Europe Should Embrace the Data Revolution

By Paul MacDonnell & Daniel Castro | February 29, 2016

Data-driven innovation is unlocking new opportunities for Europe to grow its economy and address pressing social challenges. While Europe has achieved some early successes in data-driven innovation, including in areas such as education, energy, environmental management, health care, open data, smart cities, and smart manufacturing, it has not yet come close to reaching its full potential. The primary obstacle is that Europe's policymakers, both in its capital cities and in Brussels, have not yet fully embraced data-driven innovation as a core driver of economic and social progress. To inject new leadership into this debate, Member States should appoint national chief data officers to not only champion data innovation domestically, but also serve on a new, independent advisory panel charged with counseling the European Commission on how to seize opportunities to innovate with data.

If Europe is to take advantage of data-driven innovation, the Commission and Europe's governments must fundamentally commit to a future where data is a core component of economic progress and social empowerment.

We are living through a data revolution. Information about virtually every aspect of life in the modern world—from genetic material and personal preferences to machinery and the natural environment—is being converted into machine-readable data that we can analyze algorithmically to discover new insights and make faster, more accurate decisions. The end result is a vast new array of opportunities to spur economic and social progress.

Over the coming decade, this process of innovating with data will play an increasingly pivotal role in economies around the world. Data-driven innovation is occurring now because new technologies have made it easier and cheaper to collect, store, analyze, use, and disseminate information.[1] In addition, the convergence of the industrial and digital revolutions is creating a new economic paradigm with data at its core.[2] Companies in industries as diverse as healthcare, manufacturing, transportation, and energy will prosper or fail based on their skill at using data. And not only will the private sector need to use data to remain competitive, but so too

will the public sector. This means that to succeed in the new data economy, countries and regions must establish policies that encourage organizations to unlock the value of data. Failure to do so will slow economic and social progress.

The situation for Europe is more urgent than for other parts of the world. Over the last 20 years, Europe's productivity has grown slower than prior periods and slower than the United States. Unemployment is hovering around 11 percent, twice the rate of the United States.[3] Further, because of Europe's low fertility rate and aging population, the workforce will be 14 percent smaller by 2030.[4] There is much debate about how Europe should go about fixing its growth problem, but there can be no debate about the fact that if Europe does not dramatically improve productivity, it will not grow. And if Europe's public or private sectors do not embrace data-driven innovation, then the region's productivity will continue to lag.

Fortunately, there are some signs of progress. Germany has formulated an "Industrie 4.0" initiative to transform its manufacturing sector by leveraging data and connected devices.[5] The United Kingdom is an undisputed global leader in open data.[6] And the Netherlands has one of the most advanced smart city projects in the world. Moreover, the European Commission has initiated important projects such as the Digital Single Market and Europe 2020 to create the conditions necessary for economic growth.[7] It has also created the European Open Science Cloud to enable 1.7 million European researchers to store, share, and analyze data across borders and scientific disciplines.[8] Finally, in 2014, the European Commission released a strategy to promote Europe's data-driven economy, in which it has committed to supporting "lighthouse" data initiatives that improve digital skills and infrastructure, share public data, digitize public services, and create data-friendly laws and regulations, while using public procurement to bring data technologies to market.[9] As part of this effort, the European Commission launched a public-private partnership (PPP) on big data. The goal of the PPP is to bring together European businesses, academics, and policymakers to strengthen all levels of the "data value chain" to support the data economy.[10]

However, much more progress is needed. If Europe is to take advantage of data-driven innovation, the Commission and Europe's governments must fundamentally commit to a future where data is a core component of economic progress and social empowerment. One of Europe's most vexing challenges is that while it has created a political consensus on protecting the privacy of its citizens by regulating how their personal data is handled, it has achieved no similar consensus on the measures required to provide its citizens with the full benefits of the data economy, which hinges in no small part on the question of what data can be analyzed. As a result, European policy is not yet geared to seize available opportunities to use data to advance the interests of its citizens, either at the individual level—for students, workers, retirees, or consumers—or at the organizational level—for businesses, non-profits, or governments.

Europe therefore must move beyond its existing initiatives to more fully embrace the data economy—particularly at Member State and local government levels. There are three steps policymakers can take to start down this path:

1. European nations should follow France's lead by appointing national chief data officers.[11] These chief data officers should be tasked with overseeing the implementation of open data initiatives within their respective governments, and they should take the lead in developing and promoting national strategies to accelerate the transition of the non-government sector to become more data-driven.

2. The European Council should establish an independent advisory panel made up of national chief data officers to work with the European Commission and Parliament to forge consensus around a cohesive vision and strategy for capturing the full benefits of data-driven innovation in Europe.

3. Building on its €500 million big data value PPP, the European Commission should accelerate "lighthouse" projects that demonstrate the commercial value of data-driven innovation in key sectors of the economy, including agriculture, manufacturing, finance, transportation, and healthcare. As the European Commission moves forward with refining its Digital Single Market strategy and funding the EU's Horizon 2020 research and innovation initiative, it should continue its support of data-driven innovation through PPPs, not only for research, but all for demonstration projects.

The first two of these measures are structural or institutional in nature and will be important steps in allowing policymakers in both Member States and Brussels to put data-driven innovation at the top of a shared agenda. The third initiative will help make data-driven innovation less risky and prove that it produces significant benefits with few risks for both European policymakers and the public.

WHAT IS DATA-DRIVEN INNOVATION?

Data is becoming a key driver in the 21st century economy. By enabling people to better understand the complexities of their world and use that understanding to make better decisions, data has the potential to stimulate innovation and progress in a broad range of areas, thus improving economic productivity and quality of life.

New technologies have emerged to help make sense of the world's incredible complexity. The term "big data" refers to the trend for organizations to process ever larger datasets, comprising information that is often heterogeneous and frequently updated. Instead of relying on samples, organizations can now collect data about entire groups, such as all of the users of a public service or every vehicle in a commercial fleet of trucks. In addition, data can be collected continuously rather than sporadically. Analyzing more complete and up-to-date datasets can yield insights that might otherwise be overlooked, such as information about outliers or rare events. While some fields, such as astronomy or weather forecasting, have greater experience using large datasets, the growth of digital data collection has now brought this trend to many other fields that are using big data to make better decisions and deliver more personalized products and services. For example, businesses may analyze data about their customers to obtain rapid feedback about their products' performance, their customers' evolving needs, and overall market trends.

One important new source of data is the Internet of Things, a term used to describe the set of physical objects embedded with sensors or actuators and connected to a network. The Internet of Things is creating a world of these smart objects, from wearable medical devices to home automation to intelligent roadways. By 2020, there may be as many as 50 billion such connected devices worldwide.[12] These devices will create an enormous amount of economic value. In total, the Internet of Things is expected to contribute up to $11 trillion in value per year globally by 2025.[13]

The impact of the Internet of Things and data analytics can be seen in virtually every industry. Each Airbus A380 aircraft has nearly 6,000 sensors generating 2.5 terabytes of data daily.[14] Royal Dutch Shell uses sensors to measure seismic data in oil wells to determine where it should drill. Volvo uses real-time vehicle location data and diagnostic information to prevent accidents, increase fuel efficiency, and provide preventative maintenance in its trucks.[15] And the UK's Royal Mail uses data analytics and data visualization tools to optimize delivery routes, identify service problems, and respond to customer feedback.[16]

The benefits of data-driven innovation are not limited to the private sector. Government agencies can use data-driven innovation to cut costs, prioritize social services, and keep citizens safe. For example, the European Space Agency satellites use remote sensing technologies to track and analyze changes in the global environment and to help forecast and support responses to weather events, such as hurricanes and droughts.[17] The city of Paris has installed sensors on trees and plants to

detect damaging bacteria and optimize maintenance.[18] The cities of Cologne in Germany and Eindhoven in the Netherlands have launched traffic control initiatives that use sensors on roads, railways and bridges to alert motorists of road congestion or accidents.[19]

Science has also benefited greatly from data-driven innovation. Scientists have ushered in medical genomics with the Human Genome Project, advanced particle physics at the European Center for Nuclear Research (CERN), and mapped the stars with the Sloan Digital Sky Survey—all relying on enormous quantities of data.[20] Many of the most exciting scientific initiatives, from cancer research to neuroscience, are coming from innovative uses of data. For example, the EU's Human Brain Project is using advanced computing to analyze massive datasets to better understand the human brain (including clinical data to map brain diseases), define and diagnose brain disorders, and develop new technologies modeled after how the brain works.[21]

EUROPE HAS HAD EARLY SUCCESSES WITH DATA-DRIVEN INNOVATION

Countries and regions that do not embrace data-driven innovation will be less competitive in the new data economy. Some might look at the current environment and think it bodes ill for Europe. After all, between 2010 and 2012, the United States generated more than three times as many patents globally as Europe in big data technologies and had 30 percent of the patents for Internet of Things technologies compared to 24 percent for Europe.[22] However, the challenge for Europe is not to be the lead producer in data-related technologies, but rather to be the lead adopter.

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By this standard, Europe's future looks much brighter. Europe is now home to many successful initiatives that rely on data-driven innovation in the public and private sector, from smart cities to smart manufacturing. The following examples showcase some of the ways Europe is already proving the value of investing in data-driven innovation.

EDUCATION

Data-driven innovation has the potential to transform education by providing students with personalized instruction, encouraging the use of evidenced-based pedagogical tools and methods, and improving school efficiency.

While many schools have brought computers into the classroom, only now are they beginning to use online learning tools that allow educators to gather large amounts of detailed student data. By integrating analytics into educational software, these tools can dynamically adjust how material is presented to respond to individual students' strengths and weaknesses. This allows educators to better account for differences between children and give all students the type and amount of instruction that best meets their needs. Additionally, by collecting and analyzing data about how students complete reading assignments, homework problems, and other

instructional material, these tools can give educators a much clearer idea about student competency, reducing the need for time-consuming testing. And as these tools collect and analyze more data about how students learn, educators can tailor their instruction to ensure their actions are guided by hard evidence about what works best for individual students.

Schools can also capture data about student behavior and academic achievement so they can identify trends and intervene sooner when problems arise, such as an increase in student absenteeism or poor academic performance in a particular subject. Dashboards can present this information to parents and administrators so that they can monitor student progress. Finally, educators can create longitudinal datasets of de-identified student records spanning from early childhood education to the workforce so that policymakers can develop a better understanding of how different factors influence student attainment and identify where sections of the education system are underperforming.[23]

Europe has made some positive steps towards realizing the goal of data-driven education, although widespread adoption is still some years away.[24] In 2013, the European Commission funded the creation of the Learning Analytics Community Exchange (LACE), a consortium of organizations from Belgium, Italy, the Netherlands, Norway, Sweden, and the UK, to build communities of practice around learning analytics.[25] Estonia and Finland have entered into a cooperative agreement to develop the Education Cloud (EduCloud), a digital platform to deliver interactive educational content and provide access to student information systems.[26]

In addition, a number of universities in the UK, including Manchester Metropolitan, Nottingham Trent, and the Open University, have made significant investments in learning analytics systems.[27] By monitoring student progress against a broad set of metrics—from when students turn in assignments to when they visit the library—these programs can identify students who are at-risk of dropping out and intervene. Sometimes the interventions are automated. For example, a series of escalating notifications may be sent to a student who has been absent from class. At other times the software simply provides information to educators to help them decide how they can best support their students.

ENERGY

Data from smart meters can help optimize energy consumption, lower energy bills, reduce strain on power grids, and lower emissions.

Smart meters collect and transmit data between utilities and their customers, forming a key part of the smart grid and removing the need for in-person inspections of meters. Utilities can analyze data from smart meters to forecast demand and optimize energy production for a particular neighborhood or city. In addition, they can implement dynamic pricing to reduce peak- period energy consumption.[28] And smart appliances can schedule their use to times of day when energy is cheaper.[29] Globally,

smart grid technology, including smart meters, could help reduce global carbon dioxide emissions by more than two billion tons by 2020.[30]

Sixteen EU nations—Austria, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Poland, Romania, Spain, Sweden, and the UK—have committed to large-scale roll out of smart electricity and gas meters by 2020 or earlier. Close to 45 million smart electricity meters have been installed in Finland, Italy, and Sweden and, by 2020, it is estimated that Europe will have 200 million installed smart meters for electricity, covering over 70 percent of all European consumers, and 45 million meters for gas, representing around 40 percent of consumers.[31] These developments, in conjunction with other measures, could provide information to facilitate more competition in Europe's energy markets where retail prices have not fallen in line with declining costs.[32] In the case of electricity, this can be facilitated by establishing an independent hub to grant access to smart metering data to third parties, including potential competitors to an existing supplier.[33]

ENVIRONMENTAL MANAGEMENT

Data from sensors can provide government agencies with detailed information about the natural environment, allowing them to better monitor conditions and ensure the health and safety of citizens.

One of the most interesting deployments of sensors for environmental management is in satellites, which carry increasingly sophisticated instruments onboard as well as the capability of transferring large quantities of data to researchers back on Earth. Scientists can use satellite data to monitor and forecast air quality, climate change, and global emissions levels.[34] Government agencies can use satellite data to detect and monitor for catastrophic events such as storms, forest fires, and earthquakes, creating insights that can help them reduce the loss of life and economic disruption that often follow natural disasters. Government authorities also use satellite data to accurately track changes in vegetation cover and shorelines, monitor land surface temperature, study land use, and perform other key environmental management tasks.

One of the top sources of environmental data is the European Commission-led Copernicus program. Copernicus provides earth observation data from satellites and a vast network of sensors to monitor land, water, and air.[35] For example, authorities use radar imagery to detect and combat illegal fishing.[36] In addition, researchers model the health of marine ecosystems using satellite data to measure factors such as ocean temperature and color. Policymakers can then use these models to evaluate the effectiveness of sustainable fishing policies. And the Copernicus Emergency Management Service uses data analytics to quickly identify which areas have been affected by flooding during a natural disaster.[37] Responders on the ground can use this crucial information to reach people in affected areas as quickly as possible in an emergency.[38]

Finally, Europe has developed strong capabilities of using data to combat pollution. Pollutant-detecting sensors in waterways can warn regulators or safety officials about dangerous spikes in hazardous chemicals in real time. For example, nitrogen pollution, which can poison water used for fishing, agriculture, and drinking, costs the European Union between €70 billion and €320 billion per year.[39] The sooner officials learn about new sources of pollution, the faster they can intervene. Authorities in the Getaria region of northern Spain have deployed sensors to monitor air, and water pollution in real time so that they can respond quickly to incidents that could harm citizens and the local tourist industry.[40] Another example of pollution monitoring is the Mediterranean Decision Support System for Marine Safety, a service that uses tools to collect and analyze a variety of data, including ship traffic, historical accidents, and meteorological activity to monitor and predict the risk of oil spills in the Mediterranean Sea.[41] Supported by the EU Regional Development Fund, the service enables EU members to identify areas that are particularly sensitive to oil spills or that have a high risk of spills and develop their response plans accordingly.

HEALTH CARE

Almost every aspect of health care, from drug discovery to outbreak prevention, stands to benefit substantially from data-driven innovation. Since many EU countries have embraced policies to convert paper health records into electronic health records, there is now an enormous trove of patient data that can be tapped for reducing costs, supporting medical research, improving quality of care, and providing patients and healthcare workers new tools to make more informed decisions. As advances in genetic sequencing and analytics technologies support the development of more personalized treatments, these benefits will increase even further.

Even relatively minor technological advancements in the use of data can offer substantial health benefits. For example, wearable fitness trackers can feed biometric data back to smartphone apps that can help users better manage their physical fitness and incentivize healthy behavior. Internet-connected medical devices can enable healthcare providers to offer services that remotely monitor the vital signs of vulnerable people, such as the elderly, reducing the amount of time they need to spend in hospital—thus improving patients' quality of life and reducing costs.[42] And smart pill bottles can use sensors to detect the timely removal of pills, and transmit data about prescription nonadherence to healthcare professionals via a cellular network. Failure to take medicines according to prescription is reported to cause 200,000 premature deaths in Europe and to cost €125 billion annually.[43]

Europe is at the forefront of some of the most interesting efforts to use data to improve health care. The Innovative Medicines Initiative, a public-private life sciences partnership with €1.6 billion in funding from the EU's Horizon 2020 program, operates several projects designed to advance health research with increased data sharing.[44] For example, the European

Medical Information Network is developing a framework to allow researchers to link patient-level data from a wide variety of health systems and clinical studies to identify markers of susceptibility to dementia and to predict which individuals with obesity will develop complications like diabetes.[45]

Individual European countries have also made strong commitments to using data to improve health care. For example, the UK's National Health Service has established the Care.data program to expand the use of patient data beyond direct care. The program allows researchers and administrators to compare treatment costs and effectiveness, study disease, identify disparities in care, and make more informed budgetary decisions.[46]

Drug makers are beginning to use data analytics to gain valuable insights into public health from a variety nontraditional sources. An EU-funded project, Neuromics aims to improve diagnosis and treatment for neuromuscular and neurodegenerative diseases through the study of the genetic material and the development of datasets that will help medical researchers to develop better targeted treatment.[47] The British pharmaceutical company GlaxoSmithKline has used text analytics to mine posts on parenting forums to better understand and respond to the concerns of parents who hesitate to vaccinate their children for diseases--a disinclination that has contributed to the rise in outbreaks of vaccine-preventable diseases like measles.[48] And researchers at Carlos III Universidad de Madrid have developed a system that can analyze social media posts mentioning a particular drug or its active ingredients to identify potential adverse effects of that drug not reported in clinical trials.[49]

OPEN DATA

Open data—government data made freely available online in machine-readable formats—can serve as a platform for new products and services in the public and private sectors, improve government operations, and reduce fraudulent or wasteful spending of taxpayers' money.

In the European Union, the market size for goods and services that rely on open data is expected to reach €75.7 billion by 2020, a 37 percent increase from 2016.[50] For example, retailers can use open data about population demographics, infrastructure, and traffic to determine the best location to open a new store, and insurers can use open data on environmental conditions, public health, and crime statistics to develop more accurate pricing models.[51] The cost savings and efficiency gains of public-sector open data use is expected to save European governments a total of €1.7 billion by 2020.[52] Additionally, by utilizing open transportation data, transportation applications in Europe could save drivers 629 million hours wasted sitting in traffic, reduce road fatalities, and reduce emergency response times.[53]

Many European countries have recognized the value and importance of open data. The EU committed €14.4m in November 2014 for open data projects, including an open data incubator for startups.[54] The UK has committed £1.5 million (€1.9 million) for open data training for public servants.[55] France, Germany, Italy, and the United Kingdom signed the 2013 G8 Open Data Charter, committing to release open data by default, ensure high data quality and quantity, make data usable by all, and release data for improved governance and innovation.[56] And 31 of the 69 countries participating in the Open Government Partnership, an international initiative to use open data to help empower citizens, increase transparency, combat corruption, and improve governance, are European.[57]

Though national open data policies and execution of these policies vary substantially, many European countries have established themselves as world leaders in open data. In a 2015 survey evaluating open data policies around the world, the UK, Denmark, Finland, the Netherlands, Norway, and France all rank in the top ten.[58] And in December 2012, the European Union launched the EU Open Data Portal to serve as a single point of access to the national data portals of member nations.[59]

SMART CITIES

The Internet of Things is reshaping cities by enabling them to use data to deliver better services, be more resilient, and offer a better quality of life.

Adding sensors and network connectivity to city facilities, from street lights to sewerage systems, creates new sources of data that can be used to enhance the quality of life of citizens and the productivity of municipal public servants. For example, city refuse collectors can optimize waste pickup routes based on data from sensors that detect when bins are full. Transportation agencies can collect and process data from a citywide network of sensors to manage a network of roads, tramways, and bus lanes. And motorists can use mobile apps to more quickly find available parking or the next city bus or train based on a steady stream of real-time information from sensors. For example, in Dublin, each of the city's 1,000 buses transmit GPS updates every 20 seconds to a digital map that riders can access.[60] And Barcelona has begun a pilot program to embed sensors in parking spots, allowing drivers to find an available parking space in real time, thereby reducing congestion and emissions in the city, and opening the door for local leaders to implement new parking policies and pricing based on parking habits.[61]

Europe has made strong commitments to developing and deploying technologies that promise to revolutionize the design and delivery of public infrastructure and public services. The European Commission's Horizon 2020 research and innovation program budgeted €92 million in 2014 to support smart cities research, and many European countries are pursuing important smart cities projects.[62] Finland is also allocating funds to a unique R&D partnership with India, one focus of which is smart cities, to provide research funding to projects with high commercial potential.[63]

A number of European cities, such as Barcelona, Amsterdam, and London, are among the world's leading smart cities.[64] In addition to implementing increasingly common features, such as smart public transportation systems and installing smart meters for managing energy use in public buildings, these cities are creating novel smart city applications. For example, Barcelona has built a smart water system for its public parks, so that the irrigation system adjusts automatically based on analysis of a broad set of data including current rainfall, wind conditions, and the water needs of individual plant species. In Amsterdam, the city has built a system that warns civil engineers about potential damage to its levees, thereby allowing early intervention and reducing maintenance costs, based on sensors that collect information on the levees' structural integrity, water temperature, and depth.[65] And London is piloting a system developed by the Royal London Society for Blind People called Wayfindr that utilizes networked location-marking beacons to help people with vision impairments navigate indoor urban environments.[66] London Underground installed Wayfindr beacons throughout the Euston Tube station to test how users with a corresponding mobile app could find their way through the station based on audio navigation cues triggered by a user's proximity to a beacon.[67]

Europe is also pioneering, eCall, an initiative to equip all new vehicles with a device that automatically alerts emergency services when a vehicle is involved in a collision.[68] After March 2018, all new vehicles in Europe will be required to have a device that can collect and send data automatically about an accident, including the time it occurred, the exact location, and the number of passengers on board. Emergency responders can then use this information to respond faster and more appropriately based on relevant details about the accident. Early estimates suggest that this system could save 2,500 lives per year.[69]

SMART MANUFACTURING

The application of the Internet of Things to manufacturing can reduce waste, prevent equipment failure, boost efficiency, and improve quality control. Networked supply chains can help manufacturers better manage raw materials. Machinery that collects and reports performance data in real-time can help factory managers identify opportunities to increase efficiency and perform preventative maintenance. And goods with embedded sensors can provide manufacturers with data about their performance to identify potential improvements long after they leave the factory. This application of these technologies and systems is known as smart manufacturing.

Among the most important smart manufacturing technologies is the Radio Frequency Identification (RFID) chip that can be tagged to items or raw materials used in the manufacturing process. Each tagged item, therefore, becomes its own unique data point that can be tracked and monitored automatically throughout the manufacturing process. The computers that control the robotics and machinery in the factory can then use these tags

to automate many production processes as well as produce individually-tailored products without compromising efficiencies that have been gained from traditional economies of scale. For example, customers can order cars with particular specifications, such as body color, and the robots in the factory paint shop will know which car to paint a particular color based on the RFID tag. Smart manufacturing also gives manufacturers more flexibility to quickly scale production up or down in response to changes in demand or to re-configure plants to produce other products.

Among European nations Germany and Austria have been leaders in smart manufacturing. Volkswagen Germany is already using a range of smart manufacturing technologies to form the basis of a transformation of the company's production facilities. To allow its cars to be manufactured to order, customer information is transmitted to each section of automobile production and correct parts are assembled according to the particular order.[70] Smart manufacturing can ensure that European manufacturers remain globally competitive.

EUROPE'S DATA INNOVATION CHALLENGE

While government-led data-driven innovation is thriving, there are fewer commercial examples outside of smart manufacturing. The key for Europe is to implement data-driven innovation within sectors that currently dominate its economy, because the continent's economic future depends on their continuing strength. These industries include agriculture, manufacturing, finance, transportation, and healthcare.

Data-driven innovation in Europe will require access to three things in particular: reusable data, including personally identifiable information; IT capital; and a skilled workforce. European policymakers should ensure that all of these things are readily available and that their actions support rather than hinder innovation in the data economy. Indeed, Europe's early successes may be for naught if it does not place data-driven innovation at the heart of its economic and social policies.

REUSABLE DATA

Without data, data-driven innovation is impossible. Hence governments throughout Europe have an important role to play not only in collecting and supplying data, but also in creating the appropriate legal frameworks to enable data collection and sharing.

Data-driven innovation occurs when organizations and individuals can collect, use, and reuse data in order to develop a better understanding of their world. Data innovation is severely curtailed when businesses and public-sector organizations face burdensome regulatory limits on the collection and use of data. For example, the EU's Data Protection Directive requires businesses to collect only the data they need and to use it exclusively for the purposes for which it was originally collected. These rules undercut the fundamental way data-driven innovation creates value: by finding unanticipated uses for data. Moreover, this value is often

unlocked by combining data from different sources, another method at odds with existing European privacy regulations.

Unfortunately, Europe's overly cautious approach to privacy has caused its public and private sectors to instinctively flinch away from data-driven innovation, especially when it involves the use of personal data. In particular, the expected EU General Data Protection Regulation threatens to expose companies to substantial new penalties for any compliance violations.[71] As a result, organizations are increasingly reluctant to contemplate data-driven strategies that carry a large measure of legal, and therefore, financial and reputational risk. This may leave European companies standing on the sidelines, while other international players in their industries are racing towards the future. Indeed, some in Europe have recognized the challenges. One of the primary tasks of the EU-supported European Medical Information Framework, a project that aims to create a research platform for efficiently reusing existing health data of millions of European adults and children, is to navigate Europe's complex web of privacy laws.[72]

European data innovators also face constraints when it comes to sharing data across borders.[73] First, Europe's lack of a functioning digital single market, including differences in the laws of Member States, has impeded the development of the data economy. Fortunately, the European Commission is working to address these issues with the proposed General Data Protection Regulation and the Digital Single Market strategy.[74] Second, Europe's data protection regulations make transferring data outside of the EU more difficult, necessitating one-off agreements between the EU and other countries, such as the new EU-US Privacy Shield framework.[75]

A SKILLED WORKFORCE

Globally, there is more demand for big data jobs than there are available workers with the necessary skills.[76] The data economy needs not only data scientists, but also data-literate managers. The European Commission has estimated that Europe will face a shortfall of 900,000 IT workers by 2020.[77] McKinsey's estimate that the United States faces a shortage of approximately 1.5 million managers and analysts with big data-related skills suggests that Europe, which has historically underinvested in IT in comparison to the United States, may be underestimating its own IT skills shortfall.[78] Without access to talent, European businesses and government agencies will be unable to take advantage of data-driven innovation. Currently the European Commission estimates that 32 percent of Europe's workforce has insufficient digital skills.[79] Though some European universities now offer programs in data science, business analytics, and machine learning, these programs are relatively new and small in scale relative to the need.

IT CAPITAL

Access to the latest computing resources—including hardware, software, and cloud-based services, capable of storing and processing massive datasets—is necessary to take advantage of data-driven innovation. In addition, access to the latest technologies and methods in areas such as data de-identification, privacy-preserving data mining, secure, multi-party authentication, and interoperable digital credentials can help ensure that sensitive data remains private and secure.[80] Europe has been lagging behind in IT investment for nearly 20 years. At the beginning of 2000, Europe was investing only 80 percent as much as the United States in IT, and after 2011 this figure fell to 57 percent. Europe continues to underinvest, despite evidence that IT investment has been found to contribute to higher output growth of between 0.5 percent and 0.6 percent in virtually every country studied.[81] This cycle of underinvestment in IT goes a long way towards explaining why annual growth in European productivity was only 1.6 percent between 1995 and 2004 and has averaged only 0.8 percent since then.[82]

RECOMMENDATIONS

If European policymakers want increased productivity in the coming years, they will need to make data-driven innovation a central component of a broader EU growth strategy and create legal and regulatory frameworks that encourage data sharing and reuse in both the public and private sectors. While it is beyond the scope of this report to lay out a detailed data-driven innovation agenda for Europe, there are important structural changes that would ensure that champions of data-driven innovation are better represented at the highest levels of policymaking.

European policymakers have the courage and vision to chart a new course, they can ensure that data-driven innovation takes root across Europe's public and private sectors for the benefit of all citizens.

First, all EU Members should appoint chief data officers to oversee the implementation of their countries' data initiatives and develop strategies to accelerate their transitions to a data-driven economy. Chief data officers should be the primary champions of data-driven innovation, including the adoption and use of data-related technologies such as cloud computing and the Internet of Things. Within the public sector, they should oversee open data efforts, such as ensuring compliance with the EU Directive on the Reuse of Public Information, and champion the development of smart cities. Chief data officers should also make recommendations to address key areas of concern that may be holding back their national economies, such as insufficient workforce training or investment in R&D, as well as to prioritize unique opportunities, such as smart city projects in the Netherlands or smart manufacturing projects in Germany.

Second, the European Council should establish a permanent independent advisory panel made up of national chief data officers to work with the European Commission to forge consensus around a comprehensive vision for capitalizing on data-driven innovation in Europe's economic and social development. Creating a high-level committee focused exclusively on identifying and achieving the benefits of data-driven innovation will create

a political counterweight to those who would impede progress on data-driven innovation because of concerns about other issues, such as privacy or anti-trust. By including those involved in data-driven innovation, policymakers will be able to better understand the consequences of different policy options and make decisions based on how they will affect the lives and livelihoods of European citizens.

Finally, the European Commission should expand the use of PPPs to create pilot projects in key sectors that can benefit from data-driven innovation, such as agriculture, manufacturing, finance, transportation, and healthcare. One reason that European companies have been slow to pursue data-driven innovation is that early adopters face more risk since they are often pioneering a new approach and must overcome technological and operational hurdles. Government-industry partnerships on data-driven innovation could help accelerate Europe's adoption of data-related technologies in its public and private sectors, as well as lead to the development of robust public datasets. In addition, some privacy concerns could be addressed through new technologies and methods in areas such as data de-identification, privacy-preserving data mining, secure, multi-party authentication, and interoperable digital credentials. Such projects could help make data-driven innovation less risky while at the same time show European stakeholders that data-driven innovation can provide important benefits with very low risks. In the past, Europe has used PPPs as a way to share risk between the government and the private sector and promote innovation in specific sectors of the economy. Indeed, Europe has a unique opportunity to leverage PPPs to kick-start data-driven innovation, especially since more free-market oriented countries like the United States often resist this type of approach.

CONCLUSION

Europe's progress in data-driven innovation within both its public and private sectors is already paying dividends for the productivity of its businesses, the efficiency and enhancement of its public services, and the quality of life for its citizens. Yet while Europe has many excellent examples of the public and private sectors using data for economic and social progress, its early advances will not be sustained if its policymakers, in both Member States and in Brussels, do not capitalize on what has already been achieved by ensuring that data-driven innovation is at the core of policy to grow the economy and enhance society. If Europe fails to build on these early successes, it will be overtaken by nations and regions that have had the foresight and political will to seize the moment. However, if European policymakers have the courage and vision to chart a new course, they can ensure that data-driven innovation takes root across Europe's public and private sectors for the benefit of all citizens.

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The Center for Data Innovation is the leading global think tank studying the intersection of data, technology, and public policy. With staff in Washington, DC and Brussels, the Center formulates and promotes pragmatic public policies designed to maximize the benefits of data-driven innovation in the public and private sectors. It educates policymakers and the public about the opportunities and challenges associated with data, as well as technology trends such as predictive analytics, open data, cloud computing, and the Internet of Things. The Center is a nonprofit, nonpartisan research institute affiliated with the Information Technology and Innovation Foundation.

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