

Promoting a
New Economy
for the **Middle East
and North Africa**

Editors:
Rabah Arezki
Ferid Belhaj
Parmesh Shah



WORLD BANK GROUP

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FOREWORD

This is a critical time for the economies of the Middle East and North Africa. Over the next 30 years, roughly 133 million seniors in the region are projected to leave the job market. But more than twice as many young people—nearly 300 million—will enter it. As a result, countries in the region will have to create nearly 165 million jobs just to keep pace. That’s on top of the jobs needed to absorb the 15 million people in the labor force who are currently unemployed.

What is equally critical is this is not just a problem for the future. The region needs to create 10 million jobs in the next two years; 700,000 of them in Algeria alone. It will become increasingly important—now and in the foreseeable future—to find new drivers of economic growth.

The good news is that in the Middle East and North Africa, one of those potential drivers, the digital economy, is in its infancy. Young people across the region have smart phones and access to the internet. But the bad news is that relatively few of them are using those tools to become digital entrepreneurs.

There are success stories to be sure. One is Careem, the ride-sharing company that operates in more than 90 cities across 13 countries, and was purchased by the U.S. ride-sharing giant Uber. Another is Souq, the e-commerce platform that Amazon bought for more than \$500 million. These achievements demonstrate the enormous potential for digital commerce in the region. But they are few—too few in a region where 66 percent of the population is younger than 35.

To explore how to harness the potential demonstrated by Careem and Souq, the World Bank Group convened a conference in Algiers in March 2018, which focused on how youth, technology, and finance can create a new economic opportunities in Arab countries. Creating the new economy will be difficult. It can be too hard to get financing, hire a workforce with the right skills, or deal with the nepotism and waste that are still too common in many places.

The World Bank Group is working with governments across the region to put in place the right policies to support digital entrepreneurs and prepare students with the technical skills they will need. We are working with platforms such as UpWork, Udemy, and SoukTel, not only to help train young people in digital skills, but to connect them with jobs and deliver digital solutions to businesses.

This volume is based on the proceedings of the conference in Algiers that took place on March 26 and 27, 2018—organized by the World Bank Group, in partnership with the Government of Algeria and the Arab Monetary Fund. This collection of essays, authored by business executives, policymakers, and scholars, examines issues related to start-ups and unicorns, as well as the role of digital infrastructure, regulation, finance, and education in the new economy. I hope they will

inform, inspire, and stimulate discussion on ways to drive the digital economy, and ensure that countries in the Middle East and North Africa leverage their most fundamental asset—their youth—and reach their highest aspirations.

Jim Yong Kim
Former President
World Bank Group

INTRODUCTION

Countries in the Middle East and North Africa (MENA) possess all the ingredients they need to leapfrog into the digital future. They have large, well-educated youth populations that have already adopted new digital and mobile technologies on a wide scale. They have a highly educated female population. That combination has immense potential to drive future growth and job creation. The question is whether the region can adapt to a new economic reality.

Public spending, the region's historical engine of development, has reached its limit. Because the public sector can no longer absorb the swelling ranks of university graduates, the MENA region has one of the world's highest rates of youth unemployment. For a variety of reasons, many of them cultural, highly educated women stay home. The female labor participation rate is among the lowest in the world.

The digital economy holds the promise of a new way forward, but it is still in its infancy, and young people face obstacles in putting technology to productive use. Although the internet and hand-held devices are ubiquitous throughout the region, they are currently used for accessing social media, rather than for launching new enterprises.

But there are green shoots emerging. For example, the ride-hailing app Careem has grown from a start-up to a billion-dollar company, creating thousands of jobs in 80 cities in the MENA region and in Pakistan and Turkey. And new digital platforms are already connecting job seekers and employers, providing vocational training, and hosting start-up incubators. The challenge now is to create the conditions for these green shoots to grow and multiply.

The first, essential step is for MENA countries to become "learning societies," a phrase coined by the Nobel laureate economist Joseph E. Stiglitz to describe countries in which shared knowledge leads to increased innovation. This, in turn, fosters development; and in the case of MENA, it could lead to the creation of a vibrant digital service economy.

To get there, education systems must change. For the region's young people, the curriculum is more often a source of frustration than advancement. The concept of a "skills premium"—the difference in wages between skilled and unskilled workers—dictates that higher educational attainment should lead to higher compensation and more secure employment. Yet in the MENA region, the opposite has happened: university graduates are far more likely to be unemployed than are workers with only a basic education.

Two factors work against the region's young people. First, schools are still geared toward channeling graduates into large public sectors, which means they place less emphasis on fields such as mathematics and science. Second, bloated public sectors are crowding out the private sector, which would otherwise be a larger provider of high-skill, high-wage jobs.

Because the future economy will need technologically capable workers, curricula should be reoriented toward STEM (science, technology, engineering, and mathematics) subjects and away from the social studies that were long prized by public-sector employers.

Moreover, education systems should focus on encouraging greater openness to innovation and risk-taking—a significant departure from the attitudes reproduced under a system of public sector patronage. Specifically, moving toward an innovative “learning society” will require students to hone their critical-thinking and managerial skills within collaborative work arrangements.

In addition to skills, the digital economy will also need technical infrastructure. Connectivity is a prerequisite for the delivery of new mobile and digital services in e-commerce, vocational training, health care, and finance, all of which could substantially increase overall welfare. Countries in the region thus need to focus on expanding broadband Internet access. Education and Internet infrastructure geared toward productive use would provide the foundation of a new economy.

The region can also use digital technology to improve its agricultural output.

Ensuring sustained growth in the region will require improving its financial systems as well. A digital economy depends on payment systems that are not just easy to use and widely available, but also trustworthy. Developing effective peer-to-peer payments, such as Kenya’s M-PESA system—that require no financial intermediary like a bank—will be crucial for ensuring that digital platforms for ride sharing, on-demand tasks, and other services can thrive.

Outside of the Gulf Cooperation Council countries, which have relatively advanced payment systems, the quality of financial services in the MENA region currently lags most of the rest of the world. Without improvements to the financial system, and to the banking sector in particular, the potential of the region’s vast human capital will remain unrealized.

Lastly, governments will need to develop an approach to regulation that encourages, rather than stifles, innovation. To be sure, ensuring confidence, especially in financial systems, is essential; but regulation must be balanced with policies to boost competition, so that startups can easily enter the market and test new ideas. There needs to be more space for more companies like Careem to emerge. Policymakers should look to Kenya’s model of light but effective regulation, which has fostered the rapid growth of M-PESA.

Seizing the opportunities that the digital economy offers the MENA region will require a big push. Policymakers will need to work on multiple fronts, while making the best use of all available tools. The sooner they start, the greater the chance that today’s young people can overcome economic exclusion and gain more opportunities to realize their—and their region’s—full potential.

In March 2018, the World Bank convened a conference in Algiers, Algeria to explore the needs and potential of the “new” economy in the MENA region. This compendium includes articles by many of the conference participants.

In **Section One**, authors cover the finance and venture capital realities in a MENA region that desperately needs to cultivate entrepreneurship. Mudassir Sheikha recounts the development of the region’s most successful startup, Careem.

Authors in **Section Two** explore the interplay among finance, regulation, and entrepreneurship and also looks to India and Africa for some guidance as to how devise policies in the MENA region.

Science, education and technology play a crucial role in the regions prospects and contributors to **Section Three** look at such issues as the reforms needed in education, how to harness technology to match young people with jobs and the unhappy state of science in the region and the prospects for improvement,

Finally, in **Section Four** innovators recount how technology can help farmers, especially small landholders, by providing access to mechanization, enabling identification and treatment of plant diseases, optimizing planting, harvesting, and water usage.

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SECTION ONE ■ **THE OVERVIEW**

BUILDING A BIG AND MEANINGFUL INSTITUTION: CAREEM

Mudassir Sheikha

We wanted to create something that was big and meaningful. So, in 2012, when Magnus Olsson and I founded the company, we called it Careem—the Arabic word for generous—and set ourselves a mission statement: Simplify and improve the lives of people and build an awesome institution that inspires.

We started the ride-hailing service in Dubai but have expanded rapidly—to 14 countries in the Middle East and North Africa (MENA), Pakistan, Turkey, and Sudan—and more than 100 cities. We'd like to believe that Careem is having a huge impact on the lives of people across the region.

We have created mobility for 24 million users, and in some places, we have changed lives in ways we hadn't anticipated. In Saudi Arabia, for example, people say there's a pre-Careem Saudi and a post-Careem Saudi. This is especially true when it comes to the lives of local women. Before Careem, they were often dependent on their fathers, brothers, or husbands to get around. Now, if Saudi women need to go somewhere, they just use the Careem app, press a button, and a car arrives swiftly. And following the recent decree that permitted women to drive, we are giving those women jobs as well as mobility. We did not anticipate just how big the shift was going to be, but for many it has been transformative.

Many Modes of Transport

In every country in which we have started operations, Careem has increased mobility for that area via one of the company's modes of transport—automobiles, motorbikes, boats, and tuk tuks (motorized rickshaws). But our biggest impact has been in creating jobs. I place creating jobs even above mobility, because every captain (the name we give our drivers) has a different story.

Our captains tell us that we are helping them to do such things as putting their children through school and university, getting an education they otherwise would not have received, buying a home for their family, or saving enough to help others.

One person went from picking up casual work and sleeping on park benches to a steady job as a captain and, after five years, was able to help two of his younger brothers and contribute financially to their weddings.

Moreover, for captains who find themselves in temporary financial difficulties, we have Careem's Captain Emergency Fund program to which they can apply for low-interest loans. We're

also using low-interest loans to help our captains buy their own automobiles; in Pakistan alone, we have enabled 3,000 captains to become car owners.

To date, we have created 975,000 jobs globally and are creating between 60,000 and 70,000 jobs every month—or more than 2,000 on average every day. Careem is unprecedented as a regional job creator and is now one of the largest employers in Saudi Arabia, Egypt, Jordan, and Pakistan.

Careem also started operations in Palestine, because we saw so much untapped potential where others did not and we believed it was our mission to exist there. Then we launched in Iraq and are now starting up in Sudan. We're building a service that can improve the lives of people wherever we go and give them an income-generating opportunity as well as mobility.

Local Problems, Local Solutions

Because we provide different transport modes, we have also been trying to solve local problems with local solutions. But we are also creating a unifying platform. In the last five or six years we've built a large ride-hailing business, but what we've also built is a large internet business.

Building an internet business in the region is not easy. In many parts of the world, the things needed to build an internet business already exist, so everything does not have to be built from scratch. For example, in the United States nearly everyone has a credit card, so an internet entrepreneur does not have to build a cash collection system. It is much easier to send text messages (SMS) by mobile phone and the maps are very reliable, so a business does not have to build its own map.

In our region, though, the building blocks often did not exist. So we had to find a way to work with the system. We had to create our own location database to make sure our service was reliable. We had to build a payment collection system, so we could work with cash. In other cases, the building blocks were there, but they were fragmented. SMS is one example. In the United States it is possible to integrate with an SMS gateway and send an SMS to everyone in the country. If you're on an SMS gateway in the United Arab Emirates, though, you're most likely not able to send SMS to customers in Morocco, because there are rules about who can send messages where. One must sign with a company in Morocco—then with Lebanon, then Pakistan, and so on to reach all desired countries. All these steps required integration and we had to do much more work than we would have in the United States.

In the United States there is a call masking service called Twilio. A business can essentially plug Twilio into its system and Twilio will forward a call without revealing the source phone number. But this does not exist in the MENA region, so we had to go to telecom operators directly—Zain in Saudi, Vodafone in Egypt, and so on—and say, “Hey guys, this is the Eriksson router that we would love for you to deploy, we'll pay for it, put it in your stack this way and it will enable call masking.” The effort took a year-and-a-half.

Building Infrastructure

In the process of building this large internet business, we have implemented or developed a lot of the underlying infrastructure needed in each of the different countries to run a consumer internet business and harmonized them on a single platform. This is hugely significant because it enables Careem to easily do many more things than just provide mobility. We are one of the few companies that has access to a broad swath of the population through our large tech platform.

This enables us to offer a platform for others to hop on and launch their own business without having to go through all the things that Careem went through—things that could be prohibitive to regional business startups.

Technology requires scale. An organization cannot invest hundreds of millions of dollars to build something if it can only reach, say, 2 million people in Dubai. If one wants to build a large technology platform, then the operations need to be able to reach hundreds of millions of people to whom to market products and services. But our region is so fragmented structurally that it is difficult to set up in a lot of countries simultaneously. Careem is now a platform that can target hundreds of millions of people, so we can launch new services via our app and we want to open this platform to others.

An entrepreneur in Karachi or Gaza or Baghdad—or anywhere, for that matter—who wants to build a regional internet business, can avoid the roadblocks that Careem had to overcome. Careem can let you plug onto our platform and receive those services from us as we enable the ecosystem to build regional internet businesses. Careem has set up a service, but we want to inspire others to come with us.

The mission goes on, simplifying and improving lives, and building something that will outlast us.

(Editor's note: Uber purchased Careem in March 2019. Careem retains its identity).

Mudassir Sheikha is Co-founder and CEO of Careem.

VENTURE CAPITAL FINDS THE MIDDLE EAST AND NORTH AFRICA

Issa Aghabi and *Mohamed Abdel Jelil*

Strong growth expectations, an imperfect but improving regulatory environment, and a population that is more than 40 percent under age 25 have combined to make the Middle East and North Africa (MENA) an increasingly attractive destination for venture capital investment, which specializes in risky, often startup enterprises.

Since 2010, there has been a significant increase in entrepreneurship and funding in the region: the number of investors increased tenfold, while investments tripled. Venture capitalists represent 40 percent of the investor community in the MENA region, with most of their investments in the information technology and consumer goods sectors. The composition of the investor pool has also evolved, as more international investors such as 500Startups, Nokia Growth Partners, NEA, Naspers, Volstok, Lumia, and Rakuten show their confidence in the entrepreneurial prospects for the region.

MENA's startups attracted \$560 million of investment in 260 deals in 2017, a 65 percent increase from 2016. These numbers exclude the region's two biggest startups—ride-sharing Careem and e-commerce platform Souq.com.

Concentrated Investments

Investments are heavily concentrated in the top markets. The United Arab Emirates attracted 70 percent of funds invested in MENA countries in 2017, a 6 percent increase from 2016. Second-place Saudi Arabia accounted for 9 percent of the region's investment. The dominance of the seven-emirate UAE, especially Dubai, reflects the stability and availability of large and quality assets and uncertain market conditions in rest of the region. The UAE accounted for 37 percent of the investment deals in 2017, in addition to garnering 70 percent of the capital invested.

Even though most of the startups are incorporated in the UAE, there is a need for pan-regional strategy to reflect country characteristics. The Gulf Cooperation Council (GCC) countries are characterized by strong purchasing power, with Saudi Arabia representing a large market. Non-GCC countries such as Jordan, Egypt, and Lebanon benefit from a strong base of entrepreneurial talent. The North African Maghreb countries face macroeconomic difficulties, but as in the rest of the region, there has been an acknowledgment of the need to support the local ecosystem. Maroc Digital 2020, announced in June 2016, aims to accelerate Morocco's digital transformation and reinforce

the country's status as a regional digital hub. The initiative includes a \$750 million investment to reduce by half the so-called digital divide between those who have easy access to the internet and those who do not. The initiative incorporates digitization of administrative services, improved internet access, and digital literacy programs. More recently, in Tunisia, the government passed the Startup Act, which aims to promote and encourage startups with a vision of developing Tunisia into a "startup nation" at the crossroads of the Mediterranean, the MENA region, and sub-Saharan Africa.

High Potential in Human Capital

The region's positive investment trends are an indication of the high potential in terms of innovation and human capital. Successful startups include both localized versions of international success stories—Careem is dubbed the region's Uber and Souq is called the region's Amazon, fittingly perhaps, since Uber acquired Careem in March 2019 and Amazon bought Souq in 2017. But the successful startups also include new innovative tech firms in the automotive sectors and companies that address such longstanding problems as cashless payments and service delivery.

The number of new ventures has grown considerably, as early-stage investments were up 75 per cent between 2016 and 2017. These trends also reflect the high rates of technology adoption. The MENA region has high mobile phone penetration—in some markets more than 50 percent use smartphones and 93 percent of young people have mobile devices. Some MENA countries also show high potential in terms of innovation. Tunisia was ranked the most innovative country in Africa and the Arab world, ranking 43rd globally in the *2018 Bloomberg Innovation Index*. According to the Bloomberg Index, the country is No. 1 globally in the number of science and engineering graduates per thousand people in the labor force.

The establishment of a proper entrepreneurial ecosystem is critical to the success and growth of any economy. This is all the more important in the MENA region, which faces the existential challenges of creating enough quality jobs for a burgeoning youth population and establishing an inclusive growth model. As outlined, capital investment has been following a positive trend. But that is in spite of important structural barriers. Governments are recognizing that entrepreneurship—which leads to the creation of small- to medium-sized enterprises, (SMEs)—is vital to addressing the increasing challenges of job creation. A more innovative and competition-friendly economy would lead to overall stability and economic growth, ultimately bridging the imbalances that have emerged within countries. The countries of the region will have to tackle some substantial obstacles—including inadequate finance and, despite improvement, restrictive regulation—to scale the success stories of the region and sustain a new entrepreneurial culture.

Access to finance is critical to any new company's efforts to set up, maintain, and grow its business—and is essential to a healthy entrepreneurship ecosystem. The MENA region's financial ecosystem is underdeveloped. The network of equity investors is growing fast, but financing is still nascent across the value chain—from seed to growth capital. Furthermore, regional banks rarely have a dedicated program focusing on startups and entrepreneurial business. In fact, only 20 per cent of banks have extended credit to SMEs, the lowest percentage globally. In terms of their investment exposure, only 10 per cent of SMEs have been financed via bank facilities, also among the lowest percentage globally. This low level of lending is not wholly unjustified, because most SMEs in the MENA region lack the financial transparency banks require to extend any sort of credit. In addition, the weak MENA financial infrastructure further hinders banks' ability to extend credit. Credit information is poor and the rights of creditors are weak.

Governments are awakening to the need for funding and are placing it at the top of their agenda. For example, governments are now providing liquidity to funds that know what they are doing—such as the ISSF Jordan, BDB Bahrain, and PIF KSA, among others.

Regulation Issues

Another important, yet addressable, hurdle is regulation. Although conditions have been steadily improving, foreign ownership constraints remain among the biggest legal barriers for tech entrepreneurs in the MENA region—affecting not only the flow of capital and foreign direct investment, but also the movement of companies and the ability to launch a business into different markets in the region. These restrictions stifle economic growth and limit entrepreneurs' access to foreign capital.

Labor regulations are also considered a significant drag on entrepreneurship. They create bottlenecks and other inefficiencies. While fast-growing tech-enabled industries must be responsive to changing market demands, existing labor laws—including convoluted visa procedures and national quotas that complicate the hiring of essential foreign talent—make the rapid scaling of operations and the swift movement of labor across markets nearly impossible. Meanwhile, although tech companies in most parts of the world often give equity options to their senior employees as part of a salary package to help retain key staff members, in countries like Jordan and Egypt corporate laws prohibit publicly listed companies from offering share options to employees. This hurts loyalty, productivity, and long-term commitment.

One other key element of the entrepreneurship life cycle is failure. Most business startups fail within in the first few years. This is natural and should not be inhibited. Failure is considered part of an educational process that leads entrepreneurs to re-enter the ecosystem and build on the lessons they've learned. The MENA region as a whole suffers from stringent and ineffective bankruptcy laws. The process is quite lengthy, unclear, costly, and places a large financial burden on the entrepreneurs—which, of course, makes being an entrepreneur even riskier because of the heavy toll they face from a failure.

Education and Research

Education and research are crucial pillars for the establishment of an entrepreneurial ecosystem. University programs that offer entrepreneurship programs and courses to develop an entrepreneurial spirit and provide students with the right tools to launch and run a successful venture are the primary type of formal education. Additionally, specific training can be included as part of formal education, including targeted training courses to help entrepreneurs who have started a business and are looking to polish or grow certain skills—which they can then use to start a new business or to fill gaps in their knowledge base if they are already running a business. The key here is to empower individuals with the tools required to tackle current and future obstacles through proven and successful methods. The types of topics covered usually include business plan development, marketing strategies, general management skills, financial skills, new product development, technology, human capital skills, and various business problems, among other things.

The main obstacles the MENA region faces in terms of educational resources are underdeveloped research and development and inadequate education offerings. Only 37 regional universities—fewer than 10 per cent of those in the MENA region—offer entrepreneurial courses. Just 17 universities in the region have centers for entrepreneurship and only five actually offer a major in entrepreneurship. Entrepreneurship is also neglected in secondary education. Formal education is a critical part of the entrepreneurship ecosystem and the MENA region is failing at fostering and educating its youth at such an early stage.

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FINANCING THE NEW ECONOMY IN THE MIDDLE EAST AND NORTH AFRICA

Xavier Reille and *François de Soyres*

The countries in the Middle East and North Africa (MENA) possess several factors that foster digital innovation and entrepreneurship. The region contains 400 million people who share a common language and similar cultures—a receptive environment for launching a business and developing firms at a larger scale. Moreover, with more than 40 per cent of the population under age 25 and 93 percent of them equipped with a mobile phone, the demand for digital products and innovative ways of conducting business is growing fast.

Many highly educated and dynamic people are turning toward entrepreneurship, hoping to capitalize on the region's growing internet and smartphone adoption. As a result, the e-commerce market has been growing rapidly in the past few years. Online spending grew from \$9 billion in 2012 to \$15 billion by 2015 and is expected to grow by a factor of 3.5 by 2020.

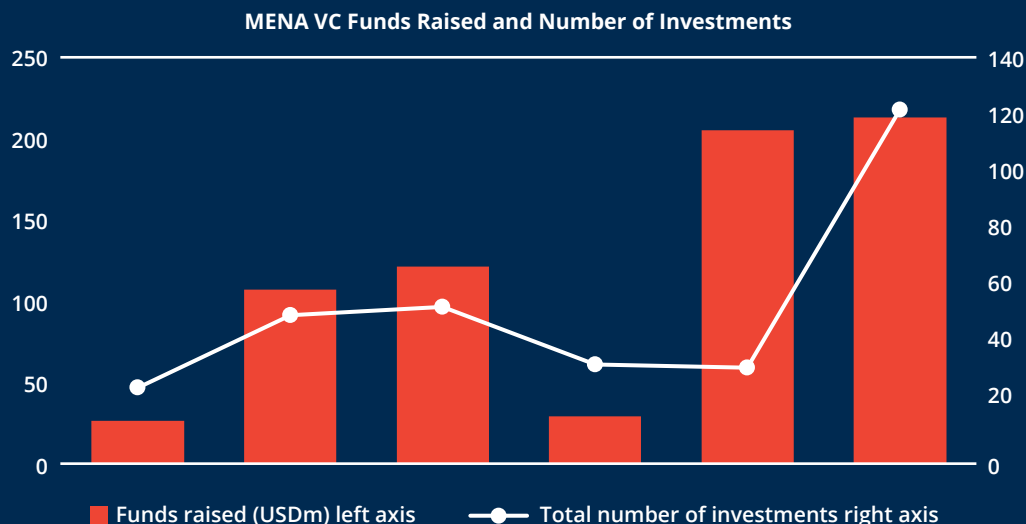
These recent developments result from the development of capital markets and access to early-stage financing options. Many MENA economies have an active ecosystem of such options—often driven by local development programs and partnerships with corporates. It includes friends and family, angel investors, and places that foster startups such as accelerators and incubators—which typically write checks in the \$20,000 to 50,000 range to startups. In 2016 alone, 15 new accelerators, where startups can work together, were launched—nearly twice as many as in 2015. However, the region still suffers from a financing gap for more mature businesses.

Significant Development

In MENA countries there has been a significant development of entrepreneurship and funding activity, both out of opportunity and necessity. Since 2010, the number of investors has increased tenfold while the number of investments has tripled (see Figure 1). Along the same lines, MENA has also experienced a surge in industry-specific accelerators. Those are encouraging signs, but there is still room for a significant growth, especially when compared to other countries.

About 40 percent of the investors in the MENA region provide venture capital, with the majority of investments in information technology (IT) and consumer goods. Although international investors (such as 500Startups, Hatcher, Nokia Growth Partners, NEA, Naspers, Volstok, Lumia, and Rakuten) have played a role, this new dynamism is anchored locally. Additionally, according to

Figure 1:
Evolution
of Venture
Capitalist
activity in the
MENA region



Source: MENAPEA.

research by Wamda, the Beirut-based investment company, more than 80 per cent of the institutions that have been established since 2010 were created by local MENA stakeholders.

Over the past couple of years, the International Finance Corp. (IFC), has reviewed several investment opportunities in the MENA region. At the early and concept stages, IFC invested in the Ibtikar Fund, a leading Palestinian venture capital fund that focuses on accelerator-based investments in Palestinian technology startups, and Flat6Labs Cairo, a regional accelerator that aims to invest in about 100 Egyptian tech startups and support more than 300 entrepreneurs over the next five years.

IFC has also invested in three venture capital funds focused on seed and later-stage investments: Wamda Capital, BECO Capital, and Algebra Ventures. The IFC made a direct investment in Souq, the largest e-commerce company in the MENA region, which was acquired by Amazon in July 2017. IFC has also invested in two financial technology (FinTech) companies: Fawry, the first and largest electronic bill payment platform in Egypt, and Network International, a leading provider of payment solutions across the Middle East and Africa.

Five Markets

Venture capital investments have been heavily concentrated in five MENA markets: the United Arab Emirates, the Kingdom of Saudi Arabia, Lebanon, Egypt, and Jordan. There is a pressing need for a pan-regional strategy that would take into account country-specific dynamics. For example, while Saudi Arabia has a large market and strong purchasing power, other Gulf Cooperation Council (GCC) countries have smaller markets. In Egypt and Pakistan, the large populations could be a powerful driver of entrepreneurial activity, but businesses sometimes find it difficult to generate a steady flow of sales and establish a reliable customer base. In Jordan and Lebanon, the strong base of entrepreneurial talent is constrained by market size, while the North African Maghreb countries have various macroeconomic difficulties that tend to hamper fragile and young firms.

The encouraging developments in the region interact with the World Bank Group strategy. The March 2017 report *Forward Look: A Vision for the World Bank Group in 2030—Progress and Challenges* introduced a new approach to leveraging the private sector for growth and sustainable development. The so-called “cascade approach” is aimed at helping countries maximize their development

resources by drawing on sustainable private sector solutions to provide value for money and meet the highest environmental, social, and fiscal responsibility standards. This preserves scarce public funds for areas in which private sector engagement is not optimal or available.

Equipping countries to attract and manage private capital can help them develop and level the playing field for the poorest. With targeted support for policy and regulatory reforms, private financing can become an option for countries that lack the right institutions or markets. The World Bank Group also provides financial instruments to help mitigate risks for investors.

Roadblocks

While there are encouraging signs for the new economy and its tremendous potential in the region, a number of issues must be addressed to support the digital transformation and change the way business is conducted:

- The *absence of a reliable funding ecosystem* at all stages of a firm's development, which poses an immediate problem for growth and reduces longer term incentives for skilled entrepreneurs to launch their startup in the region. Entrepreneurs face important issues when looking for the “missing middle” of investment between seed and early stage funding:
- *Entry barriers* that prevent new and innovative players from accessing clients in a fair and efficient way. Because many economies are dominated by large firms and face significant risks—including excessive economic and political volatility, currency fluctuations and inadequate investment protection—the region's worldwide ranking is particularly low in the areas of competition (see Figure 2) and *risk acceptance*. But there are important differences between countries. Open economies that have embraced global trade and created attractive investment climates tend to score better than countries with economic and political instability.
- *Key infrastructure and technological deficiencies*, which hamper the business climate. For example, the first and last mile delivery can be improved in many regions to allow small firms to access customers and suppliers independently and gather the momentum needed to thrive and reach larger markets. The absence or unreliability of online payment systems in many countries complicates transactions. The advent of peer-to-peer payments systems in countries such as Kenya show that important improvements can happen in the transactions area.

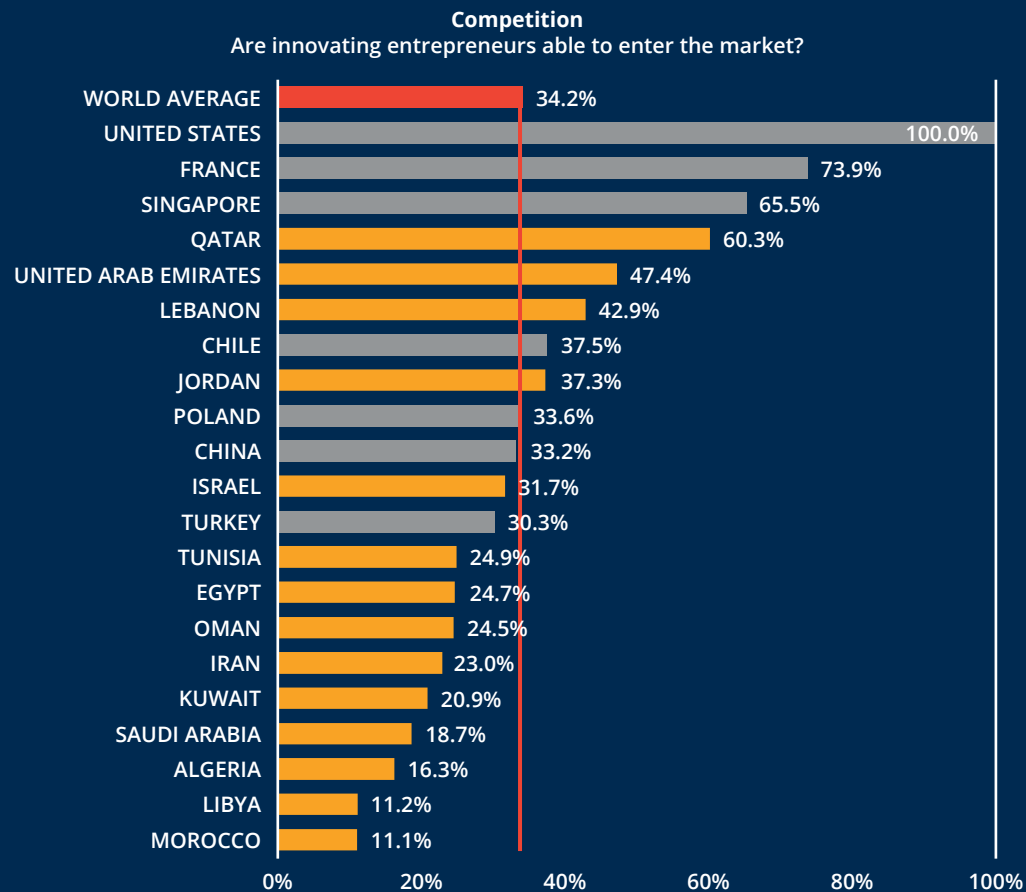
Other elements such as lack of experienced managerial talent and human resource management also retard the development of many firms and prevent them from reaching a regional or global scale.

There is a growing base of support for venture capital activities from governments as well as from retail investors and family offices (organizations that manage the investments of wealthy families). Across the region, governments have established several initiatives to boost the digital ecosystem, including the creation of smart cities, government-supported accelerators, and grants for entrepreneurs. This is particularly the case for GCC countries, where government initiatives are seen as a means to diversify and support the economy, but there are initiatives in the rest of the region too. For example, Tunisia's *Startup Act* sets out government's policies for startup growth.

Family Offices

Family offices and retail investors have also begun to invest in startups to diversify their holdings. This is particularly interesting as the overall venture capital market is underserved: venture capital investments in the MENA region are among the world's lowest—both per capita and as a percentage of GDP (see Figure 3). The IFC is engaged in a variety of actions with the goal of harnessing disruptive technology to accelerate progress in the MENA region.

Figure 2:
Overall, MENA
countries
suffer from
high entry
barriers
and a poor
competitive
environment



Source: 2018 Global Entrepreneurship Index.

With decades of experience in unlocking private investment, the IFC is involved in three key stages of startups' development:

- **Education building and dialogue:** To advance the entrepreneurial appetite in the region and help early stage projects, we are pushing for the development of the right ecosystem. We organize conferences that gather business angels, entrepreneurs, and mentors. Those events have the potential to empower young entrepreneurs by teaching them how to raise capital at very early stages.
- **Indirect investments in accelerators and venture capital funds:** To encourage and support startups with early growth, we invest in accelerators, incubators, and venture capital funds, which, in turn, provide funding opportunities and strategic guidance to select entrepreneurs.
- **Direct investments in companies that drive the digital economy:** For more mature firms with a track record of revenues, a clear cost structure, and proven product/market fit, the IFC can directly invest and provide not only equity but expertise when needed.

Moreover, with *TechEmerge*, the World Bank Group started a new matchmaking program, which connects startups globally with leading corporations in emerging economies to form new

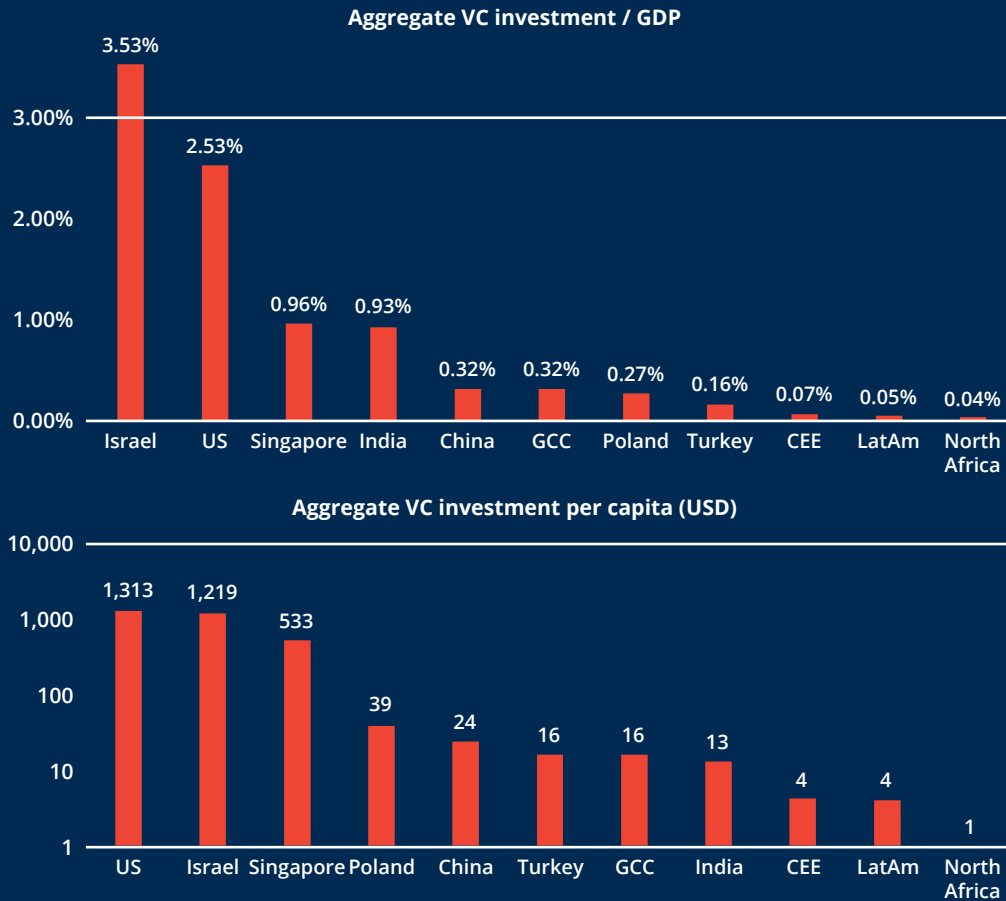


Figure 3: VC investments in MENA has a large growth potential, especially in North Africa

Source: Pitchbook.com.

partnerships. So far it has been launched in *India* and *Brazil*. The objective is to bring technologies to new markets and spur sustainable innovation in regions that need it the most. Indeed, technology can play a key role in disrupting traditional business models in a region where young people are both highly educated and connected. There is an increasing hunger for technological products and content that should be tapped into as a development strategy.

As more MENA consumers gain access to smartphones, demand for digital services and products is likely to soar. Overall, the service industry is expected to transform and use its local roots to develop, which could foster growth and employment. At the same time, the increasing supply of highly skilled individuals constitutes a tremendous opportunity for the region, provided that the necessary regulatory, infrastructure, and governance issues are properly addressed. A transformation of the economic and development model to a new economy is possible in MENA, but it will require a collective commitment from all stakeholders as well as increased region-wide coordination.

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HOW TO CULTIVATE HIGH-TECH ENTREPRENEURSHIP

Kamran Elahian

The Catalyst for Resources and Education to Advance Tech Entrepreneurship Ecosystem (CREATE Ecosystem) is a concept that integrates the components, resources, and human capital needed to cultivate high-tech entrepreneurship leveraged by broadband—or iTechpreneurship.

Create Ecosystem is the brainchild of Global Innovation Catalyst LLC (GIC)—an advisory services firm that connects countries in the Middle East and North Africa (MENA) and Asia to the resources needed to create jobs, high-tech entrepreneurship, and innovation-focused economic growth. GIC believes there are five core pillars to developing the CREATE Innovation Ecosystem:

- Education and professional development
- Mentor and resource networks
- Innovation capital
- Policy and cultural support
- Broadband and digital platforms

I will explore two of those pillars: education and professional development and the mentor and resource networks.

Pedagogical Philosophy and Educational Content. The pedagogical philosophy and educational content within the CREATE Ecosystem must be conducive to stimulating entrepreneurship and fostering a culture of innovation. The university model must be aligned with the demands of the workplace of tomorrow, and cultivate the ability to thrive amid uncertainty and change.

Traditional educational institutions often emphasize pedagogical approaches that include rote memorization, a hierarchical lecture format that incentivizes blind adherence to the authority of the instructor, no student-centric engagement and interaction between students and instructors, and learning specific facts or information for specific purpose such as standardized examinations, rather than developing the mindset needed to think critically and creatively.

The traditional educational approach engenders a mindset in students that ill prepares them for the work environment of the future. This traditional approach produces students who spend time developing skills that will be obsolete in a future in which automation, robotics, and artificial

intelligence become increasingly superior to humans in such skills. Critical thinking, creativity, communication abilities, design thinking, and other qualities must be instilled in students to produce workers with the skills demanded by the workplace of the future.

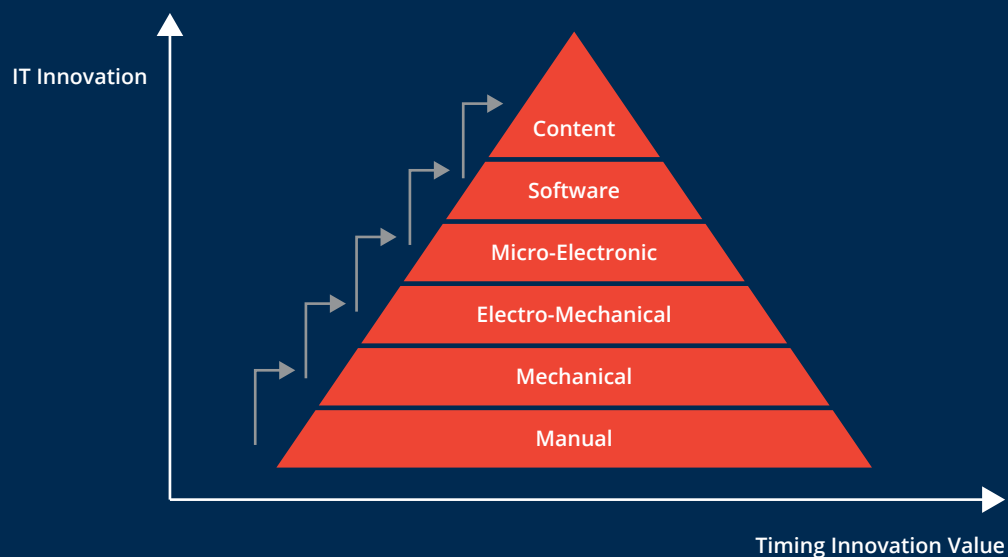
The industries of the future will include, among other things: robotics, artificial intelligence, genomics, 3-D printing, nanotechnology, quantum computing, internet of things, materials science, energy storage, and digital biology. Professors who can teach these subjects—along with high-tech entrepreneurship, investment in entrepreneurship, and social impact entrepreneurship—are scarce.

But with an ever-evolving economy and traditionally rigid university curricula, a strategy is needed to quickly evolve the university of the future. In today's technological environment, an expert in the subject does not have to be physically present to lecture students. The content itself is readily accessible through online platforms and sources; the university's role is to facilitate its instruction and provide the crucial experiential dimensions of learning.

In the CREATE Ecosystem, instructors direct the collaboration, real-world exploration, and engagement with the material that is possible in a university setting. A broad range of people can be trained to become coaches or facilitators of the experiential aspects of the learning process. This training can jump-start the process of developing a university that produces innovators, entrepreneurs, and students capable of thriving in the workplace of the future. Some of these students can also become the learning facilitators for the next generation of students.

Curriculum. The nucleus university of the CREATE Ecosystem must provide content that is aligned with the workplace of the future, and adaptable to emerging global trends—such as the movement of industries towards the higher categories of the pyramid in the figure. This ultimately will lead to an inversion of the triangle towards a larger proportion of work conducted in the realms of software and content.

The challenge of the nucleus university in the CREATE Ecosystem will be to educate its students to be productive in jobs that cannot yet be imagined and to learn to create new technologies, business, and social models for a future that is not fully envisioned. All of this speaks to the importance



of instilling the soft skills needed for youth to thrive, even in an environment that cannot be fully predicted. In part, this will require instilling leadership and resilience, along with creativity and intellectual agility.

Nano Courses and Nano Tokens for Entrepreneurship Education. The CREATE Ecosystem university can leverage existing online content, which can then be experienced with the guidance of content facilitators and coaches. With regard to the online component of education in entrepreneurship and investment in entrepreneurship, GIC recommends a comprehensive library of online, highly targeted nano courses produced by leading professors at Stanford University. GIC has evaluated every prominent online course platform for entrepreneurship education; it believes this is the best-crafted and pedagogically effective online platform for learning the fundamentals of entrepreneurship.

The Stanford nano courses will be prohibitively expensive for most users—especially for younger students in underprivileged regions. GIC is in the process of developing block-chain-enabled nano-tokens, which can be used to take the Stanford nano-courses. The tokens provide a transparent, immutable mechanism both to ensure that the courses are being taken by the desired students and to monitor and validate completion of the courses. The unique features of the block-chain-enabled smart contract permits provision of the courses at a rate that can be feasible and scalable, even for low-income regions. The use of nano tokens can be utilized by the CREATE Ecosystem university to offer cutting-edge Stanford entrepreneurship education to its students.

Computer Science. Understanding the fundamentals of computer science will be among the most essential hard skills the CREATE Ecosystem university must instill in its students. [Code.org](https://code.org) is a collaborator that can provide outstanding introductory instruction in programming. The Code.org offering can be integrated into the curriculum even at the secondary education level—and for students with no prior programming experience.

For purposes of teaching computational thinking, algorithmic thinking, and computational problem-solving, GIC recommends utilizing [Polyup](https://polyup.com) which has designed an innovative approach to learning such skills in a platform that is enjoyable and simple. Another collaborator for teaching university-level computer science is Google's [Computer Science Education group](https://www.google.com/edu/computer-science/), which comprises a wide range of courses in computer science and other relevant subjects, all accessible online.

Teaching Soft Skills. Teaching soft skills will be among the most crucial features of the CREATE Ecosystem. Creative thinking, problem-solving, leadership, communication skills, public speaking, teamwork and cooperation, empathy and compassion, intellectual curiosity, mental agility and flexibility, tolerance for uncertainty, and out-of-the-box thinking are among the soft skills that should be instilled in the students.

These soft skills are not a distinct category, but must form the foundation of the learning approach of the CREATE Ecosystem. Fostering a learning environment that develops the soft skills needed to create lifelong learners who can adapt to a rapidly changing environment, work cooperatively with others, and are motivated to improve the lives of others should be integral to the CREATE Ecosystem model.

Mentor and Resource Networks. The CREATE Innovation Ecosystem is composed of a university as the nucleus center of the ecosystem and a set of components integral to the ecosystem within its immediate proximity. Within the university, the integration of university departments most closely linked to entrepreneurship and innovation should serve as the ecosystem's core.

Typically, the business school and the engineering department will comprise the entrepreneurial anchor of a university. However, collaboration across academic units can often produce a potent catalyst for innovation. Just as the overall CREATE Ecosystem advocates an open physical environment that fosters serendipitous collaboration, the optimal ecosystem nucleus will nurture cross-pollination across campus.

Beyond the integrated university nucleus, the other vital elements of the CREATE Ecosystem include:

- *Co-working spaces*, which are open areas that usually provide broadband connectivity, a few other amenities, such as a cafeteria, and a place for work. Typically co-working spaces tend to be an open floor with shared desks for members, though some offer close-door offices. The main three benefits of co-working spaces are interaction with others, flexible working hours, and an open environment for discoveries and interactions.
- *Accelerators*, which are generally attached to a physical space, where a cohort of start-ups work together to develop their projects for a limited period of time. Accelerators can be part of a broader co-working space or incubator or a space on its own. Accelerators support entrepreneurs and start-ups in early stages of development and they often provide a competitive and open application process for entrepreneurs and small amounts of seed investment. They focus on small teams rather than individual founders, give intensive support for a limited period of time (usually three- to-six months), with active mentorship and networking, and encourage collaborative work among startups through cohort or classes of startups.
- *Incubators*, which are designed to provide startups with office space, networking opportunities, and strategic partnerships—as well as advice about business development, marketing, accounting, and compliance, among other services. Entrepreneurs typically must apply for admission into an incubator, like an accelerator program, but these often focus less on quick growth and are likely to help guide a startup for a year or more (typically on a month-to-month lease program). Also, unlike accelerators, incubators typically do not provide upfront capital and therefore take little to no equity from a startup.
- *Maker spaces*, which are community centers or co-working spaces that provide access to a series of tools and light equipment for fabrication, most significantly 3D printers and open source hardware board toolkits and technology—such as Arduino boards, which can turn inputs into such outputs as online publishing or 3D printing. These maker spaces provide a setting that enables students to shift from being passive learners to creators who engage in active, hands-on learning experiences. What is integral to the maker space concept is that it integrates many different kinds of fabrications (metal working, wood working, rapid prototyping, electronics shops, and even ceramics, printmaking, sculpting, painting and darkrooms) in a single place so that any idea a student envisions can be prototyped and tested.
- *Fab labs* are similar to maker spaces, though they have certain standard requirements—including a minimum set of tools for fabrication and an accreditation program for fab lab managers. Fab labs are small-scale workshops that were originally designed as prototyping platforms for local entrepreneurship, but have expanded to universities and higher education facilities to provide hands-on training. University fab labs can be a platform for users to implement research and incubate prototypes, and for university-industry partnerships
- *Internet cafes and other common areas*, which facilitate interaction and collaboration. These areas can be locations for study and work, but are designed to facilitate interaction across the various units of the ecosystem and the potential for serendipitous connections.
- *Venture capital investors*. Venture capital investment, which comprises the various stages of startup lifecycle, is indispensable to an entrepreneurial ecosystem.

- *Mentorship networks.* Mentoring is another crucial component of an entrepreneurial ecosystem. GIC envisions a model for mentorship that moves beyond reliance on direct interaction with the goal of vastly expanding the pool of potential mentors. GIC is in the process of developing an online platform for CREATE nano-mentoring, which facilitates mentorship by resolving key deterrents to the vital mentorship relationships so vital to budding entrepreneurs: the challenge of face-to-face communication or lengthy commitments from mentors. This project aims to simplify and streamline the mentorship process and will be an integral resource for the mentorship component of the CREATE Ecosystem.

Kamran Elahian is Founder and Chairman of Global Innovation Catalyst.

SECTION TWO ■ FINANCE AND REGULATION

REMOVING REGULATORY BARRIERS TO COMPETITION AND INNOVATION

Federica Maiorano

The countries in the Middle East and North Africa (MENA) present a mixed picture in terms of digital adoption and innovation. A *recent report by McKinsey & Co.* identifies some economic activities in which digital entrepreneurship is developing—e-commerce, digital music, delivery and logistics, financial technology (FinTech) and travel services.

However, despite much potential for growth, the MENA region lags other parts of the world. While e-commerce is seen as the most mature digital sector in the MENA region, according to McKinsey “only 8 percent of small and medium enterprises have an online presence—10 times less than in the United States. Moreover, only 1.5 percent of MENA’s retail sales are online, five times less than in the United States.”

As is the case with other economic activities, digital technologies and services are subject to and affected by regulation. Regulation can enhance those activities already developing and create a framework in which absent services can start. The 2016 *World Development Report*, focusing on digital dividends, noted that countries in which markets are open and regulatory frameworks promote competition are also those with higher digital adoption—as measured by “the percentage of businesses with websites, the number of secure servers, the speed of download, and 3G coverage in the country.” Against this backdrop, this paper provides examples of how regulations can contribute to a more favorable environment for innovation and entrepreneurship. It also provides a brief overview of how regulations can be reviewed in light of this objective—that is, to assess whether they restrict market forces, competition and innovation. I do not address regulation of the underlying infrastructure, such as broadband access.

Regulation Can Affect Competition, Innovation and Growth. Getting regulation right can make the difference between bad market outcomes, on the one hand, and more innovation, more consumer choice and more growth, on the other.

Regulation is necessary in a number of areas. For instance, data privacy regulation is essential when, as is the case in a digital economy, the use of apps and web browsing by consumers leads to the creation and storage of vast amounts of personal data. However, when regulation goes beyond what is necessary to achieve its objectives, it could restrict competition and innovation. This matters because more competition can deliver significant benefits to households and

businesses, including lower prices and better quality products and services. Many studies—*such as those by Arnold and others, Cetto and others, and Egert and others*—have shown the positive effects of more flexible regulation on productivity, employment, research and development, and investment. Moreover, new entry provides a very significant contribution to job creation. Where there are many young graduates who could innovate and create new businesses, as there are in the MENA region, this effect is especially important.

How Regulation Can Restrict or Facilitate Innovative Services. Existing regulatory frameworks designed for traditional products and services may not be suitable for the fast-moving digital economy. Updated regulations may be necessary to make new services possible. For instance, to enable online transactions, new legislation is required to establish the equivalence of paper-based and electronic contracts.

In the FinTech area, businesses have noted that some legal requirements discourage a greater use of digital services in the financial sector, according to a *2018 study by the Organisation for Economic Co-operation and Development (OECD)*. For instance, there are concerns about the extent to which digital and mobile solutions can be used to provide information to consumers and to comply with anti-money-laundering regulations. In addition, the interpretation of know-your-customer rules can require the customer's physical presence to set up a new bank account. Conversely, a regulation that could promote competition and lead to more innovative services is one that required financial institutions to share a customer's transaction information with another institution when that customer requests it. This sharing could spur new services—such as enabling a customer to view in one place all of his or her accounts across different banks.

Consumer protection regulation is another example of rules that can facilitate the development of innovative services. Enhancing trust in e-commerce is necessary to encourage further use of internet-based transactions by consumers. Consumer protection regulation needs to be adapted to ensure that it applies to online sales and that it contains safeguards for consumers—for example, a so-called cooling-off period during which consumers can cancel a contract if they change their mind after receiving a purchased item. Moreover, when sales take place through platforms, consumers need certainty on such issues such as who is liable if something goes wrong (for example, the platform or the seller) and what the process is for complaining and requesting repair or compensation.

Moreover, regulations may favor existing companies and place new entrants at a competitive disadvantage. An example of a regulation that may limit entry and innovation concerns platforms such as the ride-sharing services Careem and Uber. In some countries, authorities may impose requirements on these innovative services—such as tighter conditions on the maximum age of the vehicles or the provision of financial guarantees—that are not placed on traditional taxi services.

Retailers in some countries may be required to have dedicated business premises. While an established retailer already has a brick-and-mortar shop, a new entrant may choose to sell purely online. The regulation requiring dedicated premises would lead to higher costs of entry than would otherwise be the case. That might discourage a startup. Another type of regulation found in some countries restricts the sale of certain products online. These limitations should be carefully reviewed to assess if they are justified in light of public policy objectives. For example, the online sale of prescription medicines is not allowed in many countries on public health grounds, while over-the-counter medications are often available over the internet.

Revising Regulations to Encourage Competition and Innovation. To adapt to changing technology and market conditions, regulatory frameworks must evolve. Existing regulations should be reviewed to ensure that they do not limit new entry, entrepreneurship, and competition. Similarly,

governments should consider whether new regulations are more restrictive than necessary before introducing them. A review of existing and draft legislation should aim at achieving the policymaker's objective—such as consumer protection or public health—while minimizing restrictions on competition and innovation. This process is called *competition assessment of regulation*. It tries to ensure that regulation is not overly restrictive. When reviewing existing and draft regulation, it is helpful to consider whether the regulation:

- *Limits the number of suppliers*, for instance by creating barriers to entry, such as requiring an e-retailer to have a physical shop;
- *Distorts competition among suppliers*, for instance by establishing different regulatory conditions for companies that are already in the market and new entrants—for example, allowing only brick-and-mortar travel agents to offer package holidays, while restricting the services offered by purely online agents, as another 2018 (OECD) study points out. Another distortion that could restrict innovative products rather than traditional products is denying eligibility for tax benefits to peer-to-peer lending products;
- *Restricts consumers' ability to change suppliers or limits the information available* to consumers. In the context of e-commerce and other online services, some considerations are especially relevant. For instance, as the OECD points out, "consumer access to information (including on usage) in a machine-readable form should assist comparison shopping."

If the regulation under review is found to be potentially restrictive following this initial screening, it should be further analyzed to assess its impact on the market. This would typically involve consultations with market participants, such as industry and consumer associations or potential new entrants, as well as desk-based research—including analyzing market data or investigating international practices. It is essential to understand the policy objective of the regulation and, should the regulation be amended, preserve that objective as fully as possible. These considerations apply when the review concerns both existing and draft regulations.

When designing a review process, there are many questions to be considered, including the following:

- *What regulation?* A regulation that specifically governs a certain product or service, such as authorization and requirements for hotel booking platforms, is directly relevant to encouraging innovative services. General legislation that affects any business—for example, legislation covering company registration requirements—is also very relevant and can affect the overall cost of entry into the market;
- *How often?* Given the fast pace of innovation in the digital world, reviewing the stock of regulation only once would likely not be sufficient. The frequency and extent of the review will depend on available resources and on market conditions, including feedback from industry and consumer associations;
- *Who can conduct the review?* Competition authorities are well placed, as is ministerial staff with deep knowledge of the sector and understanding of the objectives of the policymaker. Another option would be to have a specific body in charge of the review task. The question of who is going to carry out the review is also relevant when new regulations are being drafted. International organizations can also support review work.

There are indications that restrictive regulation is an issue in some MENA economies. For instance, indexes depicting regulatory obstacles to entrepreneurship are particularly high in

countries such as Tunisia and Egypt, compared with the OECD average and with the average in the large emerging market countries of Brazil, China, India, Indonesia, and South Africa, according to the OECD-World Bank Product Market Regulation database. The *OECD* charter for regulatory quality in the MENA region calls for “regulatory reviews of existing stock of regulations to reduce unnecessary and burdensome regulatory burdens.”

Governments can contribute to attracting investment and unlocking entrepreneurship by ensuring that the regulatory framework promotes competition and innovation. I have provided some examples of regulations to look out for in the area of e-commerce and financial services and some practical considerations for reviewing regulations. More generally, countries would benefit from engaging with businesses and consumers to identify areas where existing regulations, or the lack of them, create barriers to entrepreneurship and innovation. While a more beneficial approach in the long run would be to conduct an extensive review of all legislation concerning a sector or a specific type of service, there is also value in more targeted reviews. Such a review would be focused on areas in which stakeholders see more immediate benefits in terms of innovative services.

When developing new laws, countries should consider keeping them flexible to accommodate more easily market and technology developments. For instance, if a law regulating travel agencies had specified in detail that bookings could be made only by telephone or fax, the provision would have become obsolete very quickly.

The fragmentation of regulations may also be a barrier in a region, such as MENA, where there are potential economies of scale to be gained from expansion across countries. Careem, for example, is already available in 13 countries. Many innovative digital businesses have become global enterprises. While policy responses may need to be tailored to the specifics of individual countries, the questions that need to be addressed often tend to be very similar across different countries. As always, sharing experiences and learning from each other can help to move forward.

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FOSTERING THE DIGITAL ECONOMY IN THE MIDDLE EAST AND NORTH AFRICA

Martin Peitz

While it would be nice to have a common blueprint for stimulating the digital economy in all the countries in the Middle East and North Africa (MENA), it is impossible because of significant differences among the countries. Facts on the grounds are different and each country may have different priorities.

Nevertheless, a few factors common to most countries make it possible to recommend some regulations and policies that are widely applicable in the region and that may help when planning how to foster a digital economy for the MENA region.

Three major features are shared by many countries in the region.

First, *most countries in the MENA region have, on average, a young population*. In several countries a large number of people will soon enter the labor markets with, at least by historic standards, a high level of formal education—but without opportunities commensurate to that education. Youth unemployment is a problem in many countries; in particular, there is a lack of regular jobs in the private sector. While this is a big challenge for economic policy, it can also be seen as a chance to accelerate the digital economy.

Second, while institutions differ, *there appears to be a lot of room to strengthen and give more independence to regulators and competition watchdogs active in the digital economy and beyond*. While weak or non-existent institutions sometimes have the beneficial effect of giving freedom to innovative entrepreneurs, they are often a detriment to well-functioning markets.

Third, physical infrastructure is quickly changing in the world and *a high level of urbanization and mostly dry weather conditions make it possible for countries in the MENA region to become front-runners in the deployment of new so-called 5G, wireless technology*.

But before policymakers can begin serious planning they must take stock of the situation. What are the facts on the ground? What are the aspirations of stakeholders? What can be learned from success stories (or failures) in other countries?

Internet Infrastructure Essential

A well-functioning internet infrastructure enables a digital economy. Businesses in this economy may offer digital products and services. More generally, businesses that also offer physical goods and traditional services may make use of the digital infrastructure.

A reliable internet that provides broad coverage and adequate speeds is a necessary condition for digital services and the trade of goods via the internet. *Information about download and upload speeds* are one indicator of the adequacy of the status quo. Conditions differ from country to country, both within MENA and more broadly. Countries with a higher GDP tend to perform better on those speed measures, but the relationship does not always hold. In particular, some countries with an intermediate GDP do much better than other countries at a similar or even higher output level.

When evaluating the state of the physical infrastructure, one should look at the available fiber backbone, the access network (which includes several technologies based on fiber, copper, cable, and different wireless technologies), and international connections. The potential for wireless technologies partly depends on the available spectrum.

To understand the needs and aspiration of stakeholders, policymakers have to talk to them. When examining the digital economy, not only entrepreneurs in the digital world should be taken into account. Small- and medium-sized enterprises generally and self-employed workers such as artists and artisans should also be included. Citizens and, in particular, those who deal with a wide range of people such as school teachers and local administrators are good sources to learn about needs and obstacles and to spread the word about support and incentive schemes.

Alternative Paths

In general, it is useful to look at experiences in other countries. There are often alternative paths to success and the difficulty is in figuring out which path is most likely to work, after adapting it to the specific conditions in a country. When it comes to the development of the digital economy, policymakers in developing countries should look to countries other than the United States—such as Estonia, India, Israel, and Singapore.

India and Israel, with different starting conditions in many ways, are examples of countries in which clusters for software programming and app development formed. An important factor common to both countries was human capital in the digital sector. Estonia is a frontrunner in the development of e-governance. Brazil and India are often cited as examples of the implementation of successful poverty reduction schemes using digital services. Singapore is a frontrunner in the roll-out of a next-generation optical fiber network and in smart mobility, such as electronic road congestion pricing. Other countries and examples can be added to this list. Clearly, learning from others does not imply imitation but their experiences are important inputs for authorities deciding on policy proposals adapted to the specifics of the country.

Because the European Union is nearby and so big, MENA countries should keep track of developments there—not only to learn (for example, how to improve the regulatory environment) but also to harmonize activities to facilitate trade of products and services.

An expanding digital economy offers the hope of economic growth that enhances the job prospects and earning possibilities of individuals as well as overall welfare. Policy measures should aim at putting an adequate physical infrastructure in place, as well as providing an institutional environment that is conducive to a flourishing digital economy.

Physical Infrastructure

Countries must assess the appropriate deployment of technology. A well-functioning infrastructure is no guarantee of a vibrant digital economy, but certain digital services require a minimum level of infrastructure. For instance, urban traffic management requires the deployment of devices for each car, coverage in the relevant regions to allow communication between vehicles and controllers, and a functioning electronic payment system to collect tolls, among other things. Another

example is video streaming, which requires a minimum bandwidth available to a large fraction of the population.

How best to improve physical infrastructure depends on the available resources and the needs of society. Thus, it is important in planning to foresee needs in terms of how much (bandwidth) and how fast (latency) data need to be delivered.

Development of the necessary internet infrastructure can be achieved by private enterprises; public investment and ownership; or private-public partnerships. I do not see that one approach is always better than all others. Authorities must carefully discuss the pros and cons of each approach. When physical infrastructure is built and managed by private enterprises (with perhaps some public investment subsidies) the public policy goal may be to stimulate competition among providers (and infrastructure-sharing may be allowed or even encouraged). To foster the adoption of the digital infrastructure, demand-side measures such as subsidies for consumers should be considered. Such subsidies may be effective in reducing the digital divide between those with internet access and those without, most of whom are members of disadvantaged socioeconomic groups.

In the past, connections through fixed line and mobile access networks were seen as separate markets. In the future, though, it is possible that the new 5G mobile technology can substitute for fixed line connections (already 4G provides some substitution possibility). This means that fixed line and mobile deployment plans should not be considered separately, but that, at least in some geographic areas, fixed line rollout can be replaced by 5G rollout. The conditions for 5G are favorable in many MENA countries because of the high degree of urbanization and rather dry weather conditions. A timely deployment of 5G in densely populated areas can leapfrog fixed networks and provide a physical infrastructure that allows the development and adoption of innovative digital services in some parts of the country (complemented by earlier 3G and 4G wireless technologies in other areas).

Institutional Environment

The institutional environment is shaped by laws and regulations; the agencies that are supposed to implement them, including regulators and competition watchdogs; and the court system that settles legal challenges and conflicts. Whether the digital economy is considered in a narrow or a wide sense, its success depends on public institutions such as regulators, competition watchdogs, and the courts. Authorities must take a critical look at the existing institutions. What are their mandates and are they up to the tasks? Do they satisfy the citizens' needs? For example, does consumer protection work properly in the digital economy? Competent and, to some degree, independent regulators are needed if the digital economy is to flourish.

Apart from traditional sector regulation, the following areas are important: internet security and measures to combat fraud; the definition and enforcement of intellectual property rights; product liability regimes in the digital world; the availability of and trust in digital payment system; and the security of personal data. Public investments in institutions that deal with these issues complement investments in physical infrastructure.

Favorable Culture

Whether the digital economy takes off in MENA countries depends not only on the available physical infrastructure and the institutional environment. It will also require a change from a culture that relies on the state for employment to one that encourages the private sector and the concomitant competition that rewards risk-taking and innovation.

One of the great assets in most MENA countries is a young and, in many ways, well-educated population. Even the high youth employment in several countries can be seen as an opportunity if

young people are willing to channel their energy into developing innovative businesses—either as part of the digital economy in a narrow sense or by developing businesses that make use of the internet. To make this happen, many teenagers and young adults must develop the desire to create useful products and services.

New business opportunities can go beyond purely digital services to agriculture, manufacturing and professional services, such as education and health. Among the areas that could be aided by digital services are those that permit value-added tourism, cross-border selling of local hand-craft and arts, productivity gains in agriculture, improvements in the provision of health services, and initiatives in digitally delivered education. Such services can be catalysts of widespread growth and employment because they may benefit businesses and people outside the digital economy, such as farmers, artisans, and workers in the tourist industry.

Public policy can support this in many ways. It can provide monetary and non-monetary incentives to foster the risk-taking and capacity to pursue long-term goals that are essential to developing new businesses. Those incentives could include competitions to develop innovative business ideas at schools and universities; grants to those with entrepreneurial ideas; information campaigns about and by local “heroes” and “role models”; startup funding and advice for entrepreneurs.

Ideally, an analysis of strengths and weaknesses and a cost-benefit analysis of government programs would precede public policy interventions. For some policies, trial runs (randomized field experiments) could provide a low-cost option to test the success and effectiveness of a particular policy before it is applied to the whole country.

A functioning internet offers the hope for many corners of the world to become a better place in which to live. Public policy should aim at ensuring that an adequate physical infrastructure is built, establishing an institutional environment that fosters the growth of the digital economy in a broad sense, and providing programs that support a culture of innovation, creativity, and entrepreneurship.

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TRANSFORMING INDIA INTO A DIGITALLY EMPOWERED SOCIETY

R. S. Sharma

The development and proliferation of information and communication technologies have changed the way government-to-citizen and business-to-consumer services are delivered.

In countries such as India, where more than 50 per cent of the population is younger than 30, it becomes essential to redefine governance and service delivery through use of digital technologies. This will enable young people to reach their full potential by ensuring access to resources and governance structures and by creating avenues for employment and skill enhancement. India has attempted to leverage digital technologies, mobile telephony, a digital identity infrastructure, and applications developed over these platforms to improve governance and business efficiencies—in the process enhancing financial inclusion and economic growth.

The *Digital India* (DI) program weaves together several ideas and thoughts into a single, comprehensive vision such that while each of them can be implemented individually, collectively they can catapult the country into a digitally empowered society and knowledge economy. The program, launched in mid-2015, identified a need to strengthen digital infrastructure and services for socio-economic development. The DI program's *vision* is centered on making digital infrastructure a utility for all citizens so they can receive governance and services on demand.

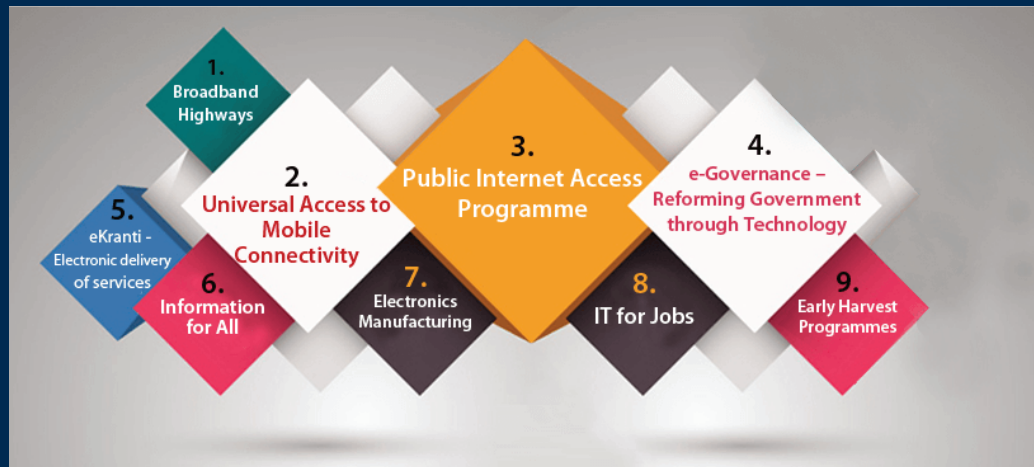
Pillars of Success

The program has identified nine pillars for success (see figure 4). Because digital infrastructure is a prerequisite to serving the nation digitally, the first three pillars—broadband highways, universal access to mobile connectivity, and the public internet access program—focus on:

- Providing high speed internet connectivity through an optical-fiber-based broadband network to 250,000 villages/gram panchayats (village local self-governments).
- Furnishing mobile coverage to more than 55,000 hitherto uncovered villages.
- Ensuring easy availability of digital services through 250,000 common services centers and 150,000 post offices.

At the base of this digital empowerment is the tripartite notion, *JAM*—which is an abbreviation for *Jan Dhan* (literally translated as peoples' money), a massive program for financial inclusion;

Figure 4:
Nine Pillars
of the Digital
India Program



Source: <http://digitalindia.gov.in/content/programme-pillars>.

Aadhaar, an inclusive digital online identity for each Indian based on demographic and biometric data; and Mobile telephony, which enables easy connectivity and access to the system for every individual. JAM along with India Stack revolutionizes the way services are delivered to citizens.

The JAM trinity has become an empowering thought for the people of India.

Aadhaar, the digital ID infrastructure for all, is the base of the trinity. Proving one's own identity may seem to be self-evident and easy. But for many of India's 1.3 billion residents, particularly the poor and the marginalized, it was not easy to prove their identity. Establishing one's credentials and identity is essential for access to most of the government benefits to which residents are entitled. Without a robust identification mechanism, those at the intersection of growing inequality and rising migration are at the greatest risk of exclusion. The number of people without an individual identity document in 2009 was estimated to be close to 400 million or about a third of India's population.

Digital Identity

To tackle the problem, India began working on Aadhaar, the world's largest digital identity program, which was founded in 2009 on the principle that an individual's identity is his or her own and a person should be able to prove it using biometrics, without aid of any token or card. The Western concepts of identity and identifiers—such as signatures and birth certificates—do not work well in a country that struggles with literacy. Aadhaar was developed for the Indian context and relies on facial, iris and fingerprint biometrics to establish unique identities. Exception procedures were put in place to ensure that no red tape could stop one from getting a unique 12-digit ID number. The enrollment was, by design, meant to include, not exclude.

The word Aadhaar, which in many languages in India means "foundation," was constructed to be a public good and a foundational ID platform that could be used by all future programs requiring identity authentication, whether government or private. Since its inception, Aadhaar has proliferated swiftly, with approximately 1.2 billion IDs generated between September 2010 and early 2018, making it the *biggest identity database* in the world. Its growth has been faster than any other internet platform, including Facebook and WhatsApp. The IDs have been used for authentication more than 19 billion times through June 2018.

Aadhaar is an inclusive and unique online identity number. It is a random number. It is purely an ID and does not of itself signify any eligibility for anything. It can be used as a universal address, especially as a universal financial address.

One of the most important services Aadhaar offers is online authentication—enabling people to prove their identity at the point of service delivery. While the uniqueness of the IDs helps the government reduce diversion of benefits to ghosts and duplicates (leakage), authentication also ensures that the benefits reach the intended beneficiaries and are not drained by unscrupulous middle-men. Authentication services of Aadhaar make it easy for individuals to subscribe to various services including financial ones. Electronic Know Your Customer (e-KYC), a digitally signed electronic ID document, is issued using Aadhaar authentication, which can ensure that citizens are able to subscribe to any service in a paperless way.

Financial Services Access

Another leg of the trinity is the *Pradhan Mantri Jan-Dhan Yojana*, or the Prime Minister's *people's wealth* scheme. Jan-Dhan leverages the new technological infrastructure to provide universal access to financial services in an affordable manner. The Jan-Dhan scheme enables the poorest of poor to enter the financial system by opening zero balance accounts in a paperless manner using e-KYC generated by Aadhaar system. This has also been accompanied by streamlining such regulatory processes as issuing banking licenses.

As of May 2018, approximately 316 million bank accounts had been opened, most using the paperless e-KYC process, accounting for deposits of nearly \$120 billion. Debit cards have been provided to around 238 million people (a number greater than the population of all but four countries in the world) and nearly 126,000 customer service points (called bank-mitras), equipped with computers and mini-ATMs, have been appointed to deliver banking services in underserved areas.

More than 19.5 billion digital authentications and 5.5 billion digital e-KYC transactions have occurred through June 2018. More than 500 million different people have authenticated themselves at least once using APIs (a communications protocol that allows two systems or two apps to talk to each other).

The Mobile Phone Is the Third Pillar of JAM Trinity. It facilitates access to digital ecosystem. India had nearly 1.2 billion mobile and 394.2 million mobile broadband subscribers on March 31, 2018. The convenience, portability, independence, and autonomy conferred by the smartphone allow for a practical and cost-effective way to include all citizens in the digital economy. When linked to mobile telephony, Aadhaar can authenticate digital identity, making a mobile number a *de facto* ID for carrying out transactions.

Targeted Subsidy Disbursal

An important way the government can promote equity is through targeted disbursal of subsidies, which is enabled by Aadhaar. While 4.2 percent of GDP, is spent on key subsidies, the existing disbursal systems are inefficient and often fail to reach the intended beneficiaries. To overcome these limitations, a system of direct benefit transfers was initiated by the government in January 2013. In a direct benefit transfer, Aadhaar acts as a financial address for transferring entitlements directly into the bank or postal accounts of beneficiaries. The financial backbone set up by the National Payments Corporation of India translates the Aadhaar number to the individual's bank account number and routes the money accordingly. The beneficiary can use the Aadhaar authentication system for the last mile real time authentication to withdraw money from a micro ATM with a bank-mitra.

Linking public service delivery with Aadhaar authentication results in the entire supply chain becoming transparent and auditable. Aadhaar has obliterated the market distortions that resulted

from problems of intermediary and ghost beneficiary leakages that left the poorest Indians bereft of benefits meant for them. Since its inception, payments from 431 programs, totaling more than \$57 billion have been sent via 3.2 billion direct benefit transfer transactions—saving the government \$13 billion. It is estimated that in FY2019, 75 percent of India’s approximately \$100 billion of annual welfare expenditure will be sent via *direct benefit transfer* to people’s bank accounts.

India Stack

India has also adopted a layered and unbundled approach to innovations and has created several products in various sectors of service delivery, collectively known as *India Stack*. Everyone’s biometrics are securely stored in a Central Identities Data Repository, making it possible to check incoming biometrics (say on an application for benefits) against verified ones recorded during enrollment in Aadhaar. The cost-effectiveness and convenience of this verification process allows for a variety of uses, many of which were not envisaged by Aadhaar’s founding team. Building on the foundation of mobile infrastructure and Aadhaar, the government has started devising programs that enable paperless, presence-less, and cashless transactions for every Indian.

The collection of programs that constitute the India Stack make it easier for innovators to introduce digital services in India across a range of sectors. These have been structured in a way that anyone can plug these tools in their specific application.

The *Stack* has four essential elements:

- A layer in which a universal biometric digital identity removes the need for people to be present to participate in formal services.
- A paperless transactions layer that permits digital records to move with an individual’s digital identity.
- A cashless layer, which includes a set of interconnected payments programs that make it easier for people to transact.
- A consent architecture, in which an individual’s data are protected and which enables more personalized services.

A Public Good

Unlike other countries, where select private companies control the keys to innovation on their proprietary platforms, the entire stack in India is open—built as a public good, managed by public institutions such as the Unique Identification Authority of India or the National Payments Corporation of India, and offered at zero or minimal costs to be used by businesses and government departments alike.

The focus of Digital India has been to create the essential open plumbing and to allow innumerable innovations to happen at the customer end of any solution. This sets the stage for the hundreds of experiments—or what Nobel Prize-winning economist Edmund S. Phelps called the “mass flourishing” of widespread, indigenous innovation.

India Stack, among other things, includes several revolutionary offerings, such as:

- A *unified payments interface*, which enables users to engage in cashless transactions to and from any bank account in India, using just their smartphone and Aadhaar number. Payments are easy, immediate and secured by the use of virtual payment addresses, which means that bank account details do not have to be revealed.
- *e-KYC*, which enables a rapid, paperless verification of identities. Aadhaar based e-KYC is being used for such purposes as opening bank accounts, getting mobile connections, or filing income taxes.

- *e-Sign* service, which can be integrated with service delivery applications to allow a user to digitally sign a document for online submission and permitting paperless citizen services.
- *Digital Locker*, a platform in which each registered user receives 10 megabytes of cloud storage space linked to his or her Aadhaar. Users can securely store e-documents and links to e-documents that can be accessed directly from the repositories, shared with requesters for online submissions to facilitate e-signing before sharing. This enables presence-less and paper-less transactions.

Emulating the Approach

The countries in the Middle East and North Africa (MENA) can benefit from the Indian approach. With the help of mega programs such as Digital India and the JAM trinity (together with India Stack), the Indian government has sought to leverage technology to promote financial inclusion, create efficiencies in welfare delivery, stimulate ease of doing business, and restructure citizen engagement with the government. Importantly, these reforms seek to harness the innovative spirit and technological inclination of India's youth.

Both the public and private sector in India benefit through these transformative schemes. The public-sector gains through delivery efficiencies enabled by the use of JAM trinity, while private businesses get access to customer segments that were previously out of reach. The ability to use new forms of data as a resource also enables the evolution of consent-based data-driven business models. Ultimately, this will lead to increased economic growth and improved quality of life for all citizens.

The noticeable part of India's transformational DI program is that it is not only frugal, robust, scalable, and interoperable, but is also largely based on open architecture and open standards and therefore, is easily replicated. The developing nations of the MENA region and other parts of Africa do not need to reinvent the wheel. They can easily customize and replicate Indian efforts to suit the needs of individual countries. The artifacts of India Stack can have a huge impact on employment generation, governance, inclusion, and overall development of the region—and help in achieving sustainable development goals. Once the required infrastructure is in place, MENA countries can create many more customized “stacks,” built as public goods that provide a platform for their residents to escape poverty and become prosperous.

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THE AFRICAN FINANCIAL DEVELOPMENT GAP: THE BRIGHT AND THE DARK

Lemma W. Senbet

The available evidence shows a strong link between financial sector development and economic development, suggesting that finance matters to economic performance. This linkage is also supported by data from Africa, although the results are not as strong, mainly due to the *quality of available data*.

The channels for the finance-development nexus are not just resource mobilization but also the multiple functions of financial systems—such as intermediating funds between savers and borrowers—and the efficient allocation of resources resulting from these functions. The mere existence of banks, even stock exchanges, is of no consequence unless they perform these vital functions. For instance, a bank that mobilizes savings and merely channels it to the government sector is not performing its function as an informed agent that provides private credit and resource allocation. It is merely profiting from the spread between lending and savings rates, and hence effectively serving as a conservative bank that takes virtually no risks.

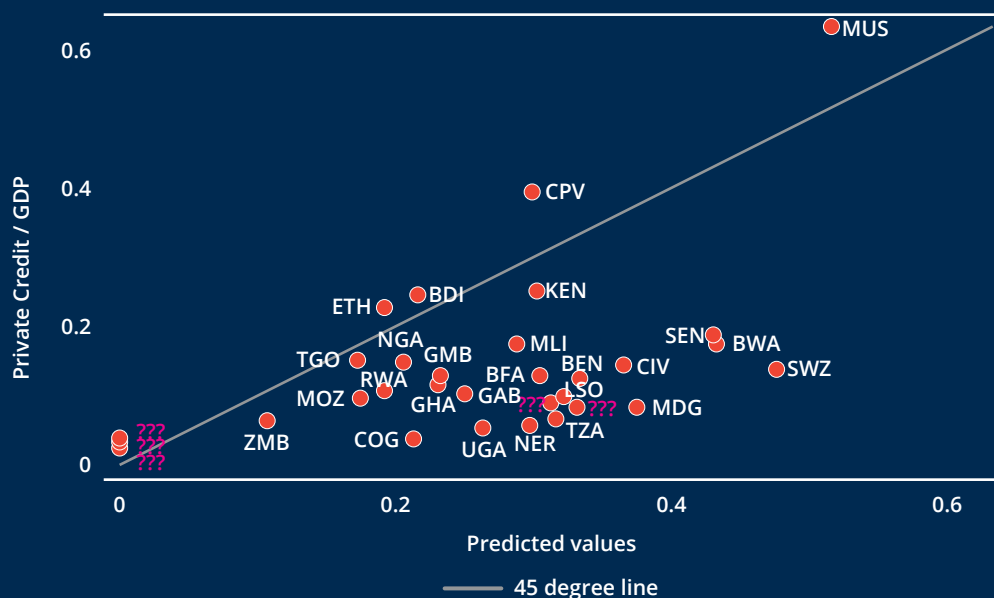
By the same token, a well-behaved stock market provides several functions besides capital mobilization. These include liquidity provision, information production, price discovery, and even disciplining *corporate behavior*—because market price serves as a signal for managerial performance. It is through these functions that stock market development can be *linked to economic development*. There are a number of stock exchanges in Africa, for example, but they have few listed stocks and are largely illiquid and fail to perform the vital multiple functions. If a stock exchange fails to serve the functions it should, it is akin to a museum.

A Well-functioning Financial Sector Needed in MENA

The positive link between financial sector development and economic development provides a strong case for establishing a well-functioning financial sector in sub-Saharan Africa (hereafter referred to as Africa) and the Middle East and North Africa (MENA). The evidence also suggests a link between financial sector development and poverty alleviation and job creation. Policies pertaining to financial sector development should be guided by how well the sectors perform their functions.

Unfortunately, the financial development gap in Africa and the MENA region is enormous—not only when compared to advanced economies but also in comparison with peer countries outside Africa and the MENA region. A *joint study by the Arab Monetary Fund and the Consultative Group*

Figure 5:
Predicted vs
Actual Levels
of Financial
Development



to Assist the Poor, found that the Arab world lags other regions in financial inclusion—with about 70 per cent of adults reporting no ownership of a bank account. Access to formal credit is also below the global average, according to the study.

In a 2016 study, we established a *benchmark financial development path* against which we measure the African financial development gap. The benchmark is based on a cross-country econometric analysis comparing the determinants of financial development in Africa with other peer low-income countries in the rest of the developing world.

The resulting African financial development gap is enormous. With the exception of the island states of Cape Verde and Mauritius, which are above the benchmark financial development line, the rest of African countries are uniformly below the line—that is, below their respective predicted levels of financial development (see figure 5). Among the larger countries, only Kenya comes close to its predicted level of financial sector development. This is not surprising, given that Kenya has been at the frontier of financial inclusion and entrepreneurship with its global leadership in mobile money.

But an exploration of the determinants of financial development in Africa produces something peculiar: The sensitivity of financial sector development to population density is larger in Africa than anywhere in our global sample. In particular, population density explained greater variation in financial sector development in Africa than in other developing countries. This reinforces the need to promote the development of infrastructure, such as roads, bridges, and power, to foster financial sector development.

The crucial issue for Africa and the MENA region is how to develop a robust financial sector that is inclusive, dynamic, innovative, and sustainable to support the development imperatives facing each region—and one that is consistent with the UN's *Agenda 2063* on Africa's future and *Agenda 2030* on sustainable development. It is commonly suggested that domestic resource mobilization, in which a country raises and spends its own resources to support its citizens, fosters the self-reliance that is at the heart of these development agendas. But self-reliant domestic resource mobilization cannot occur unless domestic financial systems are developed.

Private Initiatives

At the heart of the financial sector development agenda should be empowerment of private initiatives. Interestingly, private sector initiatives and innovations are moving at a faster pace in Africa and MENA than are policies to enable them. Below I identify some broad pillars to promote financial sector development and financial inclusion, which are similar for both Africa and MENA, based on a comprehensive *review of African financial systems*.

Inclusive Finance for Inclusive Development. Increasing attention is being paid to the notion that finance that is accessible to all is an important driver of inclusive growth in Africa and elsewhere. Financial sector development alone is insufficient for inclusive finance, because financial systems can develop while excluding certain parts of society. In fact, the very people who are the targets of inclusivity in economic development—youth, women, small farmers, and small- to medium-enterprises—are among those most likely to have no access to formal finance, and typically are unbankable and uninsurable.

Ultimately, finance is inclusive when all segments and members of the economy have access to formal financial services that are fairly priced. Again, it is through such channels as risk-sharing and reduced capital costs that inclusive finance generates development outcomes through more efficient allocation of real sector resources—such as productive small farming. Moreover, an inclusive financial system can reduce the need for such informal sources of finance as pay-day loans, whose costs can be exorbitant.

The available evidence indicates that there is a strong positive link between financial inclusion and infrastructure development—both physical, such as networks of paved roads and telephones; and electronic, such as the internet. Adult literacy and urbanization also have a positive effect on financial inclusion. Although rural areas are more likely to be excluded from finance, the inclusion gap can be narrowed greatly using innovative technology.

Financial Innovation for All. The problems associated with financial development and inclusion gaps are so enormous that business as usual is unacceptable. Africa and the MENA region must innovate to move in tandem with an increasingly fast, dynamic, and complex financial world. Africa, is innovating, although at a slow pace. The innovation is most pronounced in Kenya, where mobile banking efforts, called M-Pesa, have received global attention. M-Pesa permits users to make deposits and withdrawals, transfer funds, and pay for purchases with their mobile phones.

Traditional Banking Services

However, innovation is not just limited to path-breaking technologies. M-Pesa is well known, but less attention has been given to Equity Bank's pioneering, but traditional, banking service strategy targeting low-income customers and traditionally underserved territories in Kenya.

As part of its branch expansion strategy, Equity Bank targeted the most disadvantaged localities, including arid and semi-arid areas, and ethnic minorities who do not speak Swahili. Equity Bank is listed on the Nairobi Stock Exchange and plays an important role in integrating informal finance into the formal sector, including the stock market.

Overall, the evidence demonstrates that an innovative banking business model, which focuses on the provision of financial services to population segments that are typically neglected by traditional banks, can be profitable and sustainable while also generating social impact. And it can be accomplished without relying on sophisticated technology.

As Equity Bank is providing home-grown and traditional banking services to Kenya's unbanked and underserved population, innovative financial entrepreneurs from around the world are paying

increased attention to that population in the rest of Africa and the MENA region. At the same time, Africa's global leadership in mobile money, thanks to M-Pesa, is inspiring transformative home-grown innovations. Private sector initiatives have begun showing the way, and policymakers should be investing in an enabling environment to scale up and accelerate the momentum. Startups, capitalizing on technology-oriented solutions, are proliferating, particularly financial technology (FinTech) operations in Africa.

FinTech Startups

About 300 FinTech startups are active across Africa—especially in South Africa, Nigeria, and Kenya. According to *Disrupt Africa*, 57 African FinTech startups raised close to \$100 million between 2015 and 2017. Interestingly, it is not just impact investors—who aim to create firms of significant social consequence—who are engaged. Early stage venture capitalists from Silicon Valley are also involved. These developments are characterized by inclusive innovation and mass movement with huge potential impact on livelihoods, consistent with the imperative for inclusive development in the UN Agenda 2030—a space where profit opportunity and social impact opportunity meet.

Integrating Finance and Prospects for Financial Globalization. The national stock exchanges are illiquid and stocks are thinly traded—which makes it crucial to consolidate these markets through regional cooperation and initiatives. Fortunately, there is a growing recognition of the need for financial integration in Africa. An important regional initiative already is in place—the Abidjan-based *Bourse Régionale des Valeurs Mobilières*. There are integration efforts on the way—including the Southern African Development Community and the Economic Community of West African States. More recently, the East African Community—comprising Burundi, Kenya, Tanzania, Rwanda, and Uganda—has taken steps towards harmonizing the regulatory environment for financial and banking services.

An important benefit of regional financial integration is that it promotes the integration of Africa and the MENA region into the global financial economy. The thin size and illiquidity of the financial markets have been major hindrances to foreign investing in both regions. Consolidation into regional exchanges would increase liquidity and trading volume and potentially unlock foreign investments and help integrate the region into the global financial economy.

Privatization

Moreover, regional stock exchanges can be an avenue for privatizing large state-owned enterprises—Kenya Airways, for example, was privatized through the Nairobi Stock Exchange. Share issue privatizations contribute to the depth of the stock markets through an increased supply of listed companies. Privatizing through share issue has less obvious benefits, too, including improved corporate governance and fairer pricing through the discovery process markets afford—which depoliticizes the privatization process. Moreover, privatizations through the exchanges foster diversity of ownership of the economy.

There are encouraging forces and trends that favor the prospect of the integration of both Africa and MENA into the global financial economy. First, global financial markets, including those in emerging economies, are becoming more integrated as capital increasingly flows across borders because of reduced barriers to international capital flows. Second, there are rapid advances in information technology connecting these regions with the rest of the globe—which facilitates capital flows and global financial innovation.

As the financial systems in these regions mesh with the global financial economy, the development agenda for a well-functioning and deep financial sector, that is also regionally integrated, should be on a fast track.

Regulating Dynamic Finance. MENA and African financial regulatory frameworks must catch up with the rapid pace of innovation and dynamism in financial systems around the globe. In this process, regulation should enable, not stifle, innovation. Ill-designed regulatory systems can impede the provision of inclusive financial services and retard innovation. In addition, regulatory policies should resist the temptation to protect vested interests from innovative technology-driven services by new entrants.

There are two crucial regulatory areas:

- *Shadow banks:* The 2008 global financial crisis showed that the threat to financial instability posed by shadow banks—institutions engaged in non-transparent financial services that are identical or similar to those traditionally performed by banks. Shadow banks include investment banks, money market funds, and hedge funds. These shadow banks were operating outside the banking regulatory regime, which partially explains why they were among the key culprits of the global crisis. Regulatory regimes have been changed to incorporate shadow banks, including those that operate across borders in an interconnected fashion. Shadow banks, which are systemically important, are likely to emerge in Africa and MENA as the regions' financial sectors develop. If that is to happen intelligently, *regulatory schemes to proactively incorporate disciplinary and incentive-based mechanisms for shadow banks will be needed.*
- *Digital financial services:* There is a need to focus on regulatory standards for digital financial services that have multiple players—such as banks, shadow banks, and mobile network operators. These entities are typically under different regulatory jurisdictions based on the existing supervisory regimes. More specifically, for instance, digital financial services are activities in the domain both of banks and of telecommunications. Should such financial services be overseen by a banking or a telecom regulator? *A Committee on Global Development task force* in 2016 concluded that regulation should be guided by a functional perspective so that *equivalent* services are treated the same from a regulatory standpoint. Thus, the Task Force proposed *functional regulation* based on which institutions provided these functions—not the organizational forms of these institutions.

Financial Capacity Building. It is one thing for Africa and the MENA region to commit to the development of well-functioning and inclusive financial systems. But they also must foster a commensurate capacity for risk-management and governance, because finance and financial innovation have become increasingly complex and dynamic and will continue to do so. Actually, financial capacity development should include regulatory ability. Financial regulators need to cultivate a deep understanding of how banks and financial institutions undertake and manage risk. To do so, financial regulatory institutions, as well as financial institutions, should partner with higher education programs to develop specialized training programs to produce financial manpower and a regulatory force that matches the increasingly sophisticated and complex financial systems characterized by digitization and innovative financial entrepreneurship.

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SECTION THREE ■ **EDUCATION,
SCIENCE, AND INNOVATION**

HUMAN CAPITAL DEVELOPMENT AND TECHNOLOGICAL INNOVATION

Lesly Goh

It is widely recognized that technology innovation plays a crucial role in the economic prosperity of nations, driving higher productivity and creating new jobs in all sectors of the economy.

For example, an unpublished study of 120 nations between 1980 and 2006 by Christine Qiang from the World Bank that was cited in a *Brookings Institution report* found that each 10 per cent increase in broadband penetration adds 1.3 per cent to a high-income country's GDP and 1.21 per cent to the GDP of low-middle-income nations. Advances in technology such as the internet, mobile phones, cloud computing, artificial intelligence (AI), and block chain can help speed up innovation in a wide variety of areas including finance, manufacturing, e-governance, education, trade, health-care and social networking—ultimately generating economies of scale and powerful efficiencies.

Additional benefits of these technologies include increasing security and trust through the immutability of block chain technology and access by reducing information and regulatory barriers for small- and medium- enterprises in trade or enhancing access of disadvantaged groups in the future of the workforce. The 2017 *Digital Economy Outlook* from the Organisation for Economic Co-operation and Development (OECD) also notes that e-government was the top prioritized area of digital development policy among surveyed OECD countries.

An example of the economic effects of disruptive technologies is contained in a study by *Graetz and Michaels* of 17 countries from 1993–2007, which finds that the use of industrial robots increased countries' average growth rates by roughly 0.4 percentage point a year.

Great Promise

While developed nations have taken the lead in driving technology innovation, there is great promise and potential for developing nations such as those in the Middle East and North Africa (MENA) to actively embrace this phenomenon. To achieve economic prosperity through technology innovation, *education* is an essential area that developing nations should address.

Education, for both the youth and adults, serves as a major foundation to catalyze, stimulate, and mainstream innovation and is the starting point for the development of skills required to drive the new jobs of the future. *According to a World Bank study*, advances in technology will have a profound effect on those new jobs, and thus it is imperative to develop the human capital of each country. In a recent blog, *World Bank President Jim Kim* wrote that automation will lead to the

elimination of many of the less-complex (routine) and low-skilled jobs, and thus the remaining jobs will demand new and sophisticated skills. A 2016 study by the U.S. Council of Economic Advisers (CEA) found that 83 percent of jobs paying less than \$20 per-hour would come under pressure from automation, compared to 31 percent of jobs paying between \$20 and \$40 per-hour and 4 percent of jobs above \$40 per hour. Meanwhile, the 2017 OECD Digital Outlook study finds that 44 percent of American workers with less than a high school degree hold jobs made up of highly-automatable tasks while 1 percent of people with a bachelor's degree or higher hold such a job.

The CEA, for example, noted that new job roles may be categorized by *engagement* (with new technologies), *development* (such as highly skilled software developers), *supervision*, and *response to paradigm shifts*. Similarly, several studies have noted that technology is more likely to threaten lower-wage and lower-education jobs (correlated with lower skills) than higher-wage and higher-education jobs (correlated with higher skills), and in fact, may complement the higher-skilled jobs.

STEM Focus

Therefore, for developing nations to remain competitive in the global economy and drive higher growth, the education systems must focus more on developing science, technology, engineering and mathematics (STEM) skills at all levels—primary, secondary, university, and beyond. Strengthening STEM education is essential because jobs in these fields tend to be among the best-paying, fastest-growing, highest-in-demand, and most important for driving economic growth. For example, a 2018 *LinkedIn study* found that the 10 skills most in demand in 2018 were related to STEM: cloud and distributed computing; statistical analysis and data mining; middleware and integration software; web architecture and development framework; user interface design; software revision control systems; data presentation; search engine optimization and search engine marketing; mobile development; and network and information security.

Currently, in some countries, unfilled jobs in STEM-related roles (estimated to be 500,000 in the United States alone) *hinder economic output and growth*. For instance, *individuals employed in STEM fields in the United States enjoy prosperity, low unemployment, and career flexibility*. Teaching computational thinking and other STEM skills early in a child's education should be encouraged, so he or she can develop intellectual curiosity and have the foundation and motivation to pursue the high-skilled jobs of the future. Creative ways are emerging to make computer-coding fun and engaging for children, while teaching them computational thinking at a young age. For instance, "*All Aboard*," a program started in a school in Portugal, allows primary school students to teach other students (with the help of the teacher) how to code in simple ways and help make technology part of their daily learning experiences.

Addressing the Gender Gap with STEM Education. A special emphasis should be placed on women's STEM education because women account for fewer than 30 per cent of workers in the computer science, engineering and physics fields in some of the world's emerging economies. This problem is also visible in developed countries, such as the United States, *where women hold less than 25 per cent of STEM jobs* even as college-educated women have increased their share of the overall workforce. To maintain the interest for young girls and women, it is helpful to have sponsorship and mentors as role models. With STEM education, women become better-equipped to find sustainable jobs and lifelong careers, allowing them to maximize contributions to their communities and the economy.

Encouraging STEM education in schools is a starting point—which needs to include private sector collaboration through internships, mentorships, and training programs, as well as the teaching of entrepreneurship skills. These training programs increase the digital skills of women to enhance their participation in future work. The learning needs to be extended beyond the classroom

to expose students to real-world problems and issues and to encourage them to pursue their dreams, participate in emerging industries, and start new businesses.

Failure Is an Option

An important principle that can be learned through entrepreneurship is that it is all right to fail—if you fail fast, have tried new ideas and ways of doing things, and learn from your failure. A society that values innovation must embrace failure as a learning opportunity. This concept has been difficult to grasp for many Asian countries and other developing nations, where failure is not considered an option. However, it has served as bedrock for the success of many technology startups in Silicon Valley and other parts of the world.

To better understand gender equality, LinkedIn Economic Graph published the *Global Gender Gap Report* to illustrate how female representation in leadership is a top indicator for hiring of women at all levels, thereby creating a deeper bench of female talent at more junior levels to be promoted into leadership roles. Another important lesson is to value diversity and inclusion to leverage differences of opinions and inputs for problem solving. Finally, the ability to ask the right questions to diagnose problems and apply user-centric design or design-thinking to address problems is extremely important.

Lessons from the Association of South East Asian Nations. The use of technology to advance education in emerging markets provides another avenue to encourage innovation. Smart education is the increasing use of technology advancements—such as the internet, computers, smartphones, tablets and software programs—to enhance the learning process. An example of smart education is using *artificial intelligence (AI) to help students learn faster* and provide real-time feedback to teachers on learning behavior. The 10 ASEAN countries are leaders in smart education and learning, with Singapore and Malaysia taking the top spots. However, developing economies may find it difficult to achieve a highly developed information and communications technology (ICT) sector and vast penetration of smartphones and mobile devices. *Government initiatives toward promoting the use of technology in education* have resulted in the increased use of smartphones and devices in delivering smart education to learners in Malaysia and Indonesia.

Soft Skills and Empathy also Enable Youth Employment. Technology innovation can have the biggest impact when it is used to drive economic benefits as it also provides a social impact. Soft skills—such as leadership, collaboration, and time management—are critical elements in communicating and driving a spirit of social impact. Additionally, soft skills are highly sought after in the job market. For example, in a 2018 *LinkedIn study* of skills demanded in the U.S. labor market, 2,000 business leaders noted that soft skills—which also includes communication—are important; in fact, 57 percent of these business leaders' responses indicated that "soft skills are more important than hard skills."

Generativity—which refers to contributing to society and doing things that benefit future generations to make the world a better place—should be taught in every school curriculum. The concept represents the seventh of the eight stages of *Erik Erikson's theory of psychosocial development*, and this stage typically takes place during middle adulthood. However, teaching this concept in schools together with technology innovation can lead students to flex their creative muscles around computational thinking for a higher purpose and will lead to a greater impact on society. The idea of encouraging technology innovation for a social good is evident in a few emerging market countries, such as Bangladesh and the Philippines, where there is collaboration between the public and private sectors to come up with innovative solutions for major development challenges.

For instance, the World Bank established the “*Code for Resilience*,” a collaboration between the Bank’s Global Facility for Disaster Reduction and Recovery and Code for Japan, a civil society organization dedicated to using software coding as a means of improving social welfare. Code for Resilience runs hackathons, which bring together software and hardware designers to solve some of Asia’s disaster risk and resilience challenges.

Importance of AI for STEM Education. In a powerful feedback loop between human capital development and technological innovation, AI technologies are enabling citizens to access and gain quality education to build their human capital and ultimately to continue the process of technology innovation. Private sector firms are critical engines of technological development, reflected in various studies that see growth in private investment and venture capital in AI technologies. For example, in 2017, the McKinsey Global Institute found that *external investment tripled in AI from 2013 to 2016*, with a compound annual growth rate of about 40 percent.

While education is essential for the development of human capital and plays an important role in the adoption of technology innovation, private sector firms can also do their part. A *recent article* using LinkedIn data to shed light on tackling youth unemployment, identified the ICT skills in young people that are highly demanded in Brazil, India, Indonesia, and South Africa—statistical analysis and data mining, data presentation, algorithm, and machine learning. AI-powered analytics can be leveraged to *help students achieve academic excellence* such as improving the student graduation rate and predicting student dropout risks. AI in the classroom is an inclusive way of learning for students who are visually impaired with the *Seeing AI App* or robot-connected devices for students with long-term medical absences. AI goes beyond digitalization of the learning experience; it provides the educator and the students with data-driven insights and smarter tools to educate students of tomorrow.

Youth and Women Empowerment in the Middle East and North Africa.

In my recent visit to Tunisia, I met the startups in the *Empower Her* initiative, which is an innovative process that leverages the unbounded enthusiasm of youth and their technological skills to overcome challenges to women’s economic empowerment. The initiative develops helpful technological solutions, irrespective of the woman’s literacy level. Empower Her is a World Bank program that brought together private sector entities, government institutions, associations for women, partner agencies, and potential female beneficiaries across Tunisia to define and select the main obstacles to be tackled by the youth workshop. It followed a series of hackathons across the country.

In this program, rural women artisans team up with young unemployed tech graduates to design apps that will help the women sell their traditional, hand-made crafts to the world and have access to social and health coverage. These two groups—rural women and unemployed graduate youth—have an understandable sense of exclusion, especially in the remote interior regions of Tunisia. They have high potential, but lack opportunity. The youth lack jobs, while women artisans lack access to markets, materials, social services, and information. Microloans can only go so far, and don’t help bridge many of the gaps challenging these women. “Targeting these two very different groups for assistance is at the heart of World Bank strategy for the Middle East and North Africa,” says Afef Haddad, Deputy to the Country Director for the Maghreb and Task Team leader of Empower Her. “It struck me that Tunisia was the largest user of social media in the region, and that a growing number of university students were studying IT.... Could advanced IT tools be the glue to solve the constraints rural women have faced for generations?” If so, *she said*, “then could IT be the glue to bring together tech-savvy but unemployed technology graduates and traditional crafts-women to find the most innovative solutions to solve both their problems?”

New Ways of Teaching

Empower Her has also affected the way government officials look at education. It offers new ways of teaching. New approaches—such as those that deal with problem-based learning, competitions, working groups guided by coaching, and learning how to spark innovation—provide a better chance for employment after graduation.

Empower Her is a good example of how to broker the public and private partnership to bring about positive changes in the lives of the marginalized youth and women in the MENA region. It empowers youth and women to solve their problem using technology for their startup ideas.

As demonstrated in examples from ASEAN and MENA countries, technology can be a powerful source of social and economic cohesion—bridging regional, income, and occupational divides. Yet whether technology is an equalizing, rather than a divisive, force in society rests on public and private sector cooperation and the will to use the latest technological solutions to tackle society's biggest challenges. Human capital development is an essential ingredient in achieving this vision. Developing a growth mindset and a sense of purpose to foster an innovation culture are crucial to driving sustainable and socially impactful business models. It is important to corporate executives to come to terms with the reality that change is the only constant as their business organization evolves in the growth cycle and they address competition by leveraging the innovation culture to create new solutions and compete in the job market. Breaking down silo environments, creating incentives to encourage cross-team collaboration, as well as introducing mentoring and training programs to help build innovation teams are some of the ways that corporations can succeed and drive higher employee engagement.

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YOUNG PEOPLE NEED OPPORTUNITIES

Salvatore Nigro

Unemployment, especially among young people, is a growing concern worldwide. With a global population projected to reach 8.6 billion by 2030 and 9.8 billion by 2050, it is estimated that more than 40 million jobs must be created every year need to keep pace with the growth of the working-age population. In 2018, 2.7 million more people will become unemployed, bringing the total to 200 million, while there are 1.4 billion in *vulnerable forms of employment*. Youth are particularly vulnerable, with 66 million young people out of a job and 145 million young workers *living in poverty* (less than \$3.10 a day).

This situation is especially salient in the Middle East and North Africa (MENA), where, at 28.1 per cent, youth unemployment is among the highest in the world and more than double the global average of 13.6 per cent. The unemployment rate among young females is 42.1 per cent and 85.6 per cent of young women do not participate in the labor force—the lowest female labor force participation rate in the world. Most youth are long-term unemployed (at least one year). After years of search, many become discouraged; already two out of three working-age youths in the MENA region do not participate in the labor market and *one in four are not in education, employment or training*. Such inactivity when a person is young hurts employability, future earnings, and access to quality jobs.

Refugees Aggravate Employment Issues

This situation is aggravated by a massive influx of refugees in recent years. According to the UN High Commissioner for Refugees, 25.4 million people are refugees worldwide. But not all who leave their homes are escaping conflict. Many more young men and women migrate to seek better job and living opportunities. According to the UN Population Division, in 2017 the number of international migrants, not refugees, worldwide was 258 million, the majority of working age. A survey of 10,000 MENA youth by the European Commission-funded SAHWA Project—of which *Education For Employment* (EFE), the leading non-profit job placement network for youth in the Middle East, was a strategic partner—found that 86 per cent of respondents cited a lack of professional opportunities, lower income, and poor living conditions as reasons for wishing to emigrate, Most respondents said they chose their destination mainly because it offered better job opportunities.

The MENA region has the *world's youngest demographic*, with one in five people between 15 and 24 years old and half the population under 25. A youth population of this size should translate

into a competitive advantage for the region. However, to reap the benefits, young people must be given opportunities, starting with a good education that prepares them to compete on the global job market. In the MENA region alone, 5 million jobs must be created each year to accommodate the old and new labor force, requiring sustained annual growth rates of at least 6.5 percent, compared to the *regional average of 4.9 percent in 2016*.

Shortage of Work-ready Employees

That said, employers continuously report difficulties in hiring work-ready employees for jobs that are already available—citing, among other things, inadequate soft and technical skills as barriers to hiring. The region has a wealth of human resources that could spearhead the needed growth, but most are unutilized. While there are a number of factors contributing to youth unemployment in MENA countries—including a fast-growing youth population and rapid urbanization—one that stands out is that education does not lead to employment. In fact, unemployment is often higher among the more educated. As the MENA region becomes more connected to the global economy and fast-changing markets, educational systems are failing to provide youth with the necessary skills demanded by businesses, resulting in a severe skills mismatch between what employers want and what job-seekers can offer. Public universities continue to focus on preparing students for traditional and public-sector jobs instead of readying them for high-demand jobs in growth sectors or for jobs that will be created when technology affects traditional positions. The labor market is evolving, with a growing need for 21st-century skills that are enduring and that can be adapted and are transferrable. Among the most-demanded competencies are soft and work-readiness skills such as communications, teamwork, leadership, conflict resolution, client-orientation, professional ethics, and more recently, digital.

If provided with the right skills, young people could access available jobs and contribute to economic growth and job creation. Thus, there is need to improve their skills and employability through demand-driven, tailor-made training linked to increased labor market access.

EFE Emphasizes Skills Development

EFE has long noted the importance of skills development for labor market success and works to fill the existing gap. Through a well-established network of locally run foundations in Egypt, Jordan, Palestine, Morocco, Tunisia, Yemen, and Saudi Arabia—and global hubs in Madrid, Washington, D.C., New York, and Dubai—EFE provides unemployed youth in the MENA region with the skills and opportunities they need to build careers that create a better future for themselves, their communities, and their countries. At the same time, EFE helps companies find the talent they need to grow and create more jobs. In Algeria, with support from the Middle East Peace Initiative of the U.S. State Department, EFE also works with local partners to promote youth training and employment in the country.

EFE focuses on helping youth to thrive in their own home countries—with a special focus on empowerment of young women—contributing to sustainable economic growth and development.

At EFE we believe that talent is universal, but opportunities are not, and so we work to give talented but underserved youth a chance. I was born and raised in a small village in Southern Italy, where unemployment was the norm. Both my parents were young and unemployed, and the entire family depended on my grandfather's income as a farmer, until, after many years of fruitless search, my mother landed a teaching job 300 kilometers from home. Feelings of pride and joy were mixed with sadness of only seeing her during weekends. Growing up, I quickly understood the importance of employment, of thinking big, of supporting others. I was able to study in prestigious universities thanks to scholarships, and after I graduated, somebody believed in my potential and

offered me my first job. Since I joined the world of work I knew what my mission was: to help young people, especially those on the other side of the Mediterranean, have the opportunities that I did.

Since its inception in 2006, EFE has connected more than 72,000 young people (56 per cent of them women) to the world of work and has established more than 2,700 partnerships with local, national and international actors from the public and private sectors. While EFE affiliates offer knowledge of the local situation and execute program delivery, EFE's international offices provide links to global resources, expertise, and support that allow for economies of scale and learning that accelerates solutions to youth employment across the region.

EFE tailors its programs to each market and shares best practices across countries to maximize efficiency and impact, using a combination of online and in-classroom training. EFE has pioneered three types of training that are shaped by employer demands and link youth to tangible job and business start-up opportunities:

Pathways to a Job is a short-term program that covers such topics as resume-writing, interview tips and job-search techniques. It gives young people the tools and confidence to find a job. *Entrepreneurship* focuses on disconnected communities or those without job opportunities. This program prepares young people to become self-employed or start microenterprises. Following training, EFE connects graduates to follow-up support such as seed funding or mentorship. *Job Training and Placement*, EFE's flagship program, is dynamic and market-driven, focusing on soft-skills capacity-building, combined with sector-related technical training, with an emphasis on job placements in specific growing sectors. With an 80 per cent placement rate, EFE goes beyond training and ensures that young people are placed in jobs.

Demand-driven Methodology

EFE's success is owed to its tried-and-tested, demand-driven methodology, which sets the organisation apart:

- **Market Assessment and Partnership Building.** EFE's extensive experience in delivering training programs has highlighted the importance of focusing on specific sectors and investing in corporate outreach at the beginning of every project to tailor training to existing demand and achieve high job placement rates or business success. As a first step, EFE undertakes market assessments to map the sectors contributing to, or most likely to contribute to, growth and those that have the greatest potential for job creation, the most-demanded jobs, and, most importantly, the specific skills needed for each job and how these will evolve in the coming years. EFE meets with employer partners to break down skills and identify the required core and cross competencies to adapt its curriculum accordingly and best prepare youth for available jobs—at the same time securing pre-commitments to hire.
- **Curriculum Customization.** Following the market assessment and employer outreach, EFE customizes its existing curricula to suit employer needs and develop the capacity of beneficiaries to succeed as young professionals.
- **Recruitment and Selection of Beneficiaries.** EFE focuses on unemployed youth who are unable to tap into available resources to gain employment. EFE also emphasizes female trainee recruitment, targeting a minimum of 50 percent female participation rate. EFE finds beneficiaries through partnerships with local community-based organizations, employment agencies, career centers, universities, and its extensive social media networks (EFE has more than 500,000 followers on Facebook in the region). With some variation from country to country, the selection process involves interested candidates completing an application form, undertaking self-assessment tests, and participating in face-to-face interviews.

- **Training Delivery.** In a region where classrooms rarely reflect labor market reality, the challenge goes beyond creating and delivering programs that are valuable to employers. We need comprehensive and holistic programs that bring the workplace to the classroom. Instead of focusing solely on traditional teaching methods, EFE invests in e-learning and experiential methods, such as role-playing, mock interviews, and simulations. EFE also emphasizes private sector participation—including guest lecturers, mentors and other skills-based volunteers.
- **Job Placement or Entrepreneurship Support.** After training, EFE places these new highly skilled workers with employers who made the pre-commitment to hire them, For entrepreneurship graduates, EFE provides initial seed-funding, tool kits, and mentorship and/ or connects young entrepreneurs to sources of funding to start their businesses.
- **Monitoring and Evaluation.** EFE uses a comprehensive results-based monitoring and evaluation system that measures performance and outcomes, and enables ongoing learning. EFE collects baseline data before training, data after training completion, and then every three months after graduation for a year. Data is gathered through online surveys, phone calls, focus groups and in-class evaluations for feedback and evaluation of knowledge gained. The use of program data supports continuous improvement of programs, and informs planning, management, and execution.
- **Alumni Network.** EFE delivers full-circle services to youth, from training to job placement and business creation to alumni services that help in the post-employment and post-business establishment phase. All graduates are included in EFE's alumni network, which offers continuing support and education programs for professional development and civic engagement. These services play a crucial role in job retention and business success, in addition to supporting monitoring and evaluation efforts.

In the digital era, another distinctive feature of EFE's programs is the role of technology. Through a partnership with the management consulting firm Accenture, EFE is preparing for how the digital world will transform jobs and skills. The digital era entails new ways of doing things, and job-seekers and employees must be prepared to adapt and evolve.

We anticipate that jobs will be affected in three main ways. *Some jobs will have to be modified*, because almost all will require digital knowledge, including sales, cooking, manufacturing, health, and administrative staff. *Other jobs—such as data analysis and programming—will be maximized* and employees will need to develop and boost digital knowledge. Then there are *jobs that will be or already are being created* and will need employees with specialised digital knowledge, such as community managers, search engine optimization specialists, and digital communications experts.

The new skill “Be digital” requires openness to transformation, online, and digital identity. Young people will have to “Be digital” to be competitive. A young, well-prepared population has the potential to spur sustainable growth and development. Providing young people with the best pathway to transition from school to a decent job calls for effective education for employment programs that can help address the skills mismatch and meet the needs of young people, of businesses, of countries and of the region. High quality jobs will give workers access to social protection and basic services, and ensure equal opportunities regardless of gender, or socioeconomic, religious or political background.

Salvatore Nigro is Global Vice President of Education for Employment.

RADICAL IDEAS TO SCALE YOUTH CONFIDENCE AND INNOVATION

Sean Blagsvedt

Scaling confidence and creating innovation ecosystems are crucial to fighting poverty and stimulating economic growth. Yet, in many countries education, telecommunication, import, and immigration policies impede these goals.

This conflict between aspirations and policies struck me after my career with Microsoft moved me to India in 2004 and I came face to face with poverty in the subcontinent. My attempt to create a service to help Indians connect with jobs led me to consider a broad set of principles governments should embrace to cultivate confident innovators and modernize their economies, which I outline below.

India is a country of great promise and hope but also of great and visible inequity. The rich and poor in the United States are largely segregated, while in India they often live and work side-by-side, with slums adjacent to flats whose price per square-foot often exceeds Manhattan's.

This inequity—usually determined by birth—bugged me.

At Microsoft, I designed tools for hundreds of millions of mainly white-collar workers and I wanted to use these skills to address the unfairness I saw in Bangalore. The inspiration for how I best could do that came from a *research paper* by Duke University Professor Anirudh Krishna in 2006.

Escaping and Falling into Poverty

Krishna studied 3,000 families in Rajasthan, India, from 1978 to 2002. He found that a third of the people who were currently poor were not born that way. Poverty was not a relatively stagnant pool of unfortunate people. Instead large numbers of people escaped poverty, while an almost equally large number fell into it. In some regions, 19 per cent of the population came out of poverty but 20 percent joined the ranks of the poor—a net 1 percentage point change in aggregate poverty, but one that involved 40 per cent of the population.

The reasons why people escaped or descended into poverty were radically different. People usually became poor because of health-care related debt.

But good health alone does not permit most families avoid or escape poverty. One of the most common ways out of poverty, according to Krishna, was a different job (usually acquired on the strength of an individual's social network). The World Bank's "*Moving Out of Poverty*" corroborated this finding, adding to the list of important factors in class elevation: starting a successful business and, importantly, *confidence*.

After reading Krishna's work I realized that if we could digitize informal sector jobs, job-seekers, and, ideally, their social networks, we might be able to catalyze the escape from poverty.

I fell in love with the promise of such a digital intervention, quit my job at Microsoft in 2006 and spent the next 11 years building Babajob.com—with automated voice, mobile web, app, chat, and desktop features—to connect aspirational and often non-literate Indian job seekers with better-paying jobs.

In those 11 years, we registered over 8.5 million verified applicants and posted jobs from more than 500,000 employers. We discovered that hired job seekers reduced their commute times by 14 minutes per day and earned 20.1 percent more money. In 2017, we ultimately sold the company to India's largest classified site, Quikr, creating a combined platform of over 20 million job seekers.

It was an incredible journey and as I look back at Babajob's story, there are six ideas that I believe governments everywhere should embrace to improve their innovation environments, create more innovators, and scale confidence.

Progress Arises from Building on Top of the Best Ideas of Others. Babajob, like virtually every idea, was not a new one, but a new combination of existing ideas. In 2006, Craigslist in the United States had already been running a classified job website for several years. LinkedIn had shown how to build a social graph on the web. And callback ringtones had more than 100 million paying Indian consumers who navigated automated voice menus to choose their favorite song. At Babajob, we just assembled them in a novel way to help aspiring workers find jobs.

Perhaps the most important skill of the globally integrated future is to see interesting innovations elsewhere and add your small bit to them. Uber built on top of the Apple AppStore, Google Maps, and digital credit card systems to create a \$70 billion company.

This model of recombining the best innovations of others is as old as innovation itself. Scientists since at least the Enlightenment have shared their research with other scientists, who then built on it. Countless studies have shown how open societies thrive with new ideas and progress, while closed societies progress less.

And yet, most governments have not truly thought through all the ways they are limiting the modern world's best ideas from reaching their populations.

Cheap Mobile Phones and the Internet Are Essential. Most of the world does not have immediate, cheap, and ready access to the largest repository of ideas and innovations ever known: the internet. Without easy internet access it is difficult for one to find a better place to work, read journals, watch the latest videos, conduct video calls with global colleagues and know the news. It is essential to competition and to building world class ideas.

A quick comparison of worldwide data rates is sobering. Leaving aside purchasing power parity, the differences in the data costs by country are staggering. Based on 1 gigabyte per day consumption, figure 6 compares the costs of buying the cheapest prepaid 30 gigabyte per month data plan I could find in several countries:

India's Jio is 41 times cheaper per gigabyte than South Africa's CellC and more than 117 times cheaper than data rates in the United Arab Emirates. Moreover, when data costs as a percentage of household income are considered, India, Israel and the United States clearly have affordable plans while most MENA countries do not. Given the, essential nature of the internet—including its necessity for such other industries as mobile payments, job marketplaces like Babajob, and global outsourcing—this difference in pricing is crazy from a policy perspective. It's the same wrong type of policy decision that lets middle-class and lower-income people get by with terrible roads.

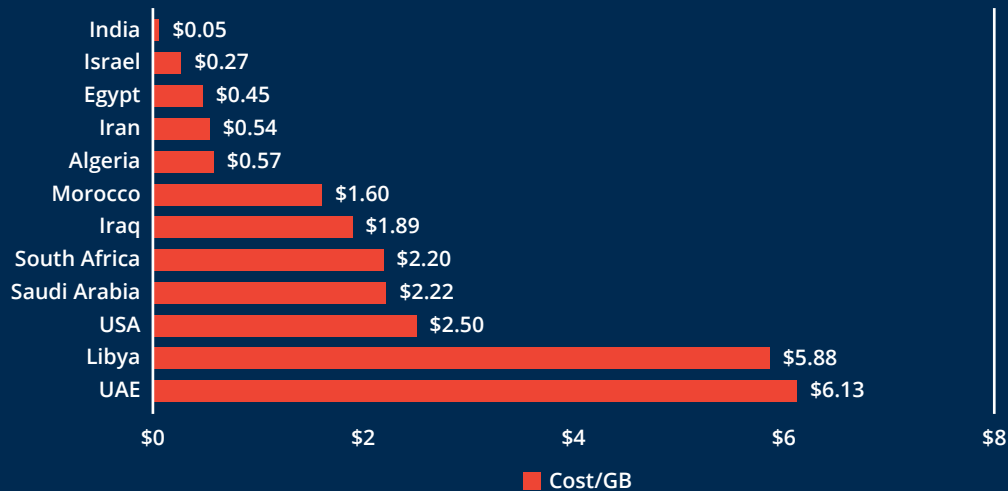


Figure 6:
Cost / GB Of
10–40 GB
Monthly Mobile
Internet Plans
by Country

Source: <https://docs.google.com/spreadsheets/d/1jB8U7uvo4eIPNE1Vv2dIX6hVVtcbLb3Zj4V4-IQz3oM/edit?usp=sharing>.

Country	Carrier	GB	Currency	Local price	Local: USD	Monthly cost	Cost/GB	Data costs vs Indi	% of income
India	Jio	42	INR	149	68.14	\$2.19	\$0.05	1.0	1.44%
Israel	Golan Telcom	30	Shekel	29	3.62	\$8.01	\$0.27	5.1	0.26%
Egypt	Egyptian Telecom	25	EGP	200	17.85	\$11.20	\$0.45	8.6	4.47%
Iran	Right Tel	24	Rial	550000	42566	\$12.92	\$0.54	10.3	2.87%
Algeria	ooredoo	30	RA	2000	117.39	\$17.04	\$0.57	10.9	2.60%
Morocco	Maroc Telecom	25	MAD	382	9.53	\$40.08	\$1.60	30.8	16.80%
Iraq	Korek	40	IQD	90000	1187.5	\$75.79	\$1.89	36.4	18.50%
South Africa	CellC	30	Rand	899	13.65	\$65.86	\$2.20	42.2	14.55%
Saudi Arabia	STC	24	SAR	200	3.75	\$53.33	\$2.22	42.7	3.19%
USA	ATT	22	USD	55	1	\$55.00	\$2.50	48.0	1.13%
Libya	almdar	10	LYD	80	1.36	\$58.82	\$5.88	113.0	11.03%
UAE	etisalat	20	AED	450	3.67	\$122.62	\$6.13	117.8	3.76%

Efforts to charge nothing for certain “socially positive” services have not driven down data rates sufficiently either. The most fun, and hence engaging, parts of the internet—like games, entertainment and video calls—are vital to build usage but will likely never be zero-rated. Zero-rating also flies in the face of net neutrality principles and makes the telecom operator the arbiter of what internet content should be cheap or expensive.

For countries looking to reduce their mobile data rates, there are alternatives. They can:

- *Provide free municipal Wi-Fi*, which could be effective and cost efficient in dense, urban slums and townships—though publicly supported Wi-Fi often pits the government directly against telecoms and hence is threatening to them.
- *Directly subsidize mobile bills* (assuming the government wants to support telco profits), as the U.S. Universal Service Fund does.

- *Invite disruptors.* India's Jio arose in some ways as part of a brotherly feud inside one of India's most well-connected billionaire families, but that rivalry has resulted in the lowest data rates in the world with all other carriers forced to match their pricing.
- *Shame providers.* It's time to publically embarrass telecoms—and their enabling government regulators—that charge data rates that are orders of magnitude above global competitors.

Make Sure Import Duties Are Low for Tinkerers and Startups. Software is a special thing. Software and information—unlike physical products—can be re-used and re-consumed instantly, anywhere, and usually with little cost (assuming cheap data rates). In my home city of Bangalore, a programmer has instant, usually free, access to the latest software innovations. Using sites like npm, he or she can quickly incorporate millions of reviewed, high-quality bits of free software packages into his or her project, add a few changes, and get paid to solve a customer's problem.

Now compare this process to Indian tinkerers or startups that want to leverage the latest *hardware* innovations. For example, the Bangalore startup NextDrop builds internet-connected water meters to enable governments and office parks to monitor water consumption in real time. NextDrop can find the parts it needs on alibaba.com in China, but would find it impossible to get next-day delivery. Moreover, customs officials often have no idea how to categorize the latest small batch technical parts and so often assess import duties of 50 to 150 per cent. Or parts are simply kept in port at the custom office for weeks or months.

These delays and increased costs put an Indian startup at a tremendous disadvantage to startups in Singapore, the United States, or Europe—where the latest parts can be obtained cheaply from anywhere in a day or two. Every venture creating any new hardware product or widget must go through scores of iterations before discovering what combination of parts can economically work in the market. Customs costs and delays massively encumber the speed of those improvement cycles.

The difference in tariff policy can partly explain the different states of the Indian software and hardware/manufacturing industries. Customs are not levied on “imported,” often open source, software. Software and outsourcing industries thrive. By contrast, the Indian hardware industry—whose every imported component is subject to tariffs and custom delays—lags tremendously other Asian countries. Babajob could function and react quickly as a website and service because we consciously decided never to have hardware dependencies.

The tariffs and other import barriers are often imposed to protect local dominant industry players and to nurture fledgling industries. But they stifle local innovation ecosystems that could be built on top of the world's newest and most innovative hardware products.

The solution? The government could impose near-zero tariffs and reduce custom delays for individual tinkerers and small businesses. Or it could explore volume-based tariffs that are minimal at low import levels but increase once a company buys a bigger quantity.

Compete for International Talent. The world's best talent has always had options regarding where to live. History is replete with examples of rich, open cities and countries that made immigration easy and attracted the world's best and brightest. For instance the United Arab Emirates and the United States (at least historically) have welcomed foreigners seeking to build better lives. In emerging market countries, immigration is often tremendously difficult, especially for foreigners who want to try to solve a local problem but have no family or business ties to the country. Often it is relatively easy for a private company's directors or investors to obtain a visa, while foreign employees have to spend weeks every year waiting at government offices and exiting and re-entering the country to satisfy visa requirements.

Top-ranked universities are brimming with *programs* to help students do meaningful work in social enterprises, but the immigration policies of most emerging market countries make hiring short-term students as employees difficult. At Babajob, hiring foreign research students was hard—even when they came with their own funding—because of government quotas on the number of foreign workers the company was allowed to employ and minimum limits on their salaries. Often after the students arrived they had to take off three-to-five days of work to visit various registration authorities.

Other countries are innovating in this area, giving financial incentives and easing immigration hassles for startups. *Startup Chile* is among the most generous programs to foreign startups, while France eases things for startups focused on climate change innovations.

Such programs create cosmopolitan, global communities. They allow local people to contribute to and learn from immigrant-run businesses and show that the best-run and most innovative businesses in the world can be operated at home.

Confidence Must Be Scaled. To tackle poverty, in addition to enhancing innovation, we need to scale confidence. Confidence is among the most important factors for success and yet, it is normally not thought of as an attribute and skill to be cultivated in school systems.

It's also delicate. Malcolm Gladwell explores confidence at length in *Outliers*, his book about many of the world's most successful people. He details the need for putting in 10,000 hours to master a skill and discusses the role of confidence in creating success. The environments we experience in youth matter tremendously. For example, over 90 per cent of Canada's hockey players are born in January because January 1 is the cut-off date for 6-year-olds to enter youth hockey clubs. Kids born in January are the oldest of their peers and have a distinct mental and physical advantage that plays out in their confidence in hockey. Children need to feel they are better than their peers to feel confident in a skill. Then they will put in the hours required to be great at it.

This phenomenon manifests negatively in later years among high-achieving students who enter science programs at elite colleges. As Gladwell discusses in *David and Goliath*, many students who enter science programs in these schools drop out, often because they lose confidence after facing strong competition in their peer group. Half of the students who were used to being at the top of their class are now below average and that hit to their self-esteem shakes them so badly that most end up studying something else.

At Babajob, we also discovered that only those with the confidence to interview many times for new jobs and often take the leap to a new field were the ones who earned more.

And so the challenge for policymakers is how to create systems such that everyone feels they can be great at something. Most educational systems do the opposite. In India, most 12th grade students take a standardized college entrance exam and the top students ("toppers") are recognized in newspapers and given access to the nation's premier universities. But virtually every 12th pass graduate is not a topper and there exist few opportunities to shine in alternative hierarchies.

Support Youth Clubs and Affinity Groups. Germany has an old tradition that appears to scale confidence. Most towns have a variety of affinity groups—such as mountain climbing, book, chess, or riding clubs. Children are encouraged to find one or two they like. They enter as novices and are taught by the older kids, the best and oldest of whom graduate out to university. With time, the younger ones improve their skills and end up mentoring the new, younger kids. Over the years, everyone finds that they can learn a new skill, teach it to others, and become the best in their community at something they really like.

The lesson seems clear: in addition to supporting traditional education, countries should support sports, drama, women's, and many different local youth community groups to enable everyone to realize they can learn a new skill no matter their school performance.

Take the Success Stories of Disparate Communities and Share Them with Those Communities.

Confidence and belief that a new path in one's life is possible is often limited by one's social networks. As Anirudh Krishna discusses in the *Broken Ladder*, sometime in their formative years youth who exit poverty often have a mentor who pushes them to study, connects them to financial aid, or exemplifies a novel professional direction. In particular, people tend to dream only as big as the people they know. For example, if everyone in my family and village works in farming, then it's highly likely that I too will choose to work in farming. But if there is a person from my community who becomes a teacher or works in an international call center, then the scope of what I can hope to become significantly broadens.

The Indian NGO, *Digital Green* extends this principle to encourage rural farmers to share and adopt better practices with their communities. The NGO's core insight is the local testimonial, in which farmers who successfully tried a new technique are video-recorded as the teachers and advocates for nearby farmers growing the same crops. Digital Green has shown that farmers are four times more likely to try a new farming practice advocated by their peers than they are from experts from the capital. Seeing someone like them risk their livelihood to try something new and succeed gives other farmers the courage to try as well.

Governments should amplify the success stories in many, disparate sub-communities so that people see how they too can realistically dream bigger and have the confidence to succeed.

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AN ARAB SCIENCE SPRING

Mussaad M. Al-Razouki

The Middle East once was a hub of scientific thought. But its importance has declined over the centuries and is now at its nadir. Although there are more than 220 institutions that funded, supported, and published nearly 1,500 significant scientific papers and registered over 30,000 unique patents in 2016, the Middle East and North Africa (MENA) region lags not only international best practices but best practices in nearby regions. The Arab World has produced but one Nobel laureate in science—the late Ahmed Hassan Zewail, an Egyptian-American scientist, who was awarded the Nobel Prize in Chemistry in 1999.

But brighter days are surely ahead for science in the MENA region (in which I include Iran and Turkey, although the World Bank does not). New accomplished minds and their collective wisdom should inspire a new generation of scientists, polymaths, scholars, and technology entrepreneurs in the region.

A portent of this brighter future comes from a recent report from the World Economic Forum, which places the United Arab Emirates (UAE) in the global top 10 in science and mathematics education. A reflection of this emphasis on science and math education, perhaps, was the 40-place jump (to No. 350) in the QS World University Rankings 2019 by the UAE's flagship institution of higher education—the United Arab Emirates University. Other MENA universities among the top 10 percent of the 4,300 global institutions in the QS rankings are King Fahd University (189), King Saud University (256), and King Khalid University (448) from Saudi Arabia; Khalifa University (315) and the American University of Sharjah (376), both of the UAE; Qatar University (332); and Sultan Qaboos University (450) of Oman.

Large Endowments

The multibillion-dollar education endowments of many Saudi Universities—including the world's sixth-richest, King Abdulla University of Science and Technology (\$20 billion), King Saud University (\$2.7 billion) and King Abdul Aziz University (\$1 billion)—portend progress. But these are the only three institutions in the region that announce the size of their endowments. More transparency is needed across the region—not only in terms of the size of economic investment in science, research and education, but more important, on the outcome of these large investments.

Fortunately, since the end of World War II science education has grown significantly in MENA universities—both quantitatively and qualitatively. Of the roughly 500 universities in MENA countries, almost half, about 220, offer programs in science. There is an average of 13 universities per country and an average of one university per 2.23 million people. Bahrain, with a university for every 360,000 people, Qatar (760,000), and Oman (930,000) have the highest concentration per capita of science universities. Approximately half of these science universities are located in just three countries—Turkey (62), Iran (35) and Saudi Arabia (30). Algeria, Egypt, Iran, Morocco, Saudi Arabia, and Turkey have more science universities as a percentage of their population than the MENA average.

Unfortunately, the link between local universities and industry, strong in many advanced and emerging economies, is weak to non-existent in MENA countries. This weak link is exacerbated by populations focused on consumerism and by feeble academic research requirements at many of MENA's universities and institutions specializing in science, technology, and innovation (STI). The symbiotic relationship between academia and industry has a profound effect on the scientific status of a country.

A strong relationship can be a potent tool for building an institutional research capacity, in addition to forming the central pillars of a national strategy that empowers the transfer of knowledge and technology from universities to corporate organizations. That knowledge transfer can encourage innovation and the competitiveness of both companies and the nations in which they are domiciled and, eventually, the entire regional economic system. The World Economic Forum's University-Industry Collaboration in research and development (R&D) ranks the average MENA country at 78 out of 138. Qatar, which ranks 10th, the UAE (25th) and Jordan (38th) are the highest-ranked MENA countries. Unfortunately, 10 of the 18 MENA countries are ranked in the bottom third of the world and seven of those 10 are in the bottom 15 percent.

Producing Employable Graduates

To foster a true knowledge economy, MENA nations must focus on nurturing special higher education programs that provide critical scientific skills training and improved science and technology teaching standards to prepare future for careers in scientific research and technology development. The production of employable graduates and promotion of all ways of teaching—including distance and open learning—must be a core tenet of MENA state policies. Both Qatar and Saudi Arabia have had phenomenal growth in the volume of scientific publications over the past decade. Many other countries in the MENA region have made plans to reduce their dependence on foreign workers by developing technical and vocational education with equal opportunities for men and women.

MENA as always been an area of strategic importance, from the earliest empires until today, because of its location and the wealth of subterranean natural resources—essentially oil, natural gas, and phosphate. The MENA region produces about a third of the world's oil—more than 30 million barrels (bbls) per day, about two thirds of which comes from the countries in the Gulf Cooperation Council (GCC). The region is also home to more than a third of the world's known gas reserves, mostly in the peninsula of Qatar. More than half of the world's phosphate reserves are in Morocco.

Recent international economic uncertainty and growing populism and nativism ensure that Middle East countries no longer can rely as heavily as they have on their natural resource endowment and imported technology. They must become more self-reliant in the area of science, technology and innovation (STI). Increased STI, together with increased STI education, should help mitigate global economic risk factors including population health, food, clean (fresh) water and energy security. MENA countries can also learn from the remarkable socioeconomic progress of countries such as Brazil, China, Japan, Korea, and Malaysia that came about in part from the development of STI-related sectors.

Need for Knowledge Economies

MENA governments that depend on both oil exports and scientific/technology imports are continuously calling for the development of knowledge economies, which facilitate the dissemination of technology. Indeed, a wide range of recent positive MENA initiatives link STI to socioeconomic development, most often in the field of energy. One example is the Zewail City of Science and Technology project in Egypt. It was announced in 2001, then floundered until it was revived in 2011. Others include the Masdar Institute, part of the Masdar City development in Abu Dhabi; the Kuwait Foundation for the Advancement of Sciences; and the Emirates Institution for Advanced Science and Technology, which operates Earth observation satellites. Each of these initiatives is considered a bright national star and several have regional aspirations.

But there are serious roadblocks in the region to development in general, including the STI sector. A significant portion of the MENA region is in turmoil. Syria, Iraq, Libya, and Yemen are considered by many to be failed states consumed by bloody civil struggles that caused untold damage to human life, physical infrastructure and, perhaps most importantly, to the intellectual development of an entire generation. In the largest global refugee crisis since World War II, 15 million people have fled their homes, many to fragile or economically strapped countries such as Jordan, Lebanon, Djibouti, and Tunisia.

The turmoil in Yemen has set that country's development back several decades. Blockades and repeated cycles of violence have made Gaza's unemployment rate the highest in the world, with GDP at only 40 percent of its potential. The relatively stable oil exporters—such as Algeria, Iran and the GCC—are grappling with low oil prices alongside chronic youth unemployment and undiversified economies.

There are some positive political developments. In Kuwait, Jordan, Morocco, and Tunisia, citizens are increasingly participating in the policymaking dialogue.

Government Inaction

There is another roadblock: government inaction across the region. Although many Middle Eastern heads of state committed to raising R&D spending (technically, gross domestic expenditure on R&D, or GERD) to 1 percent of GDP more than 25 years ago, not a single Arab country has reached that target. Geographically, the distribution of investment in knowledge across the world, and especially within the Middle East, remains unequal. The North America region still dominates globally, with 28.4 percent of world investment in public and private R&D, 26.4 percent in the United States alone. China has recently moved into second place with 20.4 percent; the pre-Brexit European Union is next at 19 percent and Japan is at 10 percent. The rest of the world represents 67 percent of the global population but accounts for 23 percent of global investment in R&D—of which the MENA region represents a mere 2.3 percent of that.

The share of GERD performed by the business enterprise sector (BERD) tends to be higher in economies with a greater focus on technology-based competitiveness in manufacturing, as reflected in their higher BERD/GDP ratio. Among the larger economies for which adequate primary and secondary data sources are readily available, the BERD/GDP intensity has risen noticeably in only a handful of countries—including the Republic of Korea and China and, to a lesser extent, in Germany, the United States, Turkey and Poland. At best, it has remained stable in Japan and the United Kingdom and receded in Canada and South Africa. Business investment in R&D is practically nonexistent across the MENA region.

In 2013, global GERD amounted to \$1.478 trillion, measured on a purchasing power parity basis, compared to \$1.132 trillion in 2007. The 30 percent increase was less than the 47 percent rise during the previous five-year period (2002–2007) but is still significant. Moreover, it took place

during the global economic crisis. As a percentage of GDP, GERD rose from 1.57 percent in 2007 to 1.7 percent in 2013.

Low R&D Spending

Unfortunately, R&D spending has remained low in most of the MENA countries, especially in the oil-rich economies, where high GDP makes it hard to increase GERD from an arithmetic perspective, even before considering unwillingness of both local governments and private national champions to invest heavily in R&D. The average GERD/GDP of the MENA region is 0.3 percent. The average for the GCC is even lower at 0.25 percent. Turkey (1.01 per cent), Morocco (0.71 percent) and UAE (0.70 percent) are the countries with the highest GERD/GDP ratios in the MENA region.

There remains much to be done in terms of the development of STI-related policies and sectors, which is an important first step that MENA governments must take to foster the growth of the so-called knowledge economy—one focused on novel technologies rather than hydrocarbon resources. An STI strategy for the MENA region must focus on improving science education in universities, enhancing scientific research capacity, increasing financial support for R&D, and fostering regional and international scientific and educational cooperation.

An online science and technology monitor should be established to follow the science and technology scene in most of the MENA countries and highlight shortcomings in implementation of a knowledge economy. This monitor should include a portal for research, development, and innovation activities and projects; a database of technological centers and universities; a directory of MENA scientists, technologists, educators and policymakers; science and technology indicators; and information on conferences, symposiums, and workshops in the MENA region. The strategy proposes setting up a network of science centers of excellence in the MENA countries to promote interactive approaches, excellence and innovation. The network would use selected outstanding technological institutions and research centers associated with universities in MENA region as regional hubs to facilitate cooperation through joint research projects, and to promote high-level training. The strategy urges MENA countries to increase financial support for R&D from the current 0.3 per cent of GDP to 3 per cent, with the private sector contributing 30 to 40 per cent of that.

This could be made possible by creating a pan-MENA fund for science and technology development, which could be supported by new financial mechanisms such as taxes and customs. The STI strategy should focus on national and pan-Arab higher education and research initiatives in 13 priority areas: biotechnology; life sciences; nanotechnology; information technology; clean water; food; agriculture technology, fisheries; space; energy; desert sciences; the environment; and renewable energy. The strategy should also call for greater mobility of scientists within the region and cooperation with international science, technology, innovation, and higher education organizations.

Harnessing Science and Technology

The MENA region must spearhead a strategy to harness science, technology, and innovation for both economic and social development by improving science education, upgrading and reforming universities, building research capacity, and encouraging international cooperation and collaboration. A good example is Masdar of Abu Dhabi, the region's most important locus of thought leadership in renewable energy. It has attracted powerful partners to the Emirati desert, including such companies as Credit Suisse and Siemens, which are cornerstone backers of the \$250 million Masdar Clean Tech Fund. Six leading research institutions—Imperial College, RWTH Aachen University, DLR (German Aerospace Center), University of Waterloo, Columbia University, and the Tokyo Institute of Technology—are all part of the Masdar Research Network.

There are other examples of the rapidly changing context for STI in the MENA region. The United Arab Emirates is investing heavily in space technologies, having committed \$5.4 billion to sending a UAE mission to Mars by 2021—to coincide with the 50th anniversary of the founding of the UAE. Morocco and Saudi Arabia are investing in development of solar energy. Egypt, Morocco and Tunisia have initiated wind energy project.

Unlike most regions of the world, the MENA region is rich in both human and natural resources. However, many of its countries lack the cultural and scientific transformation needed to achieve worldwide recognition in education, research, and economic productivity. Thankfully, there are several vanguard institutions creating a positive impact, kindling hope for a successful “science spring.”

Dr. Mussaad M. Al-Razouki is the Chief Development Officer at Kuwait Life Sciences Company.

SECTION FOUR ■ **DIGITAL AGRICULTURE**

TRANSFORMING MECHANIZATION ACROSS THE DEVELOPING WORLD

Van Jones and *Sarah McGraw*

Agriculture is a critical sector for countries across the Middle East and North Africa (MENA), but its potential remains largely untapped. Increasing access to mechanization in the region will enhance productivity and improve the livelihoods of the small- and mid-sized farmers who comprise the vast majority of the agricultural population.

Hello Tractor's experience in sub-Saharan Africa shows how a multi-party stakeholder engagement can increase mechanization and is applicable across the MENA region. Hello Tractor is an ag-tech company that connects tractor owners and smallholder farmers through a farm-equipment-sharing application. Founded in 2014, Hello Tractor is based in Abuja, Nigeria and is active across Kenya, Mozambique, Senegal, and Tanzania.

The Hello Tractor platform enables farmers to request affordable tractor services, while providing enhanced security and fleet management for tractor owners through remote asset-tracking and virtual monitoring. By organizing and digitizing the agricultural supply chain, Hello Tractor ensures that service delivery is efficient and profitable for tractor owners, allowing them to serve more smallholders and create equitable access to mechanization. We believe this will increase the utilization of tractors in smallholder markets, improving yields, strengthening supply chains, and enhancing income security across the continent. We estimate that by using the app, farmers can plant 40 times faster at one-third the cost.

Mechanization in the developing world will not play out as it has in the developed world. In markets dominated by smallholders, the average farmer is locked out of modern agricultural practices and technologies because of inadequate funds and a lack of access to financing. In short, farmers cannot afford to buy tractors.

Tractor Owners

In these markets, it is far more common for tractors and other farm equipment to be purchased by entrepreneurial men and women who view tractor ownership as a business opportunity. With some capital in hand, these contractors will purchase a tractor to provide service-for-hire to the local smallholder community. These businesses can be fairly successful within a targeted area, but widely dispersed farm plots make it difficult to provide service on a broader scale. As the number of tractors multiplies and owners seek new customers to offset costs, operating the business

profitably becomes more complex. A small-scale tractor owner looking to grow may first aim to hire additional tractor operators and repair technicians. Owners may also seek to hire salespeople to find additional customers. However, over the long term, linearly increasing staff will not drive efficiencies or produce a scalable operating model suited to last-mile farmers who have traditionally lacked economies of scale. Hello Tractor's technology and user-friendly platform aims to solve this asymmetry.

Our solution begins with a low-cost hardware device that can be installed on any tractor, connecting it to the Hello Tractor cloud for remote data tracking and analytics. This durable, adaptable device is designed for rugged use and extreme weather conditions. It is fitted with an international SIM card for higher connectivity, but can store data locally if no connection exists.

Once the device is in place, data is transferred to Hello Tractor's mobile applications, where it is displayed in a user-friendly format. Tractor owners purchase the monitoring device and a monthly subscription to our Tractor Owner app, ensuring complete visibility of asset location, activity, maintenance needs, and operator activities. The app includes a suite of tools to enhance a tractor owner's business and operations—including booking management, fleet management, operator performance, daily activity reports, and weather forecasting.

Booking Agent App

Hello Tractor has also created a Booking Agent app that integrates seamlessly with the tractor owner app and allows rural entrepreneurs to serve as a liaison to farmers in need of service. Hello Tractor works closely with booking agents, providing training on how to identify and build demand, use the app to aggregate service requests, and capture the data needed to pair bookings with tractors.

Hello Tractor's ability to expand a tractor's area of service, help owners grow their business, create new employment opportunities, and enable farmers to earn more and grow more is best demonstrated through our customer case studies.

The *Tractor Owners Hiring and Facilities Association of Nigeria* (TOHFAN) is a member-driven tractor management organization composed of tractor owners, mechanics, and agents. Agents act as an on-the-ground sales force for owners, who lease their tractors to TOHFAN to be managed remotely by its leadership team. In 2016, TOHFAN had approximately 250 tractors under management across a number of states in Nigeria. As agents identify demand, tractors are deployed from farm to farm based on rainfall patterns and the number of farmers requesting service, sometimes traveling up to 400 kilometers between plots. As TOHFAN's model grew in popularity, the organization faced increasing challenges in managing the ever-growing number of tractors in its portfolio.

Traditionally, TOHFAN relied on makeshift car-tracking devices to monitor its fleet. Widespread dead zones with no connectivity and highly limited monitoring capabilities resulted in incomplete and ineffective records. This created significant operational and security concerns for the company, whose base in Kaduna is upwards of 11 hours away from areas where its tractors work.

Doubled Tractors under Management

In 2017, TOHFAN approached Hello Tractor to help improve management of its fleet. After incorporating our technology and services into its operations, TOHFAN immediately benefited from the ability to track each asset's activities and location in real time. Not only did this give TOHFAN's leadership peace of mind, it allowed them to identify areas for improvement. With Hello Tractor's help, in just one-year TOHFAN efficiently and effectively doubled the number of tractors under management.

Recently, another customer, *Atman Corporation*, was surprised to learn that falling sales would force its primary diesel provider to close. Atman could not understand how this was possible, given its own level of purchasing. Using Hello Tractor's technology, Atman analyzed its historical

tractor activity data and quickly discovered that a few of its tractor operators had stolen diesel from Altman's tractors and re-sold it—stealing customers from the diesel supplier. Atman's ability to use Hello Tractor data to tie production with consumption ultimately enabled the company to identify and correct the problem, allowing the diesel provider to stay in business.

Hello Tractor's technology continues to provide Atman with a greater sense of comfort and security, regardless of how far away its tractors may be. Over time, this has allowed Atman to avoid unnecessary costs and to expand to new locations—all with the goal of providing service to more farmers. As Atman's executive director, Seyi Oyenuga, put it, "Hello Tractor meets the needs of our business and has a local understanding of Nigerian constraints. We are saving money and can invest more in agriculture while limiting our risk."

Creating Connections

Technology is not only critical to tractor management, but also to creating connections between farmers who require service and tractor owners who can provide it. Our experience has shown that many farmers we want to serve are not comfortable with app-based technologies. Our commission-based booking agents—primarily young people from rural farming communities—help bridge this gap. They perform critical market-aggregation, ensuring that idle tractors can connect to farmers desperately in need of service, all while earning a sustainable livelihood they otherwise might not have achieved.

Working with an agent, a farmer can enter a booking request, have his or her land GPS-located and sized, and schedule the required service. As bookings are entered into the system, our technology aggregates them into groups that are profitable for tractor owners to service. While the economics of serving the average 1-hectare farm may not be attractive, 40 to 50 collective farms within a 20 square-kilometer area represents a serviceable market. Immediate value is created—for the farmer, our booking agents, and our tractor owners.

Consider Blessing Agu—a young woman in her 20s from a farming community north of Abuja, Nigeria's capital. Thanks to her efforts, more than 250 farmers within her territory are connected to tractor service. Blessing earns a 10 per cent commission, but more important, she says, is the ability to help farmers in her community thrive.

Or take Alhaji Auwalu Rabah—a young man from Northern Nigeria near the border of Niger. Before becoming an agent, Auwalu performed small jobs around his community, often struggling to find sufficient work to make ends meet. Now, as a Hello Tractor booking agent, Auwalu earns \$200 per week—considerably higher than the national minimum wage of \$50-a-month. Recently, Auwalu shared that his earnings helped him pay for his wedding.

Mechanization Challenges

We believe Hello Tractor's technology and insights can catalyze and advance the emerging, innovative models being crafted to address mechanization challenges across emerging markets. John Deere, the U.S.-based farm equipment manufacturer, recently signed an agreement with Nigeria's Federal Ministry of Agriculture and Rural Development to bring 10,000 new tractors to the market over the next five years. As part of this deal, Hello Tractor will help implement a pay-as-you-go (PAYG) model in close coordination with top stakeholders across the public and private sector—including commercial banks, private tractor service providers, dealers, and small to medium scale farmers.

Pay-as-you-go allows capital investments—like tractors—to be financed through current revenue rather than borrowing. Under this PAYG model, the Nigerian government will lease tractors to new owners for a defined period, before allowing the assets to be re-sold at a discount. By the end of the five-year partnership, the project is estimated to bring 9 million hectares of land into

production, produce 37 million metric tons of additional food and create more than 2 million direct and indirect jobs. Hello Tractor's technology will be instrumental to its success, by providing enhanced security, tracking capabilities, and accurate value prediction. With our monitoring capabilities and management tools, private- and public-sector players leasing tractor assets can continuously monitor usage, assess farmer impact, receive alerts when service or repair is needed, enforce good governance, ensure safe use, and predict asset value changes.

In addition to working closely with individual private sector tractor owners and agents on the ground, Hello Tractor is often called upon to bring transparency, efficiency, and clarity to projects managed by governments and multilateral organizations. In Nigeria, we are working on a project called FADAMA (a Hausa word for irrigable land). The project, supported by the World Bank, takes a community-based approach to supporting clusters of cassava, rice, sorghum, and horticulture farmers. The project is now in its third phase, with Hello Tractor supporting efforts to help farmers' access tractor service-for-hire across several states. The data on this platform can be used by all stakeholders to enhance decision-making and strategic-planning.

The greatest lesson we have learned over the past several years is the importance of integrating technological and local intelligence into efforts to expand access to mechanization. This is applicable in MENA, as well as developing regions around the world. The software revolution has permanently changed agriculture—and with the right strategy in place to implement smart farming responsibly, effectively, and equitably, the change will be for the better.

Van Jones is Head of Strategy and Sarah McGraw is the Growth and Partnerships Fellow at Hello Tractor.

USING ARTIFICIAL INTELLIGENCE TECHNOLOGIES TO FIGHT PLANT DISEASES

Simone Strey

Agriculture faces myriad challenges. Climate change produces new and extreme environmental conditions. New resilient crops demand innovative management practices. Rapidly changing global markets can make it difficult to earn a living on cash crops—especially for the family farmers, who own the bulk of the world's farms.

Between 15 and 30 per cent of the global harvest is lost annually from plant diseases and pests—threatening the survival of subsistence farmers in many countries. Often, the knowledge for fast detection and treatment of plant damages is missing on the ground, which leads to expensive and resource-intensive disease management.

These issues led us at the *Progressive Environmental and Agricultural Technologies* (PEAT) to create *Plantix*, a mobile crop advisory app for farmers, gardeners, and the extension workers who help farmers follow best agricultural practices. With the help of machine learning (artificial intelligence, or AI) *Plantix* can diagnose plant diseases, pest damages, and nutrient deficiencies affecting crops and can also offer corresponding treatment measures. Users can participate in an online community to network with other farmers, discuss plant health issues, and access their local weather reports.

Machine learning and connectivity are among the most important developments in technology for the next millennium. Information, communication, and technology are crucial to progress in agriculture. But such advances should not be intended solely for individuals. They ought to serve society as a whole. *Plantix* bundles farming know-how from around the world and makes it accessible to every farmer, wherever he or she lives. For this reason, *Plantix* makes an important contribution to sustaining global food production.

A Brazilian Genesis

The genesis of the *Plantix* app goes back to 2014, when I and other members of the team that founded PEAT were investigating soil conditions in the Brazilian rainforest in the northern state of Pará. The local farmers had a unique problem: Their grazing grasses died from a fungal infestation they called *morto subito*, which translates to “sudden death.”

The farmers asked the science team if they knew what they could do about it. But *morto subito* wasn't a term the scientists had heard and an initial internet search for *morto subito* turned up

information unrelated to plant diseases—such as images of car accidents. But in a deeper internet search, in which we explored and compared underlying symptoms, we discovered that the grazing grasses suffered from *phytophthora fungi*, the scientific term for what the farmers called *morto subito*.

This was the initial spark. We recognized the lack of clear common information, especially uniform names for plant diseases. After all, the term, *morto subito* might have thrown us, but *phytophthora fungi* did not. It is a fairly well-known cause of blight (although now thought to be closer to algae than fungi). This confusion, lack of information, whatever, persuaded us of the need for a database that contains an overview of all possible plant diseases. And that set us off on the path to where we are now. In 2015 we founded PEAT, then created Plantix, the mobile app that contains the largest plant disease database there is.

Acting as Extension Agents

Plantix is primarily aimed at reaching the millions of farmers in emerging countries—where, because we have such an extensive base of crucial crop information, we can act as extension agents in areas where they are in short supply. One of mankind's biggest challenge is food production. If the global population keeps growing at today's pace, by 2050, the world will need to increase the food production by 70 percent.

Up to 30 per cent of the worldwide annual yield is lost because of plant diseases and pests. Family farmers (or about 500 million people who operate what are essentially farms with less than 2 hectares of land) are most affected by yield losses through pest infestation, nutrient deficiencies, and plant diseases. Their general productivity is hit hard by these yield losses. In developed countries, large-scale commercial grain producers have almost reached the limit of attainable yields. But farmers in Africa, where farms are largely small, reach only a tenth of the yield per hectare as farmers in Europe.

Imagine you are a farmer, living in a rural area—say in India, Mexico or Brazil—and you rely 100 per cent on your harvest for your livelihood. Now imagine that you come to your field one day and find that there is something terribly wrong with your crop and you have no clue what it is. And there is nobody who can help you. That is the reality for millions of farmers.

To deal with problems like this, we integrate the latest technologies into agriculture, one of the oldest and largest industries in the world. And the fact is that every disease, pest, or nutrient deficiency leaves a specific pattern on a plant, which allows us to create a powerful diagnostic tool based on pictures of the diseased plants users send us via the Plantix app.

We use machine learning for an automatic image recognition to detect the disease patterns. In so doing, we train powerful digital plant experts. We implement these algorithms into our Plantix app and in the process create a self-reinforcing system. In other words, each picture our users send us is entered into our database and based on these countless images and data, we train our networks to become smarter, more comprehensive, and more precise with each input. This means our networks can provide instant and individual diagnostics to our users. As a result, Plantix delivers a highly customized solution for every farmer using the app.

In addition to our artificial networks, our users can participate in our human network, in which more than 500,000 farmers from all over the world exchange information about local and global issues related to crops.

Weather Affects Yield

It is not only diseases that affect crops and crop yields. The weather is an important variable as well. It affects harvesting and the timing of chemical applications designed to fertilize and fight disease. Moreover, weather creates conditions that foster the occurrence of some diseases. Plantix

has a weather function that offers the farmer a reliable early warning system. Farmers tell us which kind of seed they want to plant and we tell them when to fertilize and harvest and when to take preventive measures to avoid infections.

To offer farmers holistic support, we plan to integrate a new feature: a crop calendar. That will enable a farmer to know exactly what to do and when to do it, from the seeding to the harvest.

Every time Plantix is used, it produces real-time data that we track. What interests users? What problems do they have? With the GPS and the time stamp from each image, we know where diseases occur and how they spread. This gives us new insights into the spatial distribution of plant diseases and pests.

Plantix is available in nine languages—Arabic, English, French, German, Hindi, Maharathi, Portuguese, Spanish, and Telegu. Algeria is the third-biggest user-country (after India and Brazil), which indicates how open Algerian farmers are to new technologies. Farmers in Algeria have uploaded 50,000 images; more than 30,000 have begun to use Plantix since the beginning of 2018 (see map). The heavy use of Plantix in Algeria indicates the farming community's openness towards new technologies. And it suggests too that Plantix could be a valuable tool for agriculture in other countries in the Middle East and North Africa region.

In a nutshell: we produce unprecedented knowledge with incredible speed.

We know which crop is grown where and when. We know which plant, in which region suffers from which disease. And we know what can be done about a disease—and as importantly, what can be done to prevent it. In fact, through Plantix we know the global demand for agricultural inputs such as fertilizer, chemicals, and seeds.

Simone Strey is Chief Executive Officer of PEAT.



Every red dot is one picture we got from our Plantix users in Algeria.

FACTS FROM SPACE THAT FEED THE WORLD

How Satellites Improve Agricultural Production and Facilitate a New Economy

Maurits Voogt and **Mechteld Andriessen**

To meet global demand, agricultural production must increase by nearly 50 per cent by 2050. But a significant portion of global food production takes place in regions that are already prone to drought. In many parts of the world, the water resources available to produce all the needed additional food, will be diminished further by the effects of climate change. Improved logistics and reduced food waste will help make up the increase in food available to meet that demand. But they will not be sufficient. It is clear that to feed the world in 2050 both land productivity (crop output per hectare) as well as water productivity (crop output per cubic meter of water) must increase. And it is in improving land and water productivity that new technology can play a vital role.

The pace of technology development is increasing, and different data sources are increasingly linked in what has been dubbed the fourth industrial revolution. *eLEAF* sits in the middle of these developments and creates satellite-based solutions for the agricultural and water management sectors. *eLEAF* has demonstrated real impact on improving productivity by employing its tools to optimize crop production using less water. Our goal is to play a role in increasing land and water productivity worldwide.

Using Satellite and Weather Data

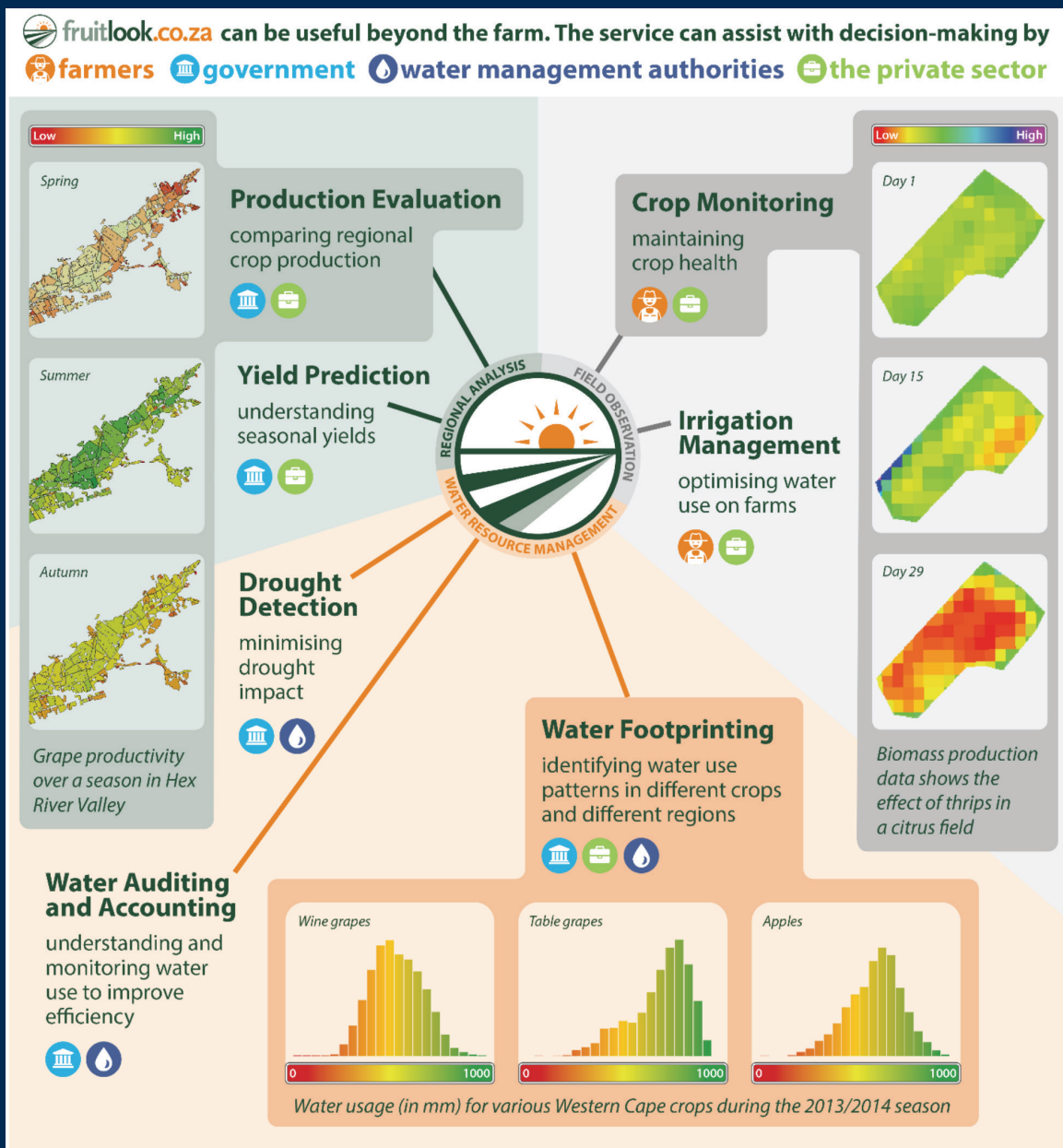
eLEAF's data and services are based on its PiMapping® technology, which transforms satellite data and weather data into relevant information on crop and water parameters for every pixel on the earth's surface. This technology allows us to see from space what the crop production is in a certain area, how much water the crop has used to get to its current level of maturity, and whether there was any water stress during the growing process. A number of dedicated information services have been developed based on PiMapping® data—such as crop monitoring tools, irrigation planning, yield forecasting, drought monitoring, and water management tools.

A number of organizations have found *eLEAF* useful—including the government of Western Cape in South Africa, the UN Food and Agriculture Organization (FAO), and the European Space Agency (ESA), which is leading the Earth Observation for Sustainable Development (EO4SD) initiative.

Among those dedicated information services are:

- FruitLook.** In the South African Western Cape province, water availability is limited and has forced the government to implement drought water restrictions throughout society. This has a severe impact on the agricultural sector in the Western Cape. To sustain the commercially important, but heavily water-dependent fruit-growing sector, the Western Cape Department of Agriculture decided in 2010 to invest in *FruitLook*, a web-based platform that runs on eLEAF's PiMapping@data.

FruitLook provides farmers and other stakeholders with field-specific weekly updates on crop performance and related water consumption and water stress. Access to such information helps farmers make better decisions on farm resource management, which will lead to more water-efficient crop production and savings. eLEAF's FruitLook portal is still operational

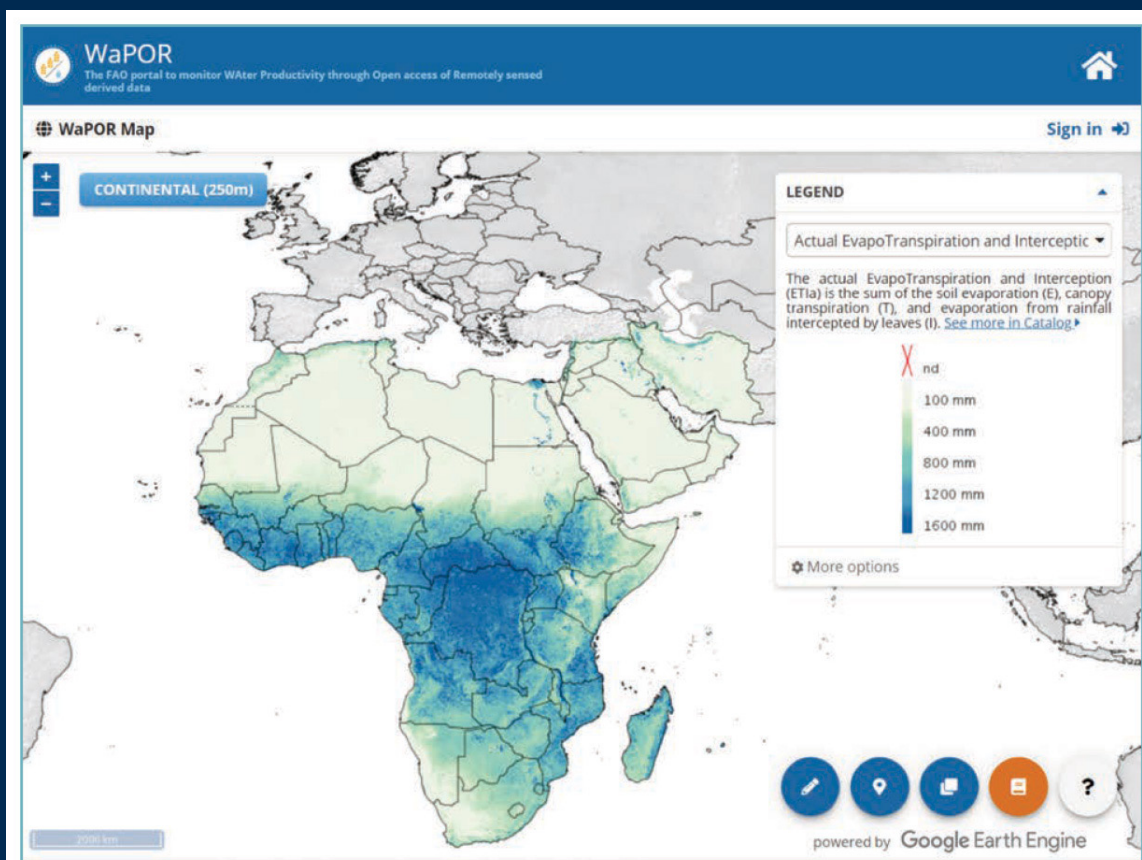


and used by many farmers, consultants and water managers to optimize their operations. More than half of the users of FruitLook reported an increase in water productivity of over 10 per cent.

- **FAO's WaPOR.** The FAO is a pioneer of the concept of water productivity. Throughout the years, the FAO has appreciated the enormous potential of satellite-derived information to monitor water productivity in a scalable, consistent, and objective manner.

In 2016 FAO launched *WaPOR*, the Water productivity open-access portal, which provides satellite-derived information on water productivity covering Africa and the Middle East. FAO approves the data and publishes it on its portal. eLEAF is leading the consortium that provides this information in a database that covers 2009 to the present. The WaPOR dataset can be used by anyone without restrictions for consultancy services and to devise applications and solutions that support farmers, water authorities or research organizations. WaPOR catalyzes the development of new initiatives and economic activities.

- **EO4SD.** Earth observation based services for agriculture in the context of the sustainable development goals can help local and regional projects and programs. This is recognized by the multilateral development banks—such as the World Bank—and their client countries. They harness the benefits of earth observation in their operations and resources management. The *Earth Observation for Sustainable Development (EO4SD)* initiative is funded by the European Space Agency (ESA), and eLEAF is leading its agriculture and rural development cluster. EO4SD brings together ESA, multilateral development banks, client countries, and European industries and knowledge institutions. Together they work towards mainstreaming the uptake of



satellite-based services to support international development—by providing a suite of earth observation-based services and by organizing capacity building and communication activities. Within the EO4SD initiative, demonstrations are being carried out in the Sahel belt, Ethiopia, Burkina Faso, Morocco, Uganda, Cambodia, and Bolivia. These demonstrations are executed in collaboration with the World Bank Group, the International Fund for Agricultural Development, the Asian Development Bank and the Global Environment Facility.

Government Role

Governments must play an important role in the development of a new economy for the Middle East and North Africa (MENA). The current situation of agriculture, water management, and data sciences provide ample opportunities in this region. The role of governments is twofold.

First, they *should create an entrepreneurial friendly climate that stimulates a generation of young entrepreneurs to start their own business*. Governments can support startups by providing subsidies and innovation-acceleration programs. Governments can also help by purchasing earth observation-based services from the private sector.

Second, governments *should democratize data*, which allows citizens and companies to have access to relevant information and solutions, including satellite-derived crop information. The provincial government of the Western Cape and the UNFAO have seen this need and proactively invested in data-access initiatives, which have had a substantial impact.

In an era of increasing population, changing diets, and climate change, technology plays an important role in food production. Moreover, the fourth industrial revolution provides ample opportunity for local entrepreneurs to develop tools and services specific to the MENA region. Available datasets can be used to optimize farm management resulting in higher land productivity and water productivity. eLEAF is one of the companies that demonstrates how to build an impactful business. Startups in the MENA region can follow eLEAF's example and make use of the opportunities the current era provides.

Maurits Voogt is Managing Director and Mechteld Andriessen is Account Manager, Projects, both at eLEAF.

CIBO'S QUEST TO SOLVE AGRICULTURE'S BIGGEST PROBLEMS

Maria Claudia Pachon

CiBO started with a wild question from its founders: could we develop a platform that allows us to know what is growing and what could be growing at any given time on all agricultural land, whether developed or undeveloped? If so, we could develop the ability to solve some of the biggest problems in the agriculture value chain—including food security, sustainability, profitability, waste, and quality of both food and the environment.

We discovered early on that the answer to this question requires a combination of skills and knowledge—science, data, and software—that is rarely found in one place, and that rarely speak the same language.

So we assembled a software and data science team that partners with scientists in different disciplines to solve those problems. This team has built a technology platform that helps us understand the potential of agriculture production. By simulating millions of scenarios in near-real time, we can work with our clients to unlock invaluable insights that can unleash sustainable agriculture and help them innovate.

Key Lessons

CiBO began operations in 2015 as a partnership between Bruno Basso, an Italian scientist and professor at Michigan State University, and Flagship Pioneering—a venture capital company based in Cambridge, Massachusetts, that has developed more than 100 scientific enterprises. CiBO Technologies is one of Flagship's earliest investments in agriculture. It has not been an easy path and we have had to pivot several times in our short life. But we have learned three key lessons:

- *Don't underestimate the value of continuously questioning where you are going and the potential of your product.* We are a “child” of Flagship Pioneering's VentureLabs, where ideas are relentlessly questioned until they either thrive or die. As we develop our products, we always ask tough questions, and are always on the lookout for opportunities to grow.
- *It is essential to hire diverse and experienced people.* We have built a team from all walks of life—among them, successful Silicon Valley startup companies, traditional software companies, and large agribusiness companies. We hired experienced engineers and developers, industry

experts, and highly trained scientists. It takes a world-class multidisciplinary team with grit, passion, and purpose that is willing to fail and thrive at the same time.

- *Investors who are fully committed to your mission and vision are necessary.* CiBO has active investors—including Flagship, which continues to be our lead investor—and, more recently, Generation Investment Management, a venture capital company dedicated to investing in sustainable companies. Our investors believe in our dream; they not only have dedicated financial resources to help us succeed, but continue to invest time to help us improve our products and our culture.

Have passion, purpose, and be relentless and know when you need to pivot. These qualities will keep you running when nothing else does.

Science-driven Software

At CiBO, we build science-driven software to simulate the complexity of agricultural systems. By taking a scientific approach to understanding agriculture, we look into the functional relationships between genetic traits, environmental conditions, and management practices—which are continuously interacting. Companies struggle to solve specific problems that require the ability to understand what is and what can be true of agricultural systems. CiBO partners with them to provide insights into these systems and deliver significant economic and environmental value. We seek to build a science-based software platform that can become a global simulation engine for agriculture.

Our platform integrates four key components: computational agronomy, which can simulate agricultural ecosystems; data generation; data analysis and visualization; and a simulation engine.

The platform allows us to:

- Determine what crops to plant, when to plant them, where to plant them, and how to plant them,
- Optimize the use of scarce natural resources,
- Minimize the impact on the environment.
- Maximize agriculture productivity for the benefit of people and the planet.

In practice, our platform uses a systems approach to understand sustainable agriculture. By analyzing the complex biological relationships among plant genetics, the response of plants to specific environmental conditions, and the management and agronomic practices used for each crop, we are able to understand how each plant responds to each factor that affects its growth process on a daily basis. We have tested our platform on different types of crops—annuals and perennials—in 46 different geographies.

A Mix of Specialties

Our approach combines computational agronomy with advanced simulation, data generation, and analysis. Plant biologists, soil scientists, and agronomists contribute their scientific understanding of agricultural systems—from plant and soil knowledge to the broad factors like weather that affect them. Then software engineers and data scientists add their mathematical and statistical rigor to create a powerful, globally scalable modeling and simulation capability that can answer complex questions for customers across the agricultural supply chain. We live in the intersection of science, software engineering and data science. CiBO's approach uses massive computation capabilities to combine and enhance historical research with current data sets that refine and improve our models, employing machine-learning algorithms. Our models are based on an understanding of the behavior of every component of the system.

We use this software to solve customer problems. CiBO Technologies was born out of a desire to disrupt traditional agriculture, transforming it into a climate-smart sector that minimizes its harmful effect on the environment—contributing to improving the current conditions of Earth. In 2016, we began to commercialize our products and develop customized solutions for our clients.

We can use this approach not only to predict crop yields or suggest management practices for farmers, but to finally solve some of agriculture's trickiest issues. We can work with agribusiness companies to streamline and turbocharge their pipeline for developing new plant genetics. We can help big food companies overcome supply chain volatility. We can partner with governments to develop effective food security strategies. We can help donor organizations evaluate the effectiveness of international aid.

We partner with public sector organizations and some of the world's largest agribusinesses to customize solutions to answer such difficult questions as:

- Where and how will a new seed variety perform under climate change scenarios?
- What would be the most impactful crop for developing the agriculture sector?
- How do extreme weather events affect agricultural productivity in areas highly vulnerable to climate change?

Solving Problems in MENA

Our technology can be used to deal with problems that are high on the agenda of the Middle East and North Africa (MENA).

For example, we have developed a product—piloted in Yemen—that leverages our platform capabilities to reconstruct agricultural scenarios. We used our computational agronomy platform to build, customize and create models of agro-ecological systems for five of the key crops in Yemen—maize, chickpeas, barley, wheat, and millet.

Using our simulation engine, we mimicked those systems, and where data was scarce or unavailable, we used our modeling capabilities and such sources as satellite imagery and computer vision and data science methodologies to reconstruct agriculture environments. We used our simulations to evaluate crop performance and how crops responded to constraints in water availability and on fertilizer use. The goal was to find the scenarios under which yield was maximized and to understand the trade-offs of different policy interventions. We were able to provide insights on expected nutritional value and potential for income generation under various production scenarios.

Our analysis platform helped us visualize the results and layer additional socio-economic and geospatial information to improve the availability of near real-time information for decision-making. This approach can help governments think about how they reconstruct or transform their agriculture sectors into a higher value and diversified agriculture system. It can also help them develop investment strategies that both increase yield and consider the effects of changing environments.

Research and Development

Private companies, research institutions, and government agencies are researching and developing new agriculture products and spend millions, probably even billions, of dollars developing them or adjusting them to specific characteristics. Under the increasingly constrained environments in the MENA region, particularly water availability and climate variability, our technology provides invaluable insights into what can be possible.

We can partner with any research organization or government agency to unify, digitize, and improve research and field testing data (from early discovery to commercial trials) to enable better, more cost-effective decisions. Using environmental characterization, which permits us to use

variables such as weather and soil to determine potential productivity, we can help our clients plan and improve field trial site selection to identify the appropriate environments to test local products. We can provide real time trial analysis and in-season simulations to understand product behavior and shorten the research and development pipeline.

These capabilities can be developed for controlled environments (for example to help countries like Morocco grow high-value agriculture products in greenhouses) or for actual field trials across the region. Simulations can be especially useful for some sub-regions in MENA where conflict or lack of infrastructure make it difficult to carry on extensive research trials.

While testing for a new biotechnology product that targeted water use efficiency, one of our customers struggled to identify interactions with environmental variables. We developed a platform that can test how genetic traits in specific crops and geographies respond to different levels of water stress (for example how a product reacts in drought prone areas), and how to design and test drought tolerant seed treatments virtually—cutting the R&D testing process by several years. What we did was provide additional insights by running various scenarios to answer questions about product potential.

Quick Scenarios

Our simulation engine has the ability to quickly run scenarios on customized product models to compare genetics, environmental characteristics, and management practices under various scenarios. We can evaluate hypothetical scenarios across diverse geographies and see connections, for example, between crop performance and precipitation before planting, and in-season heat stress and water stress.

Not only do we have the ability to evaluate “actual” data, but also to hypothesize theoretical capabilities or scenarios in the future. For countries like Algeria, and more broadly the MENA region, with increasing water constraints and a limited amount of arable land, we can test different hypotheses and simulate optimized scenarios for different crops under different water scenarios and quantify the impact on potential yield.

More recently, we have been working on how to improve and customize content for large government run extension services that bring best practices information to farmers. By partnering, with organizations that have a local presence, we can, for example, use our environmental characterization capability to understand the specific conditions and characteristics of sub-regions, and tailor advice for farmers based on specific soil, weather, crops and management practices. We can also give extension service agents real time access to information that is constantly updated to reflect the latest developments in weather and resource availability. They can provide more up-to-date information to their clients and recommend specific products that may improve productivity. They also can put information from their clients (including images) on the digitized extension platform that can alert other clients about pests and diseases.

With this lens into all that is possible, we can find ways to optimize the world’s most decentralized industry and develop an agricultural system that feeds and nourishes people and keeps ecosystems healthy. We can move beyond only focusing on yield optimization, and look at how to improve soil health, sequester carbon, and keep nutrients from going into waterways.

Someday, our computers will have a virtual simulation of the entire agricultural system. Put another way: If we can imagine it, we can model it. If we can model it, we can test it. If we can test it, we can understand it. And if we can do all of this at scale—and we can—we bet that we can transform it.

Maria Claudia Pachon is a World Bank Staff who was on an external assignment as an Engagement Manager at CiBO Technologies.



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