R&D on GDP. Although the results slightly differ, all assert that an increase in R&D spending significantly boosts a country's GDP. According to these studies, an additional 1.0 percent spent on R&D could result over time in 0.6 to 2.0 percent more growth.⁵

It is worth noting that the time required for commercial returns to be achieved can be in the magnitude of years — or even a couple of decades in sectors such as healthcare, for instance. The region should therefore adopt a sense of urgency about improving its R&D quality, to assist with the transition toward a diversified and robust economy. High-quality homegrown research can be used to manage better an array of societal challenges, and reduce dependence on imports generally.

Challenges in the GCC research environment

Structural limitations within academia, scarce partnerships with international researchers and the private sector, limited contribution to the public-sector agenda, and insufficient IP regulations are holding back research and innovation in the GCC.

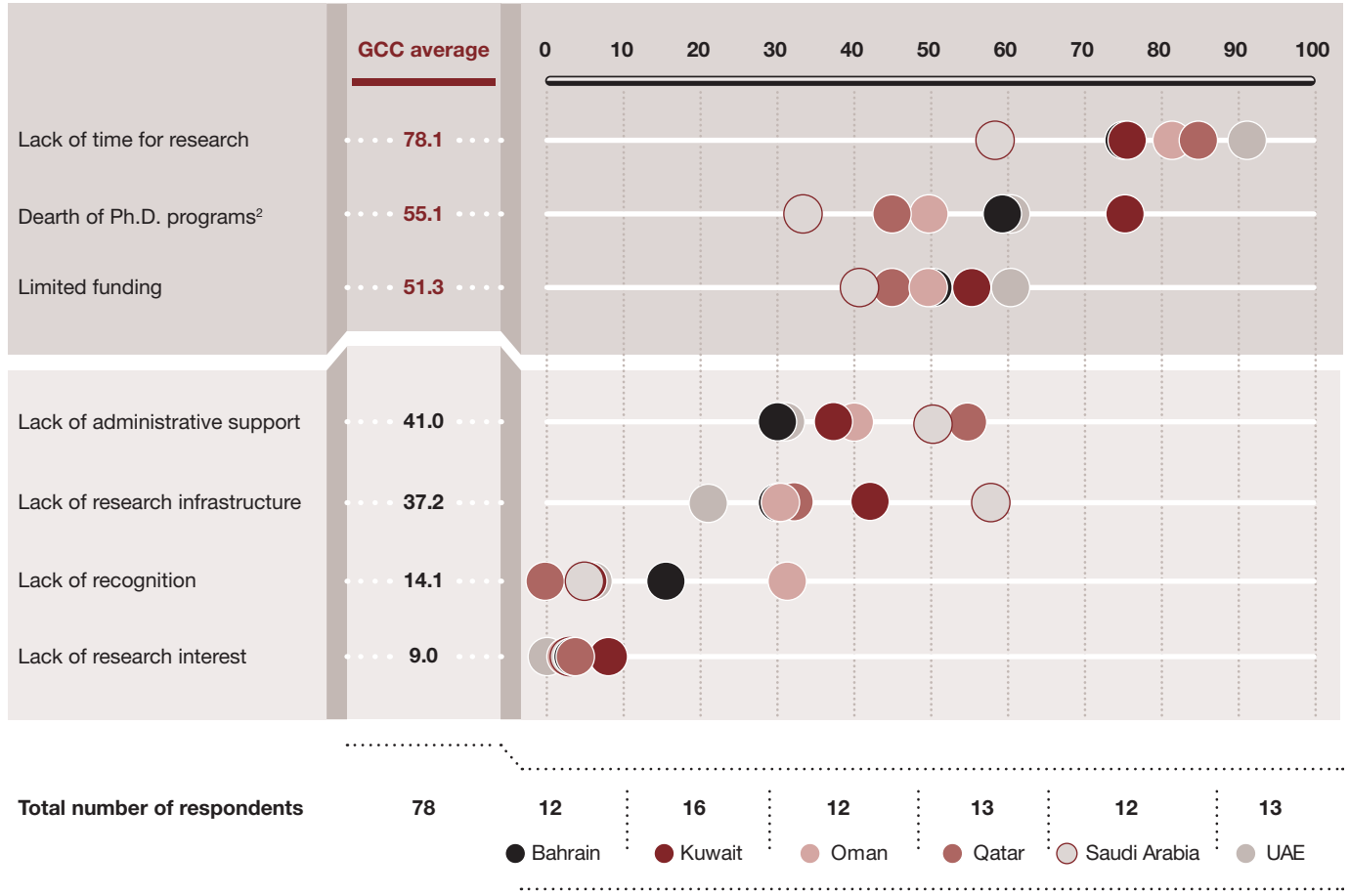
1. Structural limitations within academia

To understand the obstacles to research within academia, the Ideation Center surveyed 78 professors from 14 GCC universities.⁶ Respondents identified the top challenges as time, availability of Ph.D. programs, funding, research infrastructure, and administrative support (*see Exhibit 2*).

Exhibit 2

There are multiple obstacles to academic research in the GCC

Percentage of respondents in each country¹



xxx Top 3 constraints

¹ Answers to the question: What are the three major obstacles to academic research at your university?

² The “dearth of Ph.D. programs” category also includes professors that have cited the lack of Ph.D. students or postgraduates as a constraint to academic research.

Note: Universities include: University of Sharjah, American University of Kuwait, UAE University, GUST, University of Bahrain, KFUPM, Qatar University, University of Nizwa, Kuwait University, King Abdulaziz University, Sultan Qaboos University, American University in Dubai, American University of Sharjah, Hamad Bin Khalifa University.

Source: Strategy& survey

Lack of time for research was the most significant challenge. Although 96 percent of the surveyed professors considered research to be very important for their professional careers, 78 percent stated not being able to allocate enough working hours to research.

A closer analysis revealed that a high students-to-faculty ratio in GCC universities is partly responsible for the insufficient amount of time for research (see *Exhibit 3*). A university professor has 14.6 students in the GCC on average (for undergraduates and graduates), compared to only 4.4 in the U.S. or 6.8 in Singapore. The highest students-to-faculty ratios were in Bahrain (22.3) and Kuwait (21.1). Saudi Arabia had the lowest ratio at 7.5. This could be evidence of the GCC's less-selective entry requirements for graduate school, which ideally should remain exclusive to maintain the quality of graduates.

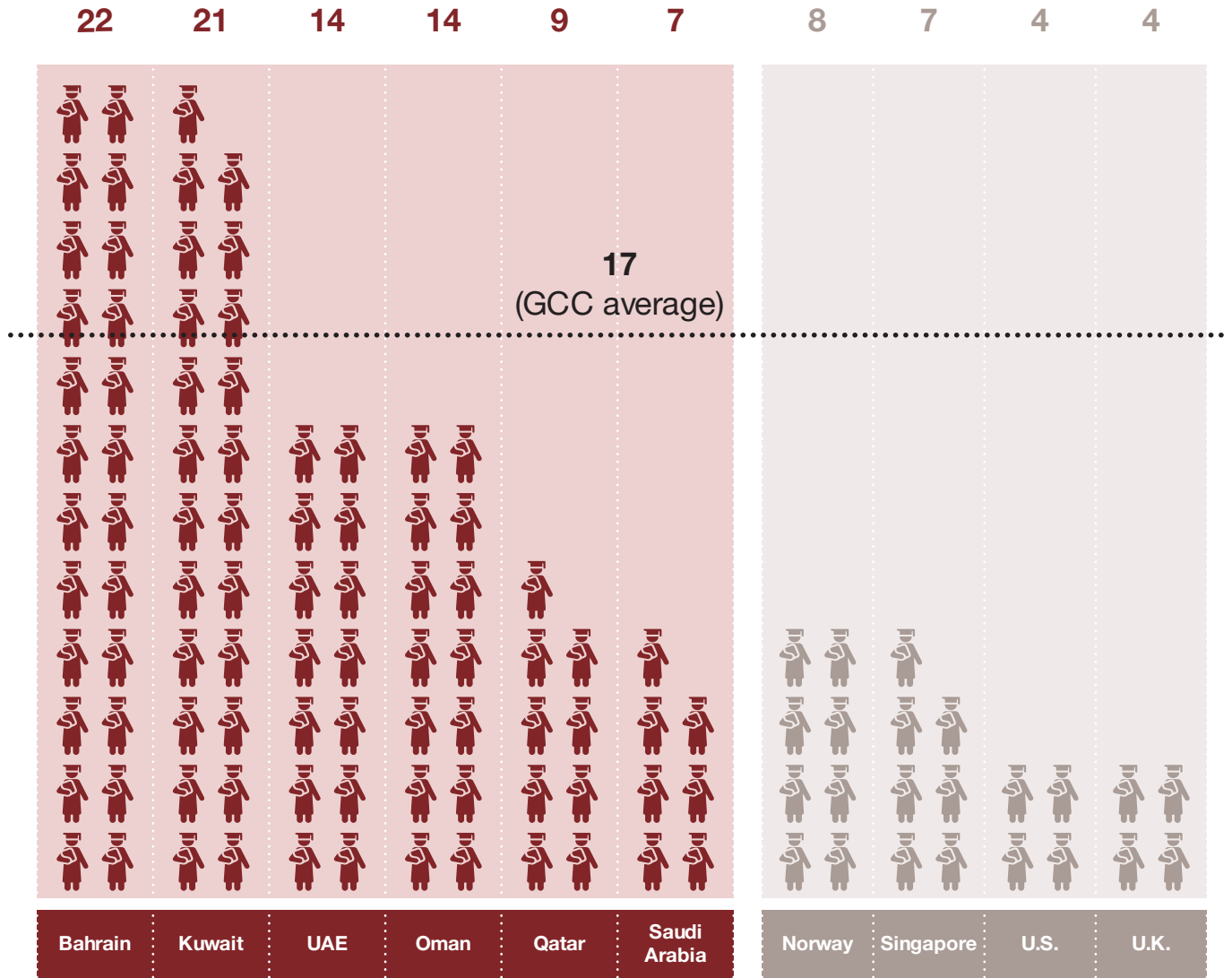
The dearth of Ph.D. programs in the region that meet international standards results in a shortage of postgraduate researchers. The average number of postgraduate researchers among the top five GCC universities is 9.1 percent of the total graduating student population, compared to an average of 43.5 percent in benchmarked countries (Norway, Singapore, the U.K., and the U.S.).⁷

Additional challenges such as insufficient funding, the lack of research infrastructure, and lack of administrative support also constrain research activity in GCC universities. Several respondents mentioned the lengthy application and approval process required to be able to attend conferences or organize research-related field trips. This absorbs valuable time that they could instead devote to research.

Exhibit 3

GCC universities have a high students-to-faculty ratio

Average number of students for one teacher in the top five universities (2016)¹



¹ Data available for only two universities in Bahrain, three in Kuwait, one in Qatar, four in Norway, and three in Singapore.

Source: QS University Rankings; UNESCO Science Report: Towards 2030; Strategy& analysis

2. Scarce partnerships with international researchers and the private sector

Partnerships between local and international academic bodies and private-sector companies can play a key role in developing innovation. Traditionally, GCC researchers have limited collaboration with international peers, do not participate as needed in their governments' public policy agendas, and have few opportunities to cooperate with the private sector on R&D.

Lack of collaboration with international researchers. The Ideation Center conducted an econometric analysis to determine the correlation between a higher research productivity and variants such as professors' collaboration with international or local researchers, the ranking of the university from which they graduated, and the country in which they earned their degree. The analysis showed that collaborating with international researchers had the highest statistical relationship with research productivity. Including professors with a degree from high-ranking universities as authors also improves research productivity. However, according to the Ideation Center survey, only 38.1 percent of GCC professors said they collaborated with researchers from OECD countries, whereas 71.4 percent collaborated with their local peers.

Limited interaction between academia and industry. In most developed countries, university research supports industrial innovation by producing monetizable deliverables (such as patented discoveries). That does not occur in the GCC. The region also has an insufficient number of internal researchers working in R&D within companies. For instance, per thousand population, Oman and Qatar have average ratios of 20.2 and 28.0 researchers, respectively, in business enterprises, compared to EU and OECD averages of 41.9 and 47.5, respectively. In the U.S. the average is 68.7.⁸

3. Limited contribution to the public-sector agenda

Academia has a key role to play in supporting the government in policy formulation and helping it to address societal challenges. However, such collaboration is limited in the region. This challenge is not unique to the GCC. A study by the Institute for Government in the U.K. provides empirical evidence that government departments in the U.K. do not effectively use academic evidence in policymaking. The study argues for increased collaboration between the public sector and researchers, arguing that "Academics offer deep knowledge, expertise and research

that can help to inform, design, improve, test and scrutinize government policy. Policy is poorer for overlooking academic contributions.”⁹

One successful model of collaboration is the Policy Research Group (PRG) of Cambridge University. The PRG works, for example, with the Economic and Social Research Council to provide insights for reshaping existing policies.¹⁰ In the U.S., the Ash Center for Democratic Governance and Innovation at Harvard’s Kennedy School seeks to better inform public policy.

4. Insufficient IP regulations

The region’s current IP regulatory framework does not sufficiently support the commercialization of knowledge through patents and spin-offs, effectively inhibiting an incentive for research and collaboration. The GCC Patent Office, which is region-wide in its remit, was established in 1998. However, it is not globally recognized, because the GCC as an entity is not a member of the Patent Cooperation Treaty (PCT), although all GCC member states are now members of the PCT.¹¹ Similarly, the GCC as an entity is not a party to the Paris Convention for the Protection of Industrial Property. There are few experts and judges specialized in IP laws and regulations in the GCC.

Companies and individuals are also insufficiently aware of existing IP regulations. Patent registration takes 42 to 48 months in the GCC, compared to 18 to 24 months in the U.S., and 18 months in the EU.

Additionally, more than two-thirds of all applications ever processed by the GCC Patent Office have been rejected or lapsed as of August 2018.¹² By comparison, 60 percent and 50 percent of all applications ever submitted to the European Patent Office and the United States Patent and Trademark Office, respectively, had been granted patents by the end of 2016.¹³

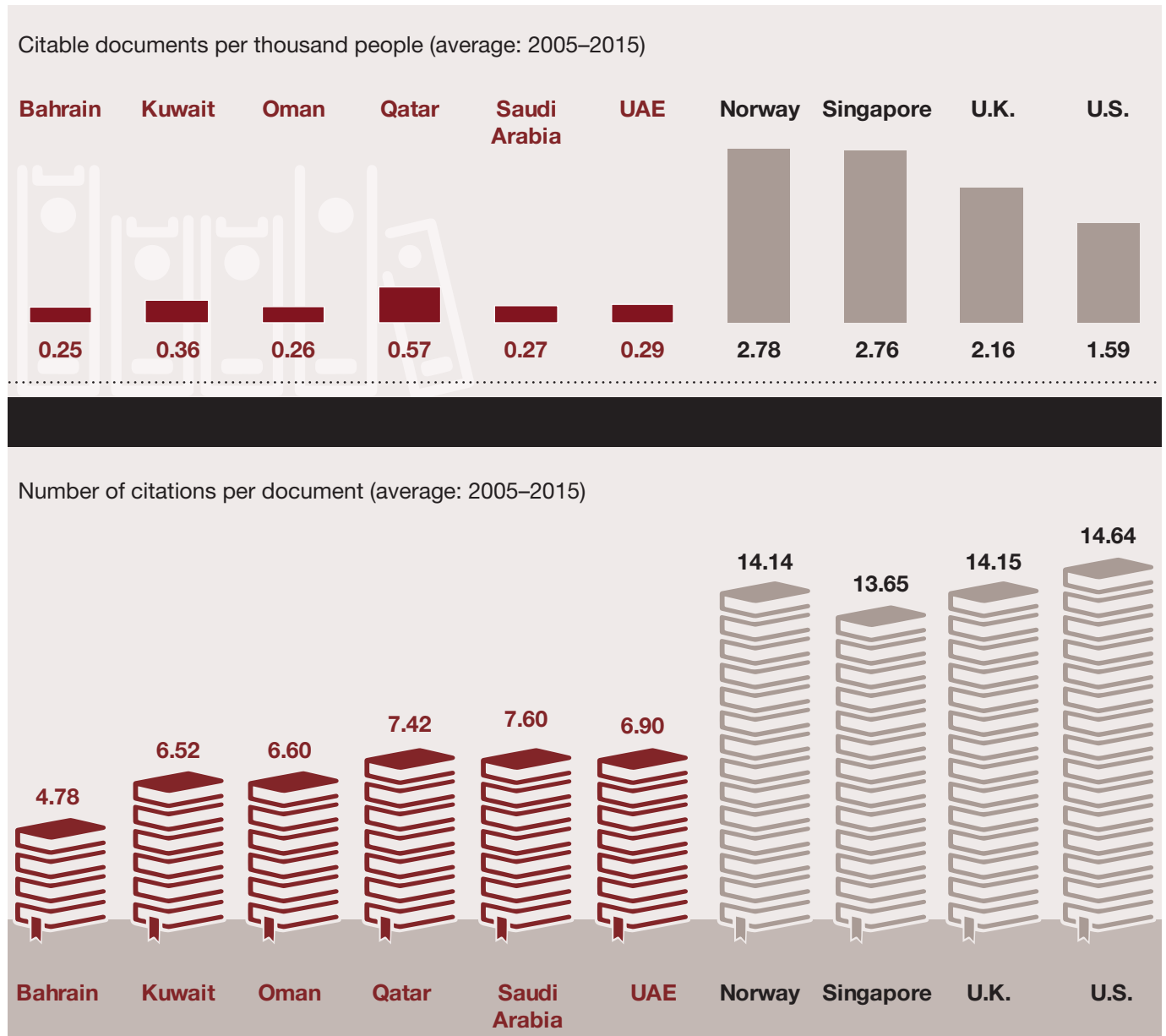
The impact on research output

GCC universities' structural limitations and insufficient collaboration with local and external partners affect the quantity and quality of research. Between one-third to one-half of surveyed professors had not published a paper in a top-100 journal over the past five years.¹⁴

The region has low research productivity, measured in terms of number of articles published by GCC researchers and their citation impact (how often each article was cited in other publications). Between 2005 and 2015, the average number of citable documents per thousand people was 0.27 in Saudi Arabia and 0.29 in the UAE. Qatar ranked highest with 0.57 documents per thousand people. By comparison, this number averaged 2.76 in Singapore and 2.16 in the United Kingdom. The number of citations per document in GCC countries was also lower than in benchmarks, averaging 7.60 in Saudi Arabia and 6.90 in the UAE, compared to 13.65 in Singapore and 14.15 in the U.K. (*see Exhibit 4*).

Exhibit 4

The quantity and quality of research in the GCC is low



Source: Scimago Journal & Country Rank; Strategy& analysis

Encouraging innovation through private-sector collaboration and entrepreneurship enablement in Saudi Arabia

King Abdullah University of Science and Technology (KAUST), founded in 2009, has spearheaded a new model for research and innovation. It is one of the fastest-growing research institutes anywhere and ranks near the top in the GCC in terms of citations per faculty.¹⁵

KAUST offers advanced R&D infrastructure, including 11 state-of-the-art research centers focusing on goal-oriented research, and nine core laboratories providing technologically advanced facilities. One of its labs is home to Shaheen, one of the most powerful supercomputers in the world. It funds research through equity investments in startups, from seed (less than US\$200,000) to early-stage (up to \$2 million). KAUST also provides competitive research grants, and financial support for conferences and workshops.

The university strengthens the academia–industry link through a membership-based industry collaboration program that harnesses innovative thinking, professional knowledge-building, and access to conferences and workshops. These promote awareness of industry to university R&D collaborations and opportunities, as well as industry to industry, and industry to government. Some of the many prominent partners of KAUST include: the Saudi Arabian General Investment Authority, the King Abdullah Petroleum Studies and Research Center, Saudi Technology Development and Investment Company (TAQNIA), and Saudi Aramco, along with international companies such as IBM, Schlumberger, Siemens, and Total.

In 2016, five KAUST-based startups made it on the Forbes Middle East list of 20 most promising Saudi startups.¹⁶

GCC governments need to build a comprehensive research ecosystem

GCC governments can do more in terms of increasing R&D by encouraging the output and quality of academic and corporate research. This can enable innovation and the development of new products and solutions, and enhance workforce skills. These advances in turn contribute to adaptability and increased productivity.

To maximize the impact of R&D spending, GCC countries should foster an enabling research ecosystem that will allow them to become more effective producers of innovation and address socioeconomic challenges specific to their countries. For example, this can lead to GCC-originated approaches to reduce fossil fuel dependence, combat water stress, and manage healthcare problems.

To build this ecosystem, GCC governments need to focus their efforts on five initiatives: putting research at the center of the GCC public-sector agenda, nurturing and empowering local researchers, introducing a performance-based funding model, promoting the university–industry link with commercialization enablers, and establishing an effective IP legal framework.

1. Putting research at the center of the GCC public-sector agenda

GCC countries need a clear governance model for their research ecosystem that will place research at the center of the public-sector agenda. This will help to formalize coordination between their research bodies and government institutions, which is critical as the public sector continues to play a dominant role in GCC economies.

As part of this, GCC governments should include clear goals for research initiatives in their national development and public policy visions. Only in this way can GCC governments ensure the desired effect and impact of R&D across all sectors. Governments should also design the right governance framework to channel research efforts and monitor them effectively. In Germany, for example, the Ministry of Education leads the German scientific research framework. The ministry coordinates and governs the implementation of research priorities. It formulates the research priorities in line with the country's economic priorities. In Germany, this includes five focus areas: communication and mobility, environment and energy, future and society, health and security, and interdisciplinary technologies. Research performance is monitored closely and shared with the public. The German government publishes several annual reports providing an overview of the state of research activities.¹⁷

In addition, GCC governments should leverage the evidence-based information and in-depth analyses of academia to tackle complex societal and economic challenges. They should do so by increasing and formalizing coordination with academia. The Institute for Government in the U.K. recommends that governments establish clear responsibility within departments for how officials engage with academics and for the quality of the evidence and expertise used in policymaking. Such roles are led by “chief scientific advisers,” which 15 British government departments now have.

2. Nurturing and empowering local researchers

GCC universities should create an environment of research collaboration and individual excellence to empower local researchers. With the support of their governments, they should launch initiatives such as introducing sabbaticals for professors to focus completely on research, funding professors' participation in conferences, or establishing faculty exchange programs. Given sufficient funding, administrative support, and time, GCC professors will be in a position to improve their research productivity and reduce universities' reliance on importing knowledge or contracting researchers from outside the region.

In 1999, the South Korean Ministry of Education and Human Resource Development launched the “Brain Korea 21” (BK21) program with \$1.4 billion in funding for local graduate students, postdoctoral researchers, and contract-based research professors at top universities. The first phase of the program ran from 1999 to 2001 and raised the average number of papers per participating professor from 2.74 to 3.72 in the fields of science and engineering, and from 1.1 to 2.3 in the humanities and social sciences. The second phase of BK21 ran from 2006 to 2012 and allocated \$2.1 billion to focus more on university specialization at the level of specific departments to cultivate excellence and develop the link with industry.¹⁸

3. Introducing a performance-based funding model

To improve the quality of university-led research, GCC governments need to rationalize and standardize the allocation of funding based on performance. Traditional performance-based funding relies on one of two models: bibliometric assessment or peer-review assessment.

The bibliometric assessment model — which countries such as Belgium, Sweden, and Norway have adopted — provides funds based on research productivity, using the h-index.¹⁹ In this model, data is analyzed to determine the popularity and impact of specific articles, authors, and publications. Some pragmatic considerations include understanding the age of material used in a discipline, and the extent to which recent publications supersede older ones. However, there are some limitations to this approach because data is often incomplete or biased, as it is largely collected by hand.

The peer-review assessment model, used in Italy and the U.K., involves a review of research outputs by experts based on set criteria and standards of quality. Funding for research is allocated selectively based on the quality and impact. In the U.K.’s Research Excellence Framework (REF), panels comprising senior academics, international members, and research users assess three distinct elements: the quality of published research outputs (originality, significance, rigor); their impact on the economy, society, and/or culture; and the significance and sustainability of the research environment behind these outputs. The REF sets

benchmarking and reputational criteria within higher education, provides accountability for public investments in research, and produces evidence showing the benefits of such investments, thereby informing the selective allocation of funding for research.

4. Promoting the university–industry link with commercialization enablers

GCC governments must encourage more collaboration between universities and the private sector. Such mobility is critical for the transfer of knowledge in formal and informal ways. Formal relationships include collaborative agreements, R&D contracting, policies, IP management, and spin-off activities. Informal contacts can mean exploiting research results published by universities in public journals, or hiring research students. However, these channels are not sufficiently developed in the GCC.²⁰

One example, from Chile, involved the government launching the Science for the Knowledge Economy (SKE) program in 2003, which aimed to enhance the link between universities and companies. Previous initiatives to promote R&D were limited to public-sector research grants, and the outputs were insufficiently relevant to private-sector business needs. The SKE program covered a wider range of policy instruments. It provided scholarships for students to conduct their research within private companies. Between 2002 and 2004, the number of science and technology researchers employed by the private sector increased from 14 percent to 50 percent. The program also allocated funding for research on a competitive basis and supported patenting and commercialization activity by establishing internal connections. By 2007 when the program ended, Chilean firms' probability of patent activity and introducing new products had increased by 37 percent and 29 percent, respectively.²¹

In particular, it is critical for universities to reform the reward systems for researchers by rewarding them in their careers for collaborating with businesses and governments. The partnership between the King Fahd University of Petroleum and Minerals (KFUPM) in Saudi Arabia and Saudi Aramco provides one example of an attempt at closer collaboration with the private sector. In 2015, KFUPM and Saudi Aramco established the School of Petroleum Engineering and Geosciences that brings faculty, students, and oil and gas experts closer together to design effective business and technical solutions for the industry.

5. Establishing an effective IP legal framework

GCC governments need to upgrade their IP laws and build an effective supporting judicial system to implement them and streamline related procedures.

GCC countries currently have a unified patent law and are in the process of developing a regional trademark law. Stronger IP laws would help decrease the possibility of patent infringement and validity issues. It is important to ensure that these laws include a detailed view on penalties in the event of the unauthorized use of IP.

GCC governments must establish dedicated IP courts to handle any IP-related issues. They must ensure they have local lawyers and judges who specialize in IP law and have a detailed understanding of all of its aspects. They then need to streamline formal patent application, registration, and protection procedures. Finally, governments need to raise awareness about these laws and procedures and make the information easily available to the public.

Patent litigation within the common law legal system of England and Wales²² provides a good example to follow. The government established the Patents Court and the Patents County Court, which have exclusive jurisdiction to hear patent and registered design infringement proceedings. They include a number of full-time assigned judges who have a technical background in IP related issues.

Once the key enablers are in place and a trend can be observed on the quality of output, GCC countries will need to build centers of excellence and critical mass in the higher-performing sectors of the research system and provide frameworks for experimentation and scaling up of solutions. A regional initiative for research and innovation excellence such as the European Research Framework would also boost the output and impact of research across the region.

How the EU encourages regional collaboration in research

The EU seeks to foster collaboration to improve the impact of research through Horizon 2020, a major research and innovation program that will invest up to \$94 billion between 2014 and 2020. Among the program’s objectives are addressing social challenges and strengthening the EU’s global position in research, innovation, and technology.

The program’s investment in research prioritizes three areas: excellent science, industrial leadership, and societal challenge. Through knowledge transfer, policy learning, and partnerships with EU states, the program is trying to create an EU-wide market for knowledge research and innovation, similar to the European Single Market.

Conclusion

A strong local research environment will be instrumental in promoting innovation across GCC countries and helping them achieve economic growth. Governments should launch structural initiatives to shore up this ecosystem starting within academia and, more important, acquire a better understanding of the ways in which academia can contribute to societal and economic improvement. However, the real impact will be generated by enterprising and fruitful collaboration between universities and corporations.

Endnotes

¹ The GCC consists of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

² For example, The Kingdom of Saudi Arabia's Budget Statement for Fiscal Year 2018 by the Ministry of Finance (<https://www.mof.gov.sa/en/budget/Documents/171228%20%20budget%20Statement%20eng%20Single.pdf>).

³ R&D expenditures are expressed as a percent of GDP and include both capital and current expenditures in the four main sectors: business enterprise, government, higher education, and private nonprofit. R&D covers basic research, applied research, and experimental development.

⁴ "IMF DataMapper: Balance of Payments Statistics," International Monetary Fund, 2016 (<http://www.imf.org/external/datamapper/datasets/BOP>).

⁵ Erdal Gumus and Ferdi Celikay, "R&D Expenditure and Economic Growth: New Empirical Evidence," *Margin – The Journal of Applied Economic Research* 9:3 (2015): 205–217 (<http://journals.sagepub.com/doi/abs/10.1177/0973801015579753?journalCode=mar>); John Wu, "Fueling Innovation: The Role of R&D in Economic Growth," *Innovationfiles*, Dec. 7, 2015 (<https://www.innovationfiles.org/fueling-innovation-the-role-of-rd-in-economic-growth/>); Svetlana Sokolov-Mladenovic, Slobodan Cvetanovic, and Igor Mladenovic, "R&D expenditure and economic growth: EU28 evidence for the period 2002–2012," *Economic Research-Ekonomska Istraživanja*, 29:1 (2016): 1005–1020, DOI: 10.1080/1331677X.2016.1211948 (<http://dx.doi.org/10.1080/1331677X.2016.1211948>).

⁶ Universities include: American University in Dubai, American University of Kuwait, American University of Sharjah, GUST, Hamad Bin Khalifa, KFUPM, King Abdulaziz University, Kuwait University, Qatar University, Sultan Qaboos University, United Arab Emirates University, University of Bahrain, University of Nizwa, and University of Sharjah.

⁷ "QS World University Rankings," QS Top Universities (<https://www.topuniversities.com/university-rankings/world-university-rankings/2018>); "UNESCO Science Report: Towards 2030," UNESCO, 2015 (<http://unesdoc.unesco.org/images/0023/002354/235407e.pdf>).

⁸ "2016 Global Innovation Index: Winning with Innovation," Cornell University, INSEAD, and WIPO, 2016 (<https://www.globalinnovationindex.org/userfiles/file/reportpdf/gii-full-report-2016-v1.pdf>).

⁹ Tom Sasse and Catherine Haddon, "How government can work with academia," Institute for Government, June 2018 (https://www.instituteforgovernment.org.uk/sites/default/files/publications/IfG_government_academia_June_2018_vb.pdf#page=5).

¹⁰ Policy Research Group projects (<https://www.psychol.cam.ac.uk/pol-res-group/projects>).

¹¹ "Kuwait: Final GCC Country with PCT Membership," *SABA Intellectual Property*, June 20, 2016 (<http://www.epo.org/searching-for-patents/helpful-resources/asian/gcc.html#faq-937>).

¹² Statistics, GCC Patent Office (http://www.gccpo.org/AboutusEn/All_Application_Records.aspx).

¹³ "IP5 Statistics Report - 2016 Edition," five IP offices (IP5), Nov. 2017 (<https://www.fiveipoffices.org/statistics/statisticsreports/2016edition/IP5SR2016full.pdf>).

¹⁴ In the engineering, humanities and social sciences, and life sciences fields.

¹⁵ Based on QS World University Rankings.

¹⁶ KAUST, "Labelled 'Promising Saudi Startups' by Forbes Middle East," December 20, 2016 (<https://innovation.kaust.edu.sa/labelled-promising-saudi-startups-by-forbes-middle-east/>).

¹⁷ Research in Germany (<https://www.research-in-germany.org/>).

¹⁸ "Brain Korea 21 Phase II: A New Evaluation Model," Rand Education, 2008 (<https://www.rand.org/pubs/monographs/MG711.readonline.html>).

¹⁹ Measure of the productivity and citation impact of the publications of a researcher.

²⁰ Reinhilde Veugelers, "The contribution of academic research to innovation and growth," *WWWforEurope*, Working Paper no 71, Dec. 2014 (http://www.foreurope.eu/fileadmin/documents/pdf/Workingpapers/WWWforEurope_WPS_no071_MS65.pdf).

²¹ José Guimón, "Science for the Knowledge Economy Project in Chile," Innovation Policy Platform, OECD and World Bank, 2013 (https://www.researchgate.net/publication/278962100_Science_for_the_Knowledge_Economy_Project_in_Chile_Innovation_Policy_Platform_OECD_and_World_Bank).

²² There is no single legal system for the four countries of the U.K. (England, Wales, Scotland, and Northern Ireland), although England and Wales share a body of common law. Christian Helmers and Luke McDonagh, "Patent Litigation in the UK," LSE Legal Studies Working Paper No. 12/2012, Sep. 23, 2012 (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2154939).

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