Perspectives on Business and Technology

USC Marshall School of Business

We need a new Operating System for the Fourth Industrial Revolution

White Paper By
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July 2018

INTRODUCTION

Society's operating system needs an upgrade. The model we have been using is simply not up to the challenges of the Fourth Industrial Revolution.

A new era is unfolding at breakneck speed. It has huge potential to address some of the world's most critical challenges, from food security, to reducing congestion in big cities, to increasing energy efficiency, to accelerating cures to the most intractable diseases. But it also raises a host of social and governance issues that need addressing.

Given the speed and scale of the changes, and the slow pace of processes defining governance models to handle them, present solutions to these questions are being rapidly superseded. We end up operating in the "too late zone".

We need to think and act quickly. At the World Economic Forum's Center for the Fourth Industrial Revolution, we are laying the foundations for a new, global "operating system (OS) to facilitate delineation between the rights and responsibilities of different stakeholders.

This is all part of efforts to ensure this new phase of civilization is human-centric, benefitting not just the privileged few and driven not by the imperatives of technological development, but serving all of society. We must ensure that algorithms driven by vast data harvesting are trustworthy; that artificial intelligence and machine learning are as ethical as they are intelligent; and that data ownership is clear. These questions and many more are coming at us faster than we can formulate answers.

What are the building blocks of an operating system that could cope with such complex questions?

Human-centric use of data

Maximizing the potential of the Fourth Industrial Revolution while minimizing its negative impact requires us to adopt "human-centric design" principles. Using these, we can project the positive or negative impact of specific technologies on society into the future, and work backwards to identify the governance protocols needed to set the right course today.

Data plays a key role: where it comes from, who owns it, what you can do with it, and who takes the rewards.

This requires a layered approach to governance:

Layer 1: The blockchain – the foundation

Blockchain's peer-to-peer security architecture, transparency and rapidly evolving features such as smart contracts and tokens make it an ideal platform to build a system of accurate, human-centric protocols.

Layer 2: The Internet of Things – where does the data come from?

There are already more connected IoT devices than people. By 2020, more than 20 billion IoT devices are anticipated. This represents a massive opportunity to collect and use data to solve our most intractable problems. But to protect ourselves from potential data misuse, and to provide the foundation for a healthy, secure and equitable data economy, three crucial IoT protocols are required:

- Authentication

  There must be a way for the OS to ensure data comes from trusted sources, otherwise data-derived algorithms may be skewed by "fake data" being pumped into the system. This authentication must be highly secure, cross-industry and not under any single governmental control: a perfect opportunity to use blockchain.

- Ethics Switch

  What happens if a data-derived algorithm asks a car or bus to drive into a crowd of people? Or a transformer to cut off power to the population? Or a high-speed train to accelerate near the train station and crash? A medical device to stop functioning and kill its host? A drone to fly into electric transmission lines? At the moment, we have no methods for knowing what these data-derived algorithms are, nor means for influencing their design principles.

  So how do we prevent them from harming society? Human- centric values must be embedded in the OS in such a way that it can apply them to the myriad practical situations confronting it every day. The Ethics Switch in the OS must allow for ethical rules to be deployed based on the legal framework of the relevant jurisdiction (city, state, nation, and region).

  These rules, as defined by the jurisdictions, could be designed using blockchain smart contracts to ensure that no-one can tamper with them, and that they can be downloaded and updated using the next protocol. Ideally these ethics rules should be universally agreed on. But there is a need for urgent action. The Ethics Switch framework could be used subsequently, once these universal rules are defined and updated.

- Over the Air (OTA) upgrade

  If devices are hacked or legal frameworks change, their software and security needs to be upgradeable without the need for physical replacement, hence the need for OTA upgrades much like those currently in use on smart phones.

With these protocols in place, we can ensure that the data are coming from trusted sources, and we can allow for the combination of vast sums of data across different domains to "de-bias" data sets, resulting in better algorithms.

Layer 3: Data ownership - who owns it, what can be done with it, and who gets the rewards?

A key concern for governments and citizens is data privacy. In the absence of any other means of control, governments tend to prohibit the movement of data outside borders, or they apply the laws of the jurisdiction in which the data is collected if it is taken across national borders. While this may reduce misuse of data, it also obstructs us combining global data sets to accelerate innovation in critical areas such as agriculture, the environment, traffic, energy and health. It

also prevents multinational companies from combining data sets to support their global operations.

A decoupled architecture would address concerns while maximizing potential. It would consist of the following aspects:

- Ownership

  The relevant agency will need to be able to determine the rightful owner of the data (person, farmer, corporation, state etc.).

- Right to use

  The owner of the data will need to be able to specify the purpose and duration it can be used for (using, for instance, blockchain smart contracts). These contracts would be attached to the datasets, and would act as gatekeepers when the data are being accessed to ensure permitted use.

- Rewards

  The owner will determine if there needs to be any compensation for the right to use. Such a reward system could be based on blockchain tokens issued by public or private sector organizations, much like the loyalty programs that are in common use today.

  For example, this would allow me, as a user, to specify that my genetic data can be used for cancer research for two years without any compensation. But if a drug manufacturer wants to access it, I could limit that use to six months and ask for compensation in the form of, say, tokens issued by the pharmaceutical company. When the terms of the smart contract expire, data access is automatically removed by the OS.

  How would one value the tokens? In the same way that a cup of coffee or carbon emissions are valued, that is through "token exchanges" to be set up at the national, regional or perhaps global level, as we have done with commodity exchanges.

The rapidly emerging "edge computing" architecture, featuring smarter devices with larger data storage capacities and longer battery lives, would provide computing architecture for these vast sums of data. They would be stored closer to the "point of collection" and made available, subject to the protocols above, near the "moment of consumption".

This protocol would also allow for flexible and secure use of data in emergencies such as wars or natural disasters, which would be regulated by international agencies. The owner of a satellite network would then be able to share their data in such cases, knowing that it would not be used outside permitted use.

Layer 4: Cross-border data flows

To fulfil the global potential of these protocols, this new operating system architecture requires interoperable – though not necessarily identical – cross-border data flow protocols across countries and regions.

For example, the CEO of a start-up operating in the "precision agriculture" space told me that in an African country, they were instrumenting the agriculture fields to dramatically increase (double and triple) the yield. But to do so, they needed to combine data from that country with other countries' data, to avoid a biased data set. This was complicated by existing data protection protocols, as the data was not allowed to be taken out of the country.

Taxes, Intellectual Property, Legal System, Insurance

We also need to consider taxation, intellectual property rights and insurance in the context of this new operating system.

If I can 3D print a product, for example, I am effectively importing it, even though it has not passed any physical border. Should I be required to pay a fee? How do we ensure the authenticity of the design specification? How does the creator of the product get paid?

If an algorithm is derived from data coming from multiple sources, and there is no "human ingenuity" involved, is it patentable, and by whom?

Finally, on the insurance front, if the outcome of a decision made by an algorithm is harmful, who is at fault?

A world of possibilities

The above protocols apply to many areas set to be a feature of the Fourth Industrial Revolution: drones, autonomous vehicles, precision medicine, 3D printing, robotics, and our management of the earth's resources.

The advances could be paradigm-shattering. Consider the following examples:

During a recent visit to India, I was informed by government officials that at state hospitals, there is one doctor for every 12,000 citizens. It is impossible to build enough hospitals and train enough doctors to meet the demand, particularly with the population continuing to rise.

What if, once a week, we could swallow or sniff a nanoparticle - later flushed out of the body - that would collect and securely upload our cellular data and vitals to the largest scientific knowledge base? After consultation with an AI-assisted doctor, a personalized formula for medication could be downloaded to the person's mobile device, to be 3D-printed at a kiosk. Using this science-fiction-like (but completely possible) model, personalized medicine could be delivered to hundreds of millions of people, rich or poor, without the need for building hospitals and training doctors.

Traffic congestion in cities is a major cause of stress, productivity loss and environmental degradation. It also pushes people out of city-center jobs, because the commute from the suburbs becomes too strenuous. What if only autonomous taxis and buses were allowed in city centers? The number of parking spaces could be reduced, making cities more livable. Public transport would become faster, safer and cheaper, with elderly and young people no longer forced to wait in bus queues or walk from the station to their homes. Emergency services would become more effective. Workers could commute to their city-center jobs more quickly.

However, this would also mean job losses - for bus and taxi drivers, for instance - so citizens would need skills retraining and social protection. Revenue for the cities would also decline, with fewer parking and traffic fines, so vehicle usage could incur a consumption-based charge depending on time of day, vehicle used and location.

Illegal fishing, particularly tuna fishing, is a source of major income loss for some nations, as well as a disruption to the ecosystem. Sanctions are largely useless, as by the time fishermen are caught, the fish are already dead. What if we could collect data from low-orbit satellites, use machine- learning algorithms to detect illegal activity, then deploy drones to prevent it?

Smallholder farmers are a key source of income and a significant food security topic, particularly in emerging markets. What if we could bring the Internet of Things (IoT) to agriculture, gathering data on sunshine, precipitation and soil conditions and delivering the right kind of fertilizer, in the correct quantities, by drone? We could consume fewer agriculture products and increase yields.

Existing regulatory frameworks and governance models are getting in the way of such advances. During the Forum's recent Latin America Meeting in São Paulo, the head of a national innovation agency shared a story about his daughter, an oncologist in

the US, who devised a blood test to detect pancreatic cancer long before traditional methods. When she needed data from nearby hospitals to validate the test, existing privacy laws prevented the hospitals sharing the data. Those laws were written at a time when such innovation was not a possibility.

A Nordic country delegation, on a visit to our Center a few months ago, said they have vast amounts of environment data that they are willing to share, but cannot find a mechanism to do so.

At the Center for the Fourth Industrial Revolution, and through our global network, we are working with governments, business, academia and civil society to co-design this new operating system. It will provide transparency, accountability and innovative ways to solve the complex challenges of the new technology revolution. We need to think big, act quickly, and lay the foundations for a new, fairer, technology-based and global society.

This paper is a derivative that is based on a more extensive work that was published by the World Economic Forum as a part of their Agenda series on 14 May 2018; https://www.weforum.org/agenda/2018/05/society-reboot-operating-system-fourth-industrial-revolution

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The views expressed in this paper are reflective of CTM's desire to increase the level of discourse related to technology's impact on business and businesses needs being addressed by technology. The views expressed in this paper may or may not reflect the views of the CTM members, the I3 members, or USC.

A special thanks to the members of the Institute for Communication Technology Management