DISRUPTIVE TECHNOLOGIES AND TRENDS IN THE FOURTH INDUSTRIAL REVOLUTION

TESDA

Are you struggling to know tech-related buzz words?

We are in the midst of technological transformation– a revolutionary period of relentless innovation. This transition is so compelling that it is being called Industry 4.0.

From the first industrial revolution (mechanization through water and steam power) to the mass production and assembly lines using electricity in the second, the fourth industrial revolution will take what was started in the third with the adoption of computers and automation and enhance it with smart and autonomous systems fueled by data and machine learning. (Marr, 2018)

1st	2nd	3rd	4th
Mechanization, water power, steam power	Mass production, assembly line, electricity	Computer and automation	Cyber Physical Systems

The Four Industrial Revolutions
(by Christoph Roser at AllAboutLean.com)

In as little as paying for groceries using our smartphones to as big as driving our cars remotely, the effects it has in our live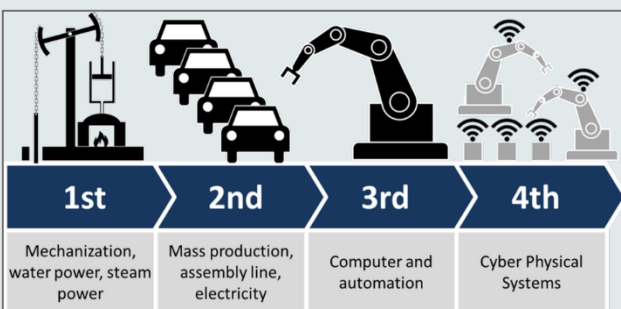s is apparent. From the moment we wake up, we have technology at our disposal. We use it thankfully, because it has made our lives significantly easier. Overall, these technological advances has greatly improved our living standards.

While these effects may seem positive on a utilitarian perspective, we may have to look at the big picture. These developmental changes could also bring pervasive negative impacts.

With the steadfast evolution of Industry 4.0, we have yet to discover the whole of its potential. However, this doesn't mean we should be heedless. Instead, we should find ways on how we could use this opportunity to our leverage. We should be open to adapting non-traditional strategies which requires us to act proactively.

These changes require us to alter our understanding of "innovation." We should now put emphasis on the things which we once thought as impossible.
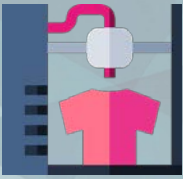
This TVET Brief conveys definition of some of fundamental technologies and trending words in 4.0.

3D Printing

Additive manufacturing (AM) also known as 3D-printing, refers to processes used to create a 3-dimensional product in which a computer control assembles materials into layers. Products can be in any form or size and shape from a 3D model. Unlike material carved and removed from a series of conventional machining process, 3D-printing or AM creates a three-dimensional object from a computer-aided design (CAD) file by sequence adding material layer by layer. [1]

5G Mobile Phones

Fifth-generation wireless, or 5G is engineered to greatly increase the speed and responsiveness of wireless networks.[2] 5G Wi-Fi connections give download speeds 100 times faster than 3G. This means that full-length movies can be downloaded in a matter of seconds.
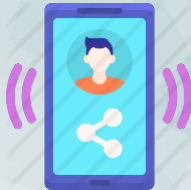
Airships

An airship or dirigible balloon is a type of lighter-than-air aircraft that can navigate through the air under its own power. Aerostats gain their lift from large gas bags filled with a lifting gas that is less dense than the surrounding air. [3]

Artificial Intelligence

Artificial intelligence (AI), the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. [4]

Assistive technologies

Assistive technology (AT) is any item, piece of equipment, software program, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities. [5]

Autonomous Vehicles

An autonomous car is a vehicle that can guide itself without human conduction. This kind of vehicle has become a concrete reality and may pave the way for future systems where computers take over the art of driving. An autonomous car is also known as a driverless car, robot car, self-driving car or autonomous vehicle. [6]

Babel-fish Earbuds

In an increasingly global world, language is still a barrier to communication which is why Google has built earbuds that could translate 40 languages in real time. The idea came up into developer's mind from Douglas Adams' cult Sci-fi classic fiction "The Hitchhiker's Guide to the Galaxy". In the cult sci-fi classic, you slide a yellow Babel fish into your ear to get translations in an instant. In the real world, Google has come up with an interim solution: a $159 pair of earbuds, called Pixel Buds. These work with its Pixel smartphones and Google Translate app to produce practically real-time translation. [7]
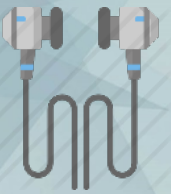
Big Data

To really understand big data, it's helpful to have some historical background. Here's Gartner's definition, circa 2001 (which is still the go-to definition): Big data is data that contains greater variety arriving in increasing volumes and with ever-higher velocity. This is known as the three Vs.

Put simply, big data is larger, more complex data sets, especially from new data sources. These data sets are so voluminous that traditional data processing software just can't manage them. But these massive volumes of data can be used to address business problems you wouldn't have been able to tackle before. [8]

Biotechnology

Biotechnology is technology that utilizes biological systems, living organisms or parts of this to develop or create different products that help improve our lives and the health of our planet.
Brewing and baking bread are examples of processes that fall within the concept of biotechnology (use of yeast (= living organism) to produce the desired product). Such traditional processes usually utilize the living organisms in their natural form (or further developed by breeding), while the more modern form of biotechnology will generally involve a more advanced modification of the biological system or organism. [9]

Blockchain

A blockchain is the structure of data that represents a financial ledger entry, or a record of a transaction. Each transaction is digitally signed to ensure its authenticity and that no one tampers with it, so the ledger itself and the existing transactions within it are assumed to be of high integrity. [10]

Cloud Computing

Cloud computing, often referred to as simply "the cloud," is the delivery of on-demand computing resources — everything from applications to data centers — over the internet on a pay-for-use basis. [11]

Drones

A typical unmanned aircraft is made of light composite materials to reduce weight and increase maneuverability. This composite material strength allows military drones to cruise at extremely high altitudes. Drones are equipped with different state of the art technology such as infra-red cameras (military UAV), GPS and laser (military UAV). Drones are controlled by remote control system also sometimes referred to as a ground cockpit. [12]

Dueling Neural Networks

The approach, known as a generative adversarial network, or GAN, takes two neural networks— the simplified mathematical models of the human brain that underpin most modern machine learning—and pits them against each other in a digital cat-and-mouse game. [13]

Energy Storage

Energy storage is a mechanism to contain useful energy which can then be used later. Since some renewable energy technologies, such as wind and solar, have varying outputs, storage technologies have great potential for smoothing out the electricity supply from these sources and ensuring that the supply of generation matches the demand.[14]

Genomics

Genomics is a more recent term that describes the study of all of a person's genes (the genome), including interactions of those genes with each other and with the person's environment. Genomics includes the scientific study of complex diseases such as heart disease, asthma, diabetes, and cancer because these diseases are typically caused more by a combination of genetic and environmental factors than by individual genes. Genomics is offering new possibilities for therapies and treatments for some complex diseases, as well as new diagnostic methods.[15]

Geographic Information System (GIS)

A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. The key word to this technology is Geography – this means that some portion of the data is spatial. [16]

Internet of Things (IoT)

Simply put, this is the concept of basically connecting any device with an on and off switch to the Internet (and/or to each other). This includes everything from cellphones, coffee makers, washing machines, headphones, lamps, wearable devices and almost anything else you can think of. This also applies to components of machines, for example a jet engine of an airplane or the drill of an oil rig.

The analyst firm Gartner says that by 2020 there will be over 26 billion connected devices... That's a loT of connections (some even estimate this number to be much higher, over 100 billion). The IoT is a giant network of connected "things" (which also includes people). The relationship will be between people-people, people-things, and things-things. [17]

Massive Open Online Courses

Massive Open Online Courses are online courses aimed at unlimited participation and open access via the web. [18]

In addition to traditional course materials such as filmed lectures, readings, and problem sets, many MOOCs provide interactive courses with user forums to support community interactions among students, professors, and teaching assistants (TAs) as well as immediate feedback to quick quizzes and assignments. MOOCs are a recent and widely researched development in distance education which were first introduced in 2006 and emerged as a popular mode of learning in 2012. [19]

Material Science

Materials science, the study of the properties of solid materials and how those properties are determined by a material's composition and structure. Materials science is therefore important to engineering activities such as electronics, aerospace, telecommunications, information processing, nuclear power, and energy conversion. [20]

Nano/micro satellites

A miniaturized satellite is an earth-orbiting device having lower mass and smaller physical dimensions than a conventional satellite, such as a geostationary satellite. Miniaturized satellites have become increasingly common in recent years. They are well-suited for use in proprietary wireless communications networks, as well as for scientific observation, data gathering and the Global Positioning System (GPS). [21]

Nanomaterial

Nanomaterials are chemical substances or materials that are manufactured and used at a very small scale. Nanomaterials are developed to exhibit novel characteristics compared to the same material without nanoscale features, such as increased strength, chemical reactivity or conductivity. [22]

Nanotechnology

Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers. Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering. [23]

Neurotechnology

Neurotechnology is defined as the assembly of methods and instruments that enable a direct connection of technical components with the nervous system. These technical components are electrodes, computers, or intelligent prostheses. They are meant to either record signals from the brain and "translate" them into technical control commands, or to manipulate brain activity by applying electrical or optical stimuli. [24]

Open Data

Open data is the idea that some data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control. [25]

Remote sensing

Remote sensing is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites. [26]

Robotics

They are defined as programmable, mechanical device used in place of a person to perform dangerous or repetitive tasks with a high degree of accuracy. [27]

Synthetic Biology

Synthetic biology is a new interdisciplinary area that involves the application of engineering principles to biology. It aims at the (re-)design and fabrication of biological components and systems that do not already exist in the natural world. Synthetic biology combines chemical synthesis of DNA with growing knowledge of genomics to enable researchers to quickly manufacture catalogued DNA sequences and assemble them into new genomes.

Improvements in the speed and cost of DNA synthesis are enabling scientists to design and synthesize modified bacterial chromosomes that can be used in the production of advanced biofuels, bio-products, renewable chemicals, bio-based specialty chemicals (pharmaceutical intermediates, fine chemicals, food ingredients), and in the health care sector as well. [28]

Solar desalination
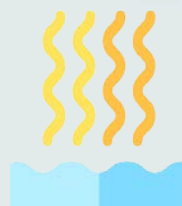
Solar desalination is a technique to desalinate water using solar energy. There are two basic methods of achieving desalination using this technique; direct and indirect. Sunlight may provide heat for evaporative desalination processes, or for some indirect methods, convert to electricity to power a membrane process. [29]

Zero-carbon natural gas

The Net Power plant puts the carbon dioxide released from burning natural gas under high pressure and heat, using the resulting supercritical CO_2 as the "working fluid" that drives a specially built turbine. Much of the carbon dioxide can be continuously recycled; the rest can be captured cheaply. [30]

WAY FORWARD

The Fourth Industrial Revolution revolves around the idea that manufacturing will undergo progressive digitization. The goal is to be connected to a system that will help optimize the entire production chain and make smart decisions even without human intervention. Everything will soon become "smart."

by Adobe Stock

As futuristic as it may sound, this already started happening in some countries all over the world. Soon, it will not only affect manufacturing but the entire world of work. The new technologies will impact all disciplines, economies and industries. It will challenge the current systems in place, leaving the inflexible ones embroiled; the resilient ones stronger.

In order to thrive, leaders will have to do away with the traditional, and explore possibilities that may have never been considered. Sound strategies must be put in place while trying to cope with these changes.

For Technical and Vocational Education and Training (TVET), the effect of Industry 4.0 is felt directly as it involves the study of technologies and related sciences and acquisition of practical skills. TESDA, as the leading authority in TVET in the country, must swiftly respond to the dynamic changes brought about by Industry 4.0.

For so long, TESDA has committed itself to producing relevant and globally competitive Philippine workforce.

This entails continuous improvement on policies based on the requirements of industries. Likewise, TESDA will have to overcome yet again another major obstacle to achieve its goal.

It is only a matter of time before these new technologies and trends are absorbed in the mainstream. Adaptability will be the most sought after characteristic of both leaders and employees alike. We have to bear in mind that our ability to adapt promptly can make or break our existing strategies. We will have to accommodate these changes in our plans and programs as they will affect the quality of service we deliver to the people.

Because of Industry 4.0, TESDAns will have to adapt faster than others and the first step would be to acquaint ourselves to these unfamiliar technologies and trends. Familiarity will enable us to empower ourselves using the information being provided to us by increased connectivity and productivity. Simply put, we have to make tech work for us, and not the other way around.

Making sure that happens is the one thing we cannot automate.

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