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PRESIDENTIAL

SAIEE THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | MAY 2019

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  - Professional Engineering Technologist, or
  - Professional Engineering Technician or
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  - Electronics (Control & Instrumentation)
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  - Computer and Software

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This May issue focusses on the SAIEE, its committees and chapters, but it also introduces you to the new SAIEE President, George Debbo. His inauguration speech, *"Digital Transformation - the enabler of economic and social inclusivity"* is on page 6.

Throughout this issue, you will find articles from various SAIEE sections and interest groups.

The SAIEE Central Gauteng Centre, in collaboration of the SAIEE, hosted the Minister of Public Enterprises, Pravin Gordhan, in an engineering engagement to discuss the challenges South Africa is facing in the power and energy industry. In concluding his talk, he posed five questions to our engineers. Find the article on page 18, and click here to enter the survey and give us your expert opinion - (https://bit.ly/SAIEE5Q)

We hosted our annual Charity Golf Day at the Pretoria Country Club, and this year, thanks to all the sponsors, we manage to have 18-four balls and all proceeds will be going to Ya Bana Village for Children.

I attended the annual African Utility Week last week in Cape Town. What a grand event the organisers put together. The SAIEE will be hosting its very own national conference from 27 - 29 November 2019 at the Sandton Convention Centre. Early registrations are now open. Visit www.saiee-conference.co.za and book your spot now. This event will include the SAIEE Annual Banquet as well as the National Student's Project Competition. Book your seat now so as not to miss out on the occasion of the year.

The next issue of the **watt**now features "Power" - if you have any articles/ white papers you want to see in print, please send it to me by no later than 7 June.

Herewith the May issue - enjoy the read.

Minx

Visit www.saiee.org.za to answer the questions related to these articles to earn your CPD points.

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DIGITAL TRANSFORMATION – THE ENABLER OF ECONOMIC AND SOCIAL INCLUSIVITY

GEORGE DEBBO
2019 SAIEE PRESIDENT

Digital Transformation addresses the changes that have taken place in the world around us as a result of the deployment and application of digital technology. Such changes have influenced all aspects of our lives, including professional and personal.

Within the professional realm, such changes have affected the way businesses are run and conducted as well as our contact and interface with such entities. Within the private field, Digital Transformation has changed how we communicate and socialise as well as how we consume information, including that which forms part of our entertainment. A key benefit of Digital Transformation is that it has allowed the disadvantaged sector of our society, especially on the continent of Africa, to access to several services from which they were previously excluded. Digital Transformation has contributed significantly to enabling inclusivity in areas such as economic and social development of the disadvantaged sectors of our society.

This paper discusses both the benefits and disadvantages of Digital Transformation, as well identifies the key digital technologies that have contributed to both Digital Transformation as well as Digital Disruption, the latter also being a significant contributor to Digital Transformation. The paper will also cover the current barriers that are hindering the progress being achieved with Digital Transformation, especially within the South African context, and proposes how the South African Institute of Electrical Engineers (SAIEE) can get involved in the public debate related to Digital Transformation, and the setting of policy in this context.

INTRODUCTION

As a simple definition, Digital Transformation is the changes that occur in the world around us as a result of the application of digital technology into all aspects of human life and society. Although we live in a physical world, the use of digital technology allows this world to be emulated in a digital world.

There are numerous examples to illustrate this, two of which are highlighted below:-

- The change that has occurred in the manner by which we correspond with one another. Just over 30 years ago, we mainly communicated in a physical format by writing or typing on paper and delivering this correspondence physically using the postal service or a messenger. Today most of our communication is done in digital format, either via email or by using one of the available digital messenger services.
- How we purchase property has also significantly changed over the past 30-years. Towards the end of the last century, if a couple wanted to buy a house, they would spend most of their weekends scanning newspapers and touring show houses. Today, with online sites such as Property

24, a couple can provide upfront with a list of criteria as to what they are looking for and their price range, and they would then be provided with a short-list of properties that meet these criteria. They could further modify this list so that they end up with one or two features that they would like to spend time to travel to and visit before making their decision as to whether to purchase or not. This application saves significant time and effort associated with the process of buying a property.

The concept of Digital Transformation also applies within the business environment and relates to how a company transforms its business processes using digital technology. Although such transformation is often driven by customer demand and technology, in essence, it is required to provide the business with a competitive advantage to gain market differentiation.

Other benefits include streamlining business processes and therefore, increasing efficiencies, achieving collaboration and interaction between internal and external stakeholders and providing better customer experience and adding more significant value.

DIGITAL DISRUPTION

Digital Disruption is the change that takes place when new digital technologies, coupled together with changes in the business model, affect the value proposition of existing products and services.

Oracle published a White Paper in 2016 in which they indicated that Digital Disruption has come in three waves over the last three decades, as is shown in Figure 1.

The first wave occurred in the 1990s and included new entrants in music, video and photography using digital technologies to disrupt current service delivery models.

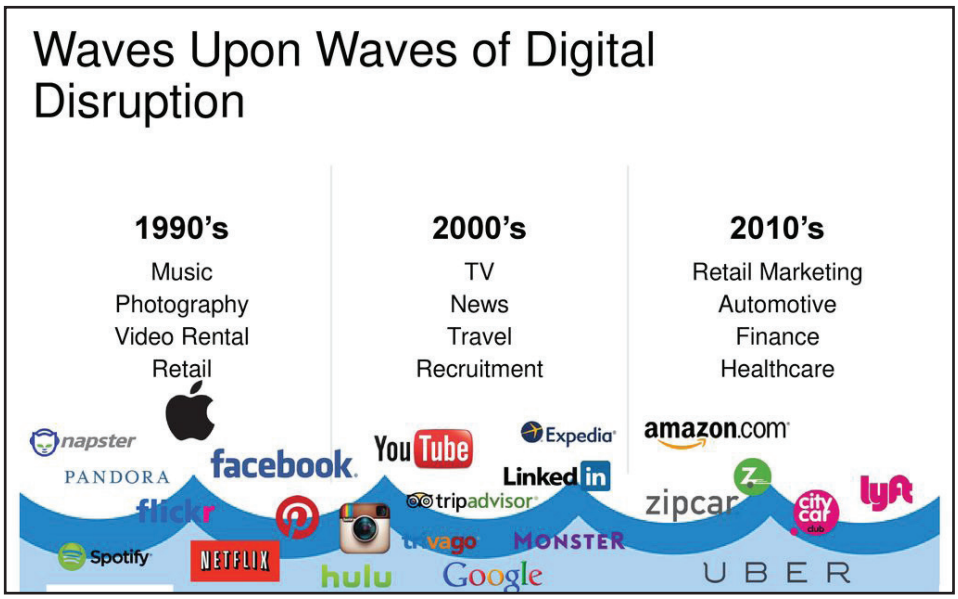

Figure 1: Waves Upon Waves of Digital Disruption

The second wave occurred in the 2000s during which new industries were disrupted using digital technologies including TV, the travel industry and recruitment.

The third and current wave has occurred in the 2010s in which digital disruption has changed the way customers interact with brands and introduced digital marketing using social media.

The following examples are companies that have significantly disrupted the industries in which they operate by the application of digital technology together with changes in the business model:

NETFLIX: Started as an online DVD rental company in 1998 by Reed Hastings because he got a $40 fine for returning a video late. In 2007 Netflix adapted their business model to start video streaming when bandwidth and data rates had sufficiently improved to allow customers to download movies. The initial idea was to make use of a "set-top-box" to download videos overnight, but this idea was replaced less than one year later with full-streaming directly from the server. In 2018 Netflix had a market capitalisation of $100 billion with an annual turnover of $15.8 billion serving 139 million subscribers worldwide.

YOUTUBE: Was started in February 2005 by three ex-PayPal employees to offer a platform for generating and consuming user-generated content. YouTube has significantly disrupted conventional methods of producing and consuming video content. In 2006 it was purchased by Google for $1.65 billion and today services some 1.9 billion active subscribers per month who upload 300 hours of video content per minute and view 5 billion videos per day.

UBER: This is a transport company that owns no vehicles. Its business model is based on providing an online platform in which it links drivers (who only have to have a licence and reasonably working car) with passengers who are required to download an app to request a ride. From a financial perspective, 80% of the fee paid by the passengers goes to the driver, and 20% to Uber. Today Uber has some 100 million users in 785 metropolitan areas around the world and has significantly disrupted the taxi industry to the point where there had been violent protests necessitating the

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need for some jurisdictions to step-in with regulation.

The relationship between digital technology and digital disruption creating digital transformation is shown in figure 2.

Digital Disruption has also had a financial impact on many industries:-

- the global music market has dropped from $28 billion in 2000 to $15 billion in 2014,
- the print newspaper advertising market fell from $65.5 billion in 2000 to $17.3 billion in 2013; and
- on the positive side, e-commerce grew from 0.09% of the retail market in 2000 to 5.8% in 2013, with a 75% contribution coming from online activity.

Although the above examples show the successes that can be attained from digital disruption, there have also been some casualties. One such victim was Kodak. Kodak invented digital photography long before its competitors. This occurred in 1975 by one of their engineers, Steve Sasson. However, because such an invention threatened their main business at the time, which was selling and processing photographic film, their management decided not to pursue this invention.

Their words at the time were *"that's cute – but don't tell anyone about it."* Management's inability to see digital photography as a disruptive technology, even as its engineers and scientists extended the boundaries of this technology, ultimately led to the company's demise. In 2007 Kodak realised that they had to get involved in digital photography and released a hard-hitting marketing video showing how Kodak

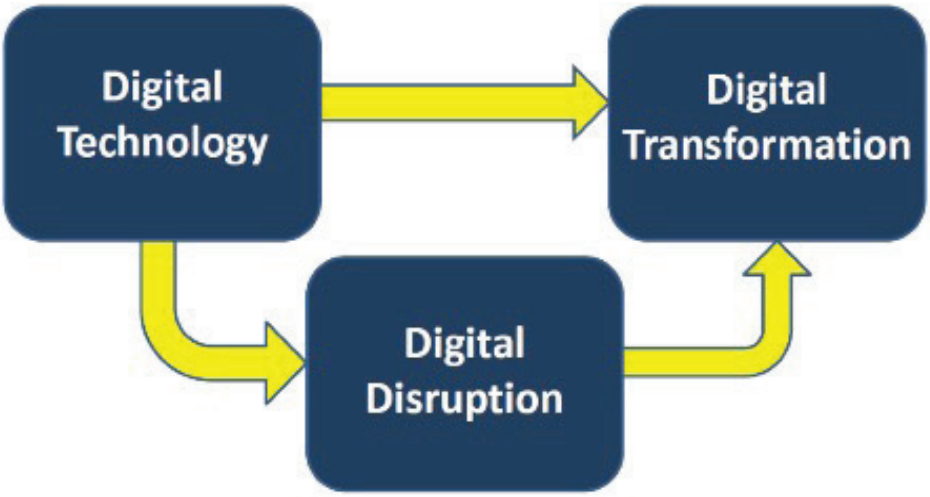

Figure 2: Relationship Between Digital Technology and Digital Disruption

was going to get back into the digital photography market. Unfortunately, and because Kodak's competitors had already captured a large percentage of the digital photography market, the company's financial performance progressively declined for the next few years, and in 2012 they filed for bankruptcy. After 128 years in business and its technology was used to record some of the most memorable events in human history, including the Second World War and the Apollo 11 landing on the moon, the company closed its doors for the last time.

Kodak experienced what has become referred to as "cannibalisation". Steve Jobs, the founder of Apple, indicated that "if you don't cannibalise yourself, someone else will, and that's precisely what happened to Kodak. They feared that introducing digital photography would cannibalise their photographic film business and decided not to follow this route. The result was that their competitors used digital photography to cannibalise Kodak's graphic film business fatally wounding the company's business from which it could not recover.

There are many examples of companies successfully cannibalising their products. Here are two:-

AMAZON: From its start as an online seller of hard copy books it dared to enter the e-book market with the launch of the Kindle, even though such a move threatened to disrupt its hard copy book business. Today Amazon is a leader in the promotion and sales of digital content in an e-book market that is worth $1.6 billion.

MICHELIN: Used the Internet of Things (IoT) to move from selling tyres to launching a service that promises performance backed by money-back-guarantees. They did this by developing software applications that optimised tyre management as well as providing training on eco-driving techniques. Such a move led to a significant reduction in fuel consumption and CO_2 emissions for commercial vehicles.

The role of digital technology is changing from being a driver of efficiency to an enabler of innovation and digital disruption. Leaders across all industries

are writing the next chapter of the digital economy. It is time to either become part of the story or just another footnote in the history of disruption.

DIGITAL TECHNOLOGY INFLECTION POINTS

The following telecommunication technologies have had a significant effect on the implementation of digital technology:

PULSE CODE MODULATION (PCM)

PCM is an encoding method used to digitally represent analogue signals that are sampled per the Nyquist Sampling Theorem. The idea of using PCM for voice communication was conceived in 1937 by Alec Reeves, who worked for International Telephone and Telegraph (ITT) in France.

Although he described the theory and advantages of using PCM, it was not a practical application because of the difficulty of implementing the concept using valve technology. A practical application had to wait until the invention of the transistor. First commercial telecommunication solutions were introduced in 1961 using twisted pair transmission lines to carry 24 telephone calls sampled at 8kHz and 8-bit resolution. PCM also formed the primary encoding method that was used in electronic exchanges that used time-division switching.

OPTICAL FIBRE

The idea of using optical fibres as a transmission medium was proposed by Charles Kao and George Hockman in 1965. Both gentlemen were working for Standard Telephones and Cables (STC) at the time. To make optical fibre practical for transmission, the attenuation of the light had to be reduced to below 20 dB/km. They achieved this by determining that impurities caused attenuation in the silicon that was used to manufacture the fibre rather than physical effects such as scattering. They correctly theorised the light-loss properties for optical fibre and proposed the right materials to be used to produce glass with high purity. Kao was awarded the Nobel Prize in Physics for this work in 2009.

Over the years the attenuation of optical fibre cable has significantly improved with the application of different doping materials (like titanium and germanium dioxide) and today attenuation of some 0.5 dB/km is being achieved using single mode fibre at 1310 nm wavelength and 0.4 dB/km using 1550 nm wavelength. Optical fibre has unlimited capacity carrying capability with the only limitation being the physics applicable to the electronics that is used to light the fibre. This is discussed later.

ETHERNET

Bob Metcalfe and David Boggs developed Ethernet in 1973 as a local area networking protocol to connect computers as well as to connect computers to other peripheral devices such as storage and printers. The term Ethernet was derived from the word *"luminiferous aether"* which was once postulated to exist as a medium used for the propagation of electromagnetic waves. Ethernet was commercially introduced in 1980 and was standardised by the IEEE in 1983 with the publication of the IEEE 802.3 standard. It replaced other competing wireline LAN connectivity technologies such as Token Ring and FDDI.

Today Ethernet's use has extended beyond LAN connectivity and is deployed in both metropolitan and wide area networks, at regional, national and international level. Its adoption in these networks came about as a result of the Metro Ethernet Forum's (MEF) creation of Carrier Ethernet in 2001, which enhanced Ethernet's ability to support carrier-grade reliability, availability and maintainability. The Internet Protocol (IP) is today carried over Ethernet, and consequently, Ethernet is regarded as one of the key technologies enabling the Internet.

Besides developing Ethernet Bob Metcalfe also created what has become known as Metcalfe's Law. Metcalfe's Law states that the impact of a network is equivalent to the square of the number of nodes. As an example, if we have a network with ten nodes, the network will have an inherent impact value of 100.

SOFTWARE CENTRIC NETWORKS

Current networks are built using many physical components, with each element having a specific function. The result is that systems are becoming extremely complex, with no flexibility or agility.

With rigid and inflexible networks, telecommunication operators are finding it difficult to compete against the likes of Facebook and Google who have adopted software-centric networks for some time now giving them agility and flexibility.

The following technology concepts are used in software-centric networks:-

- Software Defined Networking (SDN). This separates the control plane from the data forwarding plane and allows systems to be remotely programmed from a central site using a controller
- Network Functions Virtualisation (NFV). Network functions, which are today provided in physical hardware, are emulated in software and run off standard off-the-shelf servers located in central offices or data centres.

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The concept was developed in 2012, and since then there has been significant activity in terms of developing standards (both formal and opensource) as well as the deployment of many proof-of-concept trials.

Full-scale commercial implementation is now starting to take place. SDN and NFV are the foundation technologies for Fifth-generation wireless (5G).

5G is the next generation of cellular technology designed to significantly improve the user experience from previous generations (4G and 3G). 5G supports both mobile and fixed service deployment.

Key characteristics of this new technology are:

- a significant increase in connectivity speed between 20 and 100 times faster than today's 4G networks. In current trials, 5G has provided connectivity rates of 20 Gb/s. This is predicted to increase to 100 Gb/s as the technology matures.
- a significant increase in the ability to connect devices, up to 1 million devices per square kilometre is being driven by the Internet of Things (IoT).
- a significant reduction in latency, below 1 ms, driven by applications such as self-driving vehicles and gaming.
- 5G also makes use of higher frequency bands within the radio spectrum to provide higher connection rates as well as to relieve spectrum congestion.

The first phase of the standardisation process for 5G was completed in 2018, and commercial deployment was commenced early 2019.

ELECTRONICS

The following electronic developments have had a significant impact on the deployment of digital technology.

TRANSISTOR

The transistor was invented by John Bardeen, William Shockley and Walter Brattain at Bell Labs in 1947. It is a device composed of semiconductor material and used to amplify or switch electronic signals. It replaced the thermionic triode or vacuum tube that had been around since 1907 and which enabled radio technology and long-distance telephony, but it was a cumbersome device that consumed large amounts of power.

The transistor is a key active component in practically all modern electronics and is considered to be one of the greatest inventions of the 20th century.

INTEGRATED CIRCUITS

The concept of an integrated circuit (IC) originated in the 1960s and involved deploying a set of electronic circuits (made up of transistors) on one small flat piece of semiconductor material, which was usually silicon.

This resulted in the ability to create circuits that were orders of magnitude smaller and cheaper than building with discrete electronic components and consequently revolutionised the world of electronic mass production.

The advancement in IC design and fabrication has followed Moore's Law, which states that the number of transistors in a dense integrated circuit doubles every two years. However, the number of transistors that are today being incorporated using advanced wafer fabrication technology have superseded the constraints of Moore's Law. As of 2017 the largest transistor count in a commercially available single-chip processor is 19.2 billion.

LASER

Theodore Maiman built the first laser at the Hughes Research Laboratories in 1960. A laser differs from other light sources in that it emits light coherently, precisely, amplified and controlled so allowing the light to be focused onto a small area. Hence the early application of lasers was for cutting and lithography.

Initial lasers were pulse lasers that provided short bursts of energy. To be used in telecommunication systems, lasers had to provide continuous coherent light. The first commercial fibre optic communication systems were released in 1975 using gallium arsenide (GaAs) semiconductor lasers operating at 850 nm wavelength. They provided bit rates up to 45 Mbit/s with repeater spacing of 10 km.

Second generation systems emerged in the early 1980s using InGaAsP (Indium Gallium Arsenide Phosphide) semiconductor lasers operating at 1310 nm, the second window in silicon fibres was loss is lower, and chromatic dispersion is weaker, so that dispersive broadening of the light pulse is weaker. These systems were able to operate at 1.7 Gbit/s with repeater spacing up to 50 km apart.

Today we mostly use third generation systems operating at 1550nm, as the attenuation loss in the silicon fibre is the lowest in this region. In terms of transmission speeds, today's commercial systems support 400 Gbit/s with 800 Gbit/s

systems in prototype, all deploying highly pure coherent lasers.

The use of Dense Wavelength Division Multiplexing (DWDM) allows us to significantly increase the capacity carrying capability of a single fibre pair. This is done by different multiplexing wavelengths (or colours) onto a single fibre.

Typical channel plans for DWDM are 40 channels at 100GHz spacing or 80 channels at 50 GHz spacing. This means that if we use a 100 Gbit/s aggregate, we can carry up to 4 Tbit/s of data using 40 channels or 8 Tbit/s using 80 channels on a single fibre pair.

COMPUTERS

The subsequent developments within computer technology have had a significant impact on the deployment of digital technology.

MICROPROCESSOR

The first micro-computer chip (microprocessor) was developed in 1969 by the Intel Corporation using IC fabrication. This chip went into commercial operation in 1971 as the Intel 4004 processor. The Intel 8088 followed in 1979, and there have been continuous upgrades in computing power and processing speed since then.

STORAGE

Storage is the technology that is used to retain digital data. This technology has over the years, evolved from physical media, such as magnetic tapes and hard disks, to robust state solutions such as flash drives. The advent of cloud technology has also had a significant impact on storage, driven by improvements in internal bandwidth and the falling cost of storage capacity.

DATA CENTRES

These are facilities that centralise an organisations IT equipment, storage and operations, and manages and disseminates data. The principle of sharing Data Centre facilities, such as rack space, power and air conditioning, has also become big business. Today and into the future, Data Centres will sit at the foundation of Digital Transformation, much in the same way as broadband connectivity. Data Centres will also become the telecommunication hubs of the future with the evolution towards programmable and virtualised networks.

BENEFITS OF DIGITAL TRANSFORMATION

There are many generic benefits for both business and individuals at a personal level. This is by no means an exhaustive list:-

- an increase in the ability to communicate and network, including the benefits of networking using social media
- an increase in access to information both locally and internationally
- providing facilities to increase spare time and relaxation such as online shopping, online banking, websites for booking flights, accommodation etc., and many more
- facilities to either support or even replace educational and skills development initiatives including webinars and websites such as the Kahn Academy which is a non-profit organisation created by Salman Kahn in 2008 to provide online tools to educate students and which attracts over 100 million people per year.

Looking at Digital Inclusivity, defined as empowering people through ICT technologies and providing access to services that they could not get access to when in a physical format for reasons of location and affordability, there are many examples. Within the African context, these are within areas such as banking services, health care, educational services and Government services. Let us look at a few examples.

ONLINE BANKING – THE M-PESA STORY

M-Pesa (Pesa means money in Swahili) was launched in 2007 by Safaricom in Kenya. It is a mobile phone-based money transfer, financing and micro-financing service in which customers can deposit and withdraw money from a network of agents that includes airtime resellers and retail outlets acting as banking agents. The service specifically targeted the *"unbanked"* market in Kenya and as a result, experienced exceptional growth. By 2010 it became the most successful mobile phone-based service in emerging markets. In 2012 it had 17 million customers, and when it expanded to Tanzania in 2016, it attracted an additional 7 million customers.

The M-Pesa service has attracted many accolades for giving millions of people access to the formal financial system and for reducing crime in cash-based societies. However, the service was not successful in South Africa when introduced by Vodacom. The reasons for this are that South Africa already has the most technically advanced and accessible banking system on the continent with 75% of adults having bank accounts with most of the banks have already launched their Internet banking service.

M-HEALTH IN SUB SAHARAN AFRICA

M-Health is the practice of medical and public health supported via the use of

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mobile devices such as phones and patient monitoring devices. It is used mainly in Regions where access to healthcare provided by conventional means is a challenge. The drivers for M-Health include:_

- the increase in mobile connectivity. Currently, there are some 700 million mobile subscriptions in Africa, of which 50% use smartphones.
- the need to improve access to basic health care, and especially primary health care.
- the eco-system that supports M-Health includes the mobile network operators, content and app developers, health and pharmaceutical companies, device vendors as well as Government.

DISADVANTAGES OF DIGITAL TRANSFORMATION

Although the benefits of Digital Transformation far outweigh the obstacles, it is essential also to consider those aspects that will have a negative effect. These include:-

- access to vast amounts of information and the speed of such access has led to the dissemination of false and unverified information. This has created the "fake news" phenomenon often heard today;
- the negative effect on human contact and relationships based on a large number of people who socialise through digital devices and social media rather than physically. This can lead to individuals feeling disconnected and isolated, leading to depression or other forms of mental illness;
- privacy issues – there have been many incidents of confidential information leaks;
- the increase in complexity for the average human being. For example, modern cars are today becoming dependent upon electronics and software, so if they break down, there is little that one can do to assist one's self. Another example is the complexity in setting up a smartphone or tablet;
- there is a growing trend for the need to be online 24/7 so increasing work overload; and
- security concerns at Government, business and at a personal level.

Many people believe that the concept of security breaches at a network level only occurred after the introduction of the Internet. This is not true. In the past, even with analogue networks, there have been individuals who have used these networks to steal and con people out of money. Here is an example that occurred at American Telephone & Telegraph (AT&T) in the early part of the 20th century and was depicted in the 1973 movie called *"The Sting"*. The film depicts many con stories including one which was inspired by a real-life scenario at AT&T which involved winning bets on horse races by the later placing of bets based on information that is conveyed between the horse racing track and an offsite betting totalisator, which could be located in cities anywhere in the country.

The network setup for the communication service required between the race track and the offsite betting totalisator is shown in figure 3.

The communication between the race track and the offsite totalisator was carried over a single wire routed through an electromechanical exchange, which was the technology used for providing telephony services at the time. This private wire was used to convey the start of the race, which was an indication for betting at the offsite totalisator to be stopped, and once the race was run information as to the horse that won the race.

The con was carried out by having a person at the telephone exchange intercept the private wire and record, on a tape recorder, the two messages that were sent from the race track:

- the start of the race, and
- the horse that won

Once the race was over, the person at the telephone exchange would phone a colleague on a call box near the totalisator and inform him of who won. This person would then go in and place his bets on the winning horse.

After a suitable delay, the person at the telephone exchange would later play the recorded messages (start of the race and the winning horse) over the private wire to the officials at the totalisator. The con man at the totalisator would then collect his winnings.

CHALLENGES OF DIGITAL TRANSFORMATION

The implementation and adoption of Digital Transformation can experience many problems. These include but are not limited to:

- The availability of broadband connectivity and the cost thereof within the enterprise and business environment, there are also specific challenges, including:
  - pushback from employees who fear that the implementation of Digital Transformation would lead to job losses;
  - the lack of expertise and skills to lead digitisation initiatives;

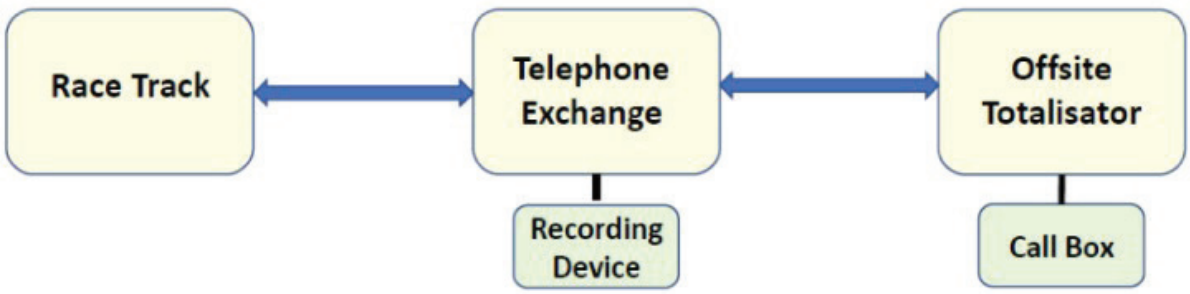

Figure 3: Communication Network Between Race Track and Off-Site Totalisator.

- limitations caused by the existing organisational structure;
- a lack of having an overall digitisation strategy; and
- limited budget.

- Another major challenge that is often experienced is the limited skills level that non-technical individuals have in understanding and handling digital technology especially taking into account the disparity in education levels that exist in our Country and the sub-Region as a whole.
- Getting the Government to see Digital Transformation as an essential driver for economic and social inclusivity and giving priority to the setting of policy to facilitate this is also a significant challenge that needs to be overcome.

HOW THE SAIEE CAN CONTRIBUTE TO DIGITAL TRANSFORMATION

It is believed that the SAIEE can contribute to the debate on Digital Transformation in two ways.

The first entails engaging with external stakeholders, and the second involves looking inward and implementing a Digital Transformation strategy within the Institute.

EXTERNAL CONTRIBUTION

This would entail engaging with external stakeholders, both public and private, around the benefits of Digital Transformation and what is required to enable this. Such engagement can provide thought leadership around what is needed to extend broadband connectivity at an affordable price, addressing issues such as frequency spectrum allocation, technology considerations and information and discussion around different business models. Together with Industry, the Institute can also assist in engaging with regulators and policymakers to ensure that applicable and workable policy and regulations are adopted for enabling Digital Transformation and reaping the benefits thereof.

Another area where the SAIEE can make a significant benefit is by using the collective expertise of our members to drive awareness of the need for locally developed or locally adopted standards, especially around emerging ICT technologies like 5G.

To address the concerns that employees have with regards to the threat of job losses as a result of implementing Digital Transformation, the Institute can assist the Government and Industry in engaging with Organised Labour. Such engagement would explain the concept of Digital Transformation in clear terms, explain the benefits and risks and facilitate discussion to formulate solutions and minimise the risks.

DEPLOYING DIGITAL TRANSFORMATION WITHIN THE SAIEE

As a learned Voluntary Association (VA) the SAIEE should be using the technologies that we, as professionals, utilise in our businesses to deliver the services that we supply to our members. It is for this reason that I am proposing the introduction of a Digital Platform into the SAIEE's organisation and operation. Such a platform will address the delivery of services within the following areas:

- webinars,
- online training,
- virtual meetings,
- collaboration,
- publications,
- the dissemination of information, and
- many other areas.

The proposal is to approach an Industry leader in the field of Digital Transformation

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and encourage them to use the SAIEE as a working proof of concept model for their proposed solution. Hence while the SAIEE is using the platform to deliver services to our members, the chosen vendor can make use of the platform for marketing and sales initiatives.

CONCLUSION

This paper has discussed the origins of Digital Transformation in terms of identifying various technology inflexion points that have contributed, as well as identified the benefits to be gained and how these benefits have assisted in using Digital Transformation to enable economic and social inclusivity.

The concept of Digital Disruption has also been discussed and in particular how such disruption if not correctly handled by the management and leadership within an organisation, can lead to the destruction of an organisation, as was the case with Kodak. As Steve Jobs indicated *"if you do not cannibalise yourself someone else will"*, and such a threat applies equally to the SAIEE as it did to Kodak.

As a result, it is proposed that the Institute embarks on its own Digital Transformation strategy by deploying a digital platform that can be used to deliver the services that we supply to our members. wn

SAIEE

ENGINEERING AN AFRICA FOR THE FUTURE

1ST SAIEE NATIONAL CONFERENCE 2019

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The SAIEE is proud to announce the

2019 Office Bearers

DEPUTY PRESIDENT SY GOURRAH

With more than two decades of experience as an electrical engineer, Sy Gourrah holds a number of qualifications including a Bachelor's degree in Engineering (Electrical & Electronics), Master's in Business Administration and Government Certificate of Competency.

Currently, she is the General Manager for the Power System division within Actom.

Sy served as the first female president of the Association of Municipal Utilities (AMEU) from 2008 to 2010 and been on the executive council since 2001 until 2011.

Sy became an SAIEE Member in 2003, is now a fellow member and has served as a council member since 2012. She is currently the Chairperson of the Finance Committee and the Deputy President of the SAIEE.

SENIOR VICE PRESIDENT PROF SUNIL MAHARAJ

Prof Sunil Maharaj became an SAIEE member in 1996.

He completed his Bachelor of Science: Engineering (Electronic) and Master of Science Engineering (Electronic) at the University of Natal. In 2005 he was instrumental in establishing the Sentech Chair in Broadband Wireless Multimedia Communications at the University of Pretoria. He has supervised and mentored many students from Honours, Masters, Doctor of Philosophy to Post-Doctoral level. Since May 2011, Sunil has been the Head of Department of Electrical, Electronic and Computer Engineering at the University of Pretoria and has served on various national and international technical committees related to the ICT arena. Sunil is currently the Dean of the Faculty of Engineering, Built Environment and IT (EBIT) at the University of Pretoria.

JUNIOR VICE PRESIDENT PRINCE MOYO

Prince Moyo (FSAIEE) joined the SAIEE in 1996.

His academic qualifications include an MBL, 2015 (Unisa); MSc Eng (2001), GDE (2000) [Wits]; BSc Eng Hons (1993) (Univ Zimbabwe) and has 24 years work experience.

Prince specialises in the specification of all low voltage and high voltage AC and DC equipment up to 765 kV. His team comprises of ± 420 engineers, technologists and technicians. His key experiences include rural electrification designs, distribution project portfolio of R1,7 BN annually and reviewing maintenance strategies for all asset classes.

Prince is actively involved as an SAIEE Council Member and is the Chairman for the Cigre SANC.

IMMEDIATE PAST PRESIDENT
DR HENDRI GELDENHUYS

Dr Hendri Geldenhuys (FSAIEE) joined the SAIEE in 1980.

His Academic Qualifications include a B Ing (Elektries) in 1979, B Ing Honneurs in 1982, M Ing in 1986 UP and PhD WITS in 1994 and have 34 years Post-qualification Experience.

Eskom currently employs Hendri as Corporate Specialist in the Technology Division. He works across organisational boundaries on technical-business issues mostly related to the distribution business of Eskom. His PhD is in the field of lightning protection of engineering systems.

Hendri currently serves on numerous CIGRE, IEC and SANS committees. Hendri was the 2018/9 SAIEE President and currently serves on various SAIEE Committees.

TREASURER
VIV CRONE

Viv was the CEO of the Siemens Spescom joint venture company, Energy Measurements (Pty) Ltd., which revolutionised the pre-payment electricity meter industry.

He was appointed as CEO of Spescom DataVoice in 1999. This company specialised in the development of innovative Multi-media Transaction Recording products and was the most profitable company within the Spescom Group at the time. Viv retired from Spescom in 2010.

He is a Registered Professional Engineer and became an SAIEE member in 1978. He is a Fellow and Past President of the Institute. He lives in Johannesburg, has three grown children, and is a part-time lecturer at Wits in the School of Electrical and Information Engineering.

HONORARY VICE PRESIDENT
MARIUS VAN RENSBURG

Marius van Rensburg started his professional career in 1976 with Eskom as Engineer in Training and became an SAIEE Member in 1978.

In 1986, he became the senior operations engineer in Distribution in George and after having held several positions in the Southern Cape Region, he relocated as Network Services Manager to Cape Town in 1994. During his time in Distribution, he chaired several committees, amongst others the Maintenance Management Steering Committee for Eskom and the steering committee that compiled the national standard NRS 082.

Marius retired in October 2018 from Eskom and is since involved in VDMV, a property development company and also assist in Drakenstein Municipality.

Minister Pravin Gordhan visits SAIEE

The SAIEE President and the Central Gauteng Centre with Minister Pravin Gordhan.

On the 17 of April 2019, the SAIEE Central Gauteng Centre (CGC) in collaboration with SAIEE Head Office hosted the Honorable Minister of Public Enterprises, Minister Pravin Gordhan, in an Engineer Engagement session under the theme: The Challenges Facing the Power and Energy Industry in South Africa. The audience of 135 people that attended the engagement session included captains of industry and the electrical engineering fraternity at large.

South Africa has been facing Electricity supply shortages, and the solutions lie with the critical skills at the engineering body and government working together. The CGC saw it fit then to engage the Minister on the challenges facing the industry especially during this challenging time that Eskom is currently experiencing.

The session hosted by CGC committee member, Kgomotso Setlhapelo, was kicked off by Mr Seetsele Seetswane who is also a member of the CGC committee. He reflected on the words of former deputy Prime Minister of Zimbabwe Professor Arthur G.O. Mutambara, Pr Eng, who challenged engineers to break out of engineering and technical comfort zones and assume their rightful places as leaders and captains of the industry who should be at the frontier of creating opportunities and growing the economy of our country. *"Today we want to challenge our fellow Engineers to return to their leadership posts. The first step in that journey is to become part of the SAIEE so that you can have a platform and amplify the voice of the engineering fraternity. As members of the SAIEE and affiliates of the Engineering Council of South Africa, we hold ourselves to the highest moral and ethical standards. We subscribe to a code of ethics which urges us to always act with integrity and discharge our duties with fidelity and honesty. In our conduct, we have pledged to always uphold the dignity, standing and the reputation of the electrical engineering fraternity,"* Seetswane added.

In his address as the keynote speaker for the evening, the Minister spoke about the role that is played by the SAIEE in this electricity crisis that we find ourselves in, which is in line with the State President's call of *"Thuma Mina,"* meaning come forward and offer your skills, assistance, passion and energy. *"This is so that we can deal with the challenges and seize the opportunity to make this country great again,"* said the Minister.

Minister Gordhan further mentioned in detail, the challenges that the country and Eskom are facing in this present juncture. *"Social justice and just transition are one of the challenges that we are facing as a country. As a professional society, how do we ensure that we have leaders who are not driven by personal greed and patronage? But who is there to ensure that social justice is spread across society, meaning; access to education, health care, social security and lack of discrimination, sexism, racism; all the other -isms that are out there."*

The Minister shared news of the unbundling of Eskom that the details are still being finalised with the relevant stakeholders. This is all to restore the company to technical and financial stability. He concluded his address by giving a challenge to the institute in the form of the following questions:

1. For a 44 to 48 GW installed capacity, running on average 38GW, what would you do to increase capacity?
2. When and how will renewable energy become a reliable source of baseload?
3. How would you reorganise electricity Distribution?
4. What campaign can you launch to help electricity cost savings?
5. How do you change the compliance culture?

The CEO of SAIEE, Mr Sicelo Xulu, also took to the podium and thanked the Minister for this engagement and further said *"such engagements present opportunities especially for the South African engineering industry, to offer some solutions and as an institution; we need to take up this opportunity and become pioneers in providing solutions."*

The session was concluded by the CGC Chairman, Mr Teboho Machabe, who delivered a vote of thanks to the CGC Team, the SAIEE leadership as well as to Minister Gordhan and his delegation.

SAIEE Southern Cape Centre News: Witsand Desalination Plant visit

In February 2019, the SAIEE Southern Cape Centre visited the first solar-powered desalination plant in South Africa at Witsand, Hessequa Municipality, in the Western Cape.

The plant was co-funded by the Western Cape Government through the drought relief fund, and by the French Treasury through a fund dedicated to the implementation of innovative green technologies.

The plant produces 100 kl of fresh water per day powered by solar energy only. This volume will supply close to 50% of the daily demand of Witsand during off-peak periods. This small town was chosen for the first project because the population increases dramatically from 300 to 3000 during the holidays and there is not enough water to accommodate the influx. The plant connected to the electrical grid, which enables it to operate during peak water demand periods on a 24-hour basis, with a maximum supply capacity of 300 kl/day. The unit has been in full production since the 20th of December.

The technology, OSMOSUN®, was developed by the French Company Mascara Renewable Water and brought to South Africa by their local partner TWS-Turnkey Water Solutions. It is the world's first reverse osmosis desalination technology coupled with photovoltaic solar energy, without batteries. The technology is designed to supply coastal or borehole-dependent communities, with drinking water at a competitive price and without CO_2 emissions.

The significant technological development was inventing a specialised "intelligent" membrane that was able to "soften" the impact of variations in solar power. Every time the sun went behind a cloud, the amount of solar power would drop, and would increase again when the clouds moved away. Without this intelligent membrane, variations in solar power could explode the reverse osmosis membrane.

The Southern Cape Centre visited the plant in conjunction with Garden Route Green Energy Forum on the 13th of February 2019 at the Witsand Community Hall. It was the second site visit the SAIEE Southern Cape Centre attended since the original Eden Green Energy Summit. It goes to show the involvement of the SAIEE members in the district, assisting the government with knowledge and experience.

Great interest was shown in the desalination plant by all attending the site visit, with especially George Municipality considering the implementation of similar projects in the future.

NRS 097 WORKSHOP | SSEG WORKSHOP – 30 & 31 MAY 2019

The SAIEE Southern Cape Centre is planning a day-and-a-half workshop on the 30th and 31th of May 2019 to discuss Grid Connections of newly installed SSEG plants. This will specifically cover the requirements of NRS-097-2-1 and NRS-097-2-3. This is due to the interest shown in the installation of Small Scale Embedded Generation (SSEG), both nationally and locally.

Interested parties such as local municipalities, consultants and contractors are invited and encouraged to attend, and participate in discussions. Through this workshop, the SAIEE hopes to assist industry and government by understanding grid connections requirements more clearly between the various parties. Details pertaining to the workshop will be send to all members in the near future.

SAIEE Charity Golf Day

The SAIEE recently hosted members and partners at the Pretoria Country Club for its annual charity golf day, in aid of Ya Bana Village for Children.

Ya Bana means "for the children." The Village is an ambitious project aimed at providing vulnerable and orphaned children with permanent housing in a family environment where trained house mothers offer love and structure. The Village believes that in order for children to become balanced and productive citizens of society, they need holistic care. Ya Bana's programs focus on the physical, emotional, educational, spiritual and cultural needs of the child.

With 18 four-balls booked by supporting members and guests, the day promised to be a huge success, notwithstanding the support of our sponsors for the day. They were Old Mutual Financial Services, MajorTeck, Sqwidnet, CMH Kempster Ford Hatfield and Dust-A-Side.

The winners of the day was the ladies team, which consists of Sini Meyer, Hettie Oberholzer, Delyse Burger and Linda Muller.

Winning Team

Sponsor: CMH Ford Hatfield

Sponsor: MajorTech

Sponsor: Dust-A-Side

Sponsor: SqwidNET

From left: Minx Avrabos (wattnow), Winning team member Sini Meyer and Patrick O'Halloran (MC).

From the Lucky draw, donating his R30 000 SAIEE Corporate Partnership to be auctioned, is Father of Ya Bana Village, George Msiza with George Debbo (SAIEE President) and Minx Avrabos.

First Nearest to the Pin winner with SAIEE President, George Debbo.

From left: George Debbo, Christo du Plessis (Zest WEG Group) the losers for the day who took the longest to complete the golf course and Patrick O'Halloran.

Second Nearest to the Pin winner, with SAIEE President, George Debbo.

Our teams....

.....►

CUT launches new SAIEE Student Chapter

From left; Prof K Kusakana, L Matutoane (SAIEE), MA Ramokone, Mr G Debbo (SAIEE President), S Ramphalile, M Mohanoe, J George, T Phali, TM Lebakeng, T Raphiri, Dr B Kotze, L Moloi, T Moshe, and KTL Mothiba.

It has always been one of the goals of the Electrical and Computer Systems Academic Association (ECSAA) to change to become the South African Institute of Electrical Engineers (SAIEE) Student Chapter.

At this milestone evening on the 16th of April 2019, SAIEE President George Debbo delivered his inaugural address - Digital Transformation in the current economic climate and officially launched the new SAIEE Student Chapter at the Central University of Technology (CUT) Bloemfontein campus.

Dr Ben Kotze, the founder of ECSAA and past Chairman of the SAIEE Central Centre, spoke about the foundation of the SAIEE and why it is imperative to establish a Student Chapter at CUT. Stalwart Tebang Phali and Student Chapter Chairperson Moeketsi Ramokone spoke about the aims and objectives of this new Student Chapter. Joseph George, Vice Chairman of the SAIEE Free State Centre, and Prof K Kusakana, HOD of the Department of Electrical, Electronics and Computer System addressed the guests.

Before the end of this auspicious evening, George Debbo honoured the founding students of the Student Chapter with certificates.

ABOUT ECSAA

The Electrical and Computer Systems Academic Association (ECSAA) was established in June 2008 by Dr B Kotze, under the leadership of Mr G Olivier, who at the time was the Program Head: Electrical Engineering.

The primary purposes of the organisation were for electrical engineering students to assist each other academically by way of study groups. They are engaged in industrial exposure by visiting companies/ workplaces relevant to their course and getting involved in community engagement and marketing. They are also involved in activities taking place at the university, visiting and educating learners at schools and the community at large.

The organisation was also a platform where students could learn leadership skills, working in groups and engaging in competitions, share ideas, develop innovation and entrepreneurial skills.

The organisation has many achievements to date and is still working hard to achieve more, focusing more on innovation, entrepreneurship and community engagement. In 2015 they received the 4th placed Trophy in VC Student leadership Awards for Student Organizations, and in 2018 they won the 3rd place Certificate in VC Student leadership Awards for Student Organizations. They achieve and developed locally and provincially.

In 2018 Dr Ben Kotze suggested that ECSAA be transformed into South African Institute of Electrical Engineers (SAIEE) Student Chapter. With the help from Mr Tebang Phali, who is the former member and now the guardian of the student organisation, and the current executive members of the organisation they managed to achieve this transformation in March 2019.

With this endeavour, a national footprint is possible for the students of this newly inaugurated student chapter as proven by the current CEO of SAIEE, in adding to make a little bit of history.

SAIEE
STUDENT CHAPTER
CENTRAL UNIVERSITY OF TECHNOLOGY

HV test offers Power Frequency, Partial Discharge and Tan Delta testing of Hydro, Coal and Nuclear Generators

There are many power stations in South Africa, including Coal fired, Hydroelectric & Nuclear, all of which can be tested by HV Test as part of commissioning and maintenance on generators and motors. The power ratings of these national assets can range from 10 MW up to 800 MW with voltage ratings as high as 22 kV.

The privately owned HV Test Resonance System has the capacity to test loads of up to 7µF with an internal PD of less than 15fC.

HV Test provides unparalleled expertise in commissioning and maintenance testing of rotating machines. Tests conducted on rotating machines are done in accordance to international standards (IEEE, IEC, NEMA & CIGRE) and include:

- High voltage test up to 50kV at power frequency
- Partial discharge Tests
- Tangent Delta Measurement
- Very low frequency overvoltage testing
- Insulation resistance and polarization index

The equipment applied to conduct these tests use cutting edge technology and have sophisticated features including extremely high accuracy and resolution yet is built to sustain the transport to and from sites across all types of terrain. The HV Test Generator and Motor test Technicians and Engineering support have successfully completed testing with this system for the past 5 years.

Contact Liz da Silva, HV Test,
Tel: 011 782 1010, Email: sales@hvtest.co.za

Pasternack Expands Line of Skew Matched Cable Pairs to Include 40 GHz and 67 GHz Models with Delay Match as Low as 1 ps

Pasternack's expanded product line is made up of seven skew matched cables offered in 40 GHz and 67 GHz versions, three original models and four newly released. These delay matched cables feature polarity indicators for matched cable ends and are available with 2.92mm or 1.85mm connectors. Performance specs include delay match as low as 1 ps and VSWR of 1.4:1. These cable pairs are also flexible, 100% tested for skew match and are all available for same-day shipping. *"Adding additional models to our already impressive line of skew matched cable pairs gives our customers more in-stock, extremely flexible options that deliver optimal delay match to decrease measurement errors created by skew,"* said Steve Ellis, Product Manager.

SEW-EURODRIVE (Pty) Ltd gives a foretaste of the future of automation with MOVI-C® system

Visitors to the Africa Automation Fair 2019 will get a foretaste of the SEW-EURODRIVE MOVI-C® modular automation system, which is readymade for the requirements of Industry 4.0.

This represents the next-generation of automation technology from Germany and will be phased in gradually by SEW-EURODRIVE (Pty) Ltd in South Africa, according to National Sales and Marketing Manager Norman Maleka.

The system provides for an end-to-end automation solution, from planning to commissioning, operation and diagnostics software, electronic control and monitoring devices, mechanical drives, and gearmotors.

What's more, it features an open communications topology from PROFIBUS and Industrial Ethernet to Modbus.

While the MOVIDRIVE® B Drive Inverter and MOVIAXIS® Multi-Axis Servo Inverter have been available for some time, the MOVI-C® modular automation system sets SEW-EURODRIVE (Pty) Ltd on a path to embrace Industry 4.0. *"This requires products that are both open and flexible,"* Maleka stresses. *"Our focus is to provide our customers with a fully modular and customisable solution."*

"Our main theme at the exhibition will focus on energy efficiency," Maleka notes. Three-segment conveyors about 1 m to 1.5 m in length will feature IE2, IE3, and IE4 motors, with the different energy consumption displayed on a screen. Apart from its motor range, the MOVIGEAR® mechatronic drive system will also be showcased. This technology is making inroads into the food-and-beverage industry due to its ease of use and quick installation, and the fact that it is easy to clean and meets strict hygiene standards, for which an optional smooth surface is available.

Norman Maleka
National Sales and Marketing Manager
SEW-EURODRIVE (Pty) Ltd.

"Our aim is not only to stay ahead of the technology curve, but to be in a position to ensure our customers always have access to the latest complete solutions that are flexible, adaptable, and cost-effective" concludes Maleka.

High quality, locally manufactured electrical products from Powermite

Powermite, a member of the Hudaco group, offers a fully comprehensive range of high quality locally manufactured electrical products for machinery and equipment including mobile generators, pumps, welding machines, continuous miners, shuttle cars, tunnel borers, and transformers used by the southern Africa's mining, marine and general engineering sectors.

"Quality and reliability are fundamental to prolonging the lifecycle of products and subsequently optimising uptime and productivity for mines and plants," states Donovan Marks, Marketing Director of Powermite, a specialist component, equipment and system supplier to the Southern African region for close on 5 decades. *"As our electrical products and components are subjected to stringent operating conditions, we make sure that quality always takes centre stage during manufacturing."*

Energy month time to invest in energy

"May is Energy Month, a time when the South African government and all authorities involved in energy renew their call to South Africans to conserve energy," says Dr Thembakazi Mali, interim CEO, South African National Energy Development Institute (SANEDI).

"However it is not just conservation that must concern us but also innovation in the energy business to create opportunities in many areas, including business development, job creation, improved energy efficiency and more. The current electricity crisis must refocus our attention on the need to be more sustainable and more efficient.

"There are enormous opportunities for digitalisation and other disruptive technologies in the renewable energy sector, increasing installations, creating demand for new jobs and uplifting the local economy. If we take the whole sustainable energy drive seriously and incorporate Industry 4.0 technologies and upskill people, we will stimulate the growth of an entirely new industry and all that it represents.

"Corporates and small business need to take responsibility to affect change in sustainable energy. Creating awareness at every level of society is a priority, about not only electricity and energy but also about water and waste too – everything is integrated, and resources are limited. Companies of varying sizes can also look at adopting policies such as ISO 50001, which supports organisations in all sectors to use energy more efficiently through the development of an energy management system. It helps people be aware of what they are doing and identify opportunities to improve efficiencies and reduce waste.

"There has been a dramatic increase in the use of rooftop PV installations in buildings of all types – shopping malls, offices, municipalities, hotels and homes – and its incorporation into new building designs, which is very positive. There has also been an encouraging swing towards passive thermal design, where the orientation of the building, and features such as insulation, location, layout, window size and placement, and shading, are all taken into account at the design stage of the building, to reduce dependence on the national grid.

"These growth points notwithstanding, more focus needs to be given to R&D in the renewable energy and energy efficiency sectors, which has experienced an unfortunate reduction in funding in recent years, because there has just been an overwhelming number of other pressing social areas demanding R&D spend. Some South African universities and TVET colleges are recognising this need for sustainable energy R&D and are trying to do more with limited funds.

"There is a tremendous value to be gained in energy collaboration across Africa, as the energy challenges that South Africa is facing are not unique in the African context. Events, such as the African Utility Week brings industry stakeholders together for many years, encourages learning from each other. There has been a definite growth in the collaborative attitude towards improving energy efficiency among many African countries, with many initiatives being established, such as the Southern African Centre for Renewable Energy and Energy Efficiency (SACREE), in Namibia.

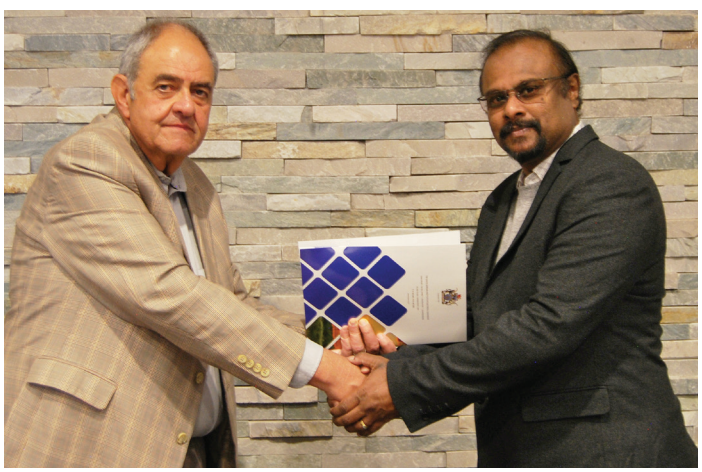
"Looking ahead, the ideal energy solution for the African continent is a combination of energy carriers. Gas must play a role, as must solar and wind, which we have in abundance in different areas in South Africa. We believe all three are the way forward for the continent and will avoid a situation where all energy eggs are in a single basket.

"This month should mark the start of a year-long effort to conserve energy at home, in the business and at a national level. We encourage all South Africans to make Energy Month become an Energy Year," concludes Mali.

SAIEE Inducts new Fellow

At the recent SAIEE Council meeting, on the 3rd of May, President George Debbo inducted a new Fellow to the SAIEE family.

Prof Chandima Gomes, from Wits University, is highly regarded internationally in a wide range of sub-disciplines, particularly within the High Voltage Engineering and Lightning Protection arena. Aside from research, Prof Gomes is a firm believer in transferring knowledge through short courses. He is involved in the SABS lightning protection committees and serves as a Board Director of the African Centre for Lightning Electromagnetics Network.



From left: 2019 SAIEE President, George Debbo and Prof Chandima Gomes.

Large poultry farm embraces lightning protection

Lightning and surge protection specialist DEHN Africa was recently involved in an extensive project to provide rooftop solar power to one of South Africa's largest poultry farms, Chubby Chick, in Potchefstroom.

All parties involved worked closely together from design to commissioning, ensuring the installation was comprehensively protected from lightning effects during its lifetime.

Chubby Chick provides fresh and frozen whole chickens to the local retail and wholesale markets, supplying meat to, among others, Woolworths and OBC Chicken and Meat Butchery, and the latter company assists in helping small communities with the supply of meat.

DEHN Africa Managing Director, Hano Oelofse, explains, *"Because solar power provides consistent, affordable and clean energy over a 25-year lifetime, it is not surprising that more and more commercial and industrial properties are investing in solar energy by installing solar panels on their buildings, as Chubby Chick set out to do, in addition to the larger free-field solar farms themselves. DEHN's extensive product and service range within the renewables segment can be applied across the solar photovoltaic (PV), thermal solar, wind energy and hydro-generation areas.*

"This renewable energy trend offers an exciting view of where the future of the energy sector is headed, both globally as well as locally. Solar energy can, quite literally, be made available to all."

"At the same time," he cautions, *"we must remember that vast tracts of South Africa are regions of high lightning ground flash density, and just like any other part of your commercial property, your solar panels must be protected from the possible destructive effects of lightning. While the costs of solar energy are coming down compared to where we were some years ago, it remains a fact that a solar PV installation can be a high investment outlay. The costs of replacing expensive parts while the solar PV system is still in the process of 'paying for itself' because the installation has not been protected from a potential lightning strike – or not protected properly – can be prohibitive.*

"Therefore, at DEHN Africa we recommend that a lightning protection system (LPS) be included in your commercial solar installation from the actual design stage. Certainly, an LPS can be retrofitted, but it is better to have it forming part of the design of your commercial PV installation from the very beginning of the process."

This is exactly how the Chubby Chick renewable energy project was unfolded, with the project following a model partnership process. DEHN Africa carried out the LPS designs and recommendations, and signed off the installation as correct and completed for the customer.

"Motla Consulting Engineers, a leading engineering consultant and EPCM (engineering, procurement, construction and management company) was appoined by Chubby Chick to design and install a solar PV system in order to reduce their energy bill," clarifies Oelofse. *"We worked with Motla Consulting Engineers on the design of the LPS on their solar energy planning. Motla Consulting Engineers, together with their installation partner, Einstein Electrical, constructed and installed the solar system and contracted Rolling Sphere Lightning Protection (RSLP) to carry out the external lightning protection and earthing installation. according to our designs and recommendations. DEHN Africa then*

signed off the LPS as a correct and completed installation for the customer."

Because of the scale of the premises, which have a large roof area, it was necessary to protect the facility, and its comprehensive electronics system, from direct lightning as well as possible surges from nearby strikes. As with free-field solar farms, lightning strikes to rooftop solar panels will cause damage at the strike point, as well as surge damage to any equipment that is connected downstream. External lightning protection helps avoid damage at the strike point itself, while surge protection devices assist in the prevention of downstream damage from strike-related surges, thereby also allowing the renewable energy system to stay online.

"This project was noteworthy due to its overall complexity as well as the collaboration that took place between the different companies involved. Multiple buildings were involved and there was also an extensive communications system to protect. Other challenges included the size of the area being protected; the size of the electrical system, and the fact that the mounting of the air termination rods had to be adapted during installation, which was overcome through collaboration with DEHN Africa, Motla Consulting Engineers, Einstein Electrical and RSLP.

"The client was extremely happy with the outcome. Chubby Chick now has solar panels powering its industrial processing plant, making it greener, reducing its power consumption, decreasing its carbon footprint and saving costs over the longer term," concludes Oelofse. wn

Zest WEG Group helps farmers find good 'ground' – electrically

According to Zest WEG Group, there are misconceptions around what constitutes 'earth' (or 'ground') and 'neutral' connections and not understanding the differences can create serious problems when connections are made from on-site transformers or other sources. This more often than not leads to earth leakage systems underperforming and compromising the safety of the equipment and operators.

Johan Breytenbach, transformer sales specialist at Zest WEG Group, says that the neutral connection in an electrical installation is designed to carry current all the time, while the earth connection is only supposed to carry current for a short period to trip your protection switch.

"Where this is not understood and the installation is not done correctly, the trip system will not work properly. In addition to this, stray currents are created that could cause other problems," he says.

Experience has shown that many farmers use the neutral connection as the earth when they do an electrical installation, and this is not correct. Current carried on a grounding conductor can result in significant or even dangerous voltages on equipment enclosures. For this reason, the installation of grounding conductors and neutral conductors is carefully defined in electrical regulations.

In alternating current (AC) electrical wiring, the earth is a conductor that provides a low impedance path to earth so that hazardous voltages do not find their way to the equipment. Under normal conditions, the earth connection does not carry any current. Neutral, on the other hand, is a circuit conductor that normally carries current back to the source.

Neutral is usually connected to earth at the main electrical panel or meter, and also at the final step-down transformer of the supply. Neutral is also the connection point in a three-phase power supply to connect cable termination in order to gain single phase power. In a three-phase circuit, neutral is usually shared between all three phases, with the system neutral being connected to the star point on the feeding transformer.

Earthing is therefore a vital part of electrical installations to ensure that circuit breakers will trip under fault conditions. Safe and legal installation needs to start with the selection of the right transformer, with a star configuration to allow the connection to the neutral point. Installation by a qualified and experienced technician is then ideal, to ensure optimal performance.

The correct earthing or grounding

A WEG pole-mounted transformer (200kVA 11kV/400V) with the neutral and earth contact terminals visible.

of electrical currents has a number of important benefits apart from the main concern around safety. It protects equipment and appliances from surges in electricity – commonly from lightning strikes or power surges – which bring dangerously high voltages of electricity into the system. Good earthing will ensure that excess electricity will go into the earth, rather than damaging equipment.

Zest WEG Group's product line-up includes low and high voltage electric motors, vibrator motors, variable speed drives, softstarters, power and distribution transformers, MCCs, containerised substations, mini substations, diesel generator sets, switchgear and co-generation and energy solutions as well as electrical and instrumentation engineering and project management services. wn

The Lightning Gurus

Investors, true enablement & experience

Since its inception in February 2019, The Lightning Gurus' formula of enabling black start-up companies to enter into the earthing and lightning protection industry has been highly successful. True to their word and aspirations, The Lightning Gurus have already created 23 new employment opportunities within B-BEEE companies and completed more than 50 projects across Southern Africa in less than six months, which in itself is unheard of for a start-up company in a technical recession.

Due to the incredible response from the market and the subsequent increasing work load, the Gurus required additional investment and expertise to meet their demand and execution requirements.

As such, the management team decided to approach some of the market mechanisms set in place by the government to help scale/grow SMEs. It was not long after that an interested party (investor group) recognised the enormous potential in The Lightning Gurus and decided to assist with access to funding for large projects, working capital and even resource investments.

But it did not stop there. During the group's due diligence (DD) and scrutiny they identified the synergies and dependency of The Lightning Gurus with Lightning Protection Concepts (LPC) and that they too would need to be able to scale and grow simultaneously. To this end, the investor group established a holding company in order to assist both companies with their respective individual needs, especially in terms of resources. At the newly established holding company's first board meeting, it was decided to appoint Trevor Manas as the Managing Director of The Lightning Gurus, with the chairman of the board stating that, *"It made perfect sense to move Trevor due to his experience, respect and passion for the lightning industry."*

Trevor started his career as a lightning protection specialist in 1994. Over the past 25 years, he has been actively involved in over 5,000 projects worldwide, authored more than 20 white papers on various aspects of earthing and lightning, and is a member of several SABS lightning protection working groups. His name is synonymous with the successful implementation of lightning protection solutions that are effective and fully compliant with both local and international standards.

Trevor served as National Director of the Earthing and Lightning Protection Association (ELPA) in 2017 and 2018, where he developed the accreditation courses for lightning protection installers, designers and inspectors. Prior to this, Trevor was the Managing Director of Pontins for more than 15 years.

"I am extremely excited to be able to assist both The Lightning Gurus and the start-up companies with the insight, skills and experience required to be successful lightning protection specialists. I also look forward to being involved in the development of these companies into the future powerhouses of our industry," said Trevor. He added: *"We under-estimated the need for a company like The Lightning Gurus in our industry. Our aim is to strengthen and refine The Lightning Guru's winning formula in areas such as higher-level training, tendering, project management and installation excellence of protection systems."*

"I would love to say that having passion, skill and a customer-centric focus is enough to make a company succeed, but I know that there are two ingredients missing in that elusive recipe for success. Those are experience and wisdom. Trevor brings with him vast amounts of both qualities, and I know that together we now have a guaranteed winning recipe. It's a real privilege to have Trevor join our company," says Sales Director Kenneth Roets. wn

THE LIGHTNING GURUS

Driven by Passion ....
Managed by Experience

"Saving lives, protecting assets - one strike at a time..."

INTRODUCING A NEW CONCEPT IN LIGHTNING PROTECTION

The Lightning Gurus is a company dedicated to empowering B-BBEE companies in the earthing and lightning protection industry. Our calling is to turn this idealistic proposal into reality. With the right designs, products, installation expertise and management we enable these companies to offer turn-key protection solutions.

The Lightning Gurus has various innovative and unique offerings that are designed to provide effective protection:

- All the Gurus are 100% black-owned companies.
- All Gurus are highly trained Master Installers who are ELPA accredited.
- The Lightning Gurus have more than 80 years experience in all industry sectors.

We are the only company to have independent testing, inspection & certification on all projects

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New start-up to empower many other start-ups

MyTechie is a new start-up that can be likened to the AirBnB of technicians – enabling techtrepreneurs. Once launched, the App will be downloadable and will connect users to technicians on call. MyTechie South Africa has been established as a facilitator of standardised information and communication technology (ICT) services to communities and ICT service providers.

By Hans van de Groenendaal, EngineerIT

For telecoms and internet service providers, MyTechie represents an opportunity to tap into a trusted team of "village" technicians available to support the ICT industry. These "village technicians" will aide in supporting consumer needs, helping the complete turnkey solution from fibre-to-the-home/business installations through to the full internet of things (IoT) ecosystem, starting with basic fibre drop installations and progressing right through to the connected smart home, even setting up a new PC or smart TV.

MyTechie is the brainchild of André Hoffmann, who has many years of experience in the industry having worked for Telkom and a host of other communication companies. He was the 2015 President of the South African Institute of Electrical Engineers (SAIEE) and still serves on Council. Hoffmann believes that the key to sustainability is a commitment to quality, a virtuous cycle of systemic beneficiation to all stakeholders, and the empowerment of people in the local community to serve their community's technical needs.

MyTechie South Africa (MTSA) will validate and accredit multiple qualified independent contractors under a purpose crafted framework agreement (Ts&Cs). These contractors will then have the opportunity to consider and, where acceptable to them, accept an order from a customer in their immediate area via their App. At that point, they will be obliged to complete the request to the specification of the customer and submit a completed document to the customer via the App. MTSA will have already raised an invoice to the customer on behalf of the independent contractor for the full amount as per the order price of the service. The customer will pay the independent contractor via its contractual payment channel. MTSA will receive the full payment from the customer and will pay the total amount to the independent contractor less its admin fee.

All MyTechies will be validated as competent, qualified technicians who will act as fully independent contractors to MyTechie South Africa. "We have many plans in the pipeline to offer training opportunities for MyTechies to upgrade their skills and through professional bodies acquire accreditation in additional disciplines", says Hoffman. This App is an excellent opportunity to become a start-up and develop your own business. Qualified technician and engineers can start their journey by sending their details to MTSA at techie@mytechiesa.co.za. MyTechie will officially launch on 31 May 2019. wn

For more information visit: www.mytechiesa.co.za.

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The South African Institute of Electrical Engineers (SAIEE) has superb digital advertising options to suit your needs.

SAIEE's monthly wattnow magazine is undoubtedly the preferred platform, but now you can also reach SAIEE Members online, with Digital Exposure.

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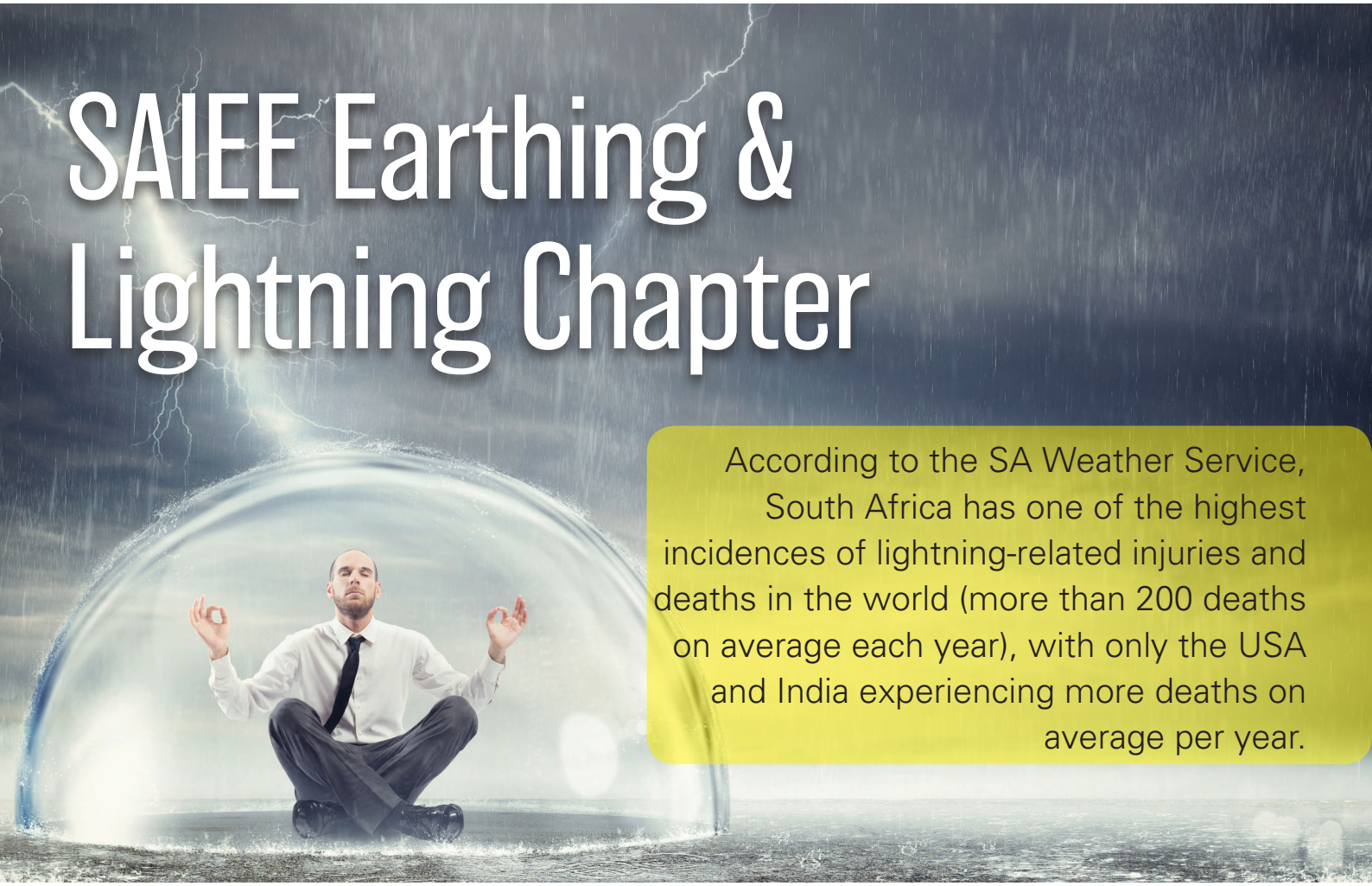
SAIEE Earthing & Lightning Chapter



According to the SA Weather Service, South Africa has one of the highest incidences of lightning-related injuries and deaths in the world (more than 200 deaths on average each year), with only the USA and India experiencing more deaths on average per year.

With this in mind, SAIEE members decided to form the Earthing & Lightning Protection Chapter, which held its first meeting at the Wits Chamber of Mines Building on 22 May 2018.

During the first meeting, roles were discussed, and Wayne Fisher was proposed as Chairman and Andreas Beutel was proposed as Vice Chairman and Secretary.

The purpose of the chapter is to find and draw on the pool of relevant experts in South Africa and abroad, the expertise of academics and industry as a combined force in Electrical Engineering with the aim of:

1. empowering its members with knowledge and networking opportunities;
2. fostering a growing interest in earthing, lightning, and lightning protection;
3. informing the public on relevant and productive behaviours and other means of achieving lightning safety; and
4. communicating developments in technologies, standards, and regulations national and international relevance to the subject of earthing, lightning, and lightning protection.

This will be achieved by providing administrative support to specific partner organisations and events, for example, ACLENet (African Centre for Lightning Electromagnetics) and ICLP (International Conference Lightning Protection) and arranging and supporting SAIEE events such as webinars and CPD courses.

An online seminar "Lightning over Johannesburg" was the Chapter's kick-off event which was captured with high-speed cameras produced by the Wits research group.

Since the first meeting, the Earthing and Lightning Protection Chapter has grown its support to 14 members and is currently working on a proposed campaign to bring awareness to public areas where sports activities take place.

If you are an expert in this field or are interested to join this chapter, and would like to pay it forward, please send an email to wayne@bergmanfisher.co.za. wn

Africa Research Journal

Research Journal of the South African Institute of Electrical Engineers

Incorporating the SAIEE Transactions

As of January 2019, the SAIEE Africa Research Journal is indexed by IEEE / IET Electronic Library (IEL) (popularly known as Xplore)

Manuscripts can be submitted by visiting the ieeexplore website.

Further training material on compiling manuscripts is provided online.

We call upon researchers to consider the SAIEE Africa Research Journal as a medium for publishing their novel scholarly research, and in this way contribute to the body of published knowledge.

We are grateful to the leadership and support of the IEEE Africa Ad Hoc Committee; through the partial sponsorship and support of this committee, the journal continues to be available as open-access.

SAIEE

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The Development of Radio Communications in Underground Mines

In 1938 Rand Mines' Chief Medical Officer approached the Bernard Price Institute to investigate whether it was possible to communicate by radio with miners who were working underground. This would significantly improve the efficiency of rescue teams in the event of a fire or other underground accident. The rescue teams comprised groups of five men (Brigades-men or "Proto" teams) who were specially selected and trained for this type of work.

BY THE SAIEE HISTORICAL SECTION

For safety reasons these five men had to stay together, hence should they encounter a problem all of the team had to return to base – clearly, they would benefit if radio communication were possible.

The problem was that the technology of the day, 2-way radios, did not allow for the transmission of radio signals through several hundred metres of rock, only a few metres of rock.

Unfortunately, the Second World War intervened, and no further work was carried out for several years as all resources were diverted to developing radar and radio etc. for the military.

In 1945 the Council for Scientific and Industrial Research (CSIR) was formed, and Trevor Wadley was assigned to investigate whether it was possible to build a radio that could fulfil the requirement to transmit through several hundred metres of rock. Wadley managed to determine in theory and then later by a practical experiment he found it was possible, subject to certain conditions.

No further work was carried until a decade later when the challenge was taken up by Dirk Vermeulen, who worked for the Chamber of Mines. In 1961 he designed and built a 10-Watt base-station radio transmitter-receiver as well as a radio transmitter-receiver that could be carried by the rescue team or teams.

These units were able to receive and transmit signals through several hundred metres of rock (depending on various factors this could vary from 300 to 600 metres).

At this time transistors were in their infancy and therefore both the base radio transmitter-receiver as well as the radio transmitter-receiver units, which would be carried by the rescue teams, were built using thermionic valves.

The base radio transmitter-receiver was built using thermionic valves which were large and necessitated a large case (±13 kg) plus antenna (±6 kg) and batteries (±15 kilograms). This resulted in just this unit weighing approximately 34 kg) which made this base radio transmitter-receiver both heavy and cumbersome – this unit is on display in the museum.

The radio transmitter-receiver was carried by the rescue team or teams and was also built using thermionic valves. To keep it smaller it was restricted to being only able to receive Voice, but it could not transmit

The SC100 - battery powered low frequency transitter/receiver as displayed in the SAIEE Museum.

Voice. It could only convey a tone where a short bleep would indicate "Yes" and a long bleep "No" As a result communication was confusing and inadequate. Also, this unit weighed 13.5 kg and required a substantial antenna which was wound onto a frame which could only be carried around the body of one of the rescue team members which made this unit not only relatively heavy but also cumbersome to carry.

Both of the above radio transmitter-receivers sets were not practical, especially as the rescue teams were already burdened with carrying other essential rescue equipment (e.g. breathing apparatus and other fire-fighting equipment.) These radio transmitter-receivers became more of an impediment rather than aid, and their use was discontinued.

No further research/development was carried until a decade later, during which time (i.e. the 1960s - early 1970s) there were significant advancements in the event of electronics (i.e. transistors, etc.) which made it possible to design and build much smaller, lighter hand-held radio transmitter-receivers, which were also more powerful.

In the mid 1970s, using the newly develop transistors, Brian Austin was able to design and build a new radio transmitter-receiver (the TRX-1) which was able to transmit voice radio through several hundred metres of rock (same as Vermeulen's set, this could vary from 300 to 600 metres), as well as send and receive 2-way voice communication using SSB (single sideband transmission).

The units were significantly smaller and light enough to be carried by the rescue teams. In addition, to which using transistors this transmitter-receiver set it was able to operate at high frequencies and higher power levels as well as being able to transmit Voice both ways using SSB, which was superior to AM (amplitude modification). This new radio transmitter-receiver was designated the TXR-1 which was shortly followed by TXR-2, which was designed and built by Brian Austin and Martin Higginson. Both of the radio models were widely used in the mines in SA. These sets are on display in the museum.

In the late 1970s, the Chamber of Mines contracted Racal SA (South African military electronics industry) to develop the both TRX-1 as well as the TRX-2 further. They then produced the SC-100 followed by the SC-200 ("substrata Communicators") which were further improvements on the TXR-1 and the TRX-2. The improvements made to the development of the SC-100 (and later the SC-200) were that the new SC-100 was smaller, lighter and relatively more robust, rugged, water-proof and weighed less than 2 kg when compared to the TRX models.

Further, the SC-200 was built and equipped with a frequency synthesiser for multi-channel operation and offered excellent voice communication (primarily used as a base station to operate in conjunction with the SC-100). Both the SC100 and the SC200 were widely used in South African mines, and speech communications equipment became the norm for mine rescue teams. The SC100 is on display in the museum.

If you are interested in joining the Historical Section, please feel free to attend our dicussions every Thursday at the SAIEE Head Office in Johannesburg.

Earn CPD Credits

PLATFORMS AND ECOSYSTEMS

-ENABLING THE DIGITAL ECONOMY

New digital and physical technologies enable the Fourth Industrial Revolution with almost limitless applicability – and enormous implications for the economy and society. New business models are being leveraged not only by emerging organizations but also by traditional entities, which view them as either complementary to well-established models or as potential replacements of their core businesses.

BY: MICHAEL G. JACOBIDES, LONDON BUSINESS SCHOOL
ARUN SUNDARARAJAN, NEW YORK UNIVERSITY
MARSHALL VAN ALSTYNE, BOSTON UNIVERSITY

The subsequent economic disruption has indeed been revolutionary. In a few short years, the ranking of most valuable companies by market capitalization has shifted to being dominated by one business model – digital platforms and ecosystems.

The World Economic Forum has launched the initiative on Digital Platforms and Ecosystems not only because it is a topic on almost every corporate board's agenda, but also because digital platform models already dominate our daily lives and our experiences as consumers, employees, community members and citizens. Considering the implications of platform and ecosystem models for society, as well as the opportunities and risks they could present in the future, it seems obvious to aim for broad collaboration between the public and private sectors, between corporate giants and start-ups, and with consumer-rights groups and civil society.

The topic of digital platforms and ecosystems has been a matter of significant interest at the World Economic Forum.

The objective of this briefing paper is to synthesize some of the critical points that have arisen during an ongoing set of discussions over the last year.

Digital platforms are expanding across economies, reshaping the business models of a wide range of industries, from finance and healthcare to media and retail, while creating fundamentally new divisions of public and private responsibility. The companies driving this trend are diverse and disparate. Some are start-ups, others are giants of the digital economy. Others, still, are traditional firms that are adapting to a more digital world by adopting an effective platform and ecosystem strategy.

This briefing paper forms part of the World Economic Forum System Initiative on Shaping the Future of Digital Economy and Society which was initiated against a backdrop of complexities brought about by digital platforms and ecosystems. Significant changes have come from various angles at the macro and micro levels, affecting commercial and financial models, employment, and societal or regulatory issues.

The project examines how digital platforms and ecosystems are created, nurtured, managed and governed, and the intelligence gathered is as critical to the private sector as it is to the public sphere.

Boston University's Marshall Van Alstyne includes a simple chart showing the striking pace of growth of platform-based companies compared to their established competitors. The stories these companies tell demonstrates the multiple advantages of digital platforms. Most impressive is the model itself, which rejects traditional paths to scale (i.e. selling more and more for less and less) in favour of one that measures success by the number of users in the community.

This "network effect" inverts the firm, shifting production from inside the firm to outside. In contrast with 20th-century industrial giants, companies with platforms do not merely create value themselves; they orchestrate value creation by outside users. In this inverted model, the platform is more important than the product. The platform value appreciates through repeated and broader use, and it increases with positive feedback, eventually dominating the static or declining value of the product.

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Because the users are themselves, the producers, and the company serves as a facilitator; the inverted model redefines traditional public-private interaction models. However, once scale is achieved, the digital ecosystems are extraordinarily powerful.

Michael G. Jacobides of the London Business School examines how the digital platform is changing the way companies think about how the end customer and private partners deliver policy objectives. Healthy ecosystems comprise many stakeholders, including suppliers and producers from the private sector, customers as innovators, and government and regulatory bodies from the public sector.

In this interconnected modular digital world, acting alone is too cumbersome for most companies. Indeed, working collaboratively – to complement, adjust and support joint efforts – is essential to leveraging digital ecosystems. And tomorrow's public-sector goals reflect broader, systemic needs that require the variety of skills, assets and expertise that ecosystems offer. Since such variables as geography, the regulatory environment and competition affect the ecosystem strategy; the optimal solution often lies in having many ecosystems, each tailored to specific local operating needs.

This level of complexity has its downside. Digital ecosystems can mimic cellular organisms by growing in unpredictable directions, depending on where they find the most nourishment. Containment is necessary through robust frameworks to ensure that the broader societal implications receive appropriate consideration.

New York University's Arun Sundararajan, delves deeper into the shifting landscape of trust and the fundamental redefinition of institutional and societal governance. Never before has the public been asked to place so much confidence in corporations; correspondingly, the reliance of global trust models on vast streams of unfiltered consumer inputs is also unprecedented. This evolving dynamic is causing a radical redefinition of boundaries between the public and the private, between regulators and the regulated, and between citizens and their governments.

In this time of transition, reflecting a progression from the top-down or vertical trust to horizontal or peer-to-peer trust, the governance of digital platforms is determined as much by the broader user communities (with some help from artificial intelligence) as it is by overseers. The public-private landscape is reshaped radically and, as complexity grows, the policy framework evolves. The blossoming of new opportunity reflects greater societal responsibility for private and digital actors. We highlight six critical choices, from neutrality, oversight and transparency to fairness, data rights and due process, each a central determinant of whether platforms and ecosystems can retain public trust over time.

Finally, we considers the recurring theme:-

- how do digital platforms redefine public and private relationships and responsibilities? As digital progress increasingly melds the public and private spheres, platforms and ecosystems bring a dynamic set of support from the private sector to engage with the public sector.

The existing and emerging fields in which platforms can define and demonstrate the efficacy of the new public-private liaison are numerous. The most promising include managing mobility, providing healthcare, renewing infrastructure, regenerating urban areas and countering the consequences of climate change. Such areas of opportunity can be fully leveraged only through strong cross-collaboration aimed at establishing sustainable foundations for all future work in the space of platforms and ecosystems, highlighting once again the importance and urgency of public-private partnerships.

Realizing the benefits of these potential partnerships requires a shift in the way the public and private sectors view each other. We conclude with a glimpse at new partnership models (including data-driven delegation) and their implications for both governments and industry.

THE OPPORTUNITY AND CHALLENGE OF PLATFORMS

Markets have existed for millennia, yet the properties of platforms seem new. Where product firms, like diamond mines, protect their profits with barriers to entry, platform firms make profits by lubricating the entry of drivers on Lyft and merchant shops on Alibaba. Where product firms' best supply chains use just-in-time inventory, platform firms beat that model selling goods and services whose marginal costs they do not incur. Market boundaries blur and new paths to dominance emerge. Pioneers ranging from Amazon to Lyft and Zillow and from Airbnb to Klöckner and ZBJ are disrupting the retail, healthcare, real estate, banking, lodging and steel industries, and labour markets. Incumbent firms must grapple with predicting change

and comprehending network business models to shape their platform strategies. Comprehension and approach begin with new logic.

CHANGING THE NATURE OF THE FIRM: INVERSION

Platform firms do not behave like product firms. They innovate faster. They operate with fewer employees, often by order of magnitude. Many are young yet achieve higher market values than their well-established competitors (Figure 1).

These new firms play by new rules that pose challenges to traditional firms that operate by old rules. Platform firms with fewer

FIRM	START YEAR	EMPLOYEES	MARKET CAPITALIZATION (BILLION $)
BMW	1916	131,000	51
Uber	2009	16,000	76
Marriott	1927	177,000	39
Airbnb	2008	10,000	38
Walt Disney	1923	199,000	163
Facebook	2004	35,000	473

Figure 1: Market values of digital platform firms vs comparable traditional firms, 2018.

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employees beat incumbents despite having started later.

The challenge for comprehension is that today's change in organizational form is as significant as the change from trade crafts to industrial firms a century ago. Both shifts yield large firms, but 21st-century monopolies are arising for a different reason, opposite that of the late 19th and early 20th centuries. Industrial-era firms were driven by supply economies of scale, with high fixed costs and low marginal costs, and could increase volume and lower prices. This led to dominance in the oil, steel, electricity, railroad and automotive industries.

By contrast, internet-era firms are driven by demand economies of scale, known as "network effects", where users create value for users, which attracts more users, which in turn creates more value, which attracts more users, etc. This has led to dominance in search engines, social networks, operating systems, e-commerce and mobile technology. It will lead to dominance in architecture, the automotive industry, finance, healthcare, industrial internet and in numerous industries in the future.

How does an executive know which sectors will transform and how to respond? The answer lies in understanding the "inverted firm", a prize-winning idea that explains the transformation and process for managing it.

Network effects cause firms to "invert" shifting production from inside the firm to outside it. Network effects cannot scale inside as quickly as outside. There are more customers than employees. If users are to create value for other users, then they must be aided and rewarded for doing so. This means firms shift from vertical integration to open orchestration. Platform firms do not merely create value themselves; they orchestrate value creation by outsiders.

The inverted firm hypothesis simultaneously explains several puzzles:

1. Why platform firms scale so fast – Shifting production outside, they can have zero marginal costs. Uber does not own its cars. Airbnb does not own its rooms. Facebook does not produce its content. Not incurring the costs of production, they can scale as fast as they can add partners.
2. Why platforms beat products – Network effects imply that platform value appreciates through use, whereas product value depreciates through use. An increasing value proposition, based on positive feedback, overtakes any static or declining value proposition.
3. Why platform firms have high market capitalization but so few employees – They harness users as producers, representing an external labour force, not counted among the traditional workforce.
4. Why the shift in executive mindset is so hard – Executives familiar with managing vertical integration must transition to managing open orchestration, from resources they control to resources their partners must volunteer.

The inverted firm is distinct from the Fourth Industrial Revolution, which is characterized by blurred lines between the physical, digital and biological spheres. It is also different from the Second Machine Age effects of Artificial Intelligence (AI) and digitized work and the economy. Instead, platforms based on inverted firms represent a change in organizational form through a distinctly predictable and manageable mechanism. Similar to these other phenomena, firm inversion causes large-scale disruption. This has significant implications for trust and ecosystem governance – factors explored later in this briefing paper.

PREDICTING CHANGE

Not every firm will become a platform. How does an executive predict this change? It is a matter of asking which firms will invert by moving production from inside to outside. At least four factors help to predict the ease of shifting.

Community and information intensity

A higher proportion of value added by information means that a community of users can more easily share value. Information scales and propagates at zero marginal cost. The community that provides this information is also valuable because it forms the basis of the network from which network effects arise. Data can be explicit, as in user-generated content, or implicit, as algorithms uncover consumption patterns that the platform's recommender systems can spread to other users. Looking at this from the opposite angle predicts non-transformation. Heavy-asset industries, like mining and construction, have a lower proportion of value in information, making them harder to transform.

Modularity

Precise modular output – a ride, a tweet, a search, a stay, an app – simplifies third-party supply. Just as importantly, modularity simplifies third-party quality certification. Firm inversion requires that outsiders know how to produce and consume, and that communicating high versus low quality is

undeniable. These are easier, the simpler the unit of value transferred among users. In the case of Facebook and Twitter, the modular output is so simple that users can shift rapidly from consumer to producer and back. The opposite, again, predicts non-transformation. Highly sophisticated, tightly integrated products, such as an aircraft or Android smartphones, are challenging to produce via crowdsourcing.

Fault tolerance

Lightly regulated, fault-tolerant industries transform to platforms more readily because they also facilitate third-party production. It is both safe and permissible for third parties to serve the demand for apps, videos and e-commerce. By contrast, opening Application Programming Interfaces (APIs) on pacemakers or nuclear power plants create extreme risk. When accidental or malicious experimentation can lead to disaster, firms vertically integrate to guarantee quality control. That is why regulated healthcare industries have not yet transformed, despite having a high proportion of value in community and information.

Capacity utilization

The higher an industry's spare capacity, the more compelling are the efficiency gains from creating an external market in that capacity. Most car owners use their vehicles less than two hours a day. Most property owners use their guest bedrooms for less than two weeks a year. It makes tremendous economic sense to create a market for third-party use of this spare capacity via Uber and Airbnb, rather than let it sit idle. In a business-to-business (B2B) context, Amazon Web Services launched after creating enough new ability to serve both internal and external demand. By this logic, considerable spare capacity in the energy grid predicts transformation to a smart platform grid, even though energy is a heavy-asset industry.

These four factors – community and information intensity, modularity, fault tolerance and capacity utilization – balance one another, yet all enable either network effects or inverted firms, which portend platforms.

BUILDING AND OPENING PLATFORMS

A platform is an open architecture with rules of governance designed to facilitate interactions. Each component matters. The open architecture allows third parties to participate. The laws of management motivate their participation. The interactions are the sources of value. Each positive interaction, whether between a person and a ride, a person and web content, or a person and another person, represents the moment when partners create new value. These factors, which promote externalized interactions, then render the levers of platform design.

Interaction

The starting point of platform design is the interaction itself since this is the source of value. This can be a "transaction", which involves a fully compensated economic exchange, or it can be more straightforward, an "interaction" that includes only time and attention as a reward. One firm's purchase of steel from another firm on steel company Klöckner's XOM marketplace represents a B2B transaction. One user's visit to Twitter to read another user's post represents a consumer-to-consumer interaction. The simpler the communication, and the lower the friction to participation, the easier scaling becomes. This also explains why the launch of more straightforward two-way interactions scales much more quickly than three- or four-way interactions. Brightcove, which launched one year before YouTube, envisioned four-way communication between TV networks, content producers, advertisers and consumers, and had a much harder time scaling than YouTube. Each additional element of complexity adds a new point of potential interaction failure.

Focusing on the interaction provides a further decision metric, guiding where to start. The platform designer must estimate both the value and the volume of a set of interactions. A single internet search has little value but trillions of occurrences. By contrast, a unique stay at Airbnb has far more interaction value but far less frequency.

A bank choosing to build a platform based on different interactions might choose among commercial loans, consumer loans, bond markets, payments, etc. Likewise, a telecommunications provider launching a platform might start by entering markets for wearables, home hub devices, drones, virtual reality and immersive media. The starting point for platform entry should hinge on how much net value an interaction has in the target market and how repeatable it is at scale.

Architecture

Platform design involves careful trade-offs in a narrow versus broad focus and an open versus closed architecture. Building a great architecture offers ecosystem partners more platform real estate on which to build, with higher chances of success. Focusing resources narrowly increases the chances that a critical interaction will succeed. Most successful platforms start in a niche

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market, where they can gain traction before opening more broadly. Facebook launched at Harvard. Lyft launched intra-city rides in San Francisco rather than in 10 cities at once. Alibaba failed in its efforts to offer full enterprise services; they succeeded when it narrowed its offer. The fundamental flaw in Alibaba's first effort, when launching Alisoft enterprise software, was offering a *"complete infrastructure that was unable to deliver specific ... customer value. There was no killer app..."*. Once it provided a robust vertical value proposition, it succeeded. Then it could expand horizontally.

The choice of an open versus closed platform is a challenge. Opening too little means that third parties cannot participate and add value. Opening too much means loss of control, inability to steer the community and failure to monetize. The most successful platforms start with a few key partners, who build critical apps on top, then open more over time. The German chemical and consumer goods company Henkel stepped back from its interests and brought in partners based on *"who would benefit the marketplace most"*.

Governance

If open architecture allows third parties to participate, just governance motivates them to do so. *"Where firms might once have furnished design specifications to a known supplier, they now tap ideas they haven't yet imagined from third parties they don't even know."* Getting strangers to bring their ideas to the platform or independent companies to invest means rewarding them for the value they create.

It cannot be the case that, just because the platform owns the infrastructure and makes the rules, it keeps all the value for itself. If this were true, third parties would not create value to have it taken away. Shared value is the essence of motivating third parties whom the platform sponsors have never met.

Governance provides the rules of who may participate, how they create and divide value, and how to resolve conflict among ecosystem partners. Deciding who may participate requires a more significant shift in mindset than most leaders realize. Klöckner's successful launch of XOM needed more open minds at two levels. Sales and marketing staff saw cross-selling by alternate suppliers as a direct threat to their control over the sales channel. Top executives understood selling complements but rejected selling substitutes. They feared competitors would cannibalize business. In both cases, greatly expanded opportunity overcame the main objections. XOM now makes more money selling third-party products than selling Klöckner products.

It captures relevant data and has forestalled platform entry by competitors who otherwise would have been denied market access. Software company SAP has built the most significant European platform by offering its products where they are the best while ceding portions of the market to third parties where others are better.

Good governance also means balancing the interests of ecosystem partners. Uber struggled initially to balance the interests of drivers and consumers. Good governance means being a fair ombudsman for the ecosystem's various conflicting interests.

MONETIZATION AND REVENUE

Nowhere is the shift in mindset more important than in understanding platform revenue. The forces that make it easier to capture value from an ecosystem make it harder to recruit and retain members. The first question of finance, *"How do we make money?"*, must instead be preceded by, *"How do we create value?"*. Only after determining how to help others to create value collectively, is it possible to monetize by asking, *"How do we share in that value?"* The problem that traditional finance introduces is that starting from the money question puts friction on third-party engagement but, without others engaging and creating value, a platform has no value to monetize. Reversing the order, focusing first on engagement that drives value creation, then on capturing a fair share of that value, leads to successful monetization. Put simply; executives first use monetization to drive network effects. Then, after achieving critical mass, they use network effects to drive monetization. Alibaba, Facebook, Amazon and Google all succeeded following this logic. AOL Instant Messenger and MySpace failed by ignoring this logic.

Monetization involves control over three flows: the product or service flow, the data flow and the revenue flow. The deal flow should occur on-platform wherever possible. If these flows occur on-platform, as they do on Lyft, XOM and Alibaba, matching people to products improve and the platform can take a transaction cut or advertise *"in-stream"* more easily. If the deal flows occur off-platform, as they do on OpenTable and eHarmony, ads are limited, and revenue derives from access fees, not transaction volume.

A further subtlety is that, unlike products, platform pricing is often *"two-sided"*. One ecosystem partner gets free or subsidized

METRIC	COMPANIES THAT USE THE METRIC
Revenue	Bookingcom, SAP, Uber
Funnel of transaction/transaction volume | number of people travelling	Booking.com, BlaBlaCar
Profit and market share	Uber
Number of participants (consumers, suppliers) | "gravity of the platform", e.g. how many complementors | number of active users	Booking.com, SAP, Deutsche Bank
Quality (customer satisfaction ratings, surveys)	Booking.com, Door2Door, SAP
Supply – number of rooms and number of properties	Booking.com
Customer adoption rate | customer engagement | customer experiences and outcomes | customer health score | customer acquisition costs	SAP, Deutsche Bank, GE Digital, BlaBlaCar
Prevalence of multi-homing	Lyft
Killer application	Alibaba
Culture and talent – talent adoption – "integrated talent management score"	GE Digital
Share of revenues from digital sales	Klöckner
Membership	BlaBlaCar
Utilization rate	Door2Door
Share of ecosystem revenue captured by partners, share captured by platform	Alibaba, SAP
Share of organic new users to paid new users	Uber, Lyft
Match rate	Alibaba, Uber, Lyft

Figure 2: Measures of digital platform success.

prices while a different partner pays. Users get free search and open social networks while advertisers pay. Consumers get supported credit cards while merchants pay. This form of free offering differs from razors and blades and cell phones and minutes because these are tied goods. Under linked pricing, the same person buys both items, only paying at different points in time. By contrast, two-sided pricing connects two various parties, with one party paying and the other riding for free. To decide which partner gets the discount and which one pays, it is necessary to consider which party attracts interactions more strongly or creates more value. Differential pricing by type can raise questions of regulatory fairness and equity, which is addressed later. The main point is that to monetize; value creation must precede value taxation.

Revenue is just one measure of success for digital platform companies. Figure 2 illustrates other vital indicators of success.

DESIGNING DIGITAL ECOSYSTEMS

FROM CREATING PRODUCTS, SERVICES OR ORGANIZATIONS, TO DEVELOPING DIGITAL ECOSYSTEMS

Rising interest in *"business ecosystems"* has prompted exponential growth in research into *"ecosystems"*, often – though not always – drawing on digital platforms. With the stock market valuation of tech giants, proud sponsors of a myriad of ecosystems, still sky-high, the excitement over digitally

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enabled ecosystems has been relentless. But what lies behind this explosion of interest? What is new here, other than a captivating metaphor?

Understanding the rise of ecosystems, a look at the process of industrial transformation is needed. For a very long time, societies the world over organized economic activities by granting special privileges to particular groups (guilds, castes, professions) who, in exchange for their rights, would ensure that the operations under their purview would be efficiently performed, aided by regulation. Sectors, from banking to healthcare, were relatively rigid and static, and it was hard to change how the business could be organized. The last few decades have heralded a more adventuresome spirit of experimentation for regulators, and the growth of digitization has created a more interconnected world. The digitization of workflows in product and service companies has made it easier to change the scope of the offerings to match both the final customers' desires and the different industry participants' interests. Add globalization to this, and the fact that digital data flows can be transferred instantaneously at little cost, and these forces are redefining the entire architecture of sectors.

If starting from scratch, designing the economy to make it most efficient would not start with the sectors existing today. Rather than taking products and services for granted, executives should ask, *"What does the (final) consumer want to do?"*, and reorganize accordingly. Digital technology allows going beyond designing products, services, customer experiences or organizations. It will enable redesigning whole industries, and leveraging digital technologies to create *"business ecosystems"*, like Uber and BlaBlaCar, which have helped shape the *"mobility ecosystem"*. This is causing excitement and ferment, but it is also raising new strategic, managerial and policy challenges, especially in balancing individual entrepreneurship and private benefit with the public good.

WHAT ARE DIGITAL ECOSYSTEMS, AND HOW CAN THEY BE LEVERAGED?

"Ecosystem" is a term used inconsistently. The organic, widespread interest reflects structural changes and new strategic opportunities that are not covered by the existing analytical arsenal, so paying closer attention can yield significant benefits.

Ecosystems writ large can encompass any set of interacting producers, suppliers, innovators, customers and regulators that shape a collective outcome – sometimes geographically bound (e.g. the *"Silicon Valley entrepreneurial ecosystem"*), while at other times focusing on a sector (*the "mobility ecosystem"*). Such loose definitions can engender more confusion than clarity. Focusing more narrowly on digital ecosystems – which consist of interacting organizations that are digitally connected and enabled by modularity, and are not managed by hierarchical authority (like in a supply chain) – may be better. In designed ecosystems, organizations come together by co-specializing with each other, creating bonds that engender collaboration, without excluding competition.

Why do ecosystems come about? They emerge because, as a result of digitization, it is now possible to connect a broad set of firms to deliver a custom solution. Rather than focusing on one segment at a time, firms increasingly want to offer a solution for a comprehensive set of needs. Not content with providing a drug only, pharmaceutical companies want to offer wellness solutions, which include monitoring and real-time adjustment to the patient, and a preventive package. To do so means moving beyond their traditional remit into diagnostics, AI, secure data transmission and response. Allianz's and Deutsche Bank's ecosystems are examples, as is consumer products company Henkel's. Other firms, like Klöckner, turn to create digital ecosystems in such traditional areas as steel to find new ways to add value for their customers, both to support their sales and to enhance value added.

So as firms move from the historically narrow to the ever-broader provision of products, services or experiences, the need to find complementors who can offer their services where the focal firm is not active becomes apparent. This is relevant for firms operating multisided platforms, like Alibaba or OLX Group; it is also the case for big industrial giants like GE, or device manufacturer Huawei, keen to enlist AI-enabled complementors. Ecosystems represent a new way to organize economic activities. Rather than relying either on the buyer to integrate goods and services themselves, they allow final customers to have some choice but pick from a limited menu, which is in turn curated and managed by an ecosystem orchestrator. Ecosystems thus become new ways of organizing complementary goods and services that involve many companies collaborating and competing to offer a complex of products and services, as Figure 3 illustrates.

From the firms' perspective, it is not impossible to have all the potential complements in-house. From the

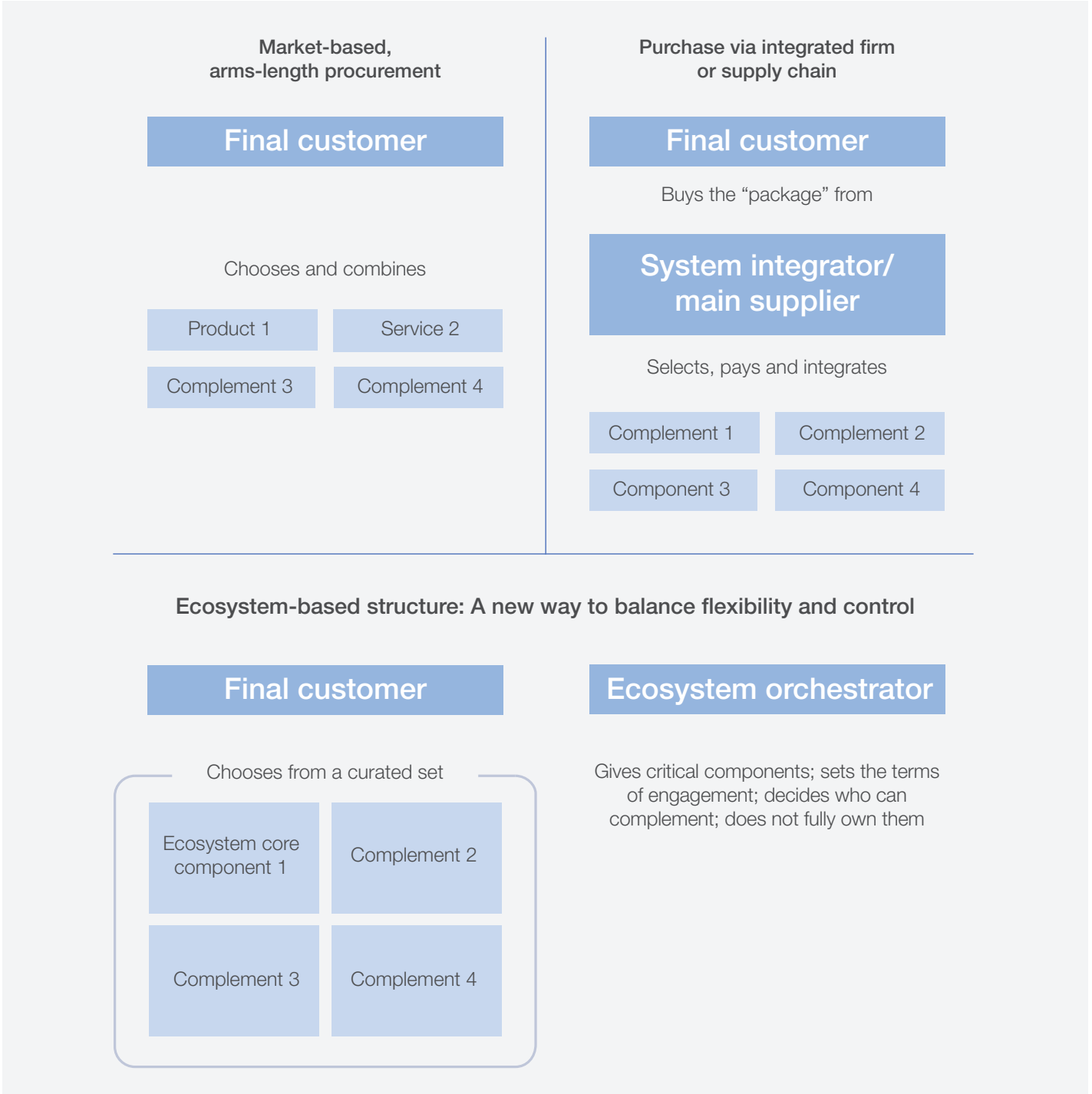

Figure 3: How ecosystems compare to production in firms vs procurement in the open market.

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customers' perspective, the desire for variety and the ability to choose are critical. Apple doesn't dictate which apps to buy, but Apple's decisions, of how many complementors can provide apps and what their rules of engagement are, define the boundaries of the basket from which final customers choose. The thirst for feature variety and the corporate desire to not have to foot the bill for all the complements needed underpin the merits of ecosystems.

More important, perhaps, (digital) ecosystems have now become a new way of organizing economic activities. While technologies are much more modular and it is much easier to create interdependent sets of offerings that can add value to the final customer, a fair amount of coordination is still needed to ensure that interdependencies are dealt with and shared objectives are met. From SAP's space ventures to OLX Group's new platforms, ecosystems often require complementors to both adjust and adapt to each other and to invest specific capital to the needs of the ecosystem. And, as they do so, ecosystems become a new way of organizing, distinct from both firms and markets, supply chains and hierarchies. They each have their space, merits and shortcomings.

BUILDING NEW ECOSYSTEMS: THE BUSINESS CHALLENGE

While the widespread discussion on ecosystems has grown considerably, it tends to be somewhat lopsided, focused on particular types of platforms, and usually directed at *"the few"* (who often hardly need advice) rather than *"the many"* (complementors, often interchangeable and powerless, occasionally in the millions for everyone orchestrator). The canonical examples tend to be Google, Apple, Facebook and Uber, companies that have traits in common, including their unique brand name and superior capabilities in delivering products and services. These examples reflect markets with network externalities, where the value in participating in a platform or being part of an ecosystem is a function of how many others join in the same platform or ecosystem. Under such conditions, *"winner takes all"* dynamics emerge that make life considerably harder for those entering late in the game.

Such network effects characterize not all settings, and there is scope for the right strategy to shape the outcome. Even in markets where one might expect network externalities, early, dominant platforms and ecosystems often lose out. In the operating system world for mobiles, Symbian, with 66% of the market in 2007, did not manage to maintain domination and folded, while Android edged its way from irrelevance to dominance. Uber's early lead in the South-East Asian ride-hailing market and the fact that it was part of a global powerhouse with bottomless funding did not secure it a spot; it had to fold and exit the market, selling to local tech company Grab, while Indonesian start-up Go-Jek dominated its market.

Early platform and ecosystem size and age are not determinants of success; if anything, the unique features of those who govern might explain their success and expansion, rather than the other way around. Amazon's dominance in retail is not just the result of its size, but also of its superior fulfilment capabilities and intimate knowledge of the customer, consciously developed as the company grew. It demonstrates that strategy can drive success and dominance is not unshakeable.

So, in an emerging field shrouded in myths more than in facts, what can corporate players be advised to do? They need to understand that they probably will not engage with one but, instead, with many ecosystems. Much as *"an alliance strategy"* or an "M&A strategy" does not focus on one alliance or one deal, a *"platform and ecosystem strategy"* will focus on the increasing variety of platforms and ecosystems. Starting with the *"business"* level, firms need to decide what their engagement in ecosystems may be. A very few may build their own, but it takes special skills, a strong position and a compelling reason that appeals both to the final customer and complementors. Others will be well advised to participate, whether as strategic partners or as complementors, in a variety of platforms and ecosystems, and have a strategy that allows them to improve their plight, rather than try to take a pole position that may never materialize, leading to a significant waste of resources. They will also want to adjust their offerings and strengthen their connections to complementary actors, and possibly look into gradually moving closer to the centre of an ecosystem; as they do so, they need to obsess about the needs of final customers and complementors alike.

The good news is that it does not take Google's resources to set up a thriving ecosystem. The companies that are now global powerhouses interviewed in the context of this project – from Booking.com to Alibaba - started humbly, obsessed about finding new ways to add value, and ultimately gained influence and power. Today, with the use of creativity, business flair and strong execution, upstart firms like Traipse and Velocia are building their collaborative value propositions, which

help link actors in a new way. Their business model adjusts as their ecosystem evolves, and the root of their success is their ability to sense, respond, and if needed, pivot. Consider, for instance, Traipse, which, in the process of developing a reward system for its geolocation game, realized that there was even more value to local partners from helping introduce a local currency, and morphed into MyLocalToken, which aims to offer a cryptocurrency-based solution to the age-old problem of supporting domestic consumption.

A GUIDE FOR NAVIGATING A WORLD OF DIGITAL ECOSYSTEMS

The growth of platforms and ecosystems leads to a fascinating new set of strategic questions and opportunities. It also leads to a world in which static descriptions and frameworks impede success. Ecosystems can be the tool to dislodge established incumbents and change the very definition of a sector, but they can also offer the means to reorganize and to protect incumbent firms that find themselves under immense pressure to provide far-reaching solutions that encompass an ever-growing gamut of potential complementors. Younger and more established participants alike are keenly aware of the desirability to offer a *"one-stop shop"* solution to cover all customers' needs. While Uber and Grab are moving to food delivery and travel management, Booking.com is expanding into travel, Ping An Insurance Company of China from insurance to healthcare, and Deutsche Bank and Allianz from banking to a broad suite of services.

As the opportunities to offer new bundles of goods and services increase rapidly, aspiring disruptors but also entrenched incumbents will find that their understanding of the customer is crucial. Getting the right customer data and superior capabilities can help to structure the right offering and ecosystems.

- How is my sector being transformed as a result of the new opportunities available through current or developing digital ecosystems?
- What pain point am I resolving for the final customer from this ecosystem? How does my offering compare to others', seen from the vantage point of my complementors?
- How can I make sure that I am forming a true ecosystem rather than constructing an ego-system, which places myself in the centre?
- What role should I play in each of the ecosystems being considered?
- What is the ultimate goal of my overall ecosystem participation? What do I seek to achieve in terms of the overall corporate objective?
- What data and analytics capabilities must I develop to better serve the customers of my ecosystem? How will they inform the question of who the right ecosystem members are, and what bundles to offer?

Figure 4: Questions for executives navigating in a world of digital ecosystems.

FROM PRIVATE BENEFIT TO THE PUBLIC GOOD

Along with new opportunities come new challenges, not only for firms but also for society overall. New platforms and ecosystems challenge incumbents and offer new sources of value added to customers as well as private benefits to those orchestrating them, but they can also accentuate inequality in terms of rewards. To complicate things further, the traditional analytical arsenals of regulators are not well equipped to consider how platform sponsors and firms at the heart of ecosystems exert control and span across previously delineated industry sectors. Anti trust's peg of competition to *"consumer welfare"*, defined as short-term price effects, in particular, appears unequipped to capture the essence of power in platforms and ecosystems.

To do so, consideration needs to be given to the impact of changing architectures in a sector – and ecosystems are part of it. Policy and regulation have so far shied away from looking at the effects of the transformation of business models.18 For all the concern about the power of *"Big Tech"*, a robust framework to guide policy for this changing world is still lacking.

Many of the orchestrators are conscious of their impact on their complementors (and the broader public) and are careful to avoid

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- How should the additional benefits for consumers be balanced against the risk of strong orchestrators who exercise control over their complementors?
- How do the strengths of the traditional intermediaries (e.g. retailers) compare against the advantages of multisided platform resellers, since they engage in similar activities?
- How can the relative power of orchestrators be assessed? What practices in the way ecosystems are governed offer examples to replicate?
- Are there any downsides to ecosystems that provide a web of services to the end customer, given the propensity for customers to stay inside an ecosystem? Is there a de facto "ecosystem entrapment" that reduces choice and competition? If so, what can be done to restore balance?
- What key metrics should be considered in ecosystem power distribution, and what are the most effective ways of formulating policy?
- Since many of the key digital platforms and ecosystems are global, how should the regulatory apparatus, which still focuses on these dynamics, one country at a time, be adapted?

Figure 5: Strategic questions in designing a digital ecosystem.

both exploiting weaker complementors and poisoning their well of success. A formalized framework is needed to assess better when the platform and ecosystem players are abusing their position, as opposed to taking advantage of business opportunities.

A better framework to guide firms that engage in or build ecosystems is also needed. Beyond tackling trust and ensuring good ecosystem governance, the rules of engagement should be considered, to encourage actual customer and complementor choice and lead to an evolvable set of ecosystems.

In considering the role of digital ecosystems, the nature of data and their ownership will be paramount. Digital ecosystems work best when they make it easier for the consumers to have all their needs met; but to fulfil various kinds of needs, aspiring firms with multiple, connected ecosystems must know a lot about them and must be able to act. It is no surprise that the most far-reaching, integrated ecosystems are in China, where there is less focus on the use of customer data. As such, the feasibility and desirability of having a broad ecosystem will depend on society's views concerning the ownership and use of data and the requirements in terms of customer consent. And, as the IT company CliniVantage has demonstrated, finding ways to balance technological feasibility with data ownership and use limitations, possibly by creating new platforms and ecosystems, may be a catalyst for leveraging the professional opportunities in sectors such as healthcare.

Digital platforms and ecosystems are here to stay. Their arrival has heralded tremendous new opportunity, but also new dilemmas, challenges and questions for businesses (established and aspiring), policy-makers and polity at large. Beyond the excitement generated by new offerings for final consumers, and the potential concerns of market power much can be achieved by a thoughtful, forward-looking approach that leads to the right questions and identifies areas of opportunity. It also helps revisit the links between the public and private spheres, brokering structures that can improve the state of the world.

BLURRING BOUNDARIES: MANAGING PLATFORM TRUST, RESPONSIBILITY AND GOVERNANCE

PLATFORM TRUST: A PEEK UNDER THE HOOD

As platform models and strategies are embedded more deeply into the fabric of global commerce, new questions related to trust and governance are emerging. Platforms are based on a new generation of commercial trust, signalling the twilight of many institutions that came of age during the managerial revolution of the 20th century, while redefining the boundaries between the firm and the market, between corporations and government, and between the public and private sectors.

Mirroring the late 20th-century

Figure 6: The five phases of commercial trust that have emerged over time.

preoccupation with creating appropriate corporate governance, a robust dialogue is expected in the 21st century to define models for platform governance.

This framework guides corporations, governments, regulators and other stakeholders in the right direction.

To establish trust – a willingness to commit to a collaborative effort before knowing how the other party will behave – trading parties often look for assurance on four dimensions. The first involves establishing authenticity – is the counterparty real and who they say they are?
The second consists in evaluating intentions – are they aligned with making the exchange productive, or is there criminal or other pernicious intent?
The third step involves assessing expertise or quality – for instance, what do the certifications from intermediaries that set standards and determine competence reveal?
The fourth consists in lowering risk – what insurance contracts, or other means, are available?

Each of these reduces the likelihood of market failure – the inability of trading parties to engage in market-based commercial exchange despite the possibility of gains from trade – and thereby expands economic activity.

The progression of commercial trust (Figure 6) shows that while its primary sources have shifted over time, each continues to play a role in facilitating modern-day exchange. As 20th-century hierarchical corporations cede way to an economy whose activities are organized via platforms and ecosystems, the burden of promoting trust and governing commercial conduct shifts onto the platform. A new basis for commercial trust – digital community and code – reflects a heightened reliance on digitally-encoded community signals of trust and the encapsulation of different forms of standardization and contracting into computer code.

Although many facets of trust via digital community and code are indeed new, others are digital extensions of familiar trust institutions. The typical trust cues fall into three broad groups:

- Digitized participant feedback: Pioneered by eBay in the mid-1990s and adopted by most modern platforms, peer review systems have become synonymous with many people's notion of *"online reputation"*. A critical differentiating factor of peer feedback on today's commerce-focused platforms is that, unlike on great review platforms like Yelp, every review is typically from an authentic user and a verified transaction.

- Digitized social capital: A second class of trust cues comes from platforms such as LinkedIn and Facebook. These platforms contain digitized representations of our physical-world, real-world social capital – a powerful signal of authenticity, reliability and intent. The potential of digitized social capital as a trust enabler is especially significant in the business-to-business rather than consumer context and will expand over time as platform models permeate industrial and professional exchange.

- Digitized real-world authentication: Many consumer platforms rely on making a range of real-world authentication systems digitally available. Governments have invested heavily in creating national IDs for residents and companies that allow platforms to authenticate a user by digitally verifying Airbnb's Verified ID badge uses one or more of these forms of ID. Similar technology, a feature BlaBlaCar offers in India as well.

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- **Declared** – Declared identity including name, photo and bio
- **Rated** – Peer-to-peer ratings based on members' prior activity
- **Engaged** – Financial commitment to the journey via prepayment
- **Activity** – Information on a member's frequency of operation and level of responsiveness
- **Moderated** – Content exchanged by members moderated and verified by the platform
- **Social** – Existing online social identity (Facebook or LinkedIn) connected with profiles

Figure 7: The DREAMS trust framework of BlaBlaCar.

STRIKING THE RIGHT BALANCE BETWEEN INSTITUTIONAL AND DIGITAL TRUST

Platform activity is enhanced dramatically by stand-alone trust systems that aggregate cues from a range of sources while also giving participants control over the data in their profiles. An effort compliant with the EU General Data Protection Regulation (GDPR) that is gaining traction in Europe is Verimi, backed by a consortium of investors and customers that includes Allianz, Daimler, Deutsche Bank, Samsung and Volkswagen.

Trust expert Rachel Botsman describes the ongoing transition as moving away from a centralized trust that flows vertically upwards through institutional authorities and towards decentralized trust that flows horizontally between trading partners within a community. And Jeremy Heimans and Henry Timms note that the challenge with this *"new power"* is not to hoard it but to harness and channel it. Nevertheless, even in today's world of new power, horizontal flows and blockchain-based smart contracts, digital trust systems must be backed by traditional institutions, robust human intervention and a trusted organization.

On Airbnb, for example, exchange relies extensively on digital ratings and the use of machine learning to weed out bad actors; government-backed trust systems manifest, for instance, in the company's Verified ID system; economic institutions back the insurance contracts that provide host reassurance against property damage; and Airbnb's brand promises safe and reliable accommodation.

Thinking beyond digital technologies is especially important when considering the decentralized markets, smart contracting and reputation technologies associated with blockchain systems. Such technologies by themselves will not create new trust institutions that are sufficiently robust unless the ecosystem itself is trusted, and its governance rules laid out clearly. Put differently, building trust within the system has little impact if the system itself is not trusted.

SIX GOVERNANCE CHOICES THAT CAN MAKE OR BREAK A PLATFORM

The scaling of platform models reflects their ascendance as one of society's primary custodians of the public trust. Their governance choices define the *"rules of the game"* for participants, akin to the role economic institutions play in nation states and the industrial economy. As Nobel laureate Paul Romer has noted, *"Institutions are the rules – the rules of the game that structure what everybody does in the nation."* And it is the hybrid between centralization and decentralization in the platform world that creates essential governance choices.

Getting the governance right involves effective choices along six key dimensions:

Define the neutrality and independence: Platform owners must decide whether their platform will be neutral and open, or whether they require exclusivity and exert control over access. For example, the emerging Klöckner XOM platform has explicitly chosen to be open, allowing competing steel manufacturers to list alongside and compete with Klöckner. In contrast, the Apple iTunes platform is tightly controlled, with permission required from Apple before an app can be listed.

Similarly, a platform may be agnostic about its participants multi-homing 27 or may demand that each of them commit to an exclusive relationship. From the perspective of Booking.com, non-exclusivity is central

to its platform governance philosophy, so long as a participant complies with a clear set of standards and guidelines. Of course, one must consider antitrust issues. According to Gisbert Rühl, Chief Executive Officer of Klöckner, the company sought and received approval from the German cartel (who paid close attention to this case as a pioneering business-to-business platform effort in Germany) before choosing an open governance model.

Neutrality has many other dimensions. The Amazon platform features millions of products and sellers who compete with Amazon for customer demand. Amazon is explicitly non-neutral by frequently highlighting a product as *"Amazon's Choice"*, and possibly ranking its offer above others whose prices may be lower. In contrast, the Klöckner XOM platform has explicitly chosen to be neutral in its ranking. Similarly, Allianz, which is Europe's most prominent insurance provider, is committed to neutrality. History teaches us that openness is generally likely to trump control in the long run – growing the ecosystem is a better investment than protecting one's turf.

Assess the scope of compliance oversight: How much should a platform ensure compliance among its participants with non-platform rules, including those dictated by the laws of the countries in which its participants operate? There are many reasons for choosing a level of oversight that is different from what is minimally required by law. Google's YouTube platform has embedded a range of censorship rules into its algorithms, well beyond legal requirements, defining what it believes is in the best interest of the ecosystem as a whole. Uber and Lyft both watch and listen as the public and regulators discuss issues concerning the ride-sharing industry, trying to be the earliest adopters of regulations.

Choose the level of transparency: A platform is often called on to make its *"rules of the game"* transparent. Societal arguments that favour transparency stems from the close connection between democratic government and transparency in governance. The case is also made well by the general principles laid out by the Institute of Electrical and Electronics Engineers (IEEE) in its Global Initiative on Ethics of Autonomous and Intelligent Systems, that *"... the complexity of autonomous and intelligent system technology will make it difficult for users of those systems to understand the capabilities and limitations of the AI systems that they use, or with which they interact. This opacity, combined with the often-decentralized manner in which it is developed, will complicate efforts to determine and allocate responsibility when something goes wrong with an AI system. Thus, lack of transparency both increases the risk and magnitude of harm (users not understanding the systems they are using) and also increases the difficulty of ensuring accountability."*

For platforms operating in the European Union, there is a wide range of transparency requirements, encapsulated in the 2018 GDPR. The law notwithstanding, greater transparency may seem like a natural choice, democratic and fair, consistent with a philosophy of doing right by one's ecosystem. However, a platform must consider many caveats. A higher level of transparency may have adverse competitive implications for the platform itself, a requirement of transparency may lower innovation incentives, and transparent systems are more susceptible to gaming by users.

Minimize the algorithmic bias: Platforms rely on a range of algorithms for their effective functioning, and these are susceptible to bias. Such bias arises more frequently if the inherent values of the people involved in creating or training the algorithm (or values represented in the associated training/test data) are reflected in its subsequent functioning.

Many jurisdictions have specific laws prohibiting discrimination of different kinds, and algorithms that do not comply place the platform in legal jeopardy. Legal compliance alone is insufficient; however; a platform faces reputational risks and a loss of faith from its participants from any revealed bias in its *"rules of the game."* Bias can also lead to missing a market shift in a rapidly evolving business landscape.

Detecting algorithmic bias starts with recognizing that it typically has four different sources. The algorithm may have been trained on a non-representative sample of the population, as seen in facial recognition systems.

The activity levels of the society may be biased in a way that causes the algorithm to favour one group over another. For instance, higher data volumes from wealthier individuals on account of their more extensive shopping activities can bias an algorithm against people of lesser means. The algorithm may have a (potentially unintentionally) flawed objective function. Finally, the implementation of the algorithm can have a reinforcing effect that exacerbates existing inequities.

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Beyond aggressive detection, good governance involves choosing the right benchmark to measure bias against; creating a culture of pretesting, testing and auditing for bias; bringing humans into the decision loop, and monitoring a shifting legal and regulatory landscape actively.

Set data property rights: Although consumers who create data on a platform frequently have no default claim of ownership over these data, and little or no authority to determine how the platform uses them, it is anticipated that a confluence of forces will return some of this authority to platform participants. Regulation around the world is likely, de jure, to redefine the division of data ownership between platforms and participants. For example, the GDPR notions of *"consent"* and its language on the right to access layout some elements of user property rights. Simultaneously, the emergence of robust third-party trusted data intermediaries like Verimi will shift the de facto norms on data property rights in favour of the user.

A very different data rights landscape is anticipated as platform business models make deeper inroads into business-to-business commerce. Some platform companies like Huawei see the default data property rights as resting exclusively with the participants. Others like Klöckner's XOM and Allianz see clear data property rights for participants in their business-to-business platforms as being a strategic necessity to gain trust.

Create due process: After setting the *"rules of the game,"* it is equally essential for a platform to provide its participants with a system to seek recourse when things go wrong, with aspects like advance notice, a fair hearing, and some peer review or arbitrated resolution. This is especially important for platforms whose participants rely on the ecosystem for their livelihood. Many YouTube users who generate income from advertising and whose content may be blocked by YouTube's censorship algorithms complain of a lack of due process in the resolution of these decisions made by their *"algorithmic bosses"*.

Greater clarity into how algorithms make participation decisions allows participants to recognize when they have been unfairly treated and can minimize unnecessary perceptions of unfairness. Bringing humans into the loop can also help. The trial system set up by Uber in London, where a *"jury of driver peers"* deliberate driver deactivation decisions, is an excellent supplement to its algorithmic approaches.

Executives and policy-makers who consider these six choices will also realize that the lines between platforms and governments are blurring, making the administrative boundary between public institutions (government agencies, regulatory bodies) and private institutions (platforms, corporations, trade bodies) increasingly permeable. As society embraces the emerging role of platforms as custodians of the public trust, new opportunities for public-private collaboration will also emerge.

HOW DIGITAL PLATFORMS AND ECOSYSTEMS CAN REINVIGORATE PUBLIC-PRIVATE COLLABORATION

Platforms and ecosystems represent a new way of organizing that can yield significant benefits for society. New products and services create citizen value, while new operating models achieve public objectives, from urban regeneration to the development of clean mobility to healthcare improvements. Most saliently, digital ecosystems can help redefine the boundaries between the public and private spheres, creating new models of *"invisible infrastructure"* while allowing entrepreneurs to provide the *"scaffolding"* for new products and services. The true potential of such collaboration will be realized if the technological, operating and regulatory innovations proceed in lockstep, rather than in isolation.

At the most basic level, government procurement can be transformed through the use of ecosystems. To illustrate: the UK's National Health Service (NHS) recently announced an ecosystem effort that empowers entrepreneurial ventures to connect to the NHS for the provision of services ranging from the mainstreaming of remote consultation and the use of *"smart inhalers"* to monitor patients remotely, to the use of AI to interpret CT and MRI scans. Changing how public services interface with new technologies can save significant costs and avoid the headaches of massive IT projects. It can also provide an external impetus for change to the public sector itself, going hand-in-hand with the organizational redesign of the administration.

Today's platforms, ranging from Uber, Lyft and Didi Chuxing to Airbnb and BlaBlaCar, have already demonstrated how the private sector can provide a new and *"invisible"* form of infrastructure, a new market-driven way of crowd-based public-private collaboration. The market mechanism *"switches on"* capacity in response to spikes in demand, at a fraction of the investment associated with high-

fixed-cost infrastructure. Airbnb provides an alternative to massive development projects before the Olympics or the World Cup. BlaBlaCar has created a global transit network without spending billions on steel and concrete. Uber and Lyft provide an order of magnitude more rides from the outer boroughs of New York than government-driven taxi services.

UK-based JustPark converts thousands of own personal parking spaces into commercial parking lots that can reduce the need for ungainly parking structures around stadiums and neighbourhoods with time-varying traffic.

These platforms are primarily private-sector entities that are subsequently subject to public oversight, often in a reactive rather than planned manner. To realize the value of such private infrastructure, technology and operating and regulatory innovation must aim to move in lockstep. Platforms must not be viewed as the target of regulation but as organizational partners. There are many partnership models, including peer regulation, creating industry consortia and data-driven delegation.

A key question, one whose resolution is central to the success of the market-based public-private collaboration, is when to decentralize regulatory execution to a single platform, and when to retain central government oversight and control.

Numerous factors define the right balance, including whether the market failure is due to information asymmetry, externalities or both, and how data availability affects regulatory effectiveness, as well as issues of privacy, timeliness, execution cost and variety.

More exciting yet is the possibility that digital platforms and ecosystems can emerge as explicitly public-private collaborations, allowing the private initiative to work with the government and achieve public goals. For example, consider Traipse, a budding venture that provides a set of themed tours of a historic business district with stops along the way to engage the user to learn interesting facts and complete riddles.

It allows local businesses to provide discounts as rewards for solving brain-teasers, participating select, local and environmentally responsible firms as part of a managed, designed ecosystem aimed to regenerate historic downtown areas. Costs are defrayed by the local authority or chamber of commerce, and productive local ecosystems are created. Traipse's sister company, MyLocalToken, took this a step further, providing the infrastructure for local authorities to develop web-enabled local payments that can help stimulate local economies, one focused ecosystem at a time, using own enthusiasm and entrepreneurship to support policy needs in the United States.

Some foresight and creativity in platform-based collaborations can expand the possibilities even further, bridging old infrastructure with new to create public good. A prime example is that of Didi Chuxing, whose platform software is used by cities ranging from Xi'an to Chengdu to optimize mobility flows in an unprecedented manner.

The city government connects IT systems that power its public infrastructure, from traffic lights to mass transit systems, with the Didi platform. Integrating these with knowledge of traffic patterns and newer ride-hail and bike-share infrastructure – coupled with the power to implement dynamic and subtle changes to the timing of traffic lights and subway trains, even the capacity of highway lanes using *"road zippers"* – yields a global view that optimizes the flow of people and cars in a manner never done before. A newer and analogously exciting development is of Velocia, a MaaS (Mobility As A Service) platform that incentivizes and rewards transportation choices by pairing its app with transit services, such as car sharing, bike sharing, taxi services and mass transit.

When people use Velocia to order a matched service (and agree to share their data), they earn points redeemable for rewards. The use of this gamified loyalty scheme generates data that can guide a multitude of decisions, from where to put bike-share stations to how to program traffic lights.

Such efforts help address vital public needs, but both the specific solutions and their implementation are driven by individual entrepreneurial action, innovatively bridging public and private objectives. It is this new bridge between the entrepreneurial spirit, public mission, public authorities and private firms that offer exciting opportunities to rethink the link between the private and the public. wn

CPD course calendar

VENUE: SAIEE HOUSE 18A GILL STREET OBSERVATORY

JUNE 2019	
3 - 4	WCC19: Fundamentals of MV Protection, Western Cape
4 - 5	Optical Fibre Technology And Networks (OFTN)
5 - 6	Earthing And Lightning Protection
11 - 12	Photovoltaic Solar Systems
12 - 14	Fundamentals Of Medium Voltage Protection
18 - 19	WCC19: Photovoltaic Solar Systems, Western Cape
19 - 20	LV, MV & HV Switchgear Operation, Safety, Maintenance & Management
25 - 26	Design Of Economical Earthing Systems For Utility Electrical Installations
JULY 2019	
1 - 2	High Voltage Testing And Measurement
2	Road To Registration For Engineering Candidates
9 - 10	Fundamentals Of Power Distribution
11 - 12	Electrical Engineering Fundamentals For Non-Electrical Engineers
16 - 18	Cigre Sc B1 Tutorial Session: Cable System Relaibility Workshop
16 - 17	Incident Investigation And Management (Incl. Root Cause Analysis)
18 - 19	Fundamentals of Developing Renewable Energy Plants
18 - 19	WCC19: New Enginneering and NEC contract, Western Cape
23 - 24	Fundamentals of LTE Mobile Communications
25 - 26	Advanced MS Excel For Engineering Professionals
30 July - 1 August	Power Systems Protection
AUGUST	
5 - 6	Photovoltaic Solar Systems
13 - 14	SANS 10142-1. 2017 Edition 2 & OHS Act
13 - 14	Arc Flash Workshop
22 - 23	Earthing & Lightning Protection
27 - 28	Internet of Things (IoT) Standards and Applications
28 - 29	Writing Good Technical Specifications
29 - 30	WCC19: Earthing and Lightning Protection, Western Cape

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Our Expert Answers

Information provided by Zest WEG Group

QUESTION ONE

What is a steam turbine and where would this equipment be used?

ANSWER ONE

A steam turbine is a type of rotating equipment that converts thermal energy into mechanical energy. The steam thermal energy is converted into kinetic energy when the steam flows through small openings in the turbine casing called nozzles. These have a restricted passing area which increases the steam velocity and consequently the kinetic energy. There is an enthalpy variation due to the steam pressure and temperature drop and an increase in the specific steam volume.

The kinetic energy obtained through the nozzles is converted into mechanical energy, according to reaction or impulse principles, turning the turbine rotor. As the rotor spins, several types of equipment can be coupled onto the shaft end.

Power plants, sugar mills, pulp and paper mills, steel mills, petrochemicals, oil and gas, food and beverage, universities and many other industries including commercial and institutional facilities use steam turbines for electricity production or to drive mechanical equipment such as compressors, fans, mills and blowers. When used for the production of electricity, the steam turbine is coupled to a generator, which is commonly referred to as a steam turbo-generator set.

QUESTION TWO

Can steam turbo generator sets replace steam pressure reducing-valves?

ANSWER TWO

The steam turbine requires a minimum steam-flow and enthalpy drop to produce power on the generator end. The OEM will be able to calculate the amount of power to be produced by the steam turbine, taking into consideration the turbine inlet steam flow, temperature and pressure, as well as the steam outlet conditions required to support the plant processes.

Typically, industrial steam turbine models start from a 30 kW capacity and go up to 150 MW. These turbines can operate at a very low steam pressure (5 bar or less) or high steam pressure up to 140 bar, saturated or superheated steam up to 540°C.

A new steam turbo-generator set could be installed in the plant to operate in parallel with the pressure reducing valve, so when maintenance is required on either the valve or turbine, the processes which require steam would not need to be stopped.

QUESTION THREE

Is it possible to include multiple extractions on a single casing steam turbine?

ANSWER THREE

The steam turbine is a very flexible piece of equipment and can be tailor-made depending on the manufacturer. A condensing or backpressure steam turbine may have multiple steam extractions allowing it to be used for boiler feed water heating, absorption chillers, district heating and paper machines as well as many other heating and cooling processes which demand different levels of steam pressure and temperature.

In consultation with the customer, the OEM will define the number of extractions to be included on the steam turbine. These extractions may be controlled or uncontrolled, depending on the usage for the extracted steam.

For better machine performance, hydraulic extraction control valves are usually the best option. These valves can control the steam extraction flow and pressure, eliminating the need for using pressure reducing valves on the extraction steam lines. High-efficiency steam turbines take most of the steam thermal energy to convert this into mechanical energy, so the extracted steam could be very close to the saturation temperature.

QUESTION FOUR

What is the operational availability of an industrial steam turbine?

ANSWER FOUR

The operational availability of an industrial steam turbine should be about 98%. A proper maintenance programme is essential not only for prolonging the life of the equipment but also to ensure the correct operation of the turbine. The best way to achieve this is to enter into a service contract with the OEM who will recommend an appropriate maintenance and service programme.

The turbine and auxiliary equipment require regular inspections to detect oil and steam leaks, vibration conditions, oil pressure and temperature, operational conditions and performance. Any problem found during such checks should be

reported to the OEM to facilitate the proper corrective action.

Scheduled maintenance is usually required every 12 500 hours of operation. During machine shutdown, maintenance specialists will be able to inspect valves, bearings, couplings, bolts, casing, oil system and other turbine auxiliary systems. Tests should also be performed on the emergency trip systems; instruments should be calibrated and wear parts replacement carried out during the maintenance services.

After 60 000 hours of operation, an initial inspection is recommended to check the internal components of the steam turbine. During this intervention, the turbine casing should be opened, the rotor and blade carriers, or diaphragms, depending on the machine, should be removed for cleaning, a general inspection done as well as Non-Destructive Testing (NDT), clearance checking conducted, seals replaced, the rotor balanced and equipment aligned, along with other routine tasks. In situations where cracks, erosion or other critical wear is found, blades and bushings should also be replaced.

QUESTION FIVE

What is the expected life of a steam turbine?

ANSWER FIVE

The expected life of a steam turbine is between 20 and 30 years. It is essential to follow the OEM recommended maintenance programme; however, other factors may also influence the lifespan of the equipment, for instance, the quality of the steam. Poor steam quality could bring unwanted particulates into the turbine which cause incrustation, wear, cracks and erosion to the rotor, blades and control valves. An increase in vibration and loss of performance can indicate incrustation, and if detected, appropriate corrective action must be taken to avoid severe damage to the equipment.

Maintaining a spare parts stockholding is an excellent way to improve the availability of the turbine and to avoid the equipment operating in unsafe conditions. Small items such as joints, gaskets, O-rings, sensors and filter elements are items that should always be kept in stock, allowing quick replacement when necessary.

Another critical factor is proper operator training. Operators must be aware of the procedures indicated by the OEM for start-up and shutdown of the machine, alarm and trip situations, curves of operation and be able to take proper action in an emergency.

May in History

May is the fifth month of the year in the Julian and Gregorian Calendars and the third of seven months to have a length of 31 days. May is a month of spring in the Northern Hemisphere and autumn in the Southern Hemisphere.

COMPILED BY |
JANE BUISSON-STREET
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1MAY

1851 The Great Exhibition opened to wide acclaim in the Crystal Palace in London. Inside the Crystal Palace, a giant glass-and-iron hall designed by Sir Joseph Paxton, over 10,000 exhibitors set up over 8 kilometres of tables. The Great Exposition was a rousing success and hosted about 6 million visitors before it closed in October. The many goods displayed ranged from kitchen appliances to false teeth, silks to farm machinery.

2 MAY

2000 President Bill Clinton signed a bill to stop the scrambling—presumably because the advantage had become outdated—therefore making the system considerably more accurate for everyone. The free, accurate GPS that resulted made all sorts of things, most notably the modern smartphone and its mapping apps, possible.

3 MAY

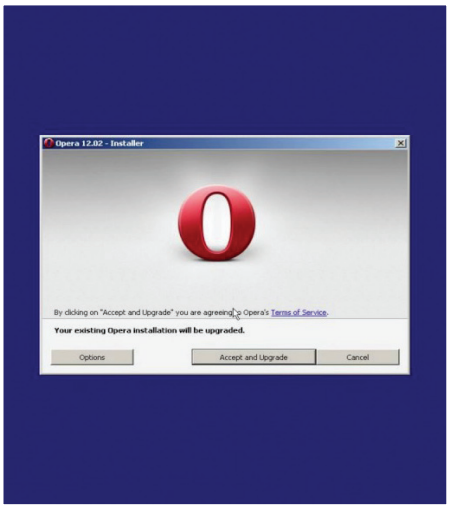
1830 The Canterbury and Whitstable Railway, England, was opened; it was the first steam-hauled passenger railway to issue season tickets and included a tunnel.

4 MAY

2012 Controversial British politician, Boris Johnson was re-elected as the Mayor of London for a second term.

5 MAY

1999 In an effort to fix some minor issues, improve USB support and upgrade Internet Explorer, Microsoft launched Windows 98 SE (Second Edition). The upgrade version also improved WDM audio and modem support, shell updates and Web Folders (WebDAV). This was the last release of the 9x series. Windows 98 SE were officially retired on July 11, 2006.



6 MAY

1954 Roger Bannister became the first person to run the mile (1.609 km) in under four minutes.

7 MAY

1954 IBM announced the IBM 704 Data Processing System, the world's first mass produced computer to feature floating point arithmetic hardware. Besides this ultra-geeky distinction, the IBM 704 would leave its mark in computer history before it was discontinued on April 7, 1960. Both the FORTRAN and LISP programming languages were first developed for the IBM 704, as well as the first music application, MUSIC. Physicist John Larry Kelly, Jr. of Bell Labs synthesized speech for the first time using this machine. Not bad for a mainframe.

8 MAY

1970 Let It Be, the twelfth and final studio album by the English rock band the Beatles, was released almost a month after the group's break-up. Like most of the band's previous releases, it was a number one album in many countries, including both the US and the UK. The album was released in tandem with the motion picture of the same name.

9 MAY

1874 The horsebus made its début in the city of Mumbai (the capital city of the Indian state of Maharashtra), traveling two routes.

10 MAY

1894 "Wireless" communication was improved when Guglielmo Marconi sent a radio wave 1.2 kilometres. Three years later the Marconi Company would successfully communicate "ship-to-shore" over a distance of 19 kilometres. Marconi's work led to the commercialization and proliferation of most of the radio technologies we know today.

11 MAY

1979 At the West Coast Computer Faire, Harvard MBA candidate Daniel Bricklin and programmer Robert Frankston gave the first demonstration of VisiCalc, the original spreadsheet software.

12 MAY

2017 A ransomware attack attacked over 400 thousand computers worldwide, targeting computers of the United Kingdom's National Health Services and the Spanish multinational telecommunications company Telefónica's computers.

13 MAY

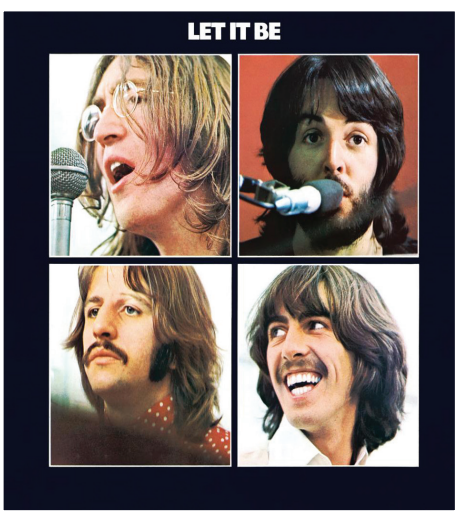
1987 Version 1.0 of the Turbo C programming language was released. It offered the first integrated edit-compile-run development environment for the C programming language for IBM-compatible personal computers. Turbo C was developed by Bob Jervis as "Wizard C".

14 MAY

2011 On the 20th April 2011, hackers took down the Sony PlayStation network. Around 77 million accounts were compromised, and gamers couldn't play online for over a month! The 14th May was the day that Sony started bringing the services back online on a country-by-country basis.

15 MAY

1836 Francis Baily observed "Baily's beads" during an annular eclipse. The Baily's beads effect, or diamond ring effect, is a feature of total and annular solar eclipses. As the Moon covers the Sun during a solar eclipse, the rugged topography of the lunar limb allows beads of sunlight to shine through in some places while not in others.



May in History

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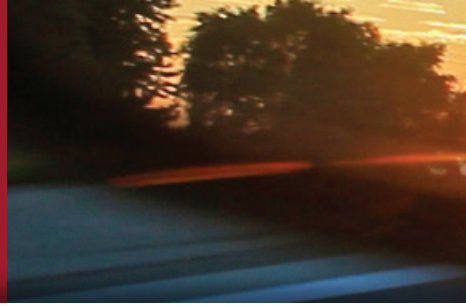


16 MAY

1931 The London United Tramways (LUT) started London's first trolleybus service. It replaced the tram service on the Twickenham Junction to Teddington route. The trolleybus had been demonstrated in London as early as 1909, and had been running in Leeds since 1911.

17 MAY

1994 Malawi held their first multi-party election.

18 MAY

1990 In France, a modified TGV (France's intercity high-speed rail service) train achieved a new rail world speed record of 515.3 km/h.

19 MAY

1999 Sixteen years after *"Return of the Jedi"*, George Lucas finally moved his vision forward with *"Star Wars: Episode I – the Phantom Menace"*. The story, set 32 years before the original film, is of young Anakin Skywalker and how Obi-Wan Kenobi brought him in, trained him, and ultimately lost him to the dark side. Filming of this film only started when George Lucas was satisfied that the technology required to tell the story was available.

20 MAY

1990 The Hubble Space Telescope (HST) blasted off aboard the space shuttle Discovery on April 24, 1990 and was deployed a day later. After a nearly monthlong checkout process, the observatory opened its eyes for the first time, capturing an image of several stars with its Wide Field/Planetary Camera on May 20, 1990.

21 MAY

1916 Daylight Saving Time was introduced in Britain as a war-time measure to save fuel. The idea began when a London builder, William Willett, presented a scheme of shifting the clock to better use the hours of daylight in summer.

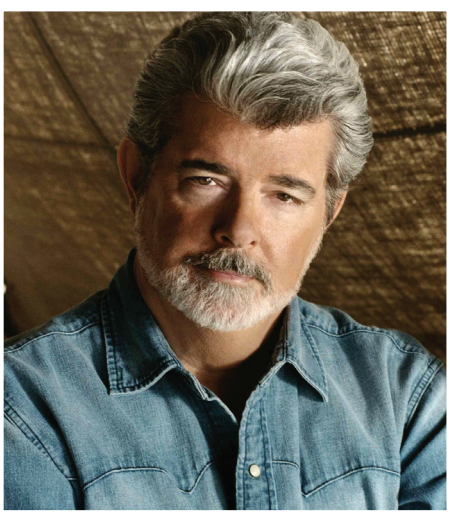
22 MAY

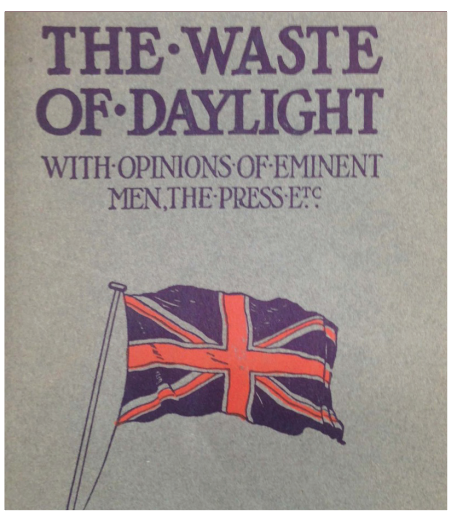
1973 Robert Metcalfe (co-inventor of the Ethernet) circulated a memo titled *"Alto Ethernet"* which contained a rough schematic of how it would work. *"That is the first time Ethernet appears as a word, as does the idea of using coax as ether, where the participating stations, like in AlohaNet or ARPAnet, would inject their packets of data, they'd travel around at megabits per second, there would be collisions, and retransmissions, and back-off."*

Metcalfe has since referred to 22 May 1973 as the day the Ethernet was born. David Boggs (the other co-inventor) identified another date as the birth of Ethernet: November 11, 1973, the first day the system actually functioned.

23 MAY

1903 The European capital cities of Paris (France) and Rome (Italy) were linked by telephone for first time.





24 MAY

1862 The first trial run of a train was made through the Metropolitan underground line (London, England), the world's first underground passenger railway. The public opening was held on 10 January 1863. The 6.437 km, 33-minute route had seven stations between Farringdon Street and Paddington.

25 MAY

240 BC The first recorded perihelion passage of Halley's Comet (a short-period comet visible from Earth every 75–76 years). The comet's periodicity was first determined in 1705 by English astronomer Edmond Halley, after whom it is now named.

26 MAY

1908 Shortly after 4:00 am, the first major Middle East oil strike was made at Masjid-i-Sulaiman, Persia (now Iran).

27 MAY

1959 After almost a decade of service, Massachusetts Institute of Technology (MIT) shut down its Whirlwind computer. Project director Jay Forrester described the computer as a "reliable operating system," that ran for 35 hours a week at 90-percent utilitisation using an electrostatic tube memory.

28 MAY

1987 CompuServe released the Graphics Interchange Format (GIF) standard as a new computer graphics file format.

29 MAY

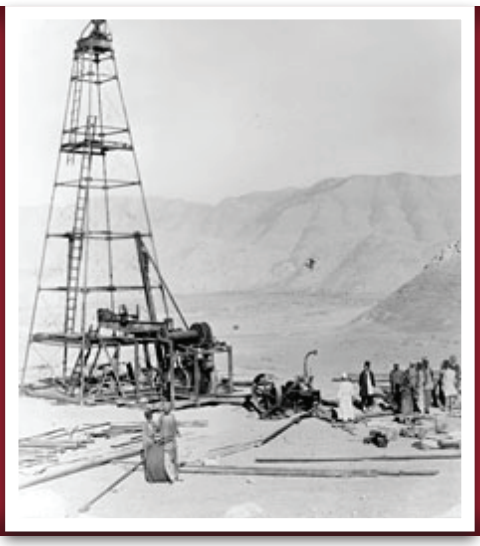
1992 At the Consumer Electronics Show in Chicago, Apple Computer CEO John Sculley first announced the coming release of the Newton personal digital assistant to a group of reporters, explaining that the Newton *"is nothing less than a revolution."* Although there was not a fully functioning prototype available, the Newton technology was demonstrated. This later proved to be a mistake as the announcement alerted Apple's competitors and created users' expectations. When it was finally released the Newton did not live up to expectations and was not a commercial success.

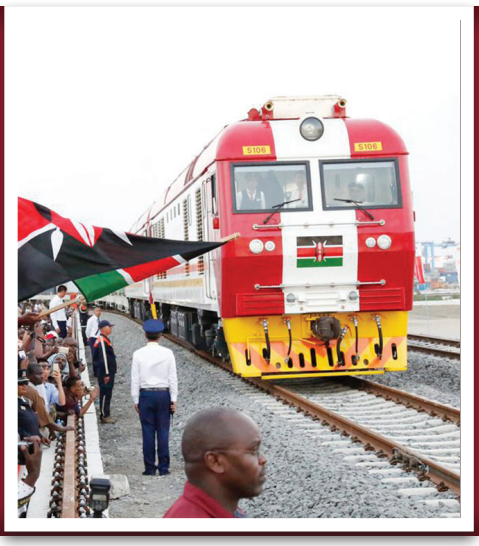
30 MAY

1974 The Airbus A300, a wide-body twin-engine jet passenger aircraft, first entered service.

31 MAY

2017 Kenya opened the Mombasa–Nairobi Standard Gauge Railway, the East African country's largest infrastructure project since gaining independence. wn





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