LIVE W/ AI

How to empower humans amid the rise of artificial intelligence in society?

A bridge between Asia and Europe on Artificial Intelligence

AXA JCDecaux AVEVA LIVE W/ AI

> ***Our AI future will be created by us, and it will reflect the choices we make and the actions we take.***

Kai-Fu Lee, Author of AI Super-Powers

Who are we?

Live with AI is a non-profit foundation based in Singapore. The foundation gathers thought leaders, decision-makers, and international researchers to lead working groups and research projects on the positive impacts of artificial intelligence to our society. The Live with AI community takes advantage of a presence at the heart of the South-East Asia region and an access to several research laboratories to issue recommendations which can be immediately applied and tested among very diverse communities looking for technology disruption.

This book gathers first non-exhaustive different ideas and thoughts from our community and board members. Some are very practical, others are more philosophical, and we hope such points of view on a better future with AI will help decision makers and thought leaders debate more, and anticipate how we can collectively act as humans together to lead this fantastic transformation. Live with AI is an independent initiative created at the occasion of the France-Singapore Year of Innovation 2018.

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This is our responsibility to positively drive our AI revolution and leverage artificial intelligence to build sustainable future for our business and societies, accessible to all and for all. LIVE WITH AI aims to gather independent thoughts to design a human centric vision of this world empowered with AI.

Pierre ROBINET
Senior Partner - Ogilvy Consulting ASIA &
Live With AI founder

Governments have all realized the power of Artificial Intelligence for the future of our societies, and over the last 18 months, most of them have already initiated working groups, ethical councils and policy frameworks, merging their strengths on particular domains (like France and Singapore have done with regards to healthcare), with all nations considering the need to control and leverage such technology to empower humans and build a greater society.

Being a strong believer that AI will positively impact our lives, I am conscious of the urgency to make the right decisions now in order to build this future. As well explained by economist Kate Raworth, we should re-design our economies for a start, and consider a "doughnut" model which delineates a safe space in which nations can meet the needs of their citizens without overshooting planetary boundaries, a space in which any business can meet the needs of their customers while ensuring they don't leave anyone behind. As she said at the Tech for a Better World event COGX2019 in London earlier this year: "If AI is not in service of this, what the hell is it doing?"

French president Emmanuel Macron hosted a "tech for good summit" in Paris, announcing the French ambition to become a leader in Artificial Intelligence and promising to invest 1.5 billion$USD in AI by 2022. He invited CEOs from a number of global tech companies, all of whom responded positively as they are also cognizant of the urgency to bring their AI expertise to our planet. For instance, Google.org, the philanthropic arm of the search giant, is funding a project which uses satellite imagery to track, quantify and publicise carbon emissions from power plants. The National Geographic Society and Microsoft's AI for Earth program are partnering to support projects that create and deploy AI tools to improve the way we monitor, model, and ultimately manage Earth's natural systems for a more sustainable future. However, this is not enough!

As mentioned in the conclusion of our LIVE WITH AI 2018 report, AI has a tremendous capacity to help us tackle most of the 17 SDGs (sustainable development goals from the United Nations), but this will only happen if business and society goals converge, if decision makers consider sustainable purpose in their AI enterprise transformation, if humans are not left behind, if collectively we leverage AI to work with us and not against the foundations of our society. By anticipating the impact AI would have on both business and societies, and by gathering various experts from the industry, corporate, technology and academic worlds, the LIVE WITH AI foundation aims to foster a positive vision of our future society and empower thought leaders to follow a human-centric leadership strategy.

In collaboration with our partners, including the Lee Kuan Yew Centre for Innovative Cities at the Singapore University of Technology and Design, DataRobot, AVEVA, AXA, and JCDecaux, we focused our research over the last several months on the future of WORK, HEALTHCARE, and SOCIETY, and the need to design human-centric AI transformation. This new report captures learnings and recommendations from our community which need to be considered in order to allow us better live with AI.

We are proud to be agnostic. We believe in the value of collective intelligence, we rely on applied case study and research, we gather multi-cultural brains from Europe and Asia, we focus first on purposes and society outcomes, and we work in a very human-centric mindset.

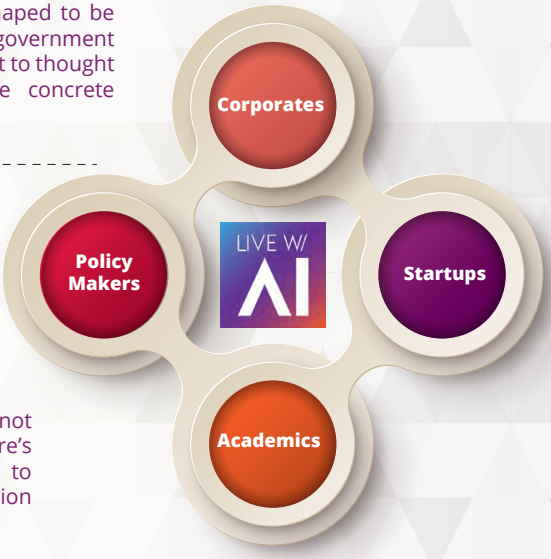
We are looking beyond data to understand the power of information, and looking beyond information to define the impact such a transformation would have on our human knowledge. We are, finally, all very positive about the future and we hope our work may support policy makers, decision makers, and business owners in defining the rules, frameworks, and concrete applicable actions we need to build this better society. AI is everyone's concern and needs to be designed for all, by all.

What is Live With AI initiative?

Content of discussions on AI is not always shaped to be useful and applicable to the Industry and government needs. We need to bring comprehensive content to thought leaders, demystify the debate, and provide concrete applied recommendations to decision makers

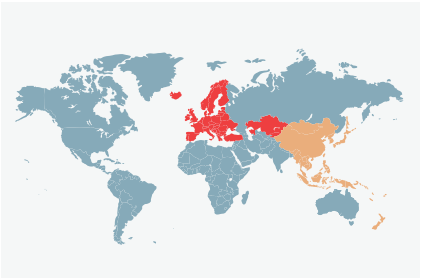
Most of the debates are led by experts focusing on the technology and do not take into consideration our human behaviour changes and needs. We need to have point of views from profiles with different backgrounds and from different regions

Most of AI-related content is very scary and not positive toward the potential of AI to our future's life. We gather a community committed to anticipate a better life with AI and to take action with human-centred initiatives



FUTURE OF WORK RESEARCH

PERSPECTIVES: LEVERAGING BLOCKCHAIN IN THE USE OF AI IN HEALTHCARE



ATTEMPTS TO UNDERSTAND CULTURAL DIFFERENCES IN AI ADOPTION

BRINGING EXPERTISE TO ALL

What we do?

Automation anxiety has been spreading lately, fear that in the future many jobs will be performed by machines rather than human beings given the remarkable advances that are unfolding in Artificial Intelligence (AI) and robotics. What's clear is that there will be a significant change, what's less clear is what this change will look like. We often find scary content when we touch on the subject of artificial intelligence. The danger with the Terminator story isn't that it will happen, but that it distracts from the real risks and opportunities presented by AI. AI is not bad or good. What matters is what are our ultimate goals, which society do we want to build at work, for healthcare services? How can we give AI goals?

Our community gathers profiles from various backgrounds (from entrepreneurs, academics, scientists or whether corporate decision makers) and nationalities: we feel that it's important that attempts to answer to these questions should be brought by all, to all. Each profile may raise different questions, and address challenges towards AI adoption in different manners.

Our think tank aims to facilitate an informed conversation about AI, that everyone should be part of.

Ultimately, this report is a call for participation. Whether you have answers or questions to provide, we hope this report inspires you to reach out to Live With AI and become part of the effort to ground the conversation about Artificial Intelligence. We get attention thanks to the collaborative work done by our community.

Eleonore FERREYROL-ALESI - LWAI Co- Founder & Dathena Client Solutions

Corporates, Start-ups, Academics, Government agencies? Join our community if you are interested in:

Applied Research
AI IN THE WORKPLACE: In strong collaboration with the LKY CIC research team, we work with our CORPORATE partners to get real case studies on the evolution of work due to the rise of Artificial Intelligence, and identify the key enablers to embrace an AI transformation project.

LWAI Moments
Meaningful closed-door roundtable discussions with POLICY MAKERS and thought leaders. TECHNOLOGY EXPERTS, DECISION MAKERS and THOUGHT LEADERS gatherings in small workshops driving the Think tank agenda and participating to key conferences to give a voice to our vision

Global Initiative
A bridge between Europe and Asia, helping European STARTUPS to develop their solution in Singapore, promoting French and Singapore GOVERNMENTS initiatives in international conferences (Hong Kong, UK) thanks to our LWAI ambassadors

AI ECO System
We bring business perspectives to ACADEMICS to develop their research with concrete examples, from all the players, STARTUPS & CORPORATES. We understand CORPORATES pain points and how the STARTUPS we identify can help.

Jean DROUFFE
AXA Insurance Pte Ltd (Singapore), CEO

AI, enabling the future

The belief that AI will enable our future has been the driving force behind our support for this amazing initiative. I'm proud that AXA Singapore has the privilege to be one of the main supporters of Live with AI once again.

For AXA, 2019 has been an exciting year of innovation. We launched AXA Next, our new organization focused on building the next AXA, and AXA Research Engineering Vision, a division dedicated to data and emerging technologies with an ambition to promote the widespread deployment of technologies such as AI, Blockchain, and IOT within our operational entities.

At AXA Singapore, our people are our greatest asset! Having participated in the Future of Work study led by the LKY Centre for Innovative Cities, we're leveraging this as a stepping stone to embark on a journey to support our people as they prepare for the skills of the future. The financial industry is transforming, we are facing intensified changes in skills and business models from both new digital players and non-insurance players looking to disrupt existing value chains using technology. We are now at the crossroad of traditional and AI powered business, with strong foundations in place to fully leverage our data and deploy company-wide advanced predictive AI to increase customer satisfaction while ensuring a seamless and fully automated claims process with the implementation of OCR and computer vision.

The future with AI is already here, and we will continue to see its deployment across multiple facets in our lives – from the way we work, to our healthcare needs and in every day society. I believe that insurance is evolving, and AI will enable us to bring new and innovative insurance solutions across the region, providing protection to the over 500 million emerging customers in SE Asia that is both affordable and seamless. This advent of opportunity not only enables the creation of value, but the chance for us to innovate and pave the way for the future of insurance.

Rob MCGREEVY
Head of Portfolio and Corporate Strategy, AVEVA

AI: the smarts behind the Digital Twin and Industry 4.0

At AVEVA we believe industry advancement should enhance the human experience, which is why we are proud to partner with LIVE with AI. Together we are actively closing the gap between human understanding and artificial intelligence so that the true potential of this technology is realized.

The next technology revolution is upon us. There has been an explosion in innovation since the turn of the century that has resulted in significant increases in computing power, connectivity, network capacity and speed. Cheaply and at scale. With Industry 4.0, everyone and everything is now interconnected, and the vast amounts of data collected can be captured, tracked and used with previously unimagined possibilities.

The resulting big data becomes the fuel for artificial intelligence solutions. But the true potential comes not through the technology by itself, but by making AI relevant to people. By creating a bridge between the technology and humankind. And responding to the human need for understanding.

For industry this means empowering users to create and amplify their digital twins (the digital representation of assets, work processes, and enterprises), and thereby mitigate business and operational risk, improve workforce safety and efficiency, and forge a more reliable and secure enterprise.

Once exclusively the domain of big tech companies, AI is becoming increasingly affordable, with inexpensive cloud computing able to provide the necessary processing power. People and companies must adopt new technology and new ways of working at an ever-increasing rate if they are to stay relevant.

This demands a new way of thinking about the way we design, build, operate and maintain critical assets and production processes; the way people perform work; and the way in which we interact with new technologies.

At AVEVA we are responding to this change by continuing our strong R&D invest-

ment into artificial intelligence and its application across our entire software portfolio. We see this partnership with LIVE with AI a critical component in helping to accelerate both the technology and the human element of this transformation. With assets, people and processes digitally assembled in to a unified construct, AI becomes the "smarts" to deliver innovative solutions and strong financial returns. To help drive workforce engagement, engineering efficiency and operational excellence. It's a win-win.

Combining the strengths of AI with the people element is already delivering significant benefits to industrial companies such as Duke Energy. Read the enclosed papers by AVEVA to discover more: **Artificial Intelligence: From Predictive to Prescriptive and Beyond** by James H. Chappell and **Augment Workforce with Intelligence to Boost Profitability in Oil and Gas** by Eddy Lek.

Evlyn YANG
Managing Director, JCDecaux Singapore

AI creating value for city dwellers

As AI opens up new horizons in many fields, we recognise the importance of joint participation among corporates, entrepreneurs, government agencies and academia to foster understanding of AI through education, research and nurturing a diverse community. At this pivot point where out-of-home (OOH) as one of the oldest media in the world is transforming to expand its offerings in the new media landscape, people remain at the core of the services we provide to urban populations. In this sense, Live With AI's mission to support society while directing change towards human-centred initiatives are aligned with JCDecaux's business philosophy, and we need to be actively involved in the conversation that steers AI's development and applications.

AI's part in digital transformation creates many opportunities to facilitate more human-centric interactions with the city's OOH solutions. OOH had traditionally been a one to many medium but gradually the need arose to achieve personalisation at scale as consumers developed increasingly higher expectations of receiving targeted and relevant messages. AI also has an impact on processes, from analysing consumer data in the shift towards programmatic buying, to delivering novel solutions for campaign optimisation, both of which are propelling the industry's shift towards an audience-based approach in engaging consumers. Among JCDecaux's suite of innovative digital OOH solutions is facial recognition technology which uses AI to optimise content targeting to specific consumers. A camera sensor picks up on specific cues from a consumer passing by, such as age or gender, visuals and copy are then displayed according to these cues such that the consumer will see the version of the content that is relevant to him or her. In addition, to automate the ad buying and ad placement process, machine learning allows data to be analysed and processed for recommendations on ad placements to be made, such that more time can be invested into actual human interactions for relationships with clients and partners.

These examples illustrate how AI functions support JCDecaux's unique position of the middleman in a value creator ecosystem involving brands, partners and consumers. As a media owner in over 4000 cities, JCDecaux has been at the heart of

cities and its ecosystems by making the urban environment more liveable since its beginnings half a century ago. The smart solutions we adopt in the urban environment are primarily human-centred and meet the needs of cities' inhabitants, such as traffic or weather data on digital screens. This is the foundation on which our innovations are built and the same approach that applications of AI should continue to take.

It is with this responsibility that JCDecaux is partnering LWAI to cultivate a better understanding of AI among city-dwellers and promote the development and utilisation of intelligent systems centred on human needs. These conversations about the acceptable use of AI will promote a more holistic understanding of AI by city dwellers to adapt to these advancements in order for them to reap the benefits.

King Wang POON
Director, Lee Kuan Yew Centre for
Innovative Cities-SUTD

Throughout history, societies have faced tremendous challenges. Some prevailed and some did not. The societies that prevailed were the ones that banded together, drew on each other's strengths, and found innovative ways to overcome those challenges.

In our time, AI will pose some of the toughest challenges disrupting society. The challenges are clear and have been extensively and debated. They include worker dislocation, asymmetric power, algorithmic basis, digital ethics, and social divides, just to name a few.

The solutions are less clear. Societies are still working out what and where the crux of the issues are.

In times like these, it is useful to remember that nobody in society has a monopoly on ideas and solutions. It means that -- like the societies that prevailed in history -- we must all work together and draw on each other's strengths to find new ways forward.

This is why initiatives like Live With AI are so important. It adds the power of the community to the voices of the public, private and people sectors. As a community of international AI experts from leading companies, think tanks, and universities, it brings the power of deep, diverse expertise to tackle the AI challenges facing us all: a combination which increases our odds of finding smart solutions. It also increases the odds that our solutions will benefit the many, and not just the few.

It is for these reasons that the Lee Kuan Yew Centre for Innovative Cities (LKYCIC) at the Singapore University of Technology and Design is happy to be a part of Live With AI. The LKYCIC's research work focuses on the impact of technology and design on people. We meld an acute appreciation of our shared humanity with a clear understanding of the power of technology, to design innovations that uplift lives in societies.

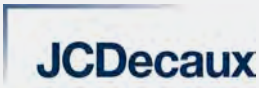
You can see an example in this report. For the future of work, the LKYCIC has developed task databases and strategies to help workers navigate clear transition pathways between jobs. Tasks are the best resolution to tackle the impact of AI on work because jobs are disrupted task-by-task, not role-by-role. We take advantage of this granularity to give workers greater certainty and confidence about their future.

Working with Live With AI, we applied our task databases and strategies to several industries and occupations. We identified where AI automation and value creation have the greatest potential. We also identified how we can make jobs more valuable and meaningful for employees. We then created visualizations that make it easy to act on the insights. All these give company leaders, policy makers, and individuals a concrete, human-centered lens to create a future where people and machines work in concert, and not in opposition.

The partnership with Live with AI has been an effective one. As the AI revolution continues to unfold, we look forward to continuing our work with Live With AI's community of like-minded global experts.

In doing so, we will uplift more people's lives, and make their world a better one.

Thank You to Our Partners



A One Year Journey
Between Asia & Europe on Artificial Intelligence

May 2018

VIVA TECHNOLOGY

- LWAI report release at the Singapore conference
- LWAI positive Impact conference
- LWAI official report official presentation on SAP boot

SGINNOVATE

- LWAI report recommendations
- Presentation at BASH, Singapore, by our board members

LWAI events in Singapore

LWAI events

SGINNOVATE

End 2019
LWAI 2nd report

Whitepaper Editing

June 2019
Participation to closed-door roundtable on "Human-Centricity: The New Frontier for Successful AI Innovation". - INNOVFEST

The Software Alliance
BSA

Presentation of the outcome to LWAI community

Sept 2018
AI-Work panel - AISUMMIT Singapore

AI in Healthcare and Insurance Panel discussion hosted by AXA

The Future of Work in Emerging Markets – INSEAD EMI

May 2019
LWAI & JCDecaux VIVATECH Challenge
– startups pitch

VIVA TECHNOLOGY

"AI impact on our society and our economy : what's happening now, what might happen next?"

– VIVA TECHNOLOGY

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

Partnership with NTU

INSEAD The Emerging Markets Institute

Partnership with INSEAD – EMI

"Augmented Employee" scenario design

Collective intelligence working session

Employees Interviews

LWAI Applied Research

Senior Management Interviews

Technology Assessment of the tasks

SUTD · DataRobot

Jan 2019
AI & WORK working group set up

JCDecaux

Partnership with JCDecaux

AVEVA

Partnership with AVEVA

Discussion on maximizing the role of Humans in an AI World - Big Data & AI Asia

Nov 2018
LWAI 2019 Roadmap presentation with our partner AXA

When it comes to the future of work, we believe AI is not killing jobs, it's killing business models. By understanding such business evolution, and by considering first work's value to employees, we would be able to empower humans in their work, augment their potential and toning down some of our human bias. This is the path to follow in order to preserve, leverage and enhance our creative skills, our emotional intelligence, our critical thinking and help us excel in solving problems and being always more creative while empowered by the machine.

AI & WORK
P.27

We must design new healthcare systems to serve our entire ageing population , leveraging the fantastic power of our human data. Design new human-centric healthcare models requires to empowering patients in the management of their health data, re-design economics and legislation rules to deliver greater medicine outcome, and eventually leverage the tremendous potential of internet of things and AI at the edge as well as new decentralized models.

AI & Healthcare
P.91

Last but not least, it becomes naturally imperative to consider human centric and cross-border governance models. We need ethical and governance frameworks, to ensure trustworthiness, fairness and explainability in AI-decision making, and we must consider the importance of our cultural differences, and history, to protect universally our autonomy and privacy.

AI & Society
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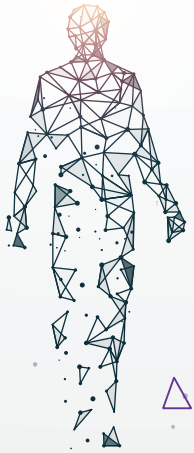
Key Takeaways



Key Takeaways

AI & WORK

AI won't simply replace Humans

It is no longer a question of whether companies should integrate AI into their organization or not. However, the jobs brought by the AI revolution won't be only reserved to computer specialists; thanks to the principle of comparative advantage, AI-enhanced human roles will emerge as well.

AI and Work: Equal to the Task

AI disrupts jobs task by task and not job by job. We - employees, HR practitioners, union leaders, policy makers and company strategists – can take advantage of this to disrupt disruption. We can use tasks to better track technology impact, chart clearer pathways between jobs, and improve work prospects for people.

How to Work with AI: Strengthening your Human Skills

To get prepared for the AI revolution, employees must focus on enhancing their innately human skills: critical thinking, creativity, emotional intelligence and empathy, as well as persuasion and negotiation.

Automation Needs You to Think More about Humans, Not Less

Taking into account the "human cause" in an automation journey means augmenting a task that satisfies the worker, not replacing it. This will place humans at the heart of the transformation process.

Augment Workforce with Intelligence to Boost Profitability: the Oil and Gas Example

The use of a digital twin becomes more and more necessary. Combined with analytics and AI, it allows us to optimise production and predict failures ahead of time. Adding augmented and virtual reality will improve operational efficiency and production uptime for workers.

From predictive to prescriptive and beyond: AI impacts business models

To take advantage of the flood of data available to businesses, organisations must turn towards predictive, prescriptive, and prognostic analytics in order to enhance decision making, improve maintenance practices, and increase overall efficiency.

Challenges to the Adoption of AI and How to Address them

Let's review the different components and imperatives to successfully drive an

AI enabled transformation in an Enterprise context: build data architecture and technology capabilities, enable trust (both internally, with employees, and externally, with clients), implement change in legacy organizational models, strategy and financial processes, and finally, understand the regulatory barriers.

AI: an Opportunity for Small Businesses to Compete with the Big Guys

Small and middle-sized enterprises must leverage their unique data to compete with the big tech companies. This will happen through accessing new capabilities, adopting new technologies, and a change from instinct-led to data-driven decisions.

The Significance of "Edge Cases" and the Cost of Imperfection as it Pertains to AI Adoption

Focusing on edge cases allows organizations to assess the potential of AI-driven robotics. These scenarios, where the systems do not perform well, can negate all the benefits of adoption. The value of introducing robotics into complex applications relies on an ability to combine the strengths of human and artificial intelligence: for example, mobile robots should be able to request remote human assistance.

Can our Wellbeing at Work be Improved in the Age of AI?

Here are five tips for managers: identify and rectify workers' pain points, adopt a bottom-up approach by empowering workers, moderate the frequency and intensity of empathy tasks, help workers to effectively multi-task, and define transparency and fairness in the algorithms that employees work with.

AI & HEALTH

Putting Back the "Care" into "Healthcare"
Given certain normative aspirations and the state of global healthcare, we might turn to AI systems to put the 'care' back into healthcare. However, we must first recognise and address the care deficit and the causality deficit when designing these AI systems.

AI at the Edge and the Need to Consider a Decentralised Model
The deployment of AI will rely on the scalability of the implementation model. Decentralization from cloud to edge is a necessary step to ensure efficient resource utilization as well as improved user experience, security and real time operation at the edge. The addition of blockchain technology will reinforce the trust around such application framework. Healthcare sector is an early adopter of this approach with new IoT devices powered by Deep Learning and blockchain combination.

Consent As a Service
This concept is a must-have to preserve our autonomy in the age of AI, as people must be capable, informed and willing to participate in a new health data system. A decentralized model would empower individuals to own their data, better manage their consent and help them manage their right to be forgotten.

A New Health Value Model Empowered by AI
The monetization of health data across multiple healthcare stakeholders is a challenge to be addressed. To do so, the value of our health data needs to be tracked along the value chain; we must reinvent our healthcare economics and rewards system and implement incentive models to motivate citizens to participate in this new health data economy.

The Shift in Data Ownership and the Need for New Legal Models
Potential legal issues will arise with the use of health data by patients themselves. In the light of the existing various legal concepts, the best model might be a licence agreement. In such a model, patients would and could receive royalties in exchange for access to their data.

A Case for Regulation of Provenance in Health AI
We must take key policy measures surrounding the provenance of AI capabilities used in healthcare. We will need to ensure the provenance of AI models and processes as much as the validity, security and privacy of the associated data.

SOCIETY

AI, Surveillance, and the Human Right to Privacy
The right to privacy is a moral entitlement owed to everybody, and as AI expands the capabilities of government-run surveillance systems, ethical guidelines should specify what constitutes an invasion of an individual's privacy. Mechanisms such as a transparent public oversight of governments' surveillance practices should be put in place.

Privacy vs. Surveillance: Where do We Put the Slider? How to Answer the Digital Question?
Governments may use surveillance systems, however, companies throughout the world also possess significant power in monitoring people, as their business model is based on generating users' data.

Building Trust in AI
The AI decision-making process will be considered explainable if it can be understood by all. As AI systems that provide explanations for their outputs are crucial for legal issues, accountability reasons and ethical matters, we must push decision-makers to enhance regulations.

Neither Indifference Nor Essentialism: the Challenges of Building Globally Inclusive AI
For AI to be truly inclusive, it cannot ignore cultural and demographic differences, but should not essentialize or "hard-code" those differences either. This requires new AI technologies that are ontologically versatile, along with empowerment of under-represented groups in AI development

Who is Accountable when AI is Used to Support Decision-Making? The Case of Autonomous Vehicles
There is no ready-made answer. However, it may be necessary to create a universal duty on AV input contributors to map their involvement and the actual and potential risks. It also seems essential to consolidate accountability requirements.

Artificial Intelligence and Legal Responsibility
Traditionally, the law imposes legal responsibility or liability for wrongs committed by humans or legal entities whose actions or omissions were directed by human minds. Yet when wrongs are committed in the course of employing Artificial Intelligence (AI), such wrongs may not always be attributable to human elements, given that AI has a mind of its own. In the absence of a human state of mind and form, allocating legal responsibility for wrongs committed by AI is problematic.

Humanoid Living Sculptures: our Next Interfaces to Machines

A point of view on the need to foster a society where the faces of robots should be a human shape, as we are naturally used to speak to humans. We must create a society where both real people and humanoid robots live together.

AI in Robotics: the "For, By and Among Humans" Rule

As animals function as a precious social landmark that reassures human users, using animality for robot's hardware structures seems relevant. What's more, users should be able to teach the AI creatures through an open source programming platform.

AI & WORK

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AI won't simply replace Humans

"We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before" says Klaus Schwab, Founder and Executive Chairman of the World Economic Forum.

The emergence of artificial intelligence (AI) has played a crucial role in ushering in the Fourth Industrial Revolution. According to the World Economic Forum, "it is disrupting almost every industry in every country."

AI is a conglomeration of concepts and technologies that mean different things to different people – self-driving cars, robots that impersonate humans, machine learning, and more – and its applications are everywhere you look even if you may not observe it. An AI is a computer system that can perform tasks that ordinarily require human intelligence. Powered by machine learning, these AI systems are critical for companies looking to extract value from data by automating and optimising processes or producing actionable insights. They enable companies to leverage their large amounts of available data to uncover insights and patterns that would be impossible for any one person to tease out, enabling them to deliver more targeted, personalised communications, predict critical care events, identify likely fraudulent transactions, and more.

Companies that fail to adopt AI and machine learning technologies are fated to be left behind:

- Global spending on AI will grow 50% compounded annually and will reach US$79.2 billion [1] by 2022.
- Industries like retail, marketing, healthcare, fintech, insurance, and more will all stand to benefit from AI and machine learning.
- Companies driven by insights from data will take US$1.2 trillion [2] a year from non-insight driven companies by 2020.
- 83 percent [3] of early adopters are already gaining value from AI and machine learning initiatives.

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[1] Refer to the end of the report for all the [numbered Endnotes]

It is often said that AI will replace humans; we believe this matter is not as trivial as it seems. AI might, on the contrary, create jobs; we must ensure that humans have their say, and, far more importantly, a genuine role to play.

A recent study by Gartner concluded that AI will create 2.3 million jobs [4] over the next two years, with a net increase of half a million jobs. Other studies have made similar conclusions. And contrary to what you may expect, these jobs won't just be for computer geeks. We will see more and more AI-enhanced human roles.

The critical reason that AI won't simply replace humans is the well-known economic principle of comparative advantage [5]. David Ricardo developed the classical theory of comparative advantage in 1817 to explain why countries engage in international trade even when one country's workers are more efficient at producing every single good than workers in other countries. It isn't the absolute cost or efficiency that determines which country supplies which goods or services. It is the relative strengths or advantages of producing each good or service within each country, and the opportunity cost of not specialising in what you are best at. The same principle applies to humans and computers.

Live With AI's wish to focus on AI & Work through different contributions written by researchers and academics, entrepreneurs, or whether corporate executives, is of significant importance. To overcome legitimate fears, that uncertainty over the future fuels daily, we must think about jobs and work evolution. By doing so, by understanding human strengths as well as AI weaknesses, we will allow a serene and enduring relationship with AI so that we can, personally as much as professionally, live better with AI.

Colin Priest – DATAROBOT

How to Envision the Future of Jobs?

In September 2018, the World Economic Forum released *The Future of Jobs Report 2018* [6]. The latest report has a focus on the potential for automation and algorithms to augment existing jobs, and the importance of human capital investment in maximising the benefits from this transition. You will find below three key points we have extracted.

AIs are rapidly becoming standard practice for tasks that are repetitive, procedural, data-driven, and large scale.

Businesses are harnessing new and emerging technologies, including machine learning and artificial intelligence, to improve efficiency, expand into new markets, and compete for a global consumer base composed increasingly of digital natives. By 2022, 73% [7] of companies will be utilising machine learning. The report lists many jobs that will decline over the coming years, including data entry clerks, business services and administration managers, accountants and auditors, telemarketers, cashiers, bookkeeping and payroll clerks, operations managers, and postal service clerks. The common features of these roles are that their tasks are repetitive, procedural, data-driven, and large scale. The report describes the need to augment human staff with technology, such that "they are freed of the need to perform routinised, repetitive tasks and better able to use their distinctively human talents." [8]

To increase job security, employees should develop their human strengths: communication, empathy and emotional intelligence, critical thinking, common sense, creativity, persuasion and negotiation, etc., as these will increase in demand and importance, particularly for customer-facing roles.

As one would expect during periods of rapid technological change, demand is high for staff with proficiency in new technologies, including technical skills – analytical thinking, technology design, programming, reasoning, and systems analysis – and key technical roles – data analysts and scientists, software and applications developers, and E-commerce and social media specialists. However, human skills such as creativity, originality and initiative, critical thinking, persuasion, and negotiation will also increase their value. Emotional intelligence, leadership, and social influence, as well as service orientation, see an increase in demand.

The report findings suggest the need for a comprehensive "augmentation strategy," in which businesses look to technology to enhance their staff's human strengths, empowering staff to extend to their full potential. Responses from the employers surveyed for the report provide evidence supporting the effectiveness of such an augmentation strategy.

Moreover, research shows that customers want to deal with human staff. When banks moved customers from using tellers in bank branches to using ATMs and internet banking, customer satisfaction levels reduced. The report expects growth in roles that leverage distinctively 'human' skills, such as customer service workers, sales and marketing professionals, training and development, people and culture, and organisational development specialists as well as innovation managers. By strengthening these inherently human skills, employees will be better positioned for the growth in job opportunities.

Businesses need to invest in structural changes to remain competitive, and that includes adopting AI and restructuring human roles to take advantage of human strengths.

To prevent an undesirable, lose-lose scenario — technological change accompanied by talent shortages, mass unemployment, and economic stagnation — it is critical that businesses take an active role to invest in structural changes. By 2022, 59% of employers surveyed [9] expect that they will have significantly modified how they produce and distribute by changing the composition of their value chain. We saw in Key Point 1 that businesses need to adopt machine learning and AI to remain competitive. But the required strategy includes supporting their existing workforces through reskilling and upskilling. Rather than narrowly focusing on automation-based labor cost savings, a strategy should consider the broader horizon of value-creating activities that can be accomplished by human workers, often in complement to technology.

By 2022, 38% of businesses surveyed [10] expect to extend their workforce to new productivity-enhancing roles, and more than a quarter expect automation to lead to the creation of new roles in their enterprise. The report predicts that 133 million new jobs [11] will be created, resulting in a net increase in employment.

The transition period to AI-powered jobs should take time to radically transform the way we work throughout the world. With this in mind, we must make this time valuable so that we meticulously understand which human skills can be better used in today's jobs as well as tomorrow's. Indeed, raising these key points about work and AI is necessary as we now must study the future of work through understanding which tasks a job requires. This task-by-task approach, rather than a job-by-job one, has been more popular over the last few years, as an increasing number of reports illustrate. Tasks give a better level of granularity of workers' activities, which help to give a better understanding of how their role can evolve and provide key insights for organisations to anticipate these changes. It will enable human and AI strengths to live together for the good of organisations.

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AI and Work: Equal to the Task

Can the future of work be better than the present? It can, but only if we are equal to the task. It is fast becoming the consensus that we need to study the future of work at the level of tasks. This is the converging conclusion of a rapidly increasing number of academics, think tanks, consultancies, companies, and governments worldwide. To understand how work is changing in the age of AI, tasks – and work activities (which are categories of tasks) – provide the right resolution.

Why tasks?

Tasks are the right resolution because jobs are disrupted task-by-task, and not job-by-job. This is the case for AI, because AI remains narrow. As Stanford University's Artificial Intelligence and Life in 2030 points out, "AI systems are specialised to accomplish particular tasks, and each application requires years of focused research and a careful, unique construction". It is also the case for globalisation. When companies outsourced and offshored work, they broke up their value chains into tasks. They then parcelled out these tasks worldwide. Parts of the jobs tied to these parcels of tasks followed.

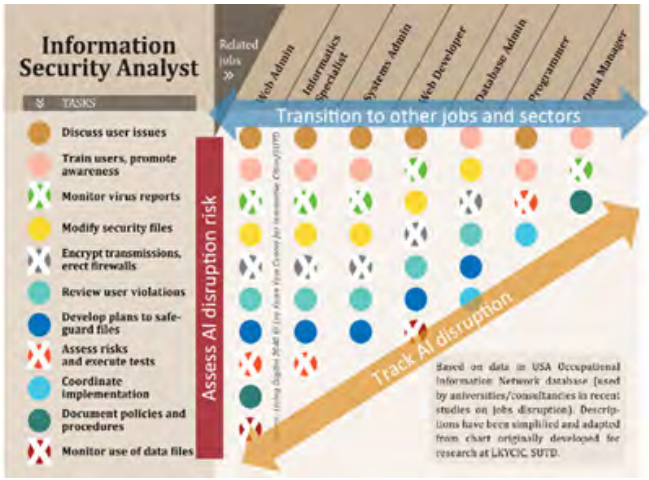
As MIT economist and professor David Autor points out, "a growing body of literature argues that the shifting allocation of tasks between capital and labour – and between domestic and foreign labour – has played a key role in reshaping the structure of labour demand in industrialised countries in recent decades."

A simple word count exercise illustrates this growing role of tasks. When the World Economic Forum (WEF) published its *Future of Jobs Report 2016*, the word counts for "skill" and "task" were 719 and 9 respectively. Two years later, in WEF's *Future of Jobs Report 2018*, they were 614 and 153 respectively. In just two years, "skill" saw a -15% change. "Task" had a 1600% change. The centre of gravity is swiftly shifting.

Making tasks work

In the Lee Kuan Yew Centre for Innovative Cities (LKYCIC) at the Singapore University of Technology and Design, we have been studying the future of work since 2014 [11a]. We have been developing our own task strategies and databases since then. We did so because we saw the power of tasks to empower everyone who wanted to create a better tomorrow. The diagram below and the accompanying explanations illustrate how. These were first published in our book *Living Digital 2040: Future of Work, Education, and Healthcare*, and refined through our work with industry partners.

Take the job of a Cyber or Information Security Analyst. Their job can be broken down into the tasks that they do. For example, they have to discuss user issues, assess risks and execute tests, and document policies and procedures. Recall that AI disrupts jobs task-by-task and not job-by-job. We can thus look at which tasks are being disrupted (i.e. the white Xs on the left of diagram). We can also look at when they are being disrupted. Combining both, we can assess the speed and scale of disruption on this job. Our task analysis has thus determined the risk profile of a job (i.e. the red rectangle in the diagram).



We can do more: our task analysis can also help workers see what other jobs they can transition to. The Cyber Security Analyst's job often shares similar tasks with other jobs. For example, if the former has to discuss user issues, so do the Web Developer, Database Administrator, and Data Manager. The expertise and experience are more likely to be transferable. Hence, by matching jobs by shared similar tasks, we can identify new jobs that a worker can more easily transition to from their current job (i.e. the blue arrow in the diagram). Our task analysis has thus created – even expanded – options for workers.

Furthermore, we can scale up this analysis to cover entire companies, industries, and sectors. When we do so, we develop two additional insights: the first is a risk profile of all the occupations in that company, industry or sector (i.e. the white Xs on the right of the diagram); the second is a series of transition options between all these different occupations (i.e. the orange arrow).

Empowering everyone

These task analysis techniques form the nucleus of the LKYCIC's task strategies and databases. We are using them to help workers, human resource practitioners, union leaders, technologists, company strategists, and policy makers.

Their power lies in how they empower each of us:

- Workers can use them to expand job options at every step of their careers.
- Human resource practitioners can use them to prioritise the jobs and workers most at risk and recombine tasks to redesign jobs that are more meaningful.
- Union leaders can use them to chart clear pathways for their workers, and work with companies to transition workers along those pathways.
- Technologists can use them to invest in AI that augments the value of the tasks that workers do, thus making workers more resilient to disruption.
- Company strategists can use them to track the speed and scale of AI disruption. This forms a common view across the entire company, which can be used to align transformation efforts between employees and management.
- And policy makers can use them to make targeted policies according to the risk profiles of industries and sectors. These can then be mapped to national efforts in worker training, skills development, and lifelong learning.

Recent studies predict that AI can severely disrupt and displace workers and jobs. The destructive effects could cascade across the entire economy. They could even tear societies apart, as recent political events around the world have shown. We must disrupt this disruption. It will not be easy. It might even be an uphill task. But we must.

Task strategies and databases can help. They can empower each and every one of us who wants to create a brighter future for our workers to better live with AI. They give us clear ways to make sure AI works for workers, and not against them. They also give us a way to align our individual efforts and to work together. Just imagine if we could do all this and more. We will find that we are more than equal to the task.

King Wang Poon – Lee Kuan Yew Centre for Innovative Cities
Singapore University of Technology and Design

Applied research and point of the view on the workforce disruption with Artificial Intelligence (Banking, insurance, advertising, advanced manufacturing)

We all believe in the importance of considering real scenarios and use cases to adjust our points of view, enrich our vision and ensure that our recommendations will be applicable. This is why the Live With AI community decided to conduct specific applied research on the impact AI would have on eight jobs from four different industries (Banking, Insurance, Advertising, Advanced Manufacturing). Conducted by a team of a dozen experts from different backgrounds (industry, academics, start-up), this applied research aimed first to achieve alignment on these jobs' disruption. This helped Live With AI to define some ideal paths to follow when pursuing an AI enterprise transformation, and debate the critical tasks and skills which we believe would need to be protected and remain in human hands. This exercise, covered over four months in 2019 and the outcome of collective discussions with our experts, should be considered as a prototype that can inform further industry and academic research. The research has combined qualitative – especially human interviews (interviews with employees, and experts) – with quantitative analytics, and the results should be considered as illustrative with potential generalizable applications. In summary, the following research comprises a point of view and reference which we believe will help decision makers pursue human-centric leadership that leverages our fantastic human strengths to work better with AI.

How did we start?

The Lee Kuan Yew Centre for Innovative Cities (LKYCIC) is currently building a task database for Singapore and developing task strategies based on this database. Their work has been funded by several organizations, including the Singapore government (including research grants from the National Research Foundation and the Social Science Research Council), the Ong Teng Cheong Labour Leadership Institute, and a government-linked company. This database will help the Singapore government, private sector companies, unions, and individual workers to be better prepared to track and tackle disruption, because there is now **converging consensus that jobs are disrupted task-by-task** [12], and not job-by-job (or skill-by-skill). The LKYCIC database adapts and builds on the experiences and data found in the USA database O*NET [13]. Following a first year of collaboration, LWAI partnered with the LKYCIC to understand how the latter's task database and strategies can be applied to assess how eight specific jobs might be impacted with Artificial Intelligence.

How did we proceed?

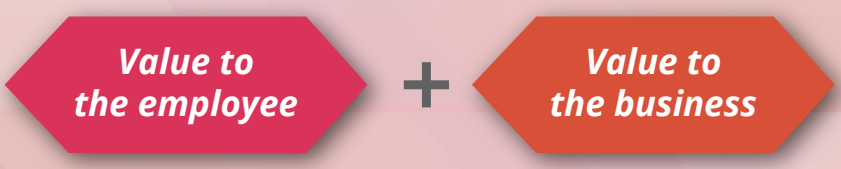
1-ANALYSE TASKS IN EACH JOB

We started by analysing tasks in specific jobs from four industries to create a consistent task mapping for each job. The LKYCIC team then proceeded to verify

this by conducting interviews with workers and management staff. The finalized list of tasks, together with how the interviewees viewed these tasks, formed the starting point for our AI disruption assessment.

2-INVESTIGATE TASK VALUES

Through interviews, we analysed the value each task would have to the business and to each employee, identifying the most valuable tasks. Employees described the tasks that they find valuable, from challenging tasks that draw heavily on their professional expertise, to tasks that are particularly satisfying to complete, to ones that were valued for their personal or human nature. It became clear that it may also be necessary to investigate the potential value each task may bring to society (however, we naturally came to the conclusion we would not find any consistency across the eight jobs we investigated and decided to not account for this criteria at this stage).



3-CAN A TASK BE DISRUPTED BY AI AND WHEN THE TASK MIGHT BE DISRUPTED?

We proceeded to an expert assessment of each task disruption, considering how AI-related technology could impact each task and when it may start. Live With AI partnered with the US start-up DATAROBOT on the technology assessment. Their automated machine learning platform empowers users to quickly and easily build highly accurate predictive models with full transparency. In 2017, DATAROBOT set up a research center in Singapore with a S$15 million investment.

The related technologies we refer to were: Machine Learning (and related ML techniques), Natural Language Processing, Robotics Process Automation.

During the assessment, we examined whether each task can be partially or fully automated, using increments of 0%, 25%, 50%, 75%, and 100%.

Considering there is not any global consensus on AI and related technological readiness and any consistency of such readiness across industries, we have defined a time horizon when we can expect the technology to be ready (when pioneers will start) that would also be consistent with typical time horizons used by industry and government: Now / 1-2Y / 3-5Y / 5-10Y / 10-20Y / Beyond or not foreseeable.

NB: In our assessment DATAROBOT underlined that a task can't be 100% automated per se: the algorithm gives a recommendation and there is always a need for a human to sign off.

4-SHOULD IT BE DISRUPTED?
We debated which critical tasks should be entirely preserved in human hands, those which might be augmented, and those which can and should be automated. This assessment was primarily done through working sessions with different experts, and through interviews with senior managers from each company that supported our research.

>We have discerned three scenarios:
-Task which should remain in human hands
-Task which should be "Augmented"
-Task which should be handled by AI

5-BUILD AN AI TASK EVOLUTION MAPPING
Based on our learnings, our analysis of each task evolution, as well as our point of view on the reason some tasks should not be disrupted, we built a specific Live With AI chart map for each job, envisioning the job's evolution and following our thoughts and recommendations (See LWAI mapping)

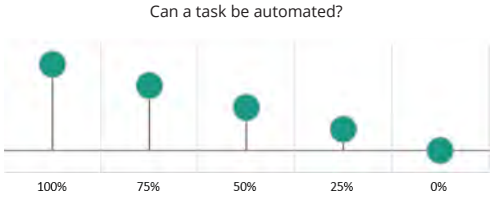
6-WHAT ARE THE IMPLICATIONS?
We debated how such disruption would impact jobs, and what the emerging tasks might be, as well as the more augmented tasks employee would face in the future. This has contributed to the building of future jobs scenarios to help employees, managers and leaders positively envision this new chapter.

A step by step investigation...helping to highlight what is possible on paper and the reality

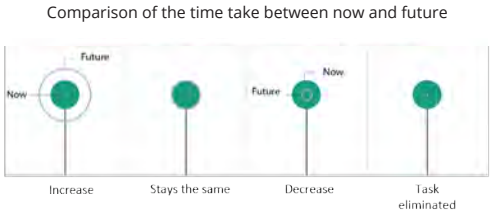
Can a task be disrupted from a tech stand point?	***When can the task be disrupted?***	***Should it be disrupted?***	***How does the role change?***
Understand how the task is operated to identify which technology could do the same	Compare when such a task can be automated or impacted by AI from a very simple technology stand point (TLR) and a more realistic business and industry stand point	In case the task can be disrupted by AI related technologies but should not for business (e.g. customer service), society, ethical reasons, we need to address the point	Identify key emerging potential tasks and envision new emerging tasks needed in the future when technology will be in place, especially in case a task should not be disrupted (previous step)

How to read our graph?

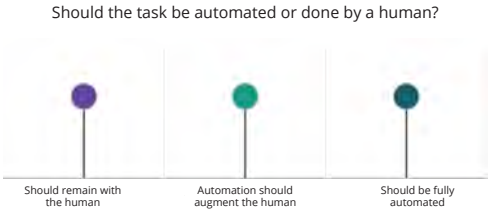
The position on the horizontal axis reflects when the first use case in the industry will be implemented, from 'now' (pioneers in this industry are already starting), to implementation in 10-20 years in the future, and beyond.



The height reflects a technological assessment of the percentage of the task that can be impacted by AI, from 100% to 0%.



The filled circle represents the task as it exists now and the ring depicts the task in the future; comparing them shows whether the time taken to do the task will increase, stay the same, decrease, or the task will be eliminated.



The color represents whether the task should remain with the human, should be fully automated, or if automation should augment the human.

SENIOR SPECIALIST, MOTOR (PROPERTY) CLAIMS (INSURANCE)

The Senior Specialist, Motor (Property) Claims advises policyholders, claimants and intermediaries on claims related matters and makes sure that claims are settled correctly and promptly. The role is critical in ensuring claims are registered within the Claim Service Standard and assessed correctly in accordance to policy coverage and within Authority Limits given. This role will also need to investigate claim issues when required.

This task can be 100% automated in the next 1-2 years as most claims can be reviewed through robotic process automation. Since the worker will only have to review the most complicated cases, the time required to complete this task will decline by 50%.

Should a task be automated?

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SHOULD BE AUTOMATED

Entering claims and related information into the computer system (the Claim Service Standard).

This task can be fully replaced, and the technology is ready, using Robotics Process Automation. This would cut down the data entry part of this role, an unpopular task with employees. Such transformation would depend on capacity of the company to invest in the right process and IT infrastructure.

SHOULD AUGMENT HUMANS

Refer questionable claims to investigator or claims adjuster for investigation or settlement.

New systems should be able to identify the simple cases and escalate them to the dedicated teams. For the ones that require more attention, the employee will need to communicate with the different teams involved in the process of settling the claims, and investigate on their own when needed, leveraging both machine recommendations and human collaborative decisions.

SHOULD REMAIN IN HUMAN HANDS

PERFECT MATCH

Investigate, evaluate, and settle claims, applying technical knowledge and human relations skills to effect fair and prompt disposal of cases and to contribute to a reduced loss ratio.

Every accident is different. It is important to preserve individual critical thinking and experience to handle exceptions. For instance, the fraud system only detects what sounds "suspicious"; the human must still deep dive into the details in order to decide who's at fault. This is an important part of this task, very well appreciated by employees who will still perceive they are handling claims investigation even when empowered by the machine.

WHAT IS VALUABLE FOR THE EMPLOYEE

Investigate, evaluate, and settle claims, applying technical knowledge and human relations skills to effect fair and prompt disposal of cases and to contribute to a reduced loss ratio.

"I especially especially like the investigative part where I feel like a detective. It is rewarding to be able to find and understand the root cause and see where it all fits."

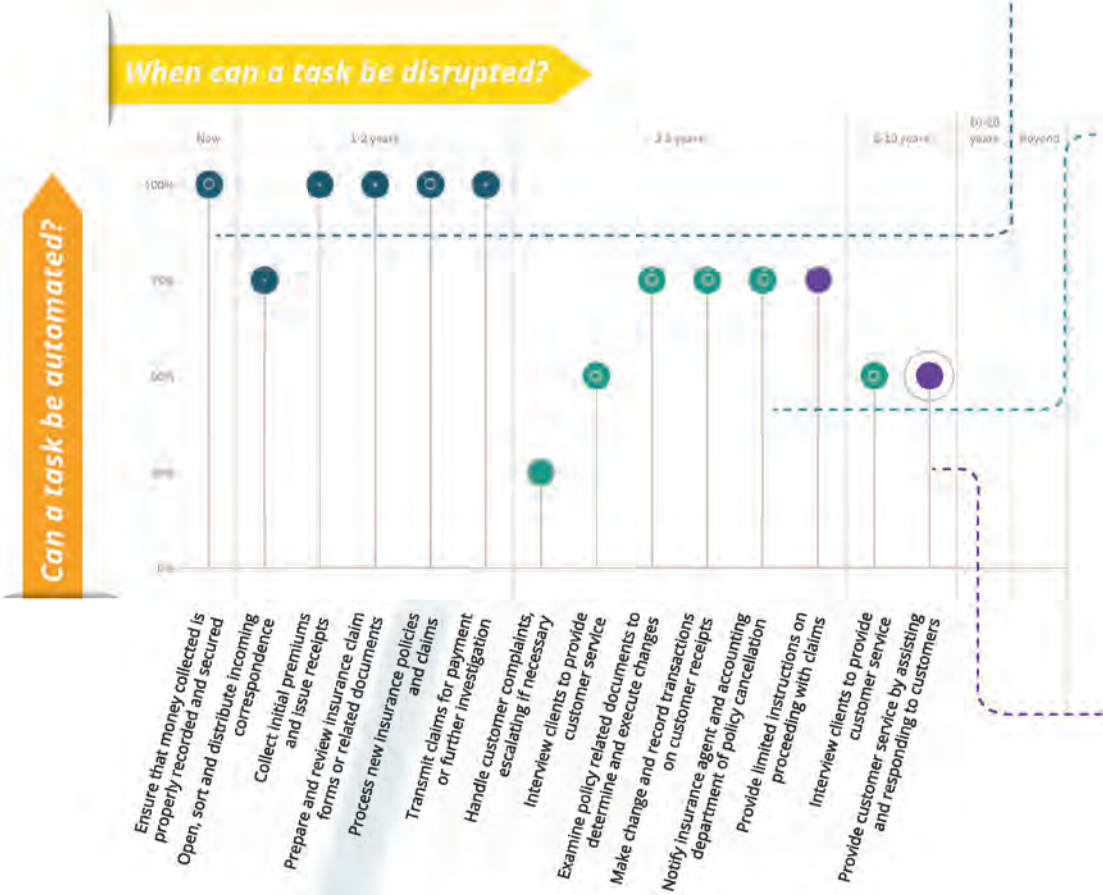
How does the role change?

- AI-related technologies can help identify suspicious claims. Machines have detected an increasing number of frauds over the past few years, due to their increasing accuracy (and an increase in fraud over all). For such reasons, insurance companies need to equip their teams with these advanced tools.

- Employees will work in an "augmented world" empowered with machine learning and automated processes. They will have to leverage their problem solving skills in order to analyse the machine's recommendations make the right decisions.

SPECIALIST (CUSTOMER SERVICE) (INSURANCE)

The Customer Service Centre Specialist provides dedicated one-stop customer service for all customers, including intermediaries and advisers. The role is responsible for responding to customer enquiries, policy servicing, handling customer complaints and ensuring all tasks are completed within the agreed service turnaround time and processed accurately.



This task can be 100% automated in the next 1-2 years as generating cover notes and policies for new business, renewals, and extensions can be done through robotic process automation. The time required to complete this task will decline by 50%.

Should a task be automated?

SHOULD BE AUTOMATED

Ensure that the money collected is properly recorded and secured, especially when the cashier may be down.

This task can be fully automated and there are a lot of payments options online. It could save time for the employees, and it doesn't bring much value to them. But some customers still want to have a face to face interaction, which need to be conserved for customer relationship reasons. Thus while this task should be fully automated, it will likely still consume some time.

SHOULD AUGMENT HUMANS

Notify insurance agent and accounting department of policy cancellation.

Sending the cases could be automated and done online – it depends on customer preference as well. This would help to have fewer cases to come in, leaving employees to focus more on the complex cases that use their problem-solving skills and leverage on their experience.

SHOULD REMAIN IN HUMAN HANDS

Provide customer service by greeting and assisting customers and responding to customer inquiries and complaints

Tasks that involve customer experience should be preserved, emphasising the empathy required. By doing so, customer relationships should move from very transactional to more emotional experiences. Employees would need to adapt their sales and customer relationship process and mindset. This would allow them to focus more on what they value the most: provide relevant customer service.

PERFECT MATCH

WHAT IS VALUABLE FOR THE EMPLOYEE

Provide customer service by greeting and assisting customers and responding to customer inquiries and complaints

"This is not about being motivated by a particular task, but more an overall focus on completing the job well and ensuring that the customer is satisfied."

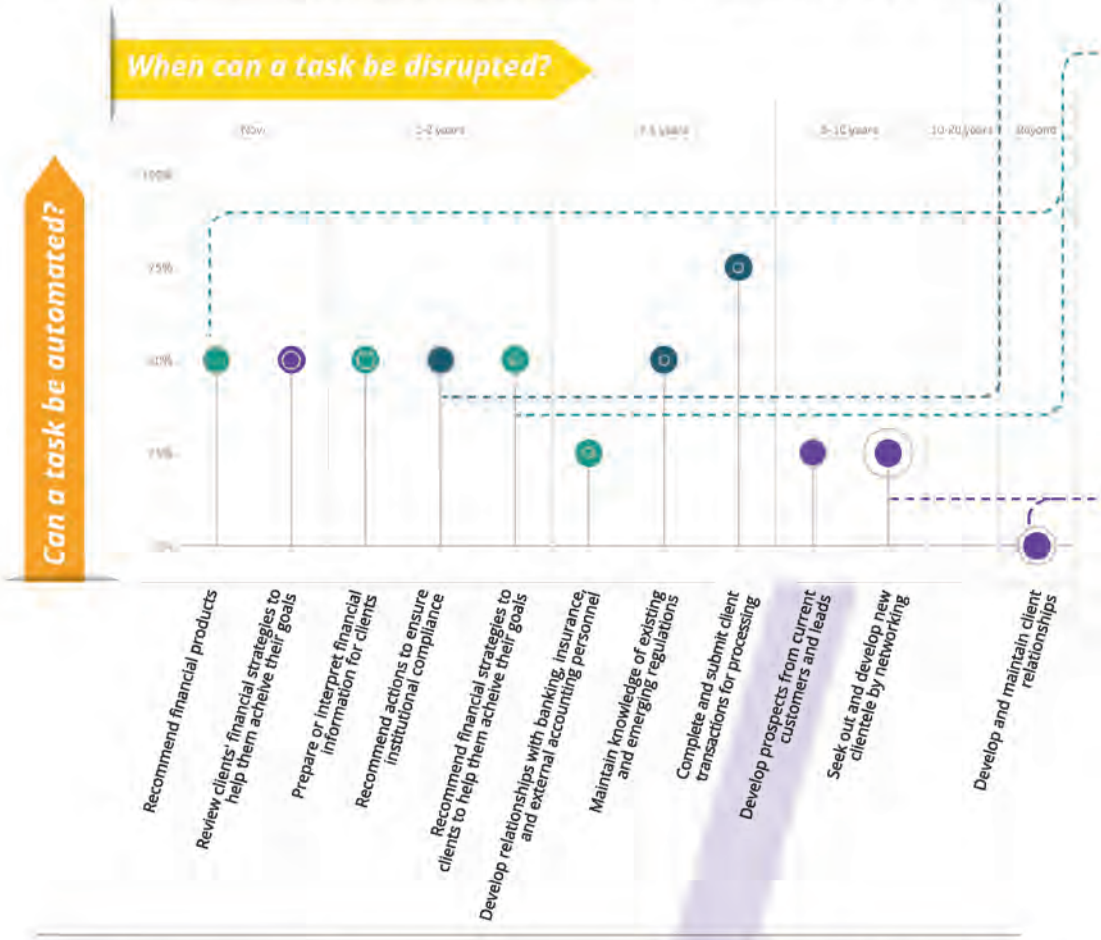
How does the role change?

- Employees would need to be trained on specific new customer relationship tools in order to oversee all customer relationships as they are delivered partially by the machine. This would require switching between the different channels and tools used by different type of customers.

- Rapid automation of the data entry tasks should be planned for in order to transfer the time spent on those tasks to the more customer-facing ones.

RELATIONSHIP MANAGER (BANKING)

The Relationship Manager (RM) is the key interface between the bank and it's high net worth clients and prospective clients. The Relationship Manager should endeavour to become the 'trusted advisor' of the client or prospect, understanding their diverse needs and aspirations across their personal, family and business lives. Due to the trusted relationship between the RM and their clients, the RM is able to 'curate' the offerings of the bank to the client, ensuring that the right global products and services are offered to the clients at the right time, and that the client is able to access expertise and relationships from across our global organization to realise their goals.



This task could be 25% automated in the next 5-10 years as machine learning can process objectives and strategy for prospects. However, given the sophistication of many clients, this task should remain in human hands and will continue to take the same amount of the Relationship Manager's time.

Should a task be automated?

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SHOULD BE AUTOMATED

Recommend actions to ensure compliance with laws and regulations, or to protect the solvency of institutions.

Many generic compliance and disclosure obligations can be automated for the Relationship Manager, both to increase efficiency and to reduce the risk for the Relationship Manager and the bank for compliance breaches. There will be, in the short term at least, a need for human oversight of the compliance and disclosure automation as many clients have complex needs and investment portfolios that require human insight to ensure the correct disclosures and approvals are provided. The employee interviewed remarked this was a low value task where they were spending lots of time.

SHOULD AUGMENT HUMANS

Recommend financial products.

Recommend to clients strategies in areas to help them achieve their financial goals and requirements.

The Relationship Manager is the primary interface between the bank and it's clients. AI will help to ensure that Relationship Managers are alerted to key events impacting their clients and strategies and ideas for responding to these events. Many clients have complex wealth management needs that need to balance multiple objectives and influences and the Relationship Manager will have a primary role in assessing whether the ideas and insights provided by the technology are a good fit for the client's overall needs and objectives.

SHOULD REMAIN IN HUMAN HANDS

PERFECT MATCH

Seek out new clients and develop clientele by networking and development of prospective clients.

Build trust and deepen client relationships through understanding of clients' broader wealth management needs and curation of the Bank's offerings to address them.

The main component is to develop and maintain client relationships, ie. forming personal trust. Networking is about humans connection, web scraping can very partially help them to identify new leads. The employee also prefers to leverage on their network and get referrals. Developing client trust, helping clients to meet their investment objectives and helping clients navigate an increasingly complex financial environment requires strong, trusting client relationships. This is the core of the Relationship Managers role and cannot be automated.

WHAT IS VALUABLE FOR THE EMPLOYEE

Seek out new clients and develop clientele by networking to find new customers and generate lists of prospective clients

Develop and maintain client relationships

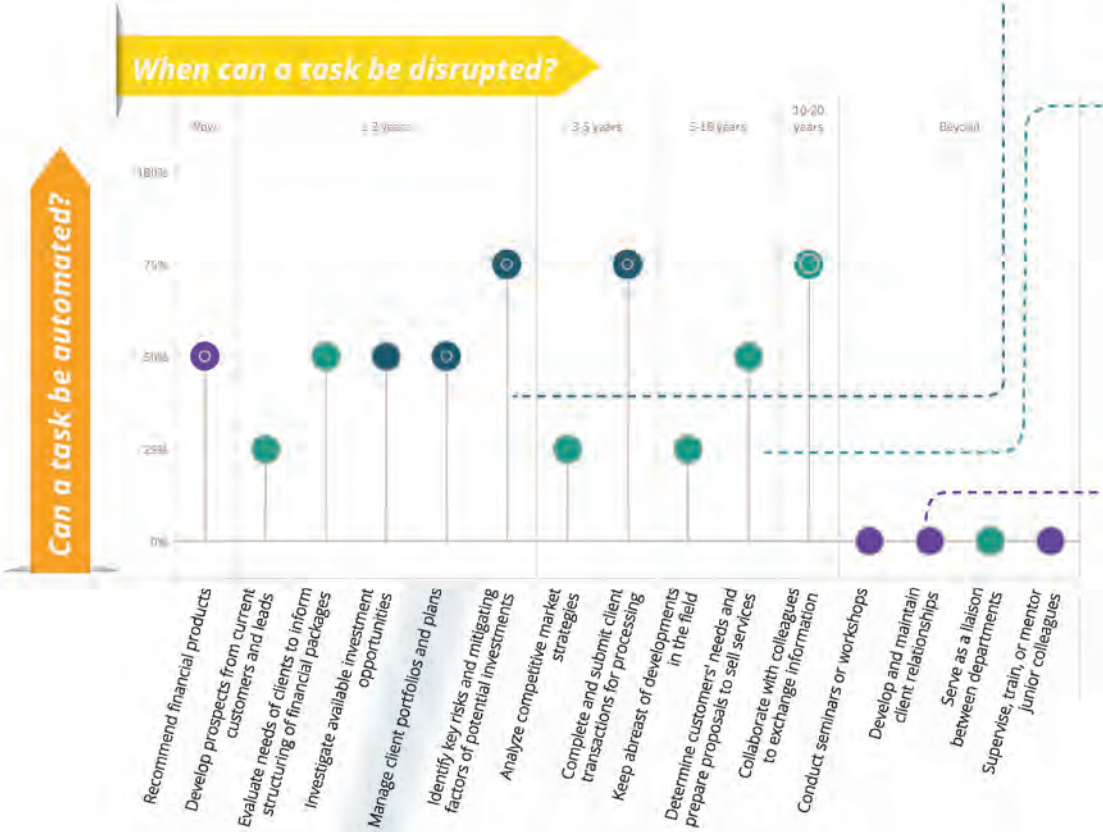
"The most human part of this job is communicating with the client, spending time on building trust and building the relationship"

How does the role change?

The core role of the Relationship Manager is to represent the bank to the client and to build a deep and trusting relationship with the client. This role is intrinsically 'human to human' and will remain so. AI will allow Relationship Managers to focus more of their attention on this critical element of their role as it will help to automate some of the more process related elements of the role such as risk, control and compliance obligations. AI will also help the Relationship Manager to proactively reach out to clients in order to manage emerging risks or take opportunities that are a good fit for the client's needs and objectives.

INVESTMENT CONSULTING (BANKING)

The Investment Consultant (IC) supports relationship managers and their clients with expert advice on investment strategy and management of their investment portfolio. The IC partners with the Relationship Manager to ensure that clients have access to the best research, analysis and product ideas to meet their investment objectives.



This task can be 50% automated in the next 1-2 years as machines can check whether portfolios are outside of a defined tolerance. Though this ideally would be fully automated, in some cases the Investment Consultant will need to follow up in order to rebalance the portfolio, meaning that time taken to complete this task decline by half.

Should a task be automated?

SHOULD BE AUTOMATED

Identify key risks and mitigating factors of potential investments, such as asset types and values, legal and ownership structures, professional reputations, customer bases, or industry segments.

Identifying transaction and portfolio related risks is already feasible for simple products and portfolios. Alerts can be shared via e-mail and e-channels when acceptable to client. The Investment Consultant is therefore able to play a monitoring or exception management role, and to ensure complex transactions and portfolio impacts are fully understood. Investment Consultants can spend more time understanding a client's more nuanced needs and offering the most suitable products to satisfy these needs.

SHOULD AUGMENT HUMANS

Determine customers' financial services needs and prepare proposals to sell services that address these needs.

While AI will be able to provide smarter recommendations to clients in straightforward or highly structured portfolio contexts, in many cases a human will be involved in ensuring that offerings to clients that are more complex or in a less structured portfolio context are suitable/appropriate for the client. Investment Consultant will refine offerings that are proposed by the AI and drive the client communications..

SHOULD REMAIN IN HUMAN HANDS

PERFECT MATCH

Develop and maintain client relationships. (Deepen understanding of client's needs to propose best wealth management solution)

The networking and human intelligence required to understand a client's more complex needs and associated Wealth Management offerings will not be automated in the near future. Some simple recommendations can be automated, and suggestions can be provided to Investment Consultants on how to align a client's portfolio to their investor context, but ultimately it will still require significant human insight.

WHAT IS VALUABLE FOR THE EMPLOYEE

Develop and maintain client relationships. (Deepen understanding of client's needs to propose best wealth management solution)

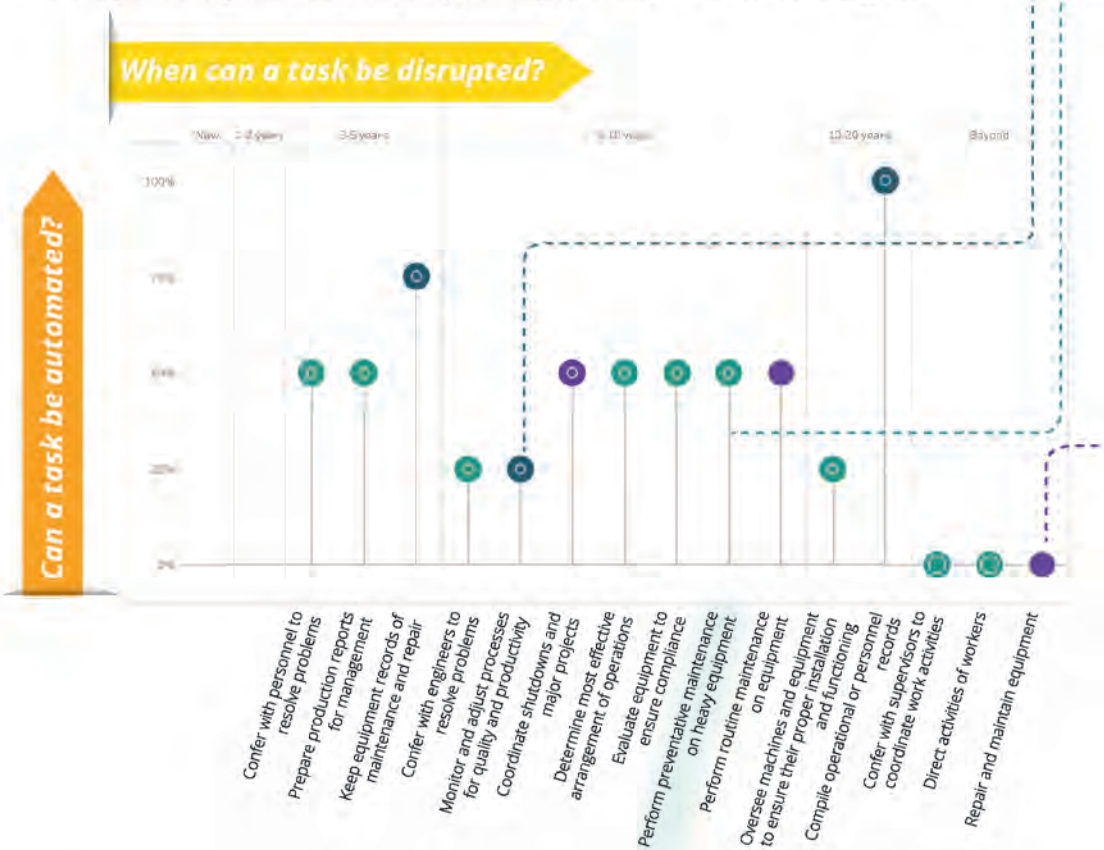
"Developing and maintaining client relationships by remaining regularly in touch with them, to build and sustain trust is the most engaging part of this job."

How does the role change?

The Investment Consultant's role is to ensure that the client's investment portfolio is managed on the basis of their needs, risk appetite and preferences. AI will augment the role of the Investment Consultant significantly, both in identifying investment products and ideas that can be vetted by the Investment Consultant and shared with the client, and by creating insight and analyses that can be shared with clients. AI will also enable much faster and more proactive monitoring of a client's investment portfolio and alerting of emerging risks and/or opportunities that should be discussed with the client. The execution and many of the compliance obligations of the Investment Consultant will be partly or completely automated via AI, but there will still be a need for human input to ensure that the more nuanced and complex needs of the client are catered for in the management of the client's wealth and that there is full engagement of the client in understanding their objectives, needs and aspirations.

MAINTENANCE TECHNICIAN
(ADVANCED MANUFACTURING)

The maintenance technician serves as the frontline to maximize the performance of operation facilities in compliance with health, safety and environment policies and regulations. This role monitors and manages machinery condition in the field, trouble-shoots problems and performs repairs in collaboration with other functional teams and subject matter experts. This worker needs to execute necessary inspection as well as preventive/predictive/risk-based maintenance actions. As their domain knowledge and experience grows over time, they can be promoted to maintenance engineer.



Prescriptive analytics began with condition-based triggers to create a proactive maintenance program, vs calendar-based preventative maintenance. Applied with AI, prescriptive bridges the gap between anomaly detection and the actions needed for resolution – enhancing workforce productivity and improving safety, reliability, quality and security and potentially saving millions of dollars through early catches. This task could be 50% automated in the next 5-10 years, decreasing the time spent on this in the future.

Should a task be automated?

LIVE W/ AI

LEE KUAN YEW CENTRE FOR INNOVATIVE CITIES

SUTD SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

DataRobot

SHOULD BE AUTOMATED

Monitor and adjust production processes or equipment for quality and productivity.

The work process for daily monitoring and adjustment can be tedious and cause fatigue for the technician. The monitoring, reporting and standard operation adjustment should be automated to relieve the human resource for more creative and effective tasks.

SHOULD AUGMENT HUMANS

Receive predictive, prescriptive, and prognostic guidance in order to perform accelerated preventive maintenance on heavy equipment.

Thanks to Machine Learning and process mining, early warning insights can be delivered to the employees – they can leverage the rich database of maintenance and receive predictive, prescriptive, and prognostic guidance in order to perform accelerated preventive maintenance on heavy equipment. Employees then become part of the business development process, leveraging recommendations from specific software and sensors.

SHOULD REMAIN IN HUMAN HANDS

PERFECT MATCH

Repair and maintain equipment, making emergency adjustments or assisting with major repairs as necessary

This refers to the field work that carried out physically by technician. Although there could be enhancement from augmented robotic arms or other advanced machinery tools, this work includes case-by-case investigation and all the actions taken are specific. For example, underwater remote operation machines can help to inspect the offshore platform scaffolds, but we still need human to be the pilot remotely.

WHAT IS VALUABLE FOR THE EMPLOYEE

Repair and maintain equipment, making emergency adjustments or assisting with major repairs as necessary

"This task was one that motivated me, because it involves solving a problem, gives a sense of accomplishment."

How does the role change?

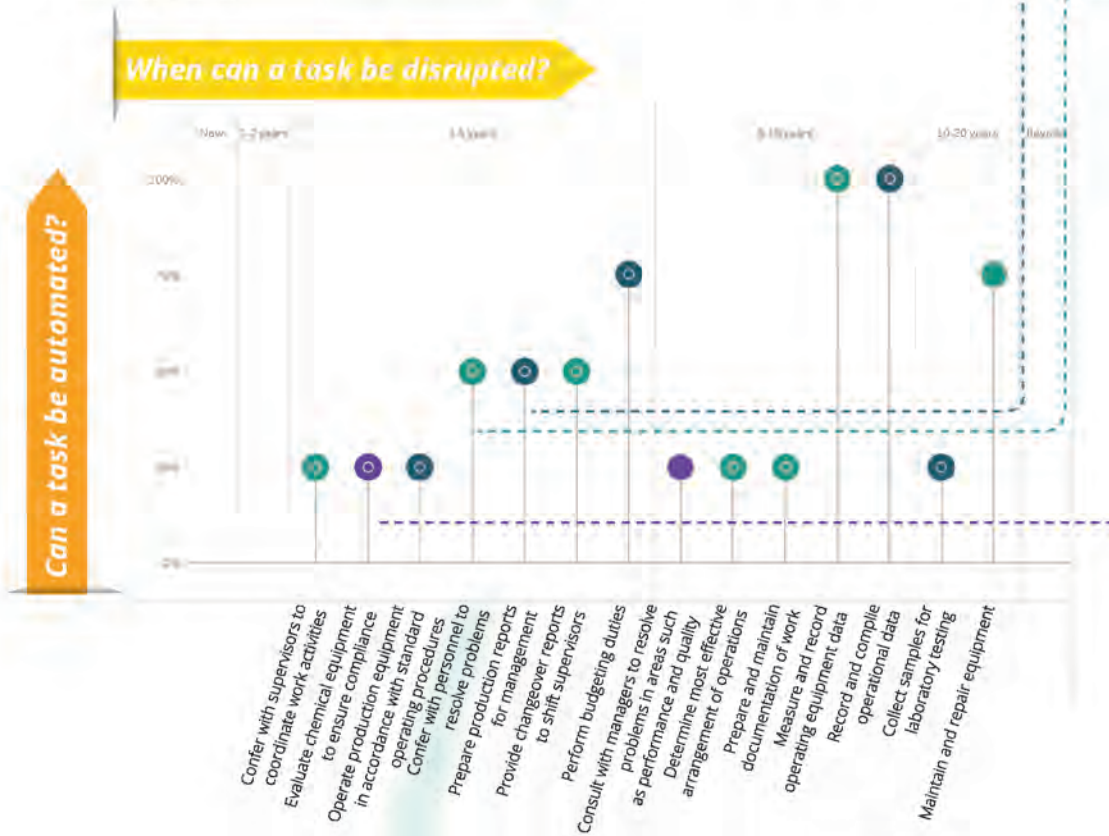
- It was highlighted that safety related tasks MUST be automated, for the employee security but also because of the potential impact an incident may have on the a society. A factory explosion due to a lack of regular controls for instance can be avoided. This type of incident can contaminate the water provision of cities for instance.

- A maintenance technician should get prepared for a deeper involvement with virtual augmentation, for example, dealing with early warning of equipment's integrity from its digital twin, or reviewing prescriptive suggestion of potential areas for inspection from virtual assistant powered by AI

- Automation of monitoring and reporting process is a win-win for management level and frontline operations. The management will obtain most updated report in timely manner, the frontline workers will be relieved from the repetitive work with low satisfaction. The data archived can also be transformed as source for further AI development on machine maintenance.

OPERATION TECHNICIAN
(ADVANCED MANUFACTURING)

The operation technician serves as the frontline for production, reaching quality targets in compliance with health, safety and environmental policies and regulations. The role monitors the process status, troubleshoots production fluctuations and minimizes disturbance. Due to the continuous nature of operations, this person works in shifts and ensures the smooth transition between shifts. There is also collaboration between operations and maintenance workers to minimize the disturbance to operations while maintenance work is carried out in the field. As knowledge and experience grows over time, the operation technician can be promoted to process engineer.



The production data consumed by digital twin is perfect source for subsequent troubleshooting & optimization. Digital twin running in the cloud environment also enables shared single truth of operation across multiple teams in a virtual or physical unified operation center. This task can be 50% automated in the next 3-5 years.

Should a task be automated?

SHOULD BE AUTOMATED

Prepare estimates of production costs and production progress reports for management.

All monitoring activities should be automated, if the data is in a digital format to easily collected and analysed. Operation cost is an important economic attribute of a process digital twin. The real-time online optimization feature of digital twin normally builds a reconciled case as the baseline for optimization . It is a natural extension for the information to be capture in standard reporting template and shared among stakeholders.

SHOULD AUGMENT HUMANS

Confer with technical and supervisory personnel upon identification of conditions affecting safety, efficiency, or product quality.

A virtual assistant powered by AI (machine learning) might be able to support the initial troubleshooting in a timely manner as requested by the operation technician as well as oversee control actions for early warning of potential mistakes. However, the subject matter expert or supervisory personnel might have more knowledge about the field and should be able to make the right decisions and adjust the machine outcome. Human input would still be required on site to understand if machine decisions are valid and what type of final report should finally be needed.

SHOULD REMAIN IN HUMAN HANDS

PERFECT MATCH

Evaluate chemical equipment and processes to identify ways to ensure compliance with safety and environmental regulations.

Safety compliance is top priority in the operation world and the employee also needs to share the consensus to be able to work happily in the plant. Thus, though all of this occupation's tasks are affected by automation, control over this task should reside primarily in human hands. The operation plant should ensure that augmenting devices, such as intelligent helmet with mixed-reality (MR) capability, will enhance the operation technician's safety to secure the frontline buy-in of the new technology.

WHAT IS VALUABLE FOR THE EMPLOYEE

Evaluate chemical equipment and processes to identify ways to ensure compliance with safety and environmental regulations

Due to the nature of operations, the operation technician works around the clock to ensure safe operation 24x7. Safety compliance becomes the top priority for these workers.

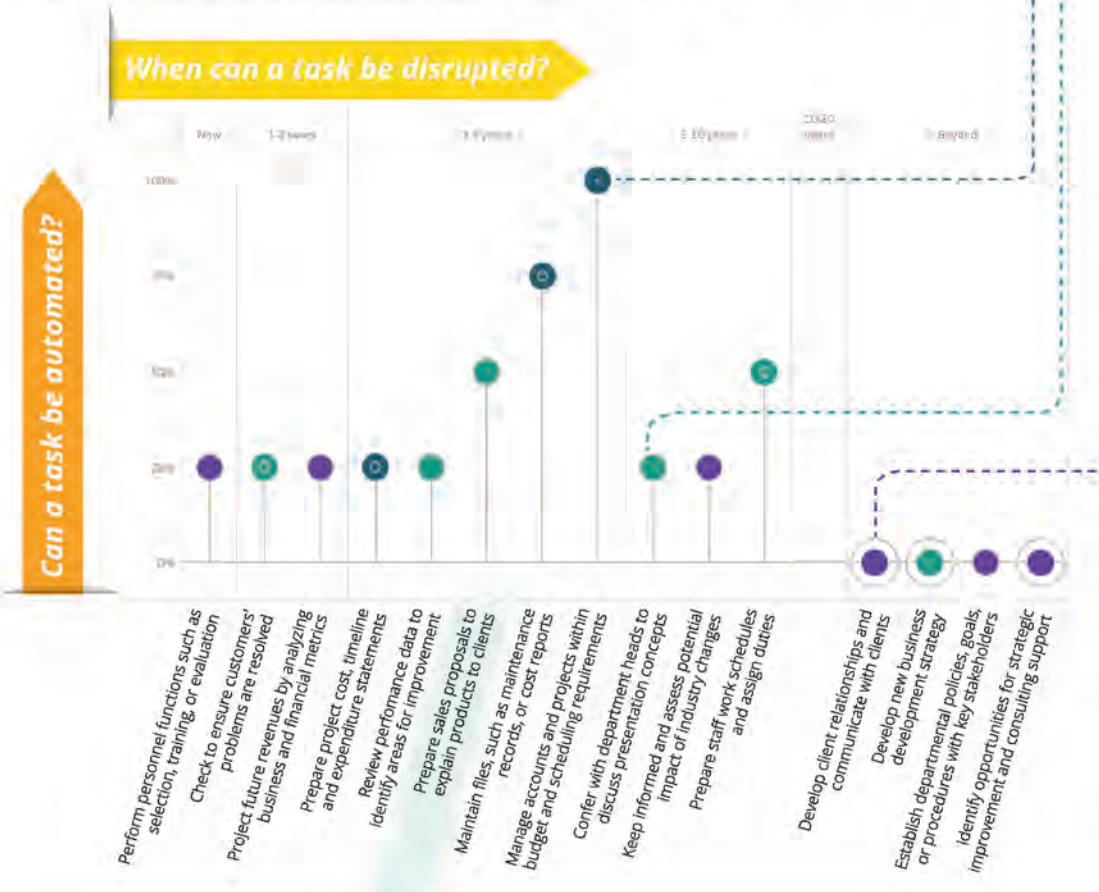
How does the role change?

- Modern operations work is not a stranger to automation. However, the advancement of AI technology will change the working style of operation technician further. The role will be evolved to focus more on the problem resolution, gap identification and implementation with prescriptive advice from the AI assistant.

- Operation end-to-end transparency increases with the implementation of process digital twin – the operation team and the management team will share the same picture and act on the issues in close-to-real-time manner in a physical or virtual unified operation hub.

ACCOUNT DIRECTOR *(CREATIVE AGENCY) (ADVERTISING)*

The Account Director serves as the key point of contact for strategic marketing communications initiatives for a group of clients. This position includes responsibility to direct and lead several client businesses developing and executing plans with consulting, creative and operational partners using all appropriate channels. These definitely include interactive, and direct marketing but regularly extend into advertising, loyalty and other aspects of the marketing mix. This position has revenue generating and financial tracking responsibility of the assigned client base. The person manages an account team and collaborates with many other group resources on behalf of clients, developing best practice knowledge over time.



Artificial Intelligence will support the account manager in presentation generation, by gathering content and critical elements. At least 50% of such a task might be automated over the next 3 to 5 years based on the agency's investment, though account director will spend the same amount of time on such work.

Should a task be automated?

LIVE W/ AI

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DataRobot

SHOULD BE AUTOMATED

Manage own accounts and projects, working within budget and scheduling requirements to ensure quality..

All project and budget management task might be automated in a near future. AI would be able to generate dashboard and reports based on management expectation.

SHOULD AUGMENT HUMANS

Confer with creative, art, copywriting, or production department heads to discuss client requirements and presentation concepts and to coordinate creative activities (mostly related to leading the creation and development of creative briefs)

There might be a time where creative briefs could be partially automated - but do we want this? Would it make more sense for agencies to maintain some expertise in creating briefs instead? At some point in the future, digital giants (e.g. GAFAM, BATX etc.) may serve the account managers with more insights and suggested ideas, however humans would still need to consider how to reframe the briefs as well as how to drive their creative teams and software

PERFECT MATCH

SHOULD REMAIN IN HUMAN HANDS

Develop client relationships and communicate with clients to explain proposals, present research findings, establish specifications, or discuss project status.

Human relationship would need to be maintained and left in human hands. These tasks requires thinking, expertise, and experience, and human interaction will create the difference between compagnies and auto-generated creative services provided by tech companies.

WHAT IS VALUABLE FOR THE EMPLOYEE

Develop client relationships and communicate with clients to explain proposals, present research findings, establish specifications, or discuss project status.

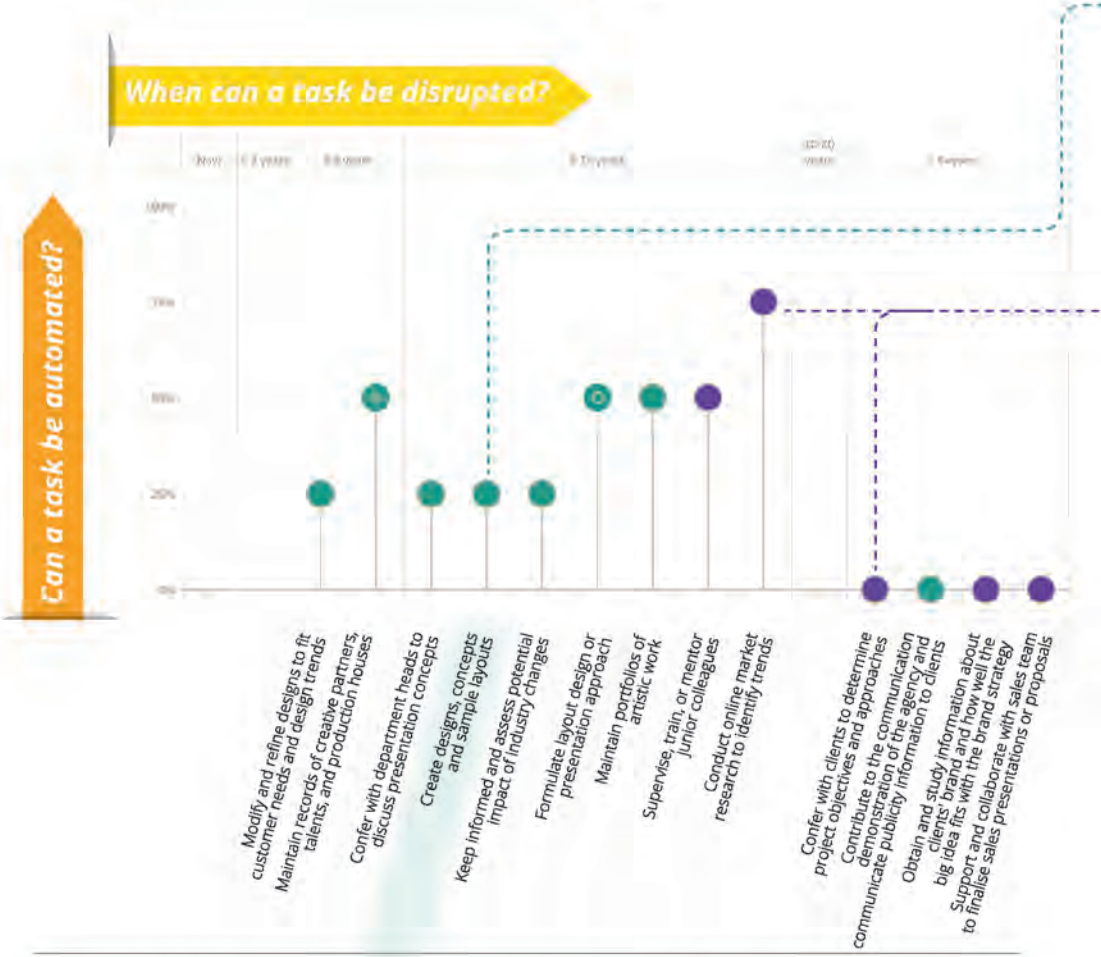
"What I love the most in my job is my connection with clients and internal partners. I wish I could take more time in interacting with my clients in the future"

How does the role change?

- Developing client relationship and communicate with clients is certainly the most emotional task and certainly the one we should keep in human hands in empowering employees with more tools and time to perform when they are leading such client relationships.
- In addition, account manager would need to dedicate more time in consulting work in order to work with strategist to generate unique value to their clients.
- Empowered with AI, account manager would gain some valuable time in gathering clients, customers and business data to nourish their strategic and creative thinking. They would need to improve their own judgement and problem solving skills in order to take faster decisions based on the multiplied sources of accessible information.

SENIOR ART DIRECTOR (CREATIVE AGENCY) (ADVERTISING)

The Senior Art Director directs or supervises the work of other artists. Not only the communicator, this role is also responsible for how the communication is conveyed. If words are the voice of the client's offline/online presence, the Senior Art Director provides the "body language" of the clients' offline/online presence (and body language accounts for over 80% of the communication).



Overall creative concept generation (not basic layouts) might be potentially provided by the machine (up to 25%) in the mid-term future. However, even with machines empowering humans, humans would still need to continue spending the same amount of time on creative concept generation.

Should a task be automated?

LIVE W/ AI

LEE KUAN YEW CENTRE FOR INNOVATIVE CITIES

SUTD SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

DataRobot

SHOULD BE AUTOMATED

Not surprisingly, such a creative job would not be easily disrupted and there were no specific creative task that was analysed to be potentially entirely automated or replaced by a machine. Even if the adoption of some software is accelerating in the creative industry, the purpose of these software will always be to serve humans by suggesting ideas, with the exception being for very simple and straightforward commercials (e.g. price, promotion or sales etc.) that might be automated. Humans will benefit from the machine by being empowered to generate big ideas that make brands matter.

SHOULD AUGMENT HUMANS

Create designs, concepts, and sample layouts, based on knowledge of layout principles and aesthetic design concepts

AI-software will definitely augment creative people in generating designs, layouts (leveraging Generative Adversarial Network technology for instance), and concepts based on client's data and new smart briefs. Senior Art Director would need to rely on such tools, compare and analyse different creative propositions and become in doing so "Creative Director" in being augmented by the machine.

SHOULD REMAIN IN HUMAN HANDS

PERFECT MATCH

Confer with clients to determine objectives, budget, background information, and presentation approaches, styles, and techniques. This relies mostly on thinking creatively

Even if a brief could be generated, creative work remains very emotional and would require a strong connection between the Senior Art Director, creative employees and their client, in order to help them perceive well the creative "finesse" requested and be able to propose something unique to their brand.

Conduct market research analysis to identify search query trends, real-time search and news media activity, popular social media topics, electronic commerce trends, market opportunities, or competitor

Even if "bots" and AI may easily provide lots of insights and selected trends and ideas to the human worker, we believe in the importance of preserving some human space to get this task completed by humans with independence and agnosticism.

WHAT IS VALUABLE FOR THE EMPLOYEE

Confer with clients to determine objectives, budget, background information, and presentation approaches, styles, and techniques. This relies mostly on thinking creatively.

"Data is like what we do in the past. But in advertising, right, sometimes we need to look forward. How do you make it more interesting, how can we use this tech to push the limits? For example, how can AR be used in advertising to lead you to somewhere? That's what we try to do.

How does the role change?

- The most valuable task for both the enterprise and its employees -- thinking conceptually -- will remain the core of the creative employees' jobs. This should remain in human hands to keep self-judgement in human hands and rely on humans to generate emotions needed to win in advertising.

- Even if sourced with relevant insights and creative inspirations from several software and tools, it will be highly important for senior art directors to maintain their own agnostic curiosity in travelling, meeting creative talents, driving their own inspiration journey with a lot of freedom and self-responsibility.

- Senior Art Director would also need to know more about several technologies to be used to ensure their ads will be well remembered.

The importance of having a concrete vision of what the augmented employee will look like in 2030

You may have seen the headlines "Robots May Steal As Many As 800 Million Jobs in the Next 13 Years" [14], or "You Will Lose Your Job to a Robot—and Sooner Than You Think" [15]. The issue is that there is no consensus on how and when AI and its related technologies will impact industries, and at what pace. Additionally, if a pioneer starts using AI in its business activities, that doesn't necessarily mean all the actors in the same industry will follow right away.

In our technology assessment, we identified different horizons, and the latest one is beyond 10 years. We took the horizon 2030 as a stop point, as we believe that by then, it is most likely that advancing AI and related technology systems will enhance human capacities and empower them.

The disruption will come slowly – by having an approach tasks by tasks, it helps to be well prepared, but also to have a better understanding on how this may happen, or to be more precise, which of our daily activities will be impacted and how. Having concrete examples leads to starting a discussion with an organisation's entire workforce, and assessing their appetite to embrace change in their job roles.

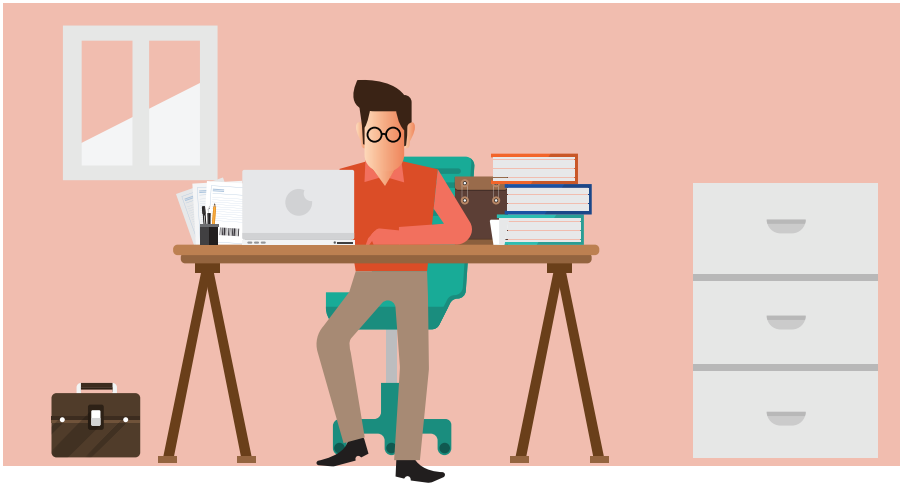
Whatever our job, our industry, we all perform mundane tasks – some we would like to keep, some that we would like to see go away! There are tasks we love to execute, but we don't have enough time to deal with. Why not leverage technology to help us focus on the task we prefer to do, the one that brings us the most self-fulfilment? If that is technically possible, what would it means in terms of work/life balance?

It is our responsibility to help the younger generation positively envision the future of their job, help them picture this future and help them design this future, by preserving some human centricity.

Let's imagine the typical day of a Senior Art Director in 2030.

Eleonore Ferreyrol-Alesi – LWAI

We will share more about our views on the challenges to address before any realistic AI disruption from a business perspective, and on a later stage in this book, what are the key questions to tackle from a society perspective when it comes to deploy AI related technologies at large scale.



Account Manager (advertising agency) > A SMART ARCHITECT

Andrew has been an account manager for 2 years in Singapore. Every morning he commutes from his home to his office, watching a self-generated video capturing the latest fresh content trending in the last 24 hours. Andrew only spends 50% of his time in the office, but remains highly connected to his clients through tele-conferencing and his working virtual assistant Henry. Henry gives Andrew access to all of his commercial activity and planning. Henry is an AI which accesses every single activity Andrew does for his clients, without compromising Andrew 's privacy and freedom, and can recommend ways of optimising his client support.

Basic account and project management tasks will have been automated and are in hands of a proprietary AI

Henry spots some issues in Andrew 's main client sales in Malaysia, as well as some production issues in the very last auto-generated shoot for a fashion brand. Henry has already re-organized Andrew 's diary to help him manage the consequences and connect with his clients to take action instantly. Henry is smart enough to have booked one hour for Andrew in his client's office and has suggested some strategic optimisation routes. Andrew will need to **leverage his human problem-solving skills** to make the right decision and manage his client relationship.

Advanced analytics should augment account managers and turn him into a smart architect

Andrew follows Henry's dashboard and realizes his team has gained in efficiency but still struggles in delivering best-in-class commercials to his fashion client. Data highlights a lack of emotion in their commercials, and brand perception has

decreased in the last quarter. This is what may happen when relying too much on technology to improve a brand's customer experience, and less on creativity. Fortunately, Andrew has access to his own data lake, and lots of learnings from previous commercials as well as related consumer behaviours. **Leveraging basic data and analytics skills**, Andrew can build his own algorithm using a proprietary framework from his agency and external third-party data. In doing so, Andrew can access deep insights on consumer needs and related marketing techniques he could suggest to his creative team. It's time to update the dynamic brand brief; anyone working on this client can access it in real time.

This creative brief self-suggests concepts and ideas which may answer client's expectations. Through a specific API designed by the agency, the brief template is dynamically infused with relevant vendor recommendations (Google, Facebook, Alibaba), while also having access to customer data and its advertising campaign on their platform.

Developing client relationship should remain in human hands

Andrew finally has more time to hunt new business. Henry has already planned a new client introduction, and Henry empowers Andrew to build new provocations and marketing proposals aligned with prospect needs. A lead scoring system helps Andrew to focus on the most promising opportunities. Andrew also knows his value relies in his ability to always deeply analyse his client's business and use his **critical thinking** to decide which content will help him grow his business. Having followed specific **persuasion and negotiation training**, Andrew also knows how to leverage such valuable information to transform the very good pre-sales strategy provided by its growth software empowered with AI.

Andrew now spends much more time with his agency's strategist, and data scientist. He has become a category expert and consultant, driving more collaboration between agency experts and his clients to win as a team. For that reason, he is highly valuable to his clients who now consider him a part of their team. Andrew is a marketing architect empowered with AI to deliver best-in-class, data-driven creative strategies.

Senior Art Director (advertising agency) > A CREATIVE MAGICIAN

Identifying trends should remain in human hands to protect human creativity

A graduate from the Singapore University of Technology and Design, Angel has been working for 5 years within the creative department of an advertising agency. Angel no longer works in a pair with a copywriter, but with lots of different creative talents, some of whom are purely virtual. Angel loves this level of collaboration with different disciplines, as she recognises the value of collective intelligence in concept generation. She does not travel for work anymore, but rather for inspiration, and she is always connected to her agency's creative platform, which in turn connects her to a worldwide community of virtual and human talents across the world. Angel knows she can access bots tracking trends for her, but she is aware she needs to keep a human eye on her market research.

A creative empowerment leveraging AI creative software to multiply creative potential

Angel has access to smart briefs from her agency, and receives notifications whenever new requirements or simple learnings from previous campaign contribute to strategic shifts. Angel acts as a creative supervisor as she oversees several creative layouts, deliverables and outcomes provided by both the creative assistant and AI-driven software (Generative Adversarial Network in particular). Angel even takes part in GAN training models and leverages such new tools to test different layouts with lots of agility.

Angel knows her work is not universal but very personal, and lots of creative components will remain in machine hands (specifically, dynamic creative tools)

as all customers will react differently to specific layouts, colours, type of ads or call to action. However, she knows how important it is to maintain some creative consistency to build a brand that matters. A lot of creativity is required to identify the overall concept and big idea which will create the most valuable and long-term impact.

Angel has some **data analytics skills** and works closely with a pool of data scientists to leverage relevant information and bring data to life, building compelling stories. Angel supervises virtual shooting and models' virtual casting as she now has access to software-generated models, opening up a whole new array of creative opportunities with far fewer financial or regulatory constraints. She sees such creative support as a fantastic opportunity to enhance her creative skills and maximise her **creative impact**. Her main mission is now to ensure some empathy can make a difference when it comes to creative messages delivered to customers, and generate an emotional response from consumers rather than simply deliver information.

Thinking creatively, generating and overseeing concepts and big ideas should remain in human hands

Angel spends now more time managing her clients and leveraging her **persuasion skills** to convince them of the best creative routes to follow. Data remains important when it comes to short term sales and engagement, but Angel also has access to long term impact KPIs and knows how important it is to protect overall concepts for a better impact. She continues to think creatively, generate concepts and supervise the idea which will help her build a brand that matters. Last but not least, in a world where content might be dynamically created by lots of different providers, brands are facing an increase in reputational issues, with fake news spread across the world. Angel knows one of her main roles will be to manage such crises in real time, leveraging her **problem-solving skills** and her ability to make strategic conversational and creative decisions instantaneously.

Angel is not conceptualising independently any more. She collaborates with a community of talent, and acts as a creative guardian of the overall creative strategy. Brainstorming, idea generation, conceptualisation and creative delivery is now empowered by machines, but Angel knows her role is critical amongst all these new players to generate emotions and create some magic.

The Challenges to Foresee a Realistic AI Disruption

During the process of writing the LWAI Report 2019, we met with several companies and their senior management. We thought it would be meaningful to identify a realistic timeline with regards to when they would be ready to start an AI transformation journey. Rather than focusing solely on technological readiness, our approach led us to consider companies' strategy, thus considering IT maturity, data availability, and their capacity to invest.

We had originally planned to use the AI Readiness Microsoft tool [16]. This tool has been released online to assess in a 20-question survey how prepared an organization is to implement AI, relating to its strategy, culture, organisation and capabilities.

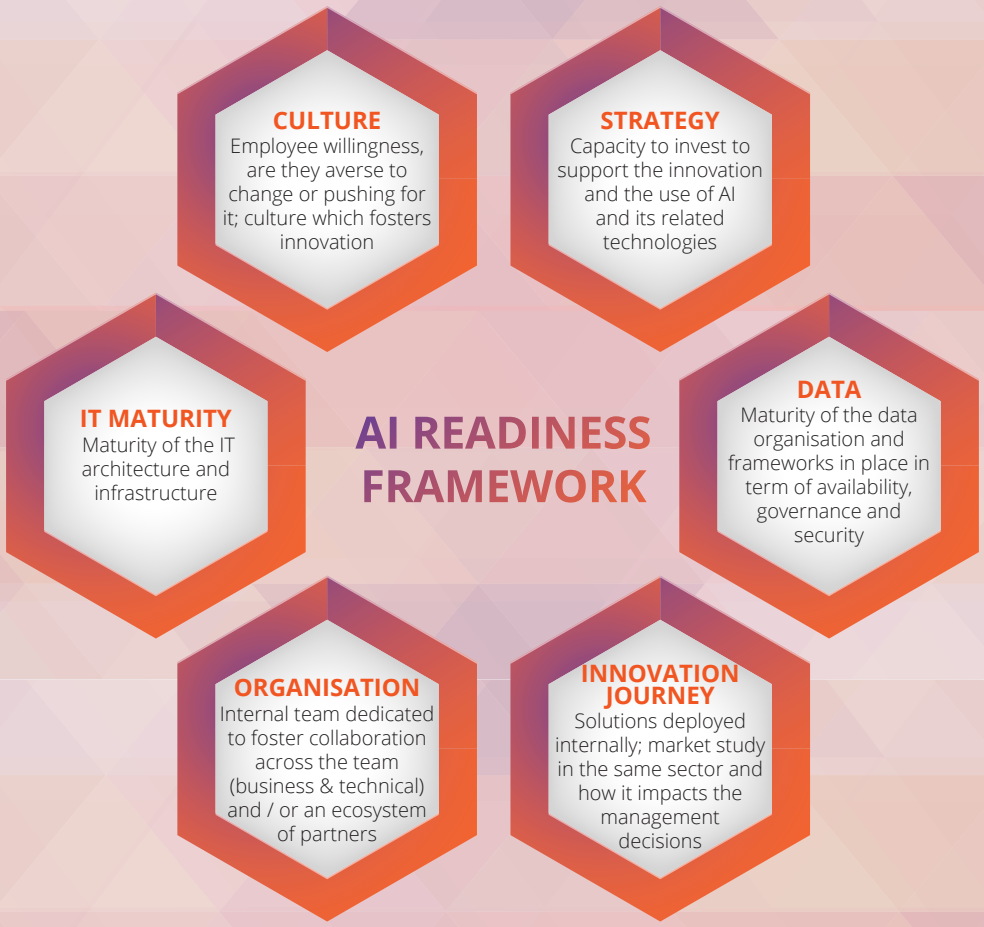
The well-known company categorised the outputs into four archetypes, in order to assess the standing of the company in terms of AI readiness.

- Where you are on the AI readiness spectrum.
- What steps other companies at your readiness level have taken
- Considerations and recommendations for moving forward with AI

This tool helped us to build our own questionnaire, and based on feedback from LWAI board members, and key contributors' inputs, as well as online search, we identified six dimensions – **strategy, data, innovation journey, organisation, IT maturity and culture** – that any organisation needs to master to create their AI transformation capability.

We sat with senior management teams to learn more about their internal initiatives: they gave examples highlighting the challenges and barriers brought on by AI potential disruption, and the initiatives implemented to overcome them. They were also asked to answer questions relating to each of the six dimensions, such as: "Have you already, amongst your company, a collaborative process across your technical and non-technical team?" or "What are the main cultural barriers you are facing with your employees toward this big data and AI revolution?"

Thanks to their input, we were able to get a better understanding of their overall strategy, and therefore, where to set their priorities. Do they use data lake technologies in order to pull together structured and unstructured data? Do they have an in-house data science team, or do they leverage their vendor partners' team? Having this understanding of senior management priorities and overall strategy is useful in designing future employees' job descriptions.



powered by LWAI

Conclusion of our applied research

This research helped us to answer to a few questions already addressed by some of our board members in this report, and further highlighted the importance that will be placed in human-centric leadership.

• Because we believe tasks matter as outlined by King Wang Poon in his thought leadership article: "AI and Work: Equal to the Task" accessible on p.30 in this report, we proposed a task diagram for each job, in order to help decision-makers consider this approach in their AI enterprise transformation.

• Because we believe in focusing on the importance of protect humans and the value each task has to employees, we decided to highlight which tasks should not be automated in each job.

• Because we believe in the importance of help employees picture a positive future in their job, we worked on a specific scenario (for the advertising industry) with the aim of making all employees feel like they are a part of this transformation.

• Because we believe all industries are different and AI disruption is related to many different factors, we have designed a specific AI readiness framework to empower decision-makers and help them consider all critical elements which need to be addressed in their transformation strategy.

How to work with AI: Strengthening your human skills

How can you prepare for the AI revolution? If you are an employee, future-proof your job security by strengthening your human skills: soft skills like common sense and your ability to communicate and connect with others. This principle applies whether you wish to follow a technical or non-technical career. Below, as we also seek to provide guidance, we focus on four human skills.

Critical Thinking

Critical thinking is the objective analysis and evaluation of an issue in order to form a judgment. It requires you to use your ability to reason. It is about being an active learner, rather than a passive recipient of information. As procedural tasks become more and more automated, employers will be looking for employees who, rather than merely following well-defined procedures, can apply critical thinking to tasks and evaluate a situation using logical thought. Someone with critical thinking skills can be trusted to make decisions on their own, without constant supervision or clearly defined procedures.

It is possible to improve your critical thinking skills through daily practice. Begin by recalling a decision that you made in the past 24 hours, then grab a pen and paper and follow the steps from the TED-Ed lesson created by Samantha Agoos [17]. Next, recall something you were told or learned in the past 24 hours, whether that be in a conversation, from a book, or via digital media. Use a pen and paper to ask yourself these questions sourced from Skills You Need [18]:

- Who said it?
- What did they say?
- Where did they say it?
- When did they say it?
- Why did they say it?
- How did they say it?

Following these two practices teaches you how to rigorously test reasons for decisions and consider alternatives. When you feel more confident using these techniques, start applying them at work. Maybe you will discover a way to improve business decisions that proves your value as an employee!

Creativity

Creativity is defined as “the use of imagination or original ideas to create something; inventiveness” [19] ; human creativity also extends to creative problem-solving. Computers, including AI systems, only know how to solve problems that are well-defined and follow known rules, but humans can apply out-of-the-box thinking to solve problems and generate new and practical ideas. Employers will increasingly seek staff who

understand when the rules shouldn't apply, when a non-standard solution is the best solution. With AIs increasingly optimising production lines and mass-producing standardised products, there will still be a market for customised individual products built by artisans. And with consumer needs changing with the AI revolution, businesses will need humans to design and invent the next generation of products and services that meet that demand.

While brainstorming is the most well-known process for creative problem-solving, it is just a part of the broader seven-step process for creative problem solving:

1. Clarify and identify the problem
2. Research the problem
3. Formulate creative challenges
4. Generate ideas
5. Combine and evaluate the ideas
6. Draw up an action plan
7. Do it! (implement the ideas)

-Many universities and organizations offer courses in creative problem-solving. For example, Coursera [20] offers an online course in creative problem-solving. If you prefer face-to-face teaching, check whether any of your local universities offer a suitable course, e.g. Harvard Business School offers "Developing Mindsets for Innovative Problem Solving" [21], and Singapore Polytechnic [22] offers "Creative Problem-Solving and Decision-Making".

Emotional Intelligence and Empathy

Emotional intelligence is "the capability of individuals to recognise their own emotions and those of others, discern between different feelings and label them appropriately, use emotional information to guide thinking and behaviour, and manage or adjust emotions to adapt to environments or achieve one's goal(s)." [23] Empathy, the ability to place oneself in another's position, to understand what they experience and how they feel, is typically linked to emotional intelligence. This is what we use when we empathise with co-workers or customers. People with high emotional intelligence are more likely to get hired, promoted, and earn better salaries [24], as they increase team productivity and staff retention.

There's nothing new about businesses using automation instead of humans for customer service. For example, in the late 20th Century, banks introduced ATMs to replace tellers in bank branches. Businesses have been learning, however, that automated customer service is not an optimal approach. When one bank introduced online banking, it found that customers increased their transactions and called the bank more, increasing costs and decreasing profitability [25]. Moreover, one study found that when banking customers used the ATM more and the teller less, their overall level of satisfaction with the bank went down [26]. It is the nature of humans that we are "inherently social creatures who get emotional value from seeing and interacting with one another." [27] Businesses will need to hire humans with high emotional quotient (EQ) for customer service because humans can be emotional whereas technology cannot. Humans prefer having people help solve our problems; less work for employees

often means more work for customers.

The conclusion is that organisations should use automation for transactional interactions, and to augment human customer service, freeing up humans from mundane and administrative tasks, to engage with customers. For example, who wants to hear an insurer's computer say "I'm sorry for the loss of your loved one"? A caring human is the preferred solution for emotional communication.

-Emotional intelligence can be learned, and you can start improving your EQ with mindfulness meditation. The University of California, Berkeley offers a course called Empathy and Emotional Intelligence at Work [28]. Six Seconds [29], a non-profit organisation specialising in emotional intelligence, offers certificate qualifications.

Persuasion and Negotiation

Persuasion and negotiation skills are closely related to emotional intelligence skills. Organisations require managers, marketers, and sales staff who are persuasive and can negotiate win-win solutions, whether that be between internal stakeholders or with external suppliers or customers. While AIs and computers can offer a great experience for online shopping for commodity purchases, the same doesn't apply for purchases that are more personal and less transactional. You are more likely to convince your colleagues to try out a new idea via a persuasive presentation than simply with facts. Persuasion skills help a marketing and sales professional to win over the hearts of people who not only become their loyal customers but also customers' recruiters. Humans have evolved ways of deciding whether they can trust another human. Human brains have "mirror neurons" that give them empathy and enable them to make first impressions of whether they trust another person. First impressions of trust happen as quickly as 39 milliseconds [30]. This process does not apply to human/computer interactions – there hasn't been enough time for computers or humans to evolve such trust mechanisms.

-Persuasion and negotiation skills can be learned. The classic textbook "Influence: the psychology of persuasion" [31] covers the science and research, explaining the ways that human biases affect the way that we influence each other, with suggestions of how to apply them. Universities offer degrees in psychology and marketing that deeply cover the tools required. Coursera offers an online version of the University of Michigan course "Influencing People" [32]. There are also many courses in sales skills on offer.

The AI revolution offers opportunities and productivity gains that will increase the number of human-centric jobs available to us. As employees, being aware of our core strengths and reinforcing them ourselves without help is one very fundamental point; some call it life-long learning. Nonetheless, it is also the role of organisations, in their ongoing transformation by AI systems, to consider bringing together automation and human strengths, as both combined will turn out to be more efficient.

Colin Priest - DATAROBOT

Automation needs you to think more about humans, not less

During our research on the future of technology, we posed a question to a chief executive of a healthcare organisation, asking her besides the typical returns on investment (ROI) and cost-benefit analyses: did her team consider what might be lost from adopting a technological platform?* What followed turned out to be one of the most memorable moments in our fieldwork. She paused. Then she said the organisation often had not considered this issue, and acknowledged it should. We knew our concern over what we later termed the "human cause" hit her hard.

What do we mean by "human cause"?

It is the fuzzy "human touch" our respondents struggled hard to articulate, yet we all know it by heart: the exchange of looks between the nurse and her patient, after the former delicately adjusts his incubation tube to make the latter more comfortable before administering the anaesthesia; the teacher who knows a student is performing poorly in school not because he is dumb or lazy, but because of family troubles at home; that wink from a waiter who just gave you exactly what you needed, before you even asked for it. It is the raison d'être which fuses your professional identity with your personal one, pushing you to go that extra mile and get to that one more email before you leave the office. One nurse told us "once a nurse, always a nurse."* It's the oft-told story that the janitor at NASA knew that even though his job was prosaic, it was just as purposeful because he helped put a man on the moon. That is human cause.

You want to make sure that your decisions around technology don't chip away at that humanity. In today's context, this unintended consequence may manifest during the push for automation, when artificial intelligence (AI) increasingly handles tasks that are previously performed by us. We are not against (or even for) automation per se. As techno-pragmatists, we are students of Goldilocks, learning not to be too hot or too cold with technology. We take a more balanced position and consider how it can improve not only performance, but also the relationships within and outside of organisations, while remaining mindful of its limits. We do this by beginning the automation journey with the human in mind. This means becoming a good listener, paying close attention to what your stakeholders tell you while your organisation maps the tasks and processes to be automated. This means knowing not only when and how, but also when not to automate.

Let's walk through two examples.

A relationship manager at a financial institution told us the task of recommending financial products to a customer should not be taken away from her.** It was not simply a routine act of selling, but an opportunity for her to exercise creativity in customising the proposal for her client. It was something she enjoyed and

was proud of. Automation, in this example, will be figuring out how to augment, not replace her task of recommendation. You break the task down into its components, separating the analysis from the customer facing. If done thoughtfully and skilfully, automation can produce a menu of candidate recommendations that matches the customer profile better (such as risk tolerance and investment horizons), yet also leaves the relationship manager to tailor the final proposal to the client. It complements the manager's core function of strengthening relationships, and the most intimate is the one between the financial institution and its clients. In this instance, high tech does not compromise high touch. Finally, because the customer experience remains social, this episode of augmentation reduces errors in the recommendations, but not at the expense of eroding professional judgment and trust. As the department head of a technology consulting firm once quipped: humans trust, machines authenticate.*

Furthermore, just because the technology is ready doesn't mean you must strip the task from your staff, even when the task is mundane and repetitive. This advice runs counter to what you may find elsewhere. But hear this: a tech professional told us she looked forward to daily mundane, repetitive tasks as her other tasks were cognitively intensive.** The respite comforted her. How can automation be done in this case? Instead of automating the routine across the board, you can offer the option of switching it on or off. Your staff member retains her autonomy. Because of the therapeutic benefit of the routine, she is also better able to return to her more cognitively intensive tasks.* This human-centric approach improves automation payoff. It elevates automation from simply reducing mistakes to something more purposeful and inclusive. By focusing on humans, we also refrain from seeing employees as inconvenient objects that automation must work around because AI cannot tame and replace them yet. Rather, to paraphrase cognitive scientist and philosopher Daniel Dennett, automation should be considered a smart tool, not an artificial colleague.

Automation is hard. It is also expensive. Not every company is equipped with the kind of financial power to delve into large scale automation projects. It therefore becomes even more critical that organisations think through both the benefits and costs, as well as the human causes that can be enhanced or inadvertently endangered in the process. Algorithms that run your tasks can never be proud of your organisation, nor can they know when and how to break protocols in order to satisfy a customer. Your employees can. One way to retain the human cause as you prepare your automation initiatives is to start with placing humans at the heart of this transformation journey, thinking harder about when not to automate.

** Drawn from the fieldwork we conducted for the Future of Cities research project that culminated in our book:* Living Digital 2040. *Poon, King Wang, Hyowon Lee, Wee-Kiat Lim, Rajesh Elara Mohan, Youngjin Chae, Gayathri Balasubramanian, Aaron Yong, and Raymond Yeong. (2017).* Living Digital 2040: Future of Work, Education, and Healthcare. Singapore*: World Scientific.*

*** Drawn from fieldwork conducted by King Wang; Goh Zi An Galvyn, Hakim, Holly, and Radha on the impact of digital transformation (e.g., automation) on the work-force.*

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Augment Workforce with Intelligence to Boost Profitability: The Oil and Gas example

Oil prices have been swinging sharply in recent years, fluctuating from lows of $30 per barrel to highs of $100 per barrel. The unexpected price volatility is causing stress on the CAPEX and OPEX of the oil and gas value chain. Compounding the challenges, the negative perception of fossil fuels, rising trade tensions and geopolitical upheaval are adversely affecting near-term demand and business costs.

As a result, more companies are looking towards "Digital Transformation" to drive effective capacity, not only through CAPEX, but also OPEX investments. By using analytics and Artificial Intelligence (AI), companies empower the workforce and enable swift responses to market changes. They can drive optimised operations and improved asset availability as these are more scalable and have a shorter lead time.

Using digital tools to tackle Oil and Gas data challenges

Long before the term "AI" was coined, Oil and Gas companies were collecting huge volumes of operational data, from exploration to production. However, in the past, turning that vast amount of raw data into contextual information around equipment and processes for production improvement was often challenging due to the limitations of technology.

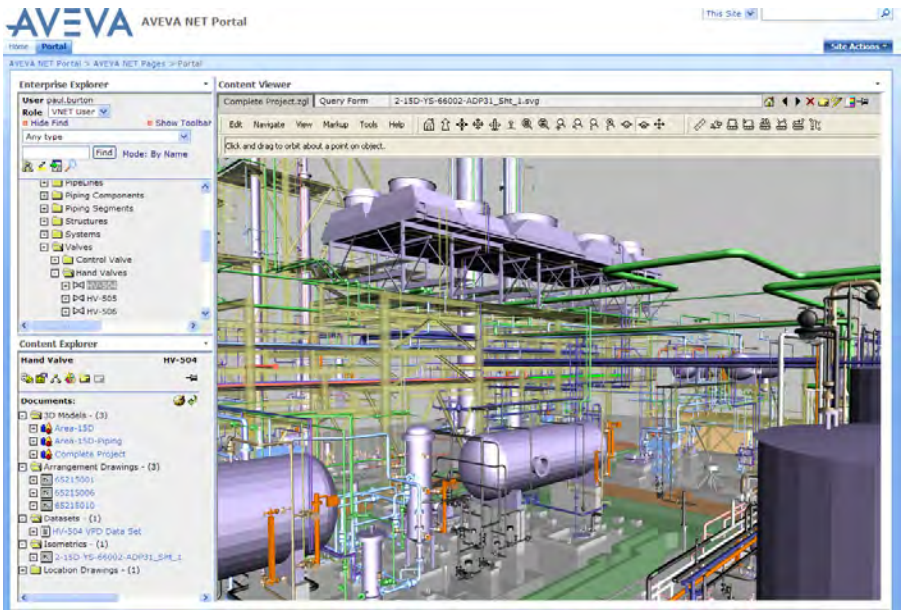
Nevertheless, the advancement in technology in recent years will allow companies to address this issue. Thanks to cloud computing, analytics and artificial intelligence, plus greater clarity on the use cases, companies are starting to realise the benefits that digital tools enable from unprecedented real-time insights of their operations. Leveraging existing operational data and new available data sources will provide great opportunities. By improving asset reliability, efficiency and safety performance, companies will significantly improve their business performance. For instance, a 0.1% increase in production due to improved process and operating efficiency can easily yield several millions of dollars in additional revenue.

First steps to enable Analytics and A.I.

A digital twin is a complete 360-degree replica of a physical asset, such as pipelines, gathering systems, heat exchangers, turbines, pumps, compressors or entire plants. It enables analytics and AI to model and control the process while monitoring equipment health and reducing unplanned downtime. As the foundation of a digital transformation, it optimises production, detects equipment problems before failures occur, and uncovers new opportunities for process improvement.

At the engineering phase, a 3D plant model allows multi-disciplinary teams to interact with the data visually. With the unified data-centric models, engineers are empowered with the ability to visualise the downstream impacts of their actions when

they make design changes during the project execution. As a result, it eliminates information silos and reduces design cycles through improved collaboration and change management process.



3D visualisation of assets using a single, integrated source of up to date, trustworthy information
Source: AVEVA

An operations management user interface
Source: AVEVA

A good illustration is the data-centric engineering and design platform deployed by Aibel that facilitates collaboration across multiple offices, enabling them to deliver the Johan Sverdrup offshore platform on time and under budget. Aibel is a leading service company within the upstream oil and gas industry. It delivers customized turnkey solutions for engineering, construction, modifications and maintenance, operating out of nine offices spread out across Europe and Southeast Asia.

Next, these common sets of data and information are shared across departments, from engineering to procurement, construction, commission, and operations.

Empowering human to better interface with Machine

As the operational life continues, the digital twin is automatically updated in real time with current data, work records, and engineering information, to optimise maintenance and operational activities. Engineers and operators can therefore easily search the asset tags to access critical, up-to-date engineering information and diagnose the health of a particular asset. Previously, such tasks would take considerable time and effort, leading to issues being missed and increasing failures or production outages. With the digital twin, operational and asset issues are flagged and addressed early on: the workflow becomes preventative instead of reactive.

A good illustration is the Abu Dhabi National Oil Company, or ADNOC's Panorama Digital Command Centre that provides operational visibility across the entire hydrocarbon value chain, from exploration to distribution of products, breaking down information silos, and providing real-time operational insights based on a single trusted view. This not only improves operational efficiencies, but also uncovers new pathways to optimise performance.

Combining Analytics and Artificial Intelligence

The real-time data processing from the digital replica can then be fed into analytics and artificial intelligence. The aim is to optimise overall production, process conditions and even predict failures ahead of time. The digital twin, when combined with powerful analytics and artificial intelligence, enables predictive maintenance and optimal operations. With advanced pattern recognition, statistical models and machine learning technology, relevant data is transformed into useful contexts with decision support. It empowers workers to make technical decisions on the fly to reduce unplanned downtime and optimise operating conditions.

Augmented and Virtual Reality to visualise data

Augmented/Virtual Reality (AR/VR) combines data and visualisation to provide field operators with an augmented overlay view of the physical asset. This allows workers to quickly access step-by-step procedures for maintenance or training needs just by aiming the mobile tablets at the faulty equipment, without having to manually search for the relevant information. It greatly improves operational efficiency and production uptime.

For instance, Italpresse Gauss [33] have been transforming their operations with AR/VR to support remote maintenance and asset performance optimisation. They build machines and automatic work cells for light alloy casting primarily for the global automotive industry. Their high-fidelity virtual environment helps provide a safe and reliable environment for their workers to study, inspect, and test asset maintenance and optimisation strategies prior to implementation.

The potential artificial intelligence and analytics hold for the oil and gas industry is not just hype. Real use cases demonstrate how leveraging advanced analytics, artificial intelligence and AR/VR for assets, processes and operational control not only enables oil and gas companies to maximise return on assets and improve operational efficiencies, but also augments workers in their daily workflows to help get more done.

Eddy Lek - AVEVA

From Predictive to Prescriptive and Beyond: AI impacts business models

AI is disrupting the workplace through digital transformation, resulting in extensive use of the digital twin, a virtual representation of a physical object or system. The combination of AI with the digital twin results in significantly enhanced productivity; this is quantifiable. AI enhances workforce productivity and improves safety, reliability, quality, and security. This AI-based disruption aids many aspects of the industrial process, from design and engineering, to operations to maintenance.

AI itself is not one thing, but comprised of a number of technology types, including neural networks, deep learning (a flavour of neural networks), natural language processing, computer vision, unsupervised machine learning, supervised machine learning, reinforcement learning, and transfer learning. The various types of AI are applied in different ways throughout the industrial world to create targeted solutions provided as descriptive, predictive, and prescriptive analytics. A relatively common solution used in a wide range of industries today is predictive analytics in the form of machine learning to identify anomalies with equipment and processes. These anomalies can indicate performance problems or asset health deterioration well in advance of any control system or SCADA warning or alarm. Issues can be identified and corrected quickly, well before they have a major impact on operations. This results in less downtime, better product quality, reduced risk, and increased overall efficiency and profitability.

From an industrial perspective, AI can be broken down into what AVEVA categorizes as the Four P's of Industrial AI:

- ***Predictive***

Based on machine learning, this is a type of pattern recognition and anomaly detection leveraging industrial big data to create digital signatures of assets and processes.

- ***Performance***

Based on first principles analytics (simulation) and machine learning, it provides early warning detection of pending problems and inefficiencies when compared to actual sensor values.

- ***Prescriptive***

Based on the issues detected in Predictive and Performance analytics, this provides root cause analysis, planning and decision-support, and probabilistic courses of action to best remedy & optimise a given situation.

• Prognostics

Leveraging neural net, deep-learning, and reinforcement learning technologies, this provides a forecast of future events.

Predictive analytics, a bargain for the industry

Predictive analytics in the form of machine learning has become one of the more common advanced technologies used in industry today. Although referred to as "predictive", it is actually a very effective method of anomaly detection in near-real-time. It is a type of advanced pattern recognition where the digital signatures of the normal behaviour of an asset or process are captured and used as a basis of comparison with incoming, real-time data from SCADA and other control systems. Real-time data from sensors is collected and compared to the expected data signature of a given asset or operational scenario. Deviations from normal behavior can be detected days, weeks, and even months before a traditional SCADA or control system alarm would trigger. This provides companies adequate time to take the appropriate actions to rectify the asset or operational problem before it's too late.

Examples of successful predictive analytics include sophisticated turbine "catches" where there were step changes of vibration reductions (not increases). Each time, the manufacturer told the customer it was OK because it was a reduction in vibration, not an increase. With this particular situation, it turned out to be due to the beginning of blade separation within the turbine stages. The system was nowhere near a control system alarm or warning. However, had it gone on, it would have resulted in a catastrophic failure that could have destroyed the turbine, caused extensive downtime (loss of power production), and a potential for significant injury to personnel. Conservative estimates by the customer showed that costs of over $34 million USD were avoided due to the early warning detection of this issue.

Prescriptive and prognostic analytics, a bridge between AI technologies and humans

It began with condition-based triggers to create a proactive maintenance program, vs calendar-based preventative maintenance. Applied to AI, prescriptive analytics bridge the gap between anomaly detection and the actions needed for resolution. It's critical to both improved asset maintenance and enhanced operational efficiency; consequently, it has become an increasingly important aspect of an overall Reliability Centered Maintenance (RCM) program.

In order to further enhance predictive and prescriptive analytics, prognostics take AI one step further by forecasting future events, such as operational performance degradation or an asset's remaining useful life. Prognostics can allow humans to make decisions such as, "can the system make it to the next planned maintenance outage?", or "can the asset make it to next week, or do we need to call in emergency personnel over the weekend on overtime wages to fix the problem?". These are critical decisions that impact both risk and costs. Managing risk is a key part of what AI brings to businesses, and it can significantly help improve the bottom line of industrial operations.

However, without a suitable bridge between AI technology and humans, appropriate actions may not be taken, and the value of this advanced technology could be lost. Prescriptive analytics are the key to making this happen in order for businesses to gain maximum value from advanced AI technologies and software investment.

Prescriptive, a requirement to keep up with the competition

Implementing prescriptive analytics is not trivial. It requires extensive, industry-specific fault diagnostic and resolution action databases that are logically defined based on changing sensor values (and other permutations) so that automatic (programmatic) recommendations can be provided to the user. This requires software to encompass vast industry expertise, experience in types of reliability-centered maintenance practices, and predictive analytics. Because of this combined uniqueness, competition in this space is limited and typically targeted to specific industries.

As software continues to evolve, integrated processes become more important. Predictive, prescriptive, and prognostic software will increasingly integrate with Enterprise Asset Management (EAM) systems in order to dynamically create work orders and integrate the forecasted remaining useful life of the asset with recommended prescriptive actions needed to rectify the issue. This will provide automation from issue detection, through root cause analysis, to remediation and rectification. Beyond EAM integration, this type of AI software will also integrate with scheduling systems to recommend the optimal time to perform emergency maintenance within the forecasted remaining useful life window of an asset in order to reduce adverse impacts on operations, minimise overall business risk, and maximise profit. This will then extend to closed-loop, automated process control, where humans merely monitor the fully automated and optimised, end-to-end operations and maintenance processes that are controlled by AI. These technologies exist today, and adoption will increase over time.

Predictive analytics software will continue to be improved and enhanced through prescriptive capabilities in order to detect and prevent problems faster, better maintain industrial operations, optimise scheduling, and enhance process control. From a societal perspective, predictive analytics will be humanised through continued advancements in prescriptive capabilities, in order to better enable and empower the workforce. The combination of these factors will allow them to improve operations, work productivity and safety, as well as the speed of knowledge transfer and learning. An increasing number of industrial companies throughout the world are actively engaged in **leveraging artificial intelligence, particularly predictive analytics. This is no longer an option in many industries but often a requirement to keep up with the competition.** In order to maximise the benefits, the bridge from predictive AI technology to humans must be as seamless as possible. That is where prescriptive plays a key role, and it is revolutionising the way work is performed.

James H. Chappell - AVEVA

Challenges to the Adoption of AI and how to address them

The structures, technology and information architecture, cultures and decision processes of most organisations were designed and built for a very different market and technical context than today. While organisations increasingly recognise the opportunities of AI and are beginning to explore how it will shape their industries, there are significant risks that must be managed. Additionally, most organisations face significant barriers as they seek to build internal capability and organisational support for AI-enabled business models. Broadly, the challenges faced in adopting AI across the enterprise are four-fold:

- Data Architecture and technology capabilities
- Trust (internal, client)
- Legacy Organizational models, Strategy and Financial Processes
- Regulatory

Data architecture and technology capabilities

While data remediation and modernisation of data storage, access and security is difficult, unglamorous and expensive, many organisations are learning that building AI at scale without a strong data architecture is all but impossible. Additionally, the data scientists required to understand, build and develop AI are difficult to source and often do not 'fit' clearly into traditional organisational structures and cultures.

A key challenge for all organisations to drive adoption of AI in a scalable way is to build a data architecture and data governance model that ensures data is of a high quality/integrity with the key data relationships defined, is available for AI systems to use for machine learning purposes, and is secure from misuse. Increasingly, it is also critical to enable the processing of both internally created and externally sourced data, as well as structured and non-structured data. From the broader organisational perspective, building an awareness of how AI is created, where the exploration for high value use cases could start, and the tools and prerequisites required for deploying AI is critical.

In specialist functions, there is high demand for data scientists across industry sectors and employers must be prepared to offer a stimulating and meaningful work environment to keep these highly qualified staff engaged. Building the structures and business sponsorship within an organisation that empowers data science teams and drives value from their insights is critical to success.

Trust

AI adoption has only increased an already breathless rate of change. With all of the negative media attention directed at some of the more concerning implications of AI, it is unsurprising that we, whether as consumers or professionals, become more sceptical about the extent to which AI can be a force for good in the world. To humanise AI, the following three principles should be incorporated into plans for the development and deployment of AI:

• Democratise access to AI so that members of your organisation can learn about the technology and use cases. Key principles include educating and training management and staff throughout the organisation on what AI is, and how to develop it; promoting co-location by having data scientists physically close to decision makers; and empowering employees via access to data and tooling solutions that simplify and automate AI experimentation, such as DataRobot.

• Build a safe environment for experimentation. On the one hand, it is critical to create data architecture and technical architecture that is secure, with anonymised data (where necessary), that supports experimentation within a test environment or 'sandbox'. On the other hand, it is important to build a culture within the organisation that welcomes data-driven experimentation and adopts a 'fail fast' attitude. For instance, rewarding people for taking risks is a source of real empowerment for those willing to innovate in a 'legacy' organisation. In support, internal governance, risk and control frameworks must be "baked in" to the design and go-to-market process for AI, as a strong risk and control framework enables innovators to move fast with the confidence that risks (operational, brand, financial) are being actively managed.

• Develop an inclusive discussion about what AI use cases to prioritise and how to deploy. To manage employees' concerns, consideration should be given to engaging affected groups to define plans and priorities, and communicating proactively on changing job roles and how employees are being up-skilled to operate in a new AI-driven business environment. Additionally, engaging customers in the design process for new or re-engineered offerings is a powerful tool to ensure you are building features that clients want and trust. Moreover, building a dialogue with regulators and community interests is critical in the process of bringing AI-enabled products to market, as they are acutely aware of how AI will shape the industries they monitor, both for good and bad.

Legacy organizational models, strategy and financial processes

The accelerated adoption of AI and increased pace of change means that rather than having years to adjust to a new competitive environment or technological innovation, increasingly organisations are expected to adapt and respond within months. Outlined below are three areas where we can expect significant disruption to how our organisations operate:

• Traditional hierarchical decision and management structures: State-of-the-art organisations have found that building agile capabilities allows significant empow-

erment of frontline teams to adapt to local challenges and enabled them to move faster and to foster more innovation that can be shared across the organisation. While many companies have enjoyed success in deploying Agile into their technology development processes, there is a need to deploy agile thinking across the business to ensure frontline teams are empowered to respond to client needs and embrace new technologies.

• Strategy, finance and planning processes: As AI enables more data-driven decisions and reduces the need for human-led analysis and decision-making, strategy and planning cycles will shorten, and budgetary and financial decision-making will need to be far more fluid. With better quality data available and better quality insights being drawn from that data, much of the 'art' of decision-making will be replaced by a more data driven, scientific approach.

• The increasing atomisation of value chains, but concentration of value: Thanks to data, analytics and network eco-systems, organisations will likely specialize even more in the areas where they have competitive advantage. In many industries such as banking, we notice the atomisation of value chains driven by open architecture information networks. These network eco-systems will direct 'work packets' to the most effective and efficient operators and, therefore, severely disrupt traditional monolithic 'end-to-end' service delivery models.

Regulatory barriers

Across industries and across the globe, governments and regulators are establishing the regulatory frameworks that will guide the use of data and the development of AI. Issues such as the privacy of personal data, the ethics of how AI can and should be used, and antitrust matters relating to new data-driven industries are being formed and developed before our eyes.

For enterprises and other organisations, it is critical to have a strong dialogue with regulators in order for plans to be ratified and regulations impacting businesses to be discussed and influenced. It is only via partnerships between regulators, consumers and businesses that the right balance can be found for many of the issues mentioned above.

As AI will be a key driver of the fourth industrial revolution, it is incumbent on organisations of all sizes to understand the wider implications of AI for clients, communities, staff and other stakeholders. The adoption of AI cannot be seen as primarily a 'technology challenge' as the impact, as described in the paragraphs above, is much more profound. By building an inclusive approach to enterprise AI enablement, we can help everyone to better live with AI.

Gerald Mackenzie - CREDIT SUISSE

AI: an Opportunity for Small Businesses to Compete with the Big Guys

According to the ASEAN [34], Small and Medium Enterprises (SME) in ASEAN countries account for between 88.8% and 99.9% total establishments and between 51.7% and 97.2% of total employment. The contribution of these companies to each ASEAN country GDP is between 30% and 53%. SMEs just cannot be ignored. Why does it often seem that SMEs are left out of the digital revolution? We believe there is an accessibility gap, and a profound asymmetry in capabilities and power.

The digital economy benefits in the hands of a few

Over the past few years, we have seen a nascent digital economy take shape, at the intersection of technology, data and algorithms; driven by exponential demand for speed and personalisation. Pioneered and probably best represented by the FAMGA (Facebook, Amazon, Microsoft, Google and Apple) and the BAT (Baidu, Alibaba and Tencent), digital and AI technologies have been democratised and made more accessible to all. For example, Amazon Comprehend, Azure Linguistic Analytics Facebook's Wit.AI and Google Cloud Natural Language are all APIs that offer natural language processing as a service. Moreover, they are either free or affordable, and easy to use.

However, they are controlled by a handful of companies and these have grown "unprecedented power" as described by Shoshana Zuboff in her latest book *The Age of Surveillance Capitalism*. It has led to an unsustainable imbalance:

• Outsized growth largely enabled by the lack of any form of social, political or regulatory resistance; pushing the boundaries of the socially acceptable (such as privacy) and new legislations (like GDPR, or General Data Protection Regulation, and Personal Data Protection Act, or PDPA data protection laws).

• Exclusive ownership of the customer experience based on subtle (i.e. Amazon open voice ecosystem) and not-so-subtle non-interoperability (i.e. Apple, Samsung), forcing users to adhere to the company's realm and creating a digital-social divide (e.g. "Are you an iPhone or an Android person?").

• Exceptional concentration of power, wealth and knowledge: a winner-takes-all game where the pursuit of market domination, financial rewards, total appropriation and proprietary intellectual capital control leads to a monopolistic market structure.

On the other hand, digital and AI technologies are still not very accessible to SMEs, who lack internal capabilities and don't really get the attention they deserve as vendors pursue big brands to make a name of themselves and think that is where the money (and the hype) is.

Keeping the pace of transformation

There is a reason why taking the digital turn can be such a Herculean task. In his book Smart Business, Ming Zeng, the former Chief of Staff and strategy adviser to Alibaba Group's founder Jack Ma, defines the path to become a Smart Business, a company capable of "automating every decision possible": a digital business should use data to create both efficiencies and greater information asymmetry in order to build a sustainable competitive advantage at scale.

It is then easy to understand why most digital and AI initiatives fail to scale. In many cases, data scarcity or availability, data mining costs and structural organisation changes outweigh the perceived future market value of such massive transformation. In short, most companies have not reformed their business enough yet to capture such value in full. And legacy businesses in particular face great inertia to implement such a roadmap.

Small businesses, especially in retail, are suffering from the aggressive competition of the larger chains and e-commerce. What are they competing against? Choice, price, reach… and insights.

Digital giants like Alibaba to Amazon have built their business around relentless and systematic data collection and AI-powered automation to better understand and anticipate customer needs: what to sell, when to sell it, and who to sell it to. The information they collect is processed and used to their advantage to manage and automate the end-to-end customer life cycle: target-engage-convert-service-retain.

Small businesses, on the other hand, have a few unique characteristics that work in their favour. For example, small independent retailers can leverage location and customer proximity (they still beat Amazon's one-hour delivery window), agility and speed (*Small is beautiful* by British economist E.F. Schumacher), human connections (they personally know their customers), simplified governance and low operating cost (see this great article from McKinsey on "the five attributes of enduring family businesses" [35]), little to no legacy technology infrastructure; to name a few.

New and small businesses can leapfrog and build these new capabilities from the ground up for a fraction of the cost and time. Most small businesses would have tons of data already, such as business website data, Facebook page data, Wi-Fi hotpot user data, point of sale data, CCTV cameras, loyalty card data, etc. Consolidating, normalising and using this data at scale can provide tremendous value: stores could predict demand for certain products and build up inventory accordingly, monitor on-shelf availability, identify low-performing products and reallocate shelf space to growing categories.

And on the solution side, a full suite of products and services are readily available, from off the shelf Internet of Things sensors, to turn-key cloud infrastructure, to ready-to-use data science platforms.

SME should leverage their unique data

The missing link is the last mile to the data: the final step to integrate the data and these services together requires some expertise and capabilities not accessible by SMEs. The main challenges for business owners include:

• Access to new capabilities: SMEs need help and support from vendors to equip them with the latest solutions. Solution providers need to understand the opportunity that SMEs represent.

• Adoption of new technologies: managers and staff will need to embrace new ways of doing things. Solution providers need to design outstanding customer experiences to lower the barrier of entry.

• Change from instinct-led to data-driven when making business decisions: business owners and managers need to rely on data more and more. Solution providers have to deliver insights and intelligence in ways that blends with their daily workflows to minimise change and maximise impact.

A successful transformation into an AI-powered digital business will therefore be possible using:

• Sustainable business models based on reciprocities: creating a fair exchange of value between the data producer-owner and the data processor-miner. It means to make data work for data owners first; and if they allow it, enable them to share for the benefit of others and to monetise for their own. Mining behavioural data for the originators' benefits and not for third parties' profits.

• New Capabilities: Enabling SMEs with the means to transform into smart businesses via low cost, intuitive, turnkey solutions.

• Mind-set shift: From instinct-led to data-driven business, small businesses have to change and adapt their behaviours to maximise the value provided via the adoption of such new technology.

Facing the big tech competition – or should we say "domination" – SMEs struggle to keep the pace of transformation. Nevertheless, as they produce data throughout their activities, this should help them bear fruit. SMEs represent a massive growth opportunity and untapped market for solution providers and platform businesses. And, for those who think these small corner shops are dead, according to kr-asia [36], online commerce still represents only 2-3% of total retail sales in South East Asia.

Damien Kopp – ENVOLVE DATA

Chatbots and virtual assistants enhanced by AI: a new opportunity for organisations

by Taiger

This article serves as a checkpoint amongst current narratives, in order to think about chatbots and virtual assistants with the ends in mind. With rising business complexity and customer expectations, AI applied to virtual assistants is becoming more critical for companies seeking to scale both efficiently and effectively. Chatbots and virtual assistants are effective for day-to-day customer responses' consistency as well as to provide ongoing analytics for customer experience management. They could help companies – and hospitals – to better service their customers – and their patients.

The internet has responded with tons of resources on what's next for chatbots and how to build the best ones; bots' development is maturing. However, current senior executives are figuring out critical questions: what is the true organisational value of a virtual assistant? How does a virtual assistant roadmap look like? It is no surprise that Garnter's hype cycle report on customer service and customer engagement in August 2018 shows that chatbots and virtual assistants are still dredging in the 'inflated expectations' stages, meaning there are a lot of solutions, a lot of claims, but sporadic successes. Those familiar with the hype cycle knows that after the 'inflated expectation' stage comes the 'disillusioned' stage. Enterprises without a long-term plan risk enter a costly journey of disillusionment instead of delivered value.

Interbots-operability: a useful tool for consumer-centric organizations

Bots and virtual assistants can be built to benefit the entire stakeholder chain both internal and external. Banks and financial institutions use bots to serve as a customer facing portal for day-to-day queries and transactions, thus providing a better customer experience. By studying their own customers over time, they identify the needs – both unmet or future – that could give them a first mover advantage on new products and services.

In the healthcare area, for instance, interbot-operability could be key to anticipate and enhance patients' needs, as chatbot and virtual assistant platform can provide a single view of the user. It would also allow patient-centric organizations such as hospital to cope with the heavy volume of interactions. A patient could use one bot to schedule health check appointments through connected knowledge banks like CRMs, appointment calendar and notification system. When the patient is in premise, one bot could serve as a concierge on most common Q&As. Post treatment, another bot may serve as an allied-health

advisor, providing recommendations and accountability to recovering patients off site. All these bots would finally funnel through one master bot interface, in order to be proactive, predict services, anticipate logistics' demands more accurately, and monitor costs more closely.

Bots' KPIs embedded into business scorecards

To set a long-term plan with chatbots and virtual assistants, companies should investigate chatbots' impact on various business functions' scorecards. What are the objectives and key results that can be significantly driven by an AI virtual assistant? Investigating the impact on end-to-end business functions is an undertaking that involves cross-functional collaboration across data and insights, customer experience, service operations, and possible risk management and procurement depending on the complexity.

User-sensitivity is the new frontier

Finally, bots might be chat-friendly, but are they user-friendly? Chatbots and virtual assistants, which are communication-centric, would need to consider usability in its full entirety. Here are a few considerations. Firstly, the ability to recognise common nuances like cultural slang and accents with accuracy would be particularly necessary for countries and industries where they exist. Secondly, the ability to process various inputs beyond text – image, speech or even facial expression recognition – would allow users to interact more freely. Thirdly, the ability to integrate with social platforms that users are accustomed to, such as Facebook, Whatsapp, Twitter or dominant Asian chat platforms like KaKao and WeChat, would also be a key consideration .

The Significance of "Edge Cases" and the Cost of Imperfection as it Pertains to AI Adoption

"For the want of a nail the shoe was lost,
For the want of a shoe the horse was lost,
For the want of a horse the rider was lost,
For the want of a rider the battle was lost,
For the want of a battle the kingdom was lost,
And all for the want of a horseshoe nail."
*Benjamin Franklin (*Poor Richards Almanack*)*

With the advent of new tools and technologies, it is tempting to think that the rules of work have changed or that old problems can be forgotten. This is often true, but as we use new technology, we see new manifestations of ancient problems. The above poem uses a dated reference, for modern militaries don't often rely on horseshoe nails. However, the spirit of this poem remains true: small problems often have large effects, as we can witness in many applications of AI. The degree to which this applies informs which AI applications can have widespread adoption, and which will remain experimental.

Image classification as an illustration of edge cases

AI has broad capabilities, with varying levels of adoption. Each application of AI inevitably encounters scenarios in which the systems do not perform as required or as expected. We call these scenarios "edge cases".

Deep learning and convolutional neural networks are two AI techniques used extensively to perform image classification. On one hand, humans can look at a picture and identify what the subject of the image is. On the other hand, machines don't fare too badly – in fact, Google's "Show and Tell" algorithm can caption an image with over 93% accuracy! However, remaining failures of image classification exist and are often amusing. If you search the Web for "sloths or pastries", "chihuahuas or muffins", or "cute dogs or fried chicken", you may have some difficulty distinguishing one from the other. Nevertheless, even with a high failure rate, wherein one in 10 images are not classified properly, these algorithms remain useful, and their failures don't cause real damage.

A self-driving ton of high-speed metal

Humans are involved in car crashes 4.2 times per million miles driven, on average. However, Waymo cars – autonomous vehicles developed by Google – were involved in just over 30 minor crashes (most of which resulting from edge case failures) after driving about 5 million miles. As self-driving vehicles have proven to have a very low failure rate, we can conclude that autonomous vehicles are roughly as safe as human drivers. Thus, why don't we have autonomous vehicles in wide-

spread use? The economic case is strong, but safety remains nonetheless a substantial concern.

We hold AI-driven robotic systems to a different standard because these edge cases manifest issues in the physical world, where real damage can be done. Autonomous vehicles, and nearly all robotics, operate as components in more complex systems. A rogue autonomous freight truck doesn't only destroy its payload, it can potentially plough through a busy intersection, disregarding crosswalks and other traffic.

These "life and death" examples serve as an illustration of how edge cases can limit, or even jeopardise the potential of AI technologies.

The value of edge cases in complex systems

The term "reliability engineering" sheds light on the significance of edge cases in any complex system. Reliability engineering focuses on the costs of failure caused by system downtime, mission success, and mission failure. One case of mission success are devices that operate independently and not as subcomponents in a more complex system. Examples include the generation of search results and image classification.

Complex systems have more elaborate missions, with more interacting components. Determining the reliability of complex systems requires summing up all the failure rates of the subsystems involved in the mission. With this, we can compute the Mean Time Between Failures (MTBF) – that is the "up-time" between two failures of a system during operation. Imagine 50 identical warehouse robots with an individual mission failure rate of 3%, each performing 40 missions per 24-hour day; the MTBF of the individual robot is calculated to be 20 hours. These warehouse robots are more reliable than our image classification algorithm (with a 7% mission failure rate) and may be deemed "good enough".

However, when these 50 devices work together as part of a larger warehouse system, we determine that the warehouse system has an MTBF of only 24 minutes! That is because over the course of 20 hours, each device can roughly be expected to fail once. Furthermore, these AI-driven robots are likely to be working together, interdependently. We cannot ignore the effects of interdependent cascading failure, whereby a single failure is very likely to cause interdependent processes to fail as well, just as in the case of the above horseshoe nail poem.

Seemingly, low occurrences of these edge case failures can quickly result in significant negative outcomes. Single digit failure rates can result in maintenance and intervention costs which outweigh any benefit that is brought about by the introduction of AI technologies.

Just another tool?

Historically, tools enhance human labour: an axe without a human being to swing is not useful. An automated assembly line provides much more leverage than the

axe, but will still invariably contain processes that require human labourers. Thus, why should AI be thought of as an exception? A human may be able to classify thousands of images per day, unassisted. With AI classification tools, the same human can focus on resolving edge cases, effectively classifying hundreds of thousands of images per day. Without a human in the loop to address edge cases, any AI system may not be economically useful, and may even become dangerous.

I think we should accept AI tools as they are: not an all-purpose solution to tackle any tedious cognitive task, but as another tool in our toolbox to enhance human effort. As an example, autopilots do a great deal of work in airplanes, but pilots remain on-board. Several AI-oriented companies have intuited this: the crowdsourcing platform Amazon Mechanical Turk offers a marketplace where "human intelligence tasks" are posted – data verification, labelling objects in videos, podcast transcription – so people can get paid to perform tasks that computers are currently unable to do. Besides, innovative start-ups such as Phantom Auto, Ottopia, and Cognicept Systems are developing systems to allow autonomous systems, such as self-driving vehicles, to request human assistance when edge cases are encountered.

The many current and dire predictions of humans being supplanted by machine intelligence and machine labour may be premature. The economist John Maynard Keynes coined the term "technological unemployment" in 1930, stating "the unemployment caused by our discovery of means to economize the use of labour will run at a faster rate than we can find new uses for work" (in Economic Possibilities for Our Grandchildren, 1930). There is no question that the nature of life and work have changed drastically as a result of technological advances, but humans always find new ways to be productive. And edge cases may very well save humanity from unemployment, once again.

Michael Sayre - COGNICEPT

Can our Well-Being at Work Be Improved in the Age of AI?

The promise of AI lies in its potential to revolutionize what workers do in their daily jobs. AI may be able to replace repetitive and mundane tasks, freeing up workers to do more creative and meaningful tasks. The age of AI can provide a golden opportunity to increase a worker's engagement, job satisfaction, motivation and reduce burnout. Simultaneously, this can also reduce attrition rates while improving performance, productivity and raising the reputation of the company.

Management has a key role to play in the improvement of our well-being in the age of AI. The following are five practical tips for managers to tap into this phenomenon. The tips are categorized into three sections: tips one and two are for identifying workers' pain points in tasks; tips three and four are for optimizing the workflow in these tasks; and tip five defines transparency and fairness in the algorithms of AI systems.

Identifying workers' pain points in tasks

The first tip for management is to identify and rectify workers' current pain points by focusing on addressing repetitive and manual tasks using AI, particularly those tasks which are time consuming and can cause burnout. For example, a team leader may have to spend many hours sorting through a staff schedule spreadsheet to deploy his/her team members to attend to the myriad components of a project. This manual and time-consuming task can cause exhaustion in the team leader. Such tasks should be the first to be addressed and automated by an AI system.

The second tip will be to adopt a bottom-up approach by empowering workers with a voice and choice in identifying the tasks they wish to do. An exemplary instance of this is the case of the patient service associates (PSAs) in Singapore's healthcare sector. PSAs used to carry out many repetitive and manual clerical tasks such as the task of manually entering patient information into a computer system and manually placing hard copy documents into mail envelopes. However, technology has automated such tasks. Rather than retrenching the PSAs, Singaporean hospitals carried out a series of engagement meetings between the hospital's management, the labor unions and the workers. The PSAs were empowered to identify new tasks that they wished to do. PSAs chose more human-centred tasks that increased patient engagement, such as blood drawing and helping elderly patients use new automated computer systems. After proper training, PSAs could then do these basic medical and patient-facing tasks that were previously undertaken by nurses. This might free up the nurses to take on some additional tasks from the doctors, and doctors might then have more time to carry out higher-order tasks. The PSAs could continue being employed, while the entire healthcare sector could improve their service delivery to patients. This provides a compelling example of

how management can work with workers to identify more meaningful tasks that benefit the workers and the company, while allowing technology and AI-related systems to automate repetitive and manual tasks. It also disproves the notion that AI will automatically lead to the retrenchment of workers.

Optimizing the workflow in these tasks

The third tip refers to the need to moderate the frequency and intensity of empathy tasks that workers do when AI systems replace lower-order tasks. Empathy tasks refer to tasks that are more people-facing which require strong soft skills. Such tasks are perceived to be "AI-resistant" since it is difficult for technology to replace the human touch. Many experts have claimed that as lower-order repetitive and manual tasks are replaced by AI systems, workers can transition to doing more empathy tasks. However, excessive frequency and intensity of empathy tasks can be harmful for the worker. For example, a care coordinator working in a hospital who must carry out many empathy tasks such as caring for several end-of-life patients simultaneously and briefing their bereaved caregivers on end-of-life preparations is likely to be emotionally exhausted. Likewise, a social media screener in a social media company who has the task of removing graphic or unsavory online content continuously can be mentally affected as well. It is imperative that management help monitor and moderate the frequency and intensity of empathy tasks that workers do. In the future, it is possible that an intelligent AI system can automatically detect the frequency and intensity of empathy tasks a worker is doing and can then re-assign him/her to another non-empathy task temporarily so that he/she can have a mental health break.

The fourth tip refers to helping workers multi-task effectively. Some experts claim that as AI systems replace repetitive and manual tasks, workers can transition to more advanced tasks. However, if not handled properly, the worker can become overloaded. For example, an AI system can help with the repetitive task of identifying potential customers to a salesperson. However, this may create unrealistic expectations by management that the salesperson must now meet much higher sales targets or should initiate contact with customers at an increased pace. Again, the increase in type, frequency and intensity of tasks can cause burnout in the worker. This is an example of how AI can be 'misused' by poor human management, instead of being the inherent fault of the technology. This potential misuse can be addressed by having policies which allow workers to have sufficient time to focus and prioritize on a singular task when needed, and adequately pacing out their tasks.

Transparency and fairness in the algorithms of AI systems

The fifth tip refers to the need for management to define the transparency and fairness in the algorithms in the AI systems that employees work with, which can profoundly impact how workers carry out tasks. An example of this is how algorithms in AI systems can generate product recommendations to insurance staff based on the customer's ethnicity, gender, or sexual orientation. This can influence the task of service delivery and may unintentionally cause the insurance staff to discriminate against certain minorities. Therefore, management can take the lead

by ensuring that the use of such algorithms, the decision-making process in deriving the algorithms, and the impact on workers' tasks are discussed with all stakeholders to ensure transparency and fairness at all levels.

In conclusion, the age of AI can be a golden opportunity to re-center the conversation on creating a better future of work. Management can identify current workers' pain points and address them, using AI where applicable to automate repetitive and manual tasks. As workers transition from lower-order to higher-order tasks, management can help monitor and moderate the frequency and intensity of empathy tasks while avoiding excessive and unnecessary multi-tasking. Eventually, AI can help with these types of monitoring and moderating too. Lastly, management can take the lead in defining transparency and fairness in the use of algorithms in AI systems. If handled properly, the age of AI can facilitate the creation of jobs suited for the new economy, that contain an eclectic range of meaningful, engaging, empathic and creative tasks.

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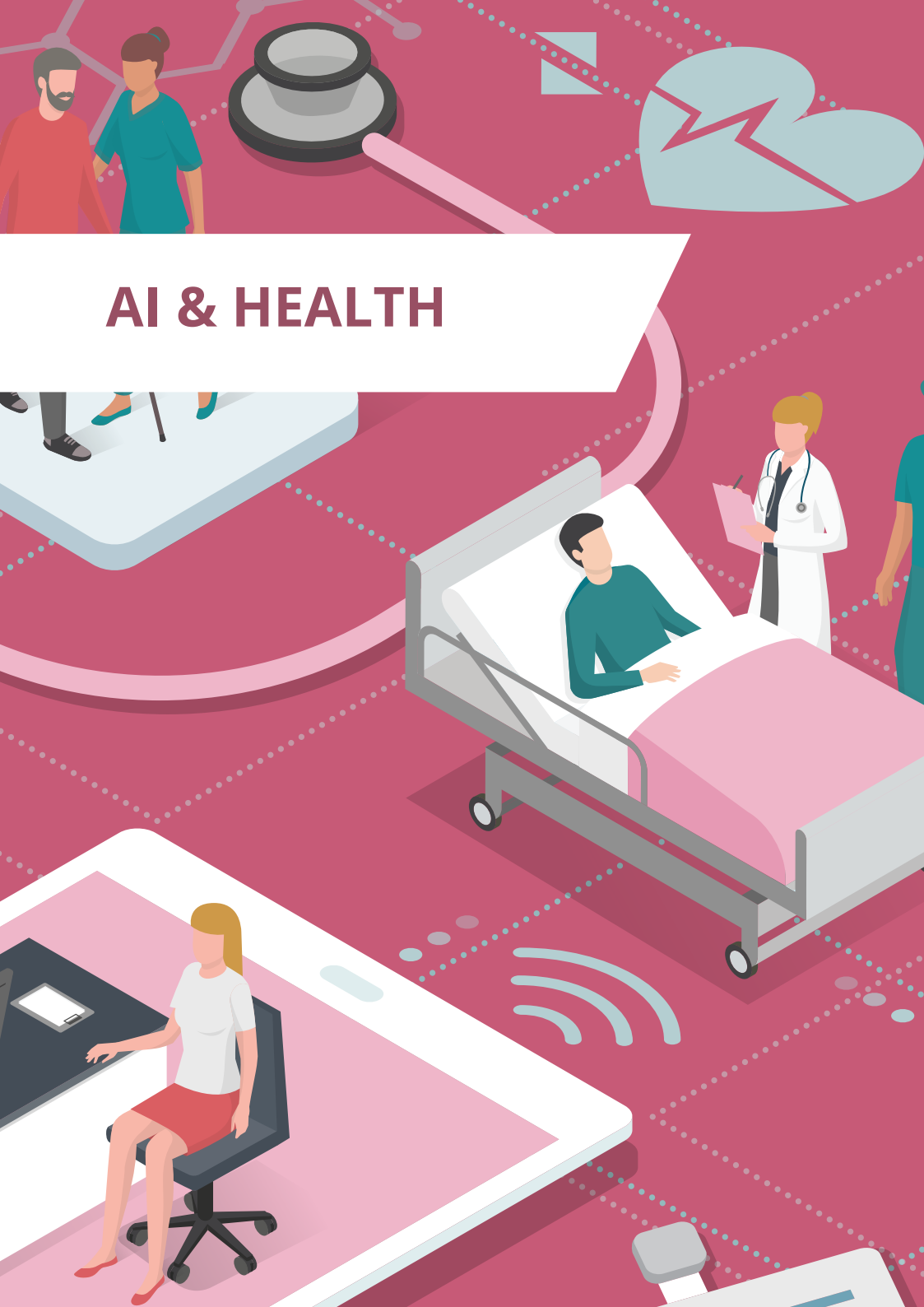
AI & HEALTH

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Putting the 'Care' back into 'Healthcare' [37][2]

We believe AI technologies have a significant role to play in the healthcare domain. Before they can be implemented, however, we must first recognise and address at least two formal deficits in state-of-the-art AI systems: the causality deficit and the care deficit. When making causal inferences and reasoning about causal relationships (on the diagnostic front) and assisting, monitoring, and providing companionship for patients (on the care-giving front), the optimal level of human-level performance far outstrips the optimal level of AI-level performance (Chen, 2019) [38]. An understanding of the current state of global healthcare, a recognition of the need to address both the causality deficit and the care deficit in the design of AI systems, and an appreciation of the value of human-oriented AI will allow us to rise to the challenge of putting the 'care' back into 'healthcare'.

The shallow and deficient state of global healthcare

To understand how best to implement AI technologies in the healthcare domain, we must first come to terms with the state of global healthcare. As a result of declining fertility rates and increasing longevity, the number of people in the world aged 60 years or over is projected to increase from 900 million (12% of the total global population) in 2015 to 2 billion (22% of the total global population) in 2050 (United Nations, 2015) [39]. In conjunction with the increasing prevalence of non-communicable diseases such as heart disease, cancer, and diabetes, climate change and other environmental factors are likely to result in the emergence of new disease threats and conditions. With these demographic and epidemiological trends in place, we have good reason to expect an increase in demand for healthcare workers in the coming years. However, it is anticipated that there will be a global shortfall of 18 million healthcare workers in 2030, especially in low- and lower-middle-income countries (World Health Organization, 2016) [40].

These demographic and epidemiological trends, along with the anticipated shortfall of healthcare resources, have already begun to exert a pressure on the healthcare domain. Symptoms of this pressure include: physician burnout (Epstein & Privitera, 2016) [41], the growing sense among patients that doctors are rushed, busy, and hurried (Singletary, Patel & Heslin, 2017) [42], the recommendation of unnecessary and overused medical tests and procedures such as medical imaging studies for lower back pain and stenting for patients who are unlikely to get any benefit (Brownlee et al, 2017) [43], and the over-prescription of drugs by doctors who are too busy to listen to their patients and the related opioid epidemic in the U.S. (Topol, 2019) [44]. If our primary concern is with the quality of care received by the patients

[2] Please refer to the endnote section at the end of the report.

and their health outcomes, then the suboptimal outcomes, sheer waste, and unnecessary harm to which we are led by the practice of contemporary medicine ought to give us pause. As Francis Peabody (1927) [45] well knew, the secret of caring for the patient is in caring for the patient. This humanistic ideal in medical practice, equally championed by Hippocrates and Sir William Osler, is what we risk losing if we fail to cope with the growing pressure on the healthcare domain.

Using human-oriented AI to put the 'care' back into 'healthcare'

Enter AI. AI systems can handle far more complex datasets than human beings, do not experience fatigue or distraction in the manner that human beings might, possess superior computational bandwidth, and have the potential to add value to the healthcare domain. The burgeoning pattern recognition abilities of machine learning-based AI systems, in particular, have led some to suggest that they could soon replace human radiologists and pathologists in reading and reviewing X-rays, CT scans, and tissue slides (Chockley & Emanuel, 2016) [46].

We believe that underlying the humanistic ideal in medical practice is the need for human-to-human bonding and support, which entails that we must think in terms of AI-human interfaces. It is not that radiologists and pathologists will be replaced by AI systems in medical imaging but rather that they will up-skill, develop more value-added functions, and enhance the quality of healthcare. Patients will benefit from more interactions with radiologists and pathologists, who will become more integrated within the clinical care teams (Recht & Bryan, 2017) [47]. Appropriately implemented, AI systems will be able to relieve at least some of the growing pressure on the healthcare domain, free up much-needed time, augment the abilities of both human healthcare professionals and human patients, and improve the quality of care received by the patients and their health outcomes. Symptom checker programs augment the self-triage abilities of patients and diagnostic abilities of healthcare professionals, telemedicine allows for the overcoming of physical barriers and the provision of clinical healthcare from a distance, and exoskeleton suits allow both human patients and caregivers to exceed their natural physical limitations. Inappropriately implemented, however, AI systems might reinforce the growing pressure on the healthcare domain: think of the increase in burnout that physicians experience from the data entry demands of electronic health record and computerised physician order entry systems (Shanafelt et al.,2016) [48].

AI systems will be appropriately implemented only if they are human-oriented and their designers take into consideration the diverse interests and concerns of the various stakeholders in the healthcare domain, including but not limited to the following: patients, doctors, nurses, physicians, pharmacists, and researchers. In all instances, we should proceed with an awareness of both the state-of-the-art-capabilities and formal deficits of AI systems, a full recognition of the humanistic ideal in medical practice and the growing pressure on the healthcare domain, and a hope that appropriately implemented AI systems can help us to put the 'care' back into 'healthcare'.

AI at the Edge and the Need to Consider a Decentralised Model

One of the key challenges in scaling AI revolves around the need to foster conditions for the trustworthy adoption of new types of big data-driven algorithmic processing. If we want the Internet of Things (IoT) health revolution to realise its full potential in the long term, patient data provenance and integrity, as well as that of their processing, need to be guaranteed to minimise undesired bias and cyber-security risks. Medical devices will accelerate patient connection with healthcare providers and self-manage pre-diagnostics and part of the treatment due to intelligent solutions. Nevertheless, this future would require new data sharing models, preserving our data privacy and security, and eventually handing control of our health data back to us. Relying on Distributed Ledger Technologies (DLTs) such as the blockchain will offer such opportunities in fostering AI-driven solutions; healthcare could be the first to benefit from this.

The rise of the IoT

The semiconductor industry has been religiously following Moore's law and kept on delivering its promise of doubling the integration level and performance of electronic circuits every two years or so. Combined with a massive increase in volume production and an aggressive competitive landscape, it has resulted in a significant component's price erosion. Consequently, we have observed the arising of far more diverse and capable electronic equipment (features, processing speed, and memory storage) at a lower manufacturing cost across all industry segments.

The IoT consists of three main semiconductor functions: processing, sensor and connectivity components. Therefore, the IoT "revolution" is a logical consequence of the aforementioned, together with major improvement in connectivity network infrastructure (Internet and Telecom). Once tens of billions of newly connected smart devices begin communicating all of their different kinds of data, it will by far surpass the volume we witness today. The era of pervasive IoT has started and also applies to healthcare, called the Internet of Medical Things (IoMT), which will bring positive contributions to lower healthcare costs in the years to come and improve treatment and services to patients.

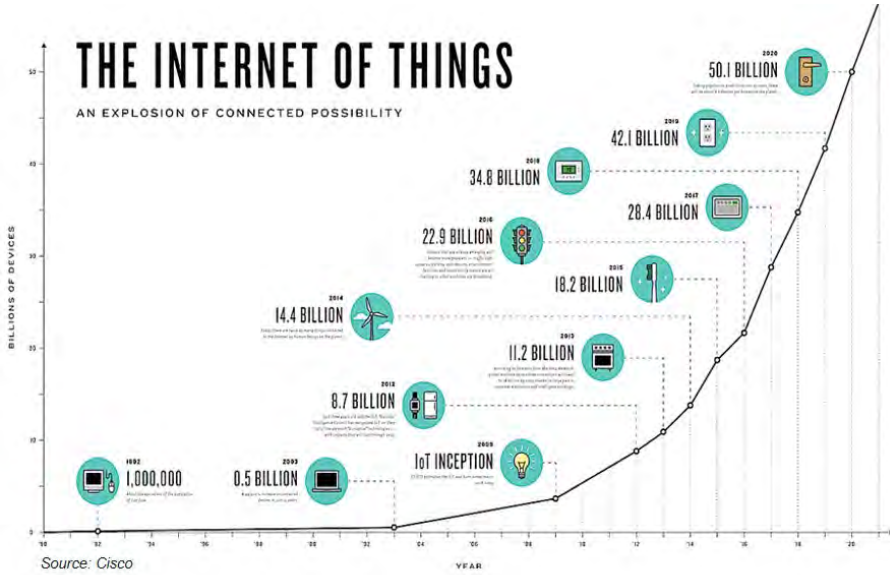


Figure 1
Source: Cisco

AI, a general-purpose technology in need of a sustainable model

Similarly, the recent acceleration and excitement around artificial intelligence have been the result of converging trends: the growing flows and stocks of high resolution data, increasing availability of high performance computing power, advances in machine learning – especially deep learning across domains such as computer vision or natural language processing – and high-speed communication networks providing widely available large data bandwidth. From that perspective, AI can be analysed as a general-purpose technology serving as the pivot point for the enablement of the next phase of the digital revolution.

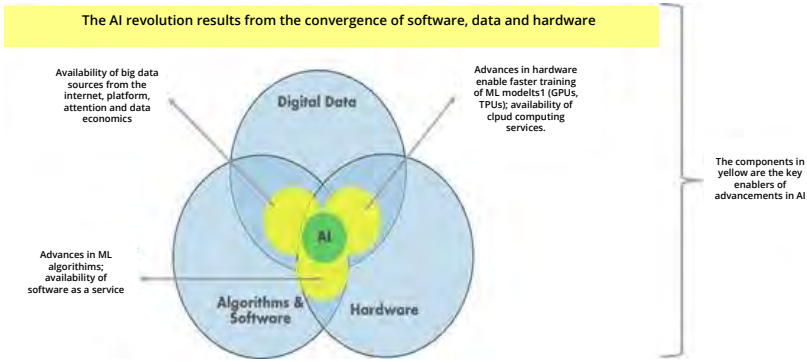
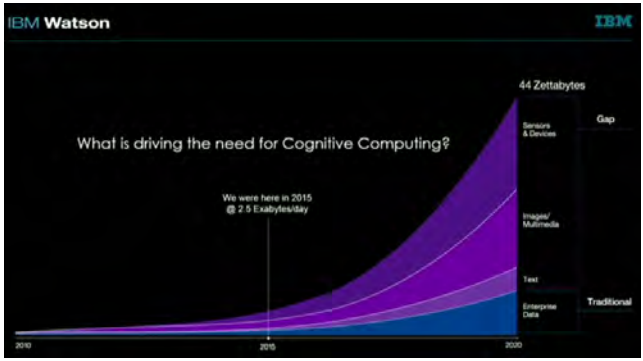


Figure 2
Source: https://thefuturesociety.org/

So far, the industrial added value chain of AI implementation has relied massively on that of cloud computing. It has enabled the rise of a good amount of innovations and solutions in autonomous mobility, medical diagnosis assistance, facial recognition, and virtual personal assistants. But this is coming at the expense of a model that is neither sustainable nor scalable, since it is assuming unlimited computing power, data storage and networks resources. Looking at the current excessive volume of largely unstructured data generated, and projected volumes ahead of the deployment of billions of IoT devices in the coming years, it will be necessary to call for a newer more complementary approach and model, and decentralise part of the value chain of AI computing.

Decentralisation as an alternative of the AI cloud-based approach



"A PC will generate 90 megabytes of data a day, an autonomous car will generate 4 terabytes a day, a connected plane will generate 50 terabytes a day."

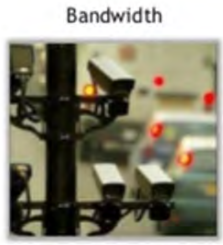


Figure 3.
Source: https://www.tractica.com/

By 2020, up to 44 Zettabytes of data (44 billion Terabytes) could be generated daily. Such an unprecedented amount of data calling for continuous transfer, processing and storage will require far more infrastructure resources to mitigate the unavoidable effect of saturation and the limitations of cloud computing. Several other factors, like real-time requirements (minimum system latency response) for

critical application, or better user experience and the necessity of increased security, are colliding and highlighting the limits of current cloud-based AI as a solitary approach.

Therefore, a decentralisation of AI cloud computing at the edge level, materialised by one or multiple gateways (a communication network concentrator aggregating multiple sensors and higher computing power) and intelligent nodes (smart sensors able to run deep learning inference) would allow a more scalable and balanced AI framework implementation.

This complementary solution approach would provide the following benefits:

•Improved real-time processing to ensure lowest-latency response with local autonomous action from systems (safety will be imperative in autonomous vehicles).
• Data privacy and security (less or no sensitive data shared over networks, insulated or self-contained system)
• Power consumption optimization for longer lasting battery (battery operated devices)
• Data sorting, filtering, pre-processing at Edge/Node level before Cloud (limit unstructured data and offload cloud processing)
• Improve efficiency usage of cloud connectivity based on availability and bandwidth
• AI's processing load optimization between cloud and edge devices

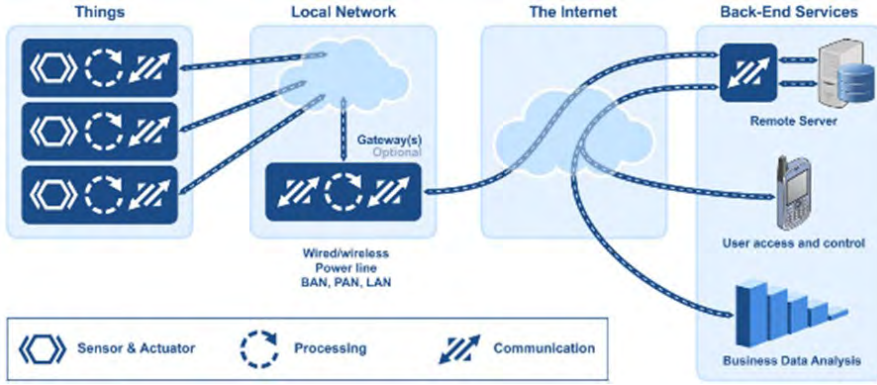


Figure 4
Source: thefuturesociety.org

A decentralised system could provide an answer to the current negative points of healthcare, such as the lack of adopted open standards for health data, the fragile interoperability, lack of handheld personal monitoring devices, and the unsuitable security architecture. For instance, European companies have started promoting and offering decentralised alternatives; the Slovenian start-up Iryo is one example amongst others.

Use distributed ledger technologies (DLTs) in healthcare

Relying on DLTs such as the blockchain could help us, not so much to secure the data itself, but to ensure its integrity, i.e. its immutability regarding potential tampering, alteration or removal. As processing relies on more complex, powerful and opaque algorithms like the now famous deep neural networks, which mobilise hundreds of parallel layers of processing, DLTs can also play an instrumental role in creating the conditions for better traceability and explainability of the decisions made on the basis of advanced algorithms: healthcare could easily take advantage of such a system.

In healthcare, the use of DLTs associated with an emerging ecosystem of new legal frameworks can also power a wave of new data sharing protocols, which are crucial to enabling the secure and free flow of data at scale. The emerging framework of "data trusts" is a good example: a bottom-up contractual mechanism whereby a very large number of data subjects choose to pool their data within a trust, and delegate data management rights (structuring, labelling, processing, storage, and portability) to professionally trained managers according to predetermined terms and conditions and a strict fiduciary duty.

Some practical example of the combination of the previously mentioned elements (IoT, AI, blockchain) can be found in the healthcare domain with a new generation of wearable devices. These devices are collecting the raw data from embedded motion sensors (accelerometer and gyroscope) and run deep learning inference to perform, for instance, the classification over different Parkinson disease's patterns, especially the freezing of gait often responsible for patient falls. Thanks to its real time processing capability (local deep learning inference), it could trigger a buzzer milli-seconds prior to the occurrence of the freezing of gait and help prevent the fall. The patient's data could also be shared among different stakeholders (patient, doctor, hospital, clinic) through a secured and immutable ledger framework using blockchain technology. This will reinforce the trust among the various stakeholders of this ecosystem and allow new business models and incentives for end users to be more proactively willing to share their data.

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Solutions for Parkinson's Disease Patients enabled by Artificial Intelligence and Blockchain Technology

Parkinson's Disease (PD) is the second most common neurodegenerative disease in the world, and affects around 1% of people over the age of 60. People with PD suffer a lack of the hormone and neurotransmitter dopamine in the midbrain, causing resting tremors and motor impairment, among various other symptoms. As such, treatment involves the substitution of dopamine. If administered appropriately, using personalised medication schedules, the drugs can help significantly ease the symptoms or even make them disappear.

However, appropriate treatment requires an individualised medication schedule, tailored to the needs of affected patients, which is currently not available in routine PD care. A personalised medication schedule would require a continuous, objective and precise measurement of motor symptoms experienced by the patients during all activities of their daily living.

ConnectedLife is a digital health diagnostics company providing IoT & AI-empowered technology solutions for chronic disease patients, with offices in Singapore and Germany. ConnectedLife has developed state-of-the-art technology which analyses the motor symptoms of PD patients by leveraging high-frequency motion sensor data collected from wearable devices such as smart watches. Using this motion data as input for machine learning models (e.g. deep neural networks), ConnectedLife is able to constantly and precisely measure the current symptom severity and corresponding dopamine requirement, therefore providing patients with personalised symptom monitoring, which makes the provision of optimised and individualised care possible.

Apart from the development of cutting-edge deep learning technology, one of ConnectedLife's major projects is the creation of an internal data repository that can be used with their reputable international clinical partners to make sharing of data transparent, trusted, and secure. These organisations are incentivised to contribute their data for research, enabling 1) prevention 2) early diagnosis and 3) personalised treatment to help in the fight against conditions like PD. The repository will provide secure access to the anonymised, valuable healthcare data of PD patients that is collected during the clinical studies.

This underpins ConnectedLife's collaboration with decentralised data sharing technology provider Ocean Protocol, which enables them to demonstrate the power of peer-to-peer data sharing using blockchain technology and smart contracts. At the same time, Ocean Protocol empowers the creation of a system to store patient's data sharing consent and records of the provenance of data and associated services. Data provenance gives information about the data's origin, which

transactions are performed on it, and where it moves over time along the data value chain. Thereby, data provenance provides transparency while facilitating the ability to trace back errors to the root cause in the process of building data-driven solutions. Provenance is particularly important in health AI applications, in order to track the robustness of machine learning models and ensure their interpretability. Fusing AI and blockchain technology, ConnectedLife creates sustainable cutting-edge AI solutions to improve the management of severe conditions like Parkinson's disease, and in turn enrich quality of life for affected patients.

connectedlife

How should we consider unlocking greatest value from the AI and blockchain convergence?

By design, blockchain technology provides AI systems with a more quantitative and qualitative engine to power the use of actionable information: smart, trustworthy automation from end-to-end. Combined, both technologies can bring lots of value to the AI-driven healthcare world. Following the previous Parkinson's case study, we should also consider how AI and blockchain can come together to improve clinical trials, as they enhance the quality of interactions between numerous stakeholders including patients, medical professionals, pharmaceutical companies and regulators.

Such new models can enhance the recruitment of patients. According to Deep 6 AI, a company trying to improve the clinical trial enrolment process by transforming the way researchers identify suitable patients, "86% of clinical trials fail to recruit sufficient patients". Deep 6 AI has designed algorithms to quickly identify patients and match them to complex trial criteria, thereby reducing the risk of failure of a trial due to unsuitable patients. This said, lots of barriers remain to ensure patient data will be used in the right way and we can envision how valuable decentralised models could be in securing, anonymising and processing patient data usage. It's time to consider new models.

The AI & blockchain convergence requires new models and human-centric services

1/ Propose a new "consent as a service" model

The organiser of a clinical trial should always obtain the participants' informed consent to the use of their personal data, particularly given its sensitive nature. This should involve the organiser disclosing to the participants all pertinent information regarding the trial, including the protocol and the potential risks, so that the participant is able to make a fully informed decision as to whether to allow their personal health data to be used. Collecting and recording patients' consent on the blockchain can guarantee reliability and traceability of, and facilitate access to, data. In this regard, researchers at the University of California recently succeeded in creating a proof-of-concept trial method for ensuring the integrity of clinical trial data using blockchain, whereby all data is recorded using an algorithm (SHA256 or Secure Hash Algorithm, like a signature for a text or a data file as an almost-unique, fixed size 256-bit hash).

2/ Use AI to define a new health value economic model

To foster health data sharing, it is essential that people become aware of the value generated, as it will benefit many sectors of the healthcare industry as well as many various other patients. For instance, it will allow the R&D and innovation

sectors to delve into new research. On the other hand, as various stakeholders will benefit from this, citizens need to be empowered and motivated: we must reinvent healthcare economics and reward systems. To unlock the data economy's full potential, it is vital that we define a new health value economic model, a financial system with sustainable and inclusive foundations, enabling the auto-regulation of this new health data economy.

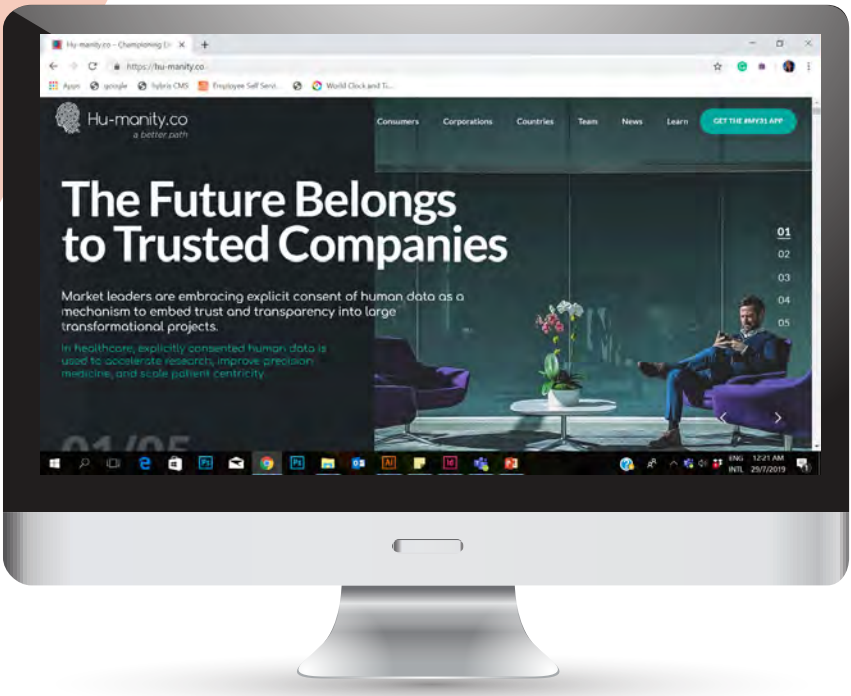
3/ Understand the shift in data ownership to define new legal models

We must define how data should be regulated, as health data sharing is a complex process. It involves many stakeholders, making it essential to create new data sharing protocols. First and foremost, we must ensure patient safety, as the use of health data could give rise to potential legal issues. An essential legal matter arises when patients want to value their health data. To give patients control over their data and reward them for sharing it, we should take into consideration new collaborative models for data sharing. Thanks to their core processes, AI and blockchain can allow the data economy to increase its impact throughout the world, but we need to ensure new legal models would be capable of fostering this collaboration.

4/ Ensure data quality in regulating data provenance

Could clinical trials involving AI and blockchain still face the same difficulties, as traditional data recording means protecting data privacy? Getting quality data for training AI models is complex, but working with large quantities of data in the healthcare space is the real challenge, due to the privacy issues associated with personal health information. Solutions currently being considered to protect data privacy are the pseudonymisation of patient data, restricting access to the blockchain, and recording sensitive data off-chain. De-identification of electronic health records via AI algorithms provides the opportunity to use such data for research without it affecting patient privacy. That said, data provenance has more importance than ever, making new tracking models essential.

Claire Douangmala – MALTEM
Pierre Robinet – OGILVY CONSULTING
Lucas Nicolet-Serra – SIMMONS & SIMMONS LLP
Daryl Arnold – OCEAN PROTOCOLE


Hu-manity.co
a better path
Consumers
Corporations
Countries
Team
News
Learn
The Future Belongs to Trusted Companies
Market leaders are embracing explicit consent of human data as a mechanism to embed trust and transparency into large transformational projects.
In healthcare, explicitly consented human data is used to accelerate research, improve precision medicine, and scale patient centricity
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05

The Hu-manity.co use case

The start-up Hu-manity.co was launched almost one year ago in the USA. It has created "My31app", whose name represents what the founders deem as the 31st human right (making reference to the 30 articles in the United Nations' Universal Declaration of Human Rights): "your data, your choice, your future".

The vision of the product is quite simple: allowing consumers the choice to share their personal information with corporations using what they call "consent as a service". To make this possible, the users' data are stored on a blockchain, which is updated and validated directly by the owners of the data. The end users can decide to lock or unlock the information they want to share depending on the topic. At the end, the consumers are rewarded directly by the entity that chooses to use the information they provided within the blockchain.

The idea of Hu-manity.co is to break the unfair economy on personal data which has been growing for decades, led by big tech companies. By inverting the relations between corporations and consumers, bringing ownership of personal data back to consumers and developing more trust, the start-up improves the amount of accurate information in the market for the greater good.

This ethical vision can be applied to the healthcare domain, where the shift in ownership of data will benefit everyone. First and foremost, the consumer is financially compensated for the usage of their information, and can benefit from the result of the research in some studies. In addition, the entire healthcare industry stands to gain from massive amounts of accurate data to explore and process their data models and algorithms more efficiently, in order to ultimately get better results. The start-up might be in a very early stage, but we look forward, nevertheless, to seeing if their vision will become a reality.

Using decentralised models might help in answering some of the healthcare industry imperatives: the need to enhance the consent management experience as the use case we have presented proves its usefulness, the need for wealth management distribution and a new economic model that goes with it, the need for new legal models to ensure transparent distribution, and finally, the need to regulate health AI using provenance information. The next articles will try their best to provide information and clarify these imperatives.

Claire DOUANGMALA - MALTEM

Consent as a service

The ethical guidelines laid out in the Hippocratic Oath nearly 2,500 years ago are about to collide with 21st century artificial intelligence [49]. The American Medical Association [50] warns that healthcare AI must safeguard the privacy and security of patient information, as a commitment to doctor-patient confidentiality has been a cornerstone of medicine since Hippocrates. While we are excited by the value we see in emerging and proposed patient platforms, we must ensure that technology providers and decision-makers are building an ethical, inclusive, integrated and patient-first model. Facing such a revolution, one question remains nevertheless critical to empower humans: what are the needs to turn our "health consent" into a commoditised service which is valuable to us and our peers?

We envision the need to move toward a universal healthcare system. This model should consider human diversity and the value of personal data in both medical knowledge creation and application, in order to recommend measures for a healthy lifestyle and deliver the most efficient treatment. This naturally leads us to consider newer platforms and services, which will help us in the near future to have full control over our own health data, and a civic mandate to manage it properly and responsibly.

"Consent as a service" is a must-have to preserve our autonomy at the age of AI

Consent is what philosophers call a normative power. This ability is one part of autonomy: by giving consent, we are able to control our moral relationship with other people. Giving consent requires three main components:

• We need to be **capable**: we have to understand the information given about our health data usage. It is essential to use this information to make an informed decision. In cases of incapacity (accidents, ageing population, etc.) blockchain technology can help stamp some of our data usage decisions and seamlessly help in case of emergency treatments.

• We need to be **informed** and be given all the information about any treatment or use of our data, including benefit, risks, profit, and collaterals. However, informing people on such un-framed consequences is a huge challenge considering we, as humans, suffer from our own biases and a huge availability heuristic when it comes to our health data management.

• We need to be **willing to** give consent and must not be influenced by pressure from any medical staff, friends, insurance, family, or any healthcare third parties. Achieving this willingness through easy, efficient and impactful action will intrinsically require specific patient empowerment services.

Blockchain to dispel people's fear toward health-data sharing

As data privacy is fundamental to health data, we believe that new technologies such as blockchain and AI could be used to ensure informed consent of the patient and allow them to control the access to their medical information. For instance, in France, within the scope of clinical trial, the organiser must always conduct a pre-trial interview and obtain informed consent from participants to use their personal data. Pseudonymisation of patient data, private or permissioned blockchain and recording sensitive data off-chain are solutions enabled by new technologies which are currently being considered.

As a blockchain can already solve some of the aforementioned pain points and redistribute the power of managing health data to citizens, we believe in the importance of them being well-informed. Any citizen should be able to fully own the power of their DNA, genome and health and wellness data.

As reported by Microsoft in one of their last health reports [51], Nicolas Bedlington from the European Patient Forum, EPF [52] states that "patients are generally willing to share their data to advance research in their disease area. But they are never cavalier. The holy grail is data security data quality and data compliance. This is why EPF is driving a new "Data Saves Lives" initiative at European level to raise awareness about the issues linked to data that really matter to patients". There is more work to be done to increase the voice of the patient in healthcare design, and the patient community is willing to engage.

We also believe in the urgent need to continuously empower citizens in consent sharing actions. In that regard, how might we leverage AI and machine learning to identify the best moments and actions to convince more citizens to contribute to healthcare enhancement by giving their consent? The Health-EU [52] initiative leverages AI to provide all citizens with a human avatar, and integrates behaviour sciences and is capable of truly delivering on the promises of personalised, preventive and participatory medicine. This may help enable such self-efficacy: who better than you to convince you this is the moment to share your data? This is a very good example of the use of AI to foster consent as a service commoditisation.

Finally, implementing the right legal framework is essential and will allow people to continuously review any decision made on any data sharing. Empowered with advanced available services and platforms, more and more of which are decentralised and supported by government initiatives, we may finally consider that we all need to control our "right to be forgotten". Such a human right is critical if we want to preserve human autonomy, very often highlighted as a key pillar of ethical frameworks on AI governance. And this human right will need to be better considered as we move forward into a time when our data will be accessible to everyone, everywhere, all the time.

Pierre Robinet – OGILVY CONSULTING

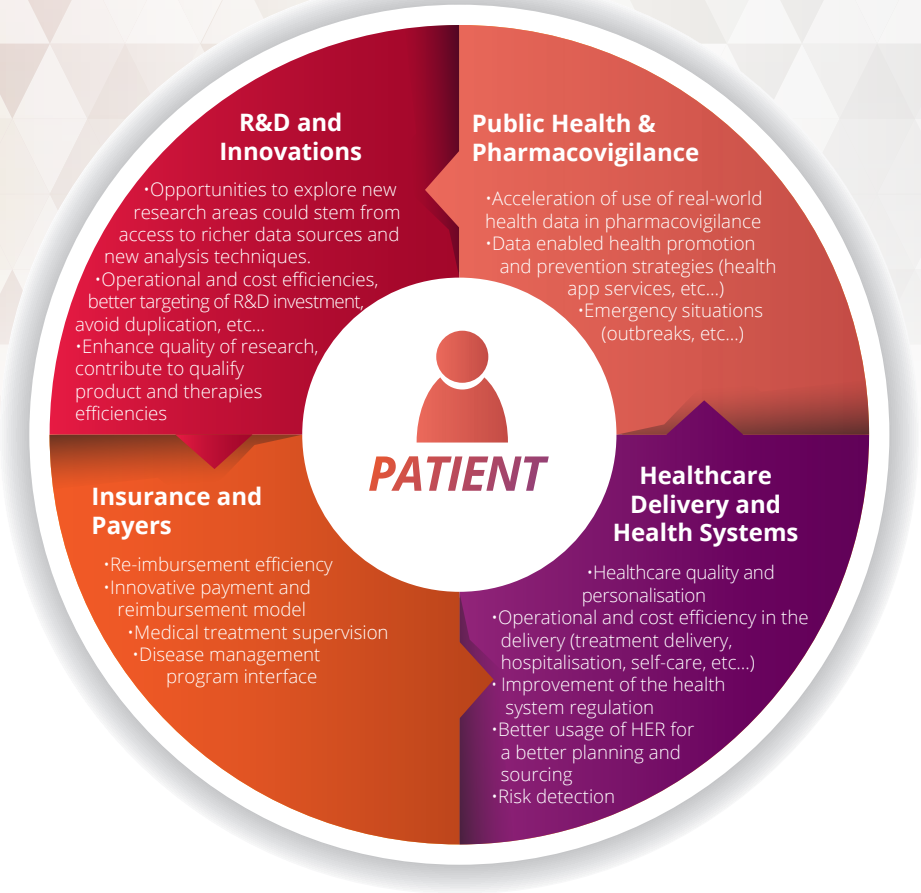
A new health value model empowered by AI

Fostering a decentralised model to improve health management requires honest, straight thinking. From exploring the opportunity of distributed ledger technologies, to highlighting the importance of consent as a service, we have to address all of the challenges related to health data sharing — and that includes the monetisation of health data across multiple healthcare stakeholders. How do we build a sustainable and inclusive financial system that auto-regulates this new health data industry?

AI may play a role in auto-regulating this new data and consent-related economy

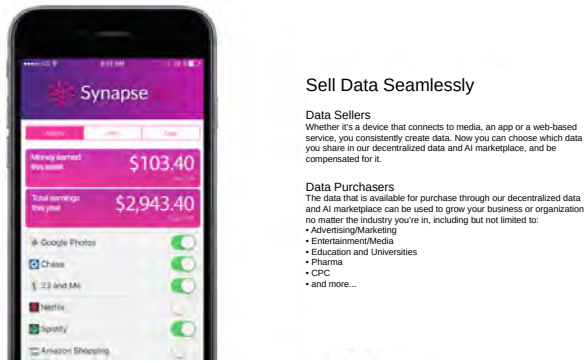
It has already been proven that various stakeholders would benefit from access to third party data in the healthcare industry, at different stages of the patient journey and in very different contexts. The marketplace, based on blockchain infrastructure, will create the network and related incentives needed for data owners and collectors to make their data available to others; it will contribute to unlock the data economy's full potential.

Considering this new data-empowered healthcare system, we realise how interconnected all parties are, and the inherent value in access to qualitative data, with the patient remaining in the centre of everything:


R&D and Innovations
·Opportunities to explore new research areas could stem from access to richer data sources and new analysis techniques.
·Operational and cost efficiencies, better targeting of R&D investment, avoid duplication, etc...
·Enhance quality of research, contribute to qualify product and therapies efficiencies
Public Health & Pharmacovigilance
·Acceleration of use of real-world health data in pharmacovigilance
·Data enabled health promotion and prevention strategies (health app services, etc...)
·Emergency situations (outbreaks, etc...)
PATIENT
Insurance and Payers
·Re-imbursement efficiency
·Innovative payment and reimbursement model
·Medical treatment supervision
·Disease management program interface
Healthcare Delivery and Health Systems
·Healthcare quality and personalisation
·Operational and cost efficiency in the delivery (treatment delivery, hospitalisation, self-care, etc...)
· Improvement of the health system regulation
·Better usage of HER for a better planning and sourcing
·Risk detection

Welcome to the health data economy! Researchers and experts estimate this could dramatically increase profit in the healthcare industry up to 55% by 2025 (Accenture Share-of-profit increase per industry between baseline in 2035 and AI steady state in 2035 [54]). The AI healthcare market is expected to hit $6.6 billion by 2021, according to Accenture. The study added that clinical health AI applications have the potential to create annual savings of $150 billion for the U.S. healthcare economy by 2026 [55].

Build a wealth re-distribution model to foster health data sharing



Source: Synapse.ai

All patients may shortly be all able to sell more of their own data and control their consent, using advanced services like Synapse.ai [56] (see above). However, this also raises critical ethical: Given the amount of value and benefit expected from all parties, as well as the projected savings in healthcare spending due to increased efficiency along the healthcare value chain, should we consider a smart model which helps us to ensure that wealth is re-distributed consistently? What would that model look like?

First, **the value of our health data needs to be tracked along the value chain**, and a decentralised model would help stamp any data contribution to healthcare models, research or product development, or even emergency services. Companies like Ocean Protocol are already building this traceability into their chain. But what if we train a model to understand the contribution our data makes to the healthcare economy? This algorithm may help us partially understand the causality effect between different data sources. As individuals, it may also be able to provide valuable information and give relevant recommendations regarding the data we share.

This would lead us to a second need: **we must reinvent our healthcare economics and rewards system**, both at an individual and corporate level, in order to design a system that serves the entire population, especially the under-served. For

instance, how do we value blood data from an emerging middle-class Indonesian if this contributes to the development of a new immunotherapy luxury drug for the affluent population? First, if we could demonstrate how valuable his contribution was, we could make him eligible to receive the drug for free. Second, we should consider the relative value of such data and ensure that the value generated will be at least equal to the healthcare value needed by this person in his region. This kind of value map and system would naturally require lots of monetary regulation. We believe AI, empowered with decentralised systems, can help doing lots of the matching pre-work to identify real value in a broader economic context.

Any citizen needs to be empowered and motivated. As previously described in our first *Live With AI 2018* report and in *Living Digital 2040: Future Of Work, Education And Healthcare* by the Lee Kuan Yew Centre, all of these personalised technologies, information and data matter very little if citizens are not motivated to manage their own health. And beyond their own health management, we would need to consider their peers' ecosystem, as we will always prioritise the value we bring to ourselves and to our community. Artificial intelligence, embedded in a decentralised model, could help map this value and enable a system which motivates people's participation. How? By continuously driving a citizen's willingness to share more data, leveraging strong personalisation triggers, and behavioural science principles. We need to remember that we each have our own biases, and none of us will perceive this benefit to society in exactly the same way.

A decentralised model will undoubtedly be very valuable to our new data economy and significantly improve our healthcare system. That said, plenty of unknowns remain, and we anticipate several different barriers. On the one hand, an economic one, as our own data will be worth more than ever, but its value will be fractioned. On the other hand, there is a legal boundary that we must address in order to install trust at the core of this new health data sharing model. AI already crosses borders, fostering health-data inter-operability, making a case for a worldwide "consent as a service" decentralised model and the auto-regulation of our health data value without bias, and with the unique objective to serve everyone. As it is all about our new data ownership and its evolution, new legal frameworks are needed to serve international and universal regulation.

Pierre Robinet - OGILVY CONSULTING

The shift in data ownership and the need for new legal models

The involvement of many stakeholders – patients, medical professionals, pharmaceutical companies and regulators – has led to the collection of health data becoming a complex process. To enable a transparent system that does not undermine patient safety, we must investigate the legal issues that come with it.

Potential legal issues arise with the use of health data by patients themselves

According to the principle of "market-inalienability of the human body", the body – except for hair and nails – is subject to restrictions on transferability, ownership, or use. For instance, blood and organ donation cannot give rise to any remuneration, direct or indirect, in France or in Singapore. Underlying this principle, there is fear of the possible dangers of instrumentalisation and exploitation of persons and their bodies. It is a protection mechanism that places the body outside the realm of objects and property entitlement.

Even if the notion of health data has mostly been addressed through the data privacy angle, it may also be considered as an emanation of the personality and, therefore, protected by the principle of "market-inalienability of the human body". However, contrary to the body, health data is usually not vital, nor material, and a unique regime applicable to both the human body and health data might be subject to debates. Furthermore, health data is already being used by industries and various stakeholders to create value without the patients themselves taking any advantage of this value. There is a fundamental ethical and legal question around the option for patients to value their own health data and benefit from it.

Having acknowledged the value of health data, various jurisdictions may take different views on how to regulate its value. In a global economy, there is a clear need to define and determine how such data should be regulated and valued. An international convention on health data could be a great instrument to provide a common legal framework empowering individual, and to create a patient-centric model to share health data.

The use of new technologies and creation of new economic and legal models

Two platforms, Ocean Protocol and Embleema, have already created a new collaborative model for data sharing which gives patients control over their data and rewards them for sharing it – in a transparent, secure and controlled environment – with pharmaceutical companies and researchers. Available data on the marketplace can be used as training sets to train AI algorithms and improve the

performance of clinical trials. More individual patients may be able to store and control access to their medical data and make it visible to trial recruiters using AI and blockchain.

This new economic model raises the question of the right to use the data: how is everyone involved in the value chain compensated for their contribution to the clinical trials data, and what is the basis of their reward? Various legal models could be envisaged:

• ***Joint ownership.*** This concept was created in the context of intellectual property and corresponds to the situation where various persons participated in the creation of a joint work have rights to the work. The persons shall contribute to common creative work.

• ***Composite work.*** This concept was also created to grant intellectual property rights on a new work which is incorporated into a pre-existing work. It is characterised by the lack of participation of the first author to the new work.

• ***Collective work.*** This apprehends the right to a work created by several persons but merged on the whole, without being able to attribute to each of them a separate right to the ensemble.

• ***Fractional ownership.*** A key manifestation of this notion is the tenancy-in-common in common-law countries, where each owner has a percentage ownership in an asset.

• ***License.*** A license agreement is an agreement giving someone permission to use something. The licensor gives permission to use their right over an asset to the licensee. In exchange, the licensee pays royalties to the licensor for the right to sell the product or use the right.

Various actors are involved in clinical research via new technologies:

• ***Raw health data.*** To conduct clinical trials, raw health data from individuals is obviously necessary. Without the patients' data, clinical research cannot be performed. The paternity of the data should therefore be rewarded.

• ***Data selection.*** In itself, raw health data is not practicable and involves selection and transformation via AI and/or software, therefore the party who created the algorithm to analyse the data should also benefit from his/her work.

• ***Data interpretation.*** Researchers are subsequently interpreting and using the data to allow pharma companies to create their products.

Each actor should be incentivised for getting involved in the research

The new economic model can be characterized as truly collaborative via projects

such as Ocean Protocol where all the actors of the value chain (i.e., the patients, the searchers, the doctors, the pharma companies, the coders) can be rewarded. Patients' participation is mandatory to allow the research to be conducted by providing access to raw health data, that might be categorised as the patients' asset.

In the light of the various legal concepts analysed, the most accurate notion to translate this new economic model might be a license agreement whereby the patient gives access to his/her health data in exchange for a royalty. The value of participation should be set in the original license agreement and could amount to a fixed fee or a variable fee, depending on the usefulness of the end results. This flexible tool can also allow the patient to manage the confidentiality of the data as well as his/her consent, and the revocability of the latter, by providing dedicated clauses in the licence agreement.

Lucas Nicolet-Serra - SIMMONS AND SIMMONS LLP

The time is fast approaching when we must embed technological advances into clinical practices. The Academy of Royal Medical Colleges (ARMC) in the United Kingdom notes in their recent report: "For AI to truly flourish, not only must IT be overhauled and made inter-operable, but the quality and extent of health data must be radically improved too" [57]. We can help ensure data quality by considering data provenance as a core element of our analysis.

Beware of garbage in – garbage out

AI models depend on data, with more data often leading to better performance – up to a point. It's a case of quality over quantity, with high quality data contributing to much better models. For example, referencing US Department of Transportation studies, "Google collected far more data per car [then other companies] to feed a more advanced machine learning system, and its cars improved by 400% - an amazing jump in innovation, and more than ten times as much as cars utilizing less data." [58]

However, we have become very familiar with the possible effects of 'garbage in - garbage out' on the Internet. A 2018 study by MIT leaves us in no doubt that the impact and scale of misinformation are significant: "It seems to be pretty clear [from our study] that false information outperforms true information" [59]. Unsupervised AI training processes do not have a 'human in the loop' to fend off dubious training data. Moreover, many AI systems are being shown to be very 'brittle' in the face of adversaries who supply intentionally 'bad' training data [60].

In the context of healthcare, ARMC recommends [61]: "For those who meet information handling and governance standards, data should be made more easily available across the private and public sectors. It should be certified for accuracy and quality [...] External critical appraisal and transparency of tech companies is necessary for clinicians to be confident that the tools they are providing are safe to use. In many respects, AI developers in healthcare are no different from pharmaceutical companies who have a similar arms-length relationship with care providers. This is a useful parallel and could serve as a template. As with the pharmaceutical industry, licensing and post-market surveillance are critical and methods should be developed to remove unsafe systems."

As a concrete example, AI model performance is strongly dependent on label quality in the work of Hannun et al. on arrhythmia detection, yet the input labels that characterise training data are only approximately 75% accurate [62]. The safety ramifications of such poor metrics are a sobering thought.

Where an AI system does not have a human in the loop, who mediates training data? When machines talk directly to machines, there is no-one between the input data, the model, and the answers.

How do we ensure quality of AI capabilities?

How do we ensure that our data sets come from reliable sources, and are of credible authenticity and quality, especially when we may rely on totally automated – and autonomous – processes to obtain and assimilate that data? And how do we ensure that AI models resulting from training on such data are safe? How do we know that these models have been tried and tested? Should we seek independent validation to help ensure quality and safety? Similar questions have been asked of pharmaceuticals for half a century: are AI capabilities for use in healthcare so very different?

Provenance information is critical

Provenance information seeks to increase confidence in digital information and processes, by providing contextual and circumstantial information concerning the production or discovery of that object, and its history. "As the quantity of data that contributes to a particular result increases, keeping track of how different sources and transformations are related to each other becomes more difficult. This [challenge] constrains the ability to answer questions regarding a history of a result, such as: What were the underlying assumptions on which the result is based? Under what conditions does it remain valid? What other results were derived from the same data sources?" [63].

Provenance information needs to provide answers to these (and other similar) questions, and this information needs to have demonstrable independence from the supplier to provide enough assurance of its validity.

In the art market, provenance translates into value: "Nothing in the known universe, no item, object or quantity of material, has ever appreciated in value as fast as the Salvator Mundi", whose value rose from USD 1,175 in 2005 to USD 450 million in 2018, following its attribution to Leonard da Vinci [64]. In the healthcare sector, provenance translates into safety as well as financial benefit.

Regulation of health AI provenance?

Pharmaceutical products have been regulated in the EU for half a century, accelerated in large part following the Thalidomide disaster, which exemplified the need for evidence-based authorisation [65]. For example, the European Commission summarises the widespread situation: "When applying for marketing authorisation, companies must provide documentation showing that the product is of suitable quality [...] The manufacture or import of medicinal products itself [...] is subject to manufacturing or import authorisation." [66]

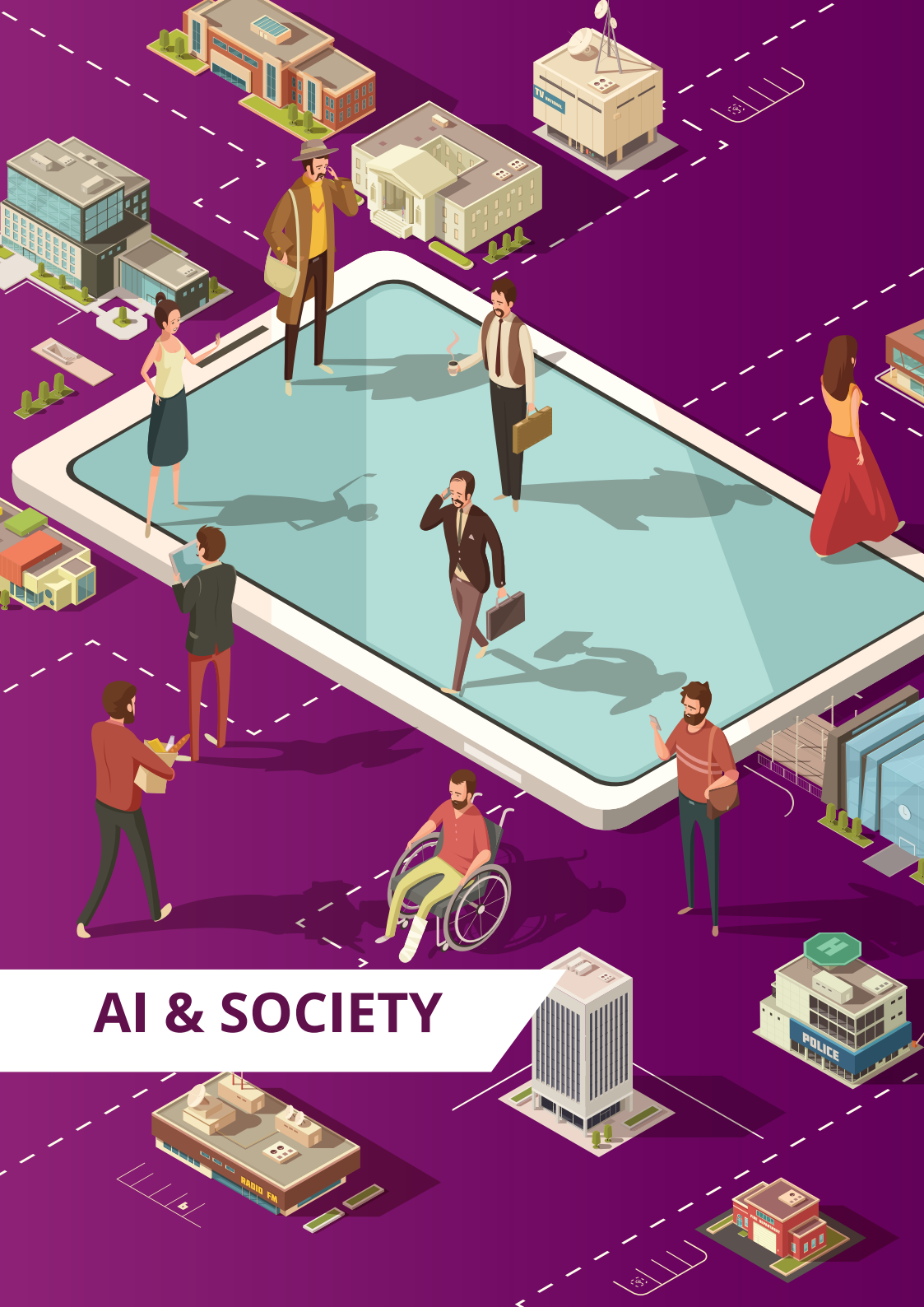
And the call for good provenance is extending to the field of genetics. The World Health Organisation (WHO) guidelines say: "The cloning procedure should be care-

fully documented, including the provenance of the original culture, the cloning protocol, and the reagents used." [67]

We urgently need to take key policy measures for the provenance of AI capabilities used in healthcare. For example, as a 2018 report from the UK Government Office for Science said concerning computer modelling: "Decision-makers need to be intelligent customers for models, and those that supply models should provide appropriate guidance to model users to support proper use and interpretation. This includes providing suitable model documentation detailing model purpose, assumptions, sensitivities, and limitations, and evidence of appropriate quality assurance ... Government and the corporate sector need to consider how to govern and where necessary regulate the use of advanced models of complex systems" [68].

In the digital domain, patient safety depends not only on the provenance of its AI models and processes, but also on the validity, security and privacy of the associated provenance data itself. We must take a view on the balance in regulations between the opposing forces of increased availability from open sharing, with the safety, privacy and security ramifications, in a digital world where cyber-attacks are increasingly impactful, and commercial motivations seek to aggregate and control critical information.

Daryl Arnold - OCEAN PROTOCOL



AI & SOCIETY

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Introduction

LWAI's name says it all: live with AI. Artificial Intelligence (AI) and algorithms have engulfed the world, assisting industrial sectors, transforming societies, and raising alongside its development questions regarding its conception, accessibility, and negative effects. Throughout innovation's history, it is the effective use of a ground-breaking technology that reveals its strengths and weaknesses, its opportunities and challenges. In the case of AI, even if its future and its credible applications are yet to be known, our responsibility lies in the understanding of current applications, especially when AI is used at the service of public authorities' prerogatives such as justice, health, or public transportation.

To that end, the European commission has gathered high-level experts in order to draft the working document AI Ethics Guidelines for Trustworthy AI, released in December 2018 [69][3] . Inspired by the fundamental rights and societal values on which Europe is grounded, they have developed five ethical principles to ensure a human-centric AI: beneficence (do good), non-maleficence (do no harm), human autonomy, justice, and explicability. With this same perspective, Singapore has also made its contribution to the global discussion about AI and ethics. Thanks to Singapore's Personal Data Protection Commission, a public consultation, open in January 2019, has been launched to collect feedback on the Proposed Model Artificial Intelligence Governance Framework [70]. Two major principles stand out to allow organisations to develop AI in an accountable way: decisions taken by or with an AI must be explainable, transparent, and fair to consumers, and AI solutions must be human-centric.

As continents, countries and societies have their own interpretation of ethics, we have decided to focus on one point of tension: how might we consider cultural differences when it comes to building ethical AI? The association of two Singapore-based and French-based think tanks makes it interesting. Having in mind the values promoted by the European Commission and Singapore's reports on AI, we have formulated five global questions to translate these ethical principles into pragmatic measures to adopt. The articles you are about to read focus on the arbitration between privacy and surveillance, the alarming observation regarding bias and discriminatory AI, the accountability of AI's decisions, the social and physical interaction between humans and robots, and, finally, the necessary autonomy humans fear they will lose due to the development of robots and intelligent machines. For each of the four questions, we have gathered two points of view: one from Singapore thanks to our organisation, and one from France through the help of the Paris-based think tank Digital New Deal Foundation.

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[3] Please refer to the endnote section at the end of the report.

We have decided to tackle this broad topic of AI & Society by thinking in terms of genuine applications, therefore new challenges and unknown barriers may arise along this journey. We did our utmost to highlight cultural differences between Singapore and France, because both countries, due to their respective histories, societies and governments, will experience different challenges and have therefore different priorities when embracing AI opportunities. We have strived to showcase outlooks, analysis and solutions from people with dissimilar backgrounds; the points of view we have gathered in this report come from entrepreneurs, social sciences academics, scientists, philosophers, and lawyers. Finally, we hope this report will enlighten citizens to better build their future society, in order to better live with AI.

PRIVACY VS SURVEILLANCE

In recent years, facial recognition technology using AI has spread throughout the world. For instance, Beijing, Shanghai and Chongqing now use surveillance technology that identifies people by their walking style [71]. Thanks to several metrics, the technology functions without the need to see the face, and records everything in a database. This extreme use raises alarm: how conscious are the citizens of this trend? It is important not to be unduly pessimistic, however, privacy should not be sacrificed on the altar of surveillance. Hereinafter are two transversal views from two Singapore-based academics and one French lawyer.

AI, Surveillance, and the Human Right to Privacy

Artificial Intelligence (AI) offers the means to dramatically expand the capabilities of government-run surveillance systems. But as individuals become more intensively surveyed, the extent of privacy they enjoy shrinks. We maintain that governments and the makers of AI surveillance technologies are morally obliged to respect people's privacy as a universal human right. This requires instituting significant checks on surveillance regimes.

What is Privacy?

Within legal and philosophical literature, privacy has been defined in many ways. This speaks in favour of understanding privacy as a "cluster concept" with various dimensions. Philosopher Anita L. Allen outlines four dimensions of privacy (Allen 2005: 485) [72]:

1. Decisional privacy: freedom from outside interference with personal decisions;
2. Physical privacy: seclusion, solitude, and bodily integrity;
3. Informational privacy: confidentiality, anonymity, data protection, secrecy of personal facts;
4. Proprietary privacy: limits on the use of a person's name, likeness, or other attributes of identity.

The Human Right to Privacy

A human right to privacy is affirmed in all international and regional human rights instruments, including the Universal Declaration of Human Rights (Article 12), the International Covenant on Civil and Political Rights (Article 17), the African Union Principles on Freedom of Expression (Article 4), the American Convention on Human Rights (Article 11), the Arab Charter on Human Rights (Articles 16 and 21), the European Convention on Human Rights (Article 8), and the ASEAN Human Rights Declaration (Article 21) (Privacy International [73]).

In agreement with these instruments, we argue that a human right to privacy is a moral entitlement owed to all human beings. Nearly all human beings have an interest in privacy, and consequently, the flourishing of human societies depends on the presence of norms that enable individuals to secure a condition of privacy. A large body of ethnographic research suggests that although the socially expected scope of privacy may vary across cultures, people everywhere display an interest in maintaining privacy (Westin 1967; Altman 1977; Moore 2003) [74]. Even in societies where people appear to live with minimal privacy, there exist practices that empower individuals to limit contact with others and to control what others know about them. For instance: the Mehinacu of Brazil observed long periods of seclusion, had strong prohibitions against asking embarrassing questions of each other,

and they regularly lied to avoid revealing sensitive information (Altman 1977: 73) [75].

AI and Threats to Privacy

Given privacy's importance, the threats to privacy emerging from AI-augmented surveillance technologies must be addressed. China's surveillance of the Muslim-majority Uighur population in the Xinjiang region demonstrates how egregiously the right to privacy can be infringed upon with the help of AI. Chinese authorities use AI-based facial recognition systems to search surveillance camera footage and track Uighurs based on their ethnically distinctive facial appearance [76]. The facial recognition technologies can raise red flags when Uighurs congregate, and can tag the faces of any Uighurs who leave Xinjiang. These surveillance technologies support a well-documented regime of repression to which the Uighurs have been subjected by the Chinese government [77]. Over 1 million Uighurs have been interned in indoctrination camps, where detainees are separated from their families, forced to renounce their faith, and deprived of food and sleep.

Surveillance can potentially improve law enforcement and terrorism prevention efforts, making societies generally safer. From this premise, some argue that we should tolerate reductions in privacy for the sake of greater security (Himma 2016) [78]. Yet in many ways, privacy protections are essential to the security of individuals and communities. They operate as safeguards against bad actors who would use surveillance to conduct violence and repression (cf. Moore 2016) [79]. The current plight of Chinese Uighurs is a case in point: they endure a state of extreme insecurity because their government has so thoroughly stripped them of privacy.

Overcoming the Threats

Some companies at the forefront of AI research and development, like Google and Microsoft, have drafted lists of principles to guide the design, production, and use of AI. Their stated principles include a commitment to privacy (Microsoft: "AI systems should be secure and respect privacy," and Google: "We believe that AI should … incorporate privacy design principles"), among other values like fairness, reliability, safety, and accountability. However, these statements don't explain what might constitute a violation of privacy, or how the companies intend to balance different values in situations where they compete. For example, it is left undetermined what should be done when maintaining privacy may conflict with safety concerns.

Ethical guidelines for AI technologies need to be more specific and concrete. Rather than a vague promise to "incorporate privacy design principles," companies and institutions should specify what reasons constitute legitimate or illegitimate invasions of an individual's privacy. For instance, keeping people safe is legitimate, whereas maintaining one-party rule, eliminating cultural or religious differences, and quashing dissent are not. Importantly, even if surveillance does facilitate greater security for most people, the costs of surveillance should not be borne disproportionately by innocent minorities.

Transparency is vital. Without the possibility of external review, particularly judicial

review, governments and companies are free to decide for themselves where to put the slider between legitimate and illegitimate invasions of privacy. Leaving the decision in their hands leaves people unjustifiably vulnerable, and thus we recommend that regulation and oversight of the use of surveillance technologies be conducted in a manner transparent to the public. These measures will help to keep up an open, informed debate on how to balance privacy and security.

Standing for Privacy

AI surveillance technologies are tempting governments to keep an ever-closer watch over private individuals, whether it be in service of security or authoritarian control. Likewise, companies manufacturing these technologies will be tempted to supply the growing demand for AI surveillance, without asking crucial questions about how their clients will use it. These temptations should be checked. The Uighurs' experience is a grim reminder of how surveillance can make people less secure when it's used as an instrument of repression. From transparent public oversight of governments' surveillance practices to the self-policing codes of ethically conscientious manufacturers, a panoply of mechanisms is needed to safeguard the human right to privacy worldwide.

Andres Carlos Luco and Kathryn Muyskens - NTU

AI-enhanced surveillance systems' guidelines should specify that they cannot legitimately be used to maintain one-party rule, eliminate religious differences, or quash dissent. Furthermore, surveillance systems should be subject to external review – particularly judicial review – and this oversight should be transparent to the public. This government-perspective outlook is worthwhile if paired up with a corporate-perspective view, as big tech companies' capability in gathering huge amount of data brings its own set of questions.

Privacy and surveillance ascribe the level of liberty our society can afford today. They define how companies can monitor and automate individuals, driving them towards a passive state where technology can be used to deny their rights and liberties. For companies keen to evolve in the Information Age, people end up being perceived not as consumers or citizens, but as information pools and information fields, ready to be mined and harvested.

Data: a means of social control and business power

If privacy has become such an important issue, it's because the tight grip which big tech companies have over the data of their users is the basis for their dominance, and possibly for the way they abuse it. In other words, information capitalism has turned data into a means of social control, and privacy harms can trigger a wealth of related harms, chilling freedom of speech, consciousness, association, etc.

But concerns for privacy are often described as being anti-business; Richard Posner, the American jurist and economist, famously argued that individual privacy hindered capitalism by interrupting the free flow of information that markets need to be efficient. Andreas Mundt, head of Germany's antitrust regulator, took Posner at his word when he explained that "data can provide market power", and this market power means a transformative power over society. In February 2019, he did not hesitate to pronounce a surprising condemnation of Facebook, arguing in a 300-page ruling that the company could only gather so much data because it was in a dominant position, and that this data would in turn increase the dominance of their position [80].

And it doesn't stop there. In 2013, Edward Snowden took tremendous risks to reveal the active role big tech companies play in state surveillance, denouncing "the blurring of public and private boundaries in surveillance activities" as well as "collaborations and constructive interdependencies between state security authorities and high-tech firms". It's a vicious circle. But it's a lucrative one. It's no surprise that Peter Thiel once famously said "competition is for losers".

As of today, text messages and mail apps are being controlled by Apple and Google, Facebook bought Whatsapp and Instagram, Snapchat bought Zenly, and Microsoft bought Linkedin. Only a few select companies are now able to operate worldwide, and they try as hard as they can to forbid new ones to emerge.

In 2011, Cory Doctorow declared at the Chaos Computer Club: "The world we live in today is made of computers. We don't have cars anymore; we have computers we ride in. We don't have airplanes anymore; we have flying Solaris boxes attached

to bucketful of industrial control systems. A 3D printer is not a device, it's a peripheral, and it only works connected to a computer. A radio is no longer a crystal: it's a general-purpose computer, running software."

The issues of competition, democracy, privacy and surveillance are thoroughly interconnected. Together, they frame the digital question. Answers used to come in the form of meta-regulation such as net neutrality – a concept propounded by the American expert Tim Wu in the paper: Network Neutrality, Broadband Discrimination [81] – but it's now clear that it is not enough as it's only about tube neutrality.

The new cognitive habits normalised by Facebook, Snapchat and Google have deep, near-spiritual consequences. The new UX/UI experience transforms our perception and our reflexes. Augmented reality and virtual territories superimpose with our normal, physical environment. The former concepts of presence, distance and inclusion take on different meanings.

The results are already here and create many complex things we don't fully understand today: how will competing algorithms work together? Will they provoke market crashes? Should we allow them to decide if a student is allowed to enter one school or another?

From privacy to personal data

People were already asking these questions back in 1978, when the first French and German laws on data regulation were enacted – beginning with the claim that computers should be at the service of citizens, and that no decision concerning their rights should be entirely automated. These regulations stood the test of time and are still surprisingly relevant today. Indeed, they were translated into a directive in 1995, and they then formed the basis of the infamous European GDPR regulation (General Data Protection Regulation) in 2016. But they were adapted to a new context, including several competition provisions in order to try to do with data protection what appears to be difficult with antitrust regulations – thus, the GDPR on compliance, data portability, transparency and the increased importance of regulation authorities.

It's true that the EU is not a big player when it comes to big tech companies, with only eight companies out of the worldwide top 100. But with its rich, open, liberal and pro-market social democracies, the EU is the economic engine of the digital industry. Big tech companies enjoy their biggest market shares in the EU, and more than a third of their revenues. The EU market is extremely open, much more than the US market and its Asian counterparts. It's only logical that other players are beginning to take interest in it, mainly China and Russia, with a focus on messaging.

Despite its lack of big tech companies, the EU is becoming the regulatory arena of the rest of the world. It's the place where laws are being written, fines are being sentenced, lobbying is happening and ideas are being tested – Germany forbidding Facebook to mix the data it gathers from its various services, including WhatsApp and Instagram. In Europe, privacy is sacred – thus worthy of special protection –

as personal data, for instance, is perceived as an extension of the human being. These European ideas have far-reaching consequences. China and India now have their own GDPR-inspired legislation, and in June 2018, even the US Supreme Court struck a serious blow to the third-party privacy doctrine – the view that one can have not privacy expectations when sharing information with a third party.

Even if local particularities or interpretations can complicate the implementation of a global framework, a growing worldwide consensus is now emerging on privacy in the digital age, or more generally, on the digital question. It's not so much about drawing a line between privacy and surveillance, but understanding that even when people share their data, privacy protections should travel with it, and apply to the digital environment where they should protect the virtual persona of the individual. The concept is clearer when referring to the French notion of "personal data" rather than "privacy".

In the end, it's all about contextual regulation, depending not only on how the data is being used, but also what for, where, and by whom – with an increasing view that the regulations applying to these data must protect not only privacy, but also competition and democracy.

It's only the beginning.

Jean-Baptiste Soufron – Partner at FWPA Lawyers in Paris, former General Secretary of the French National Digital Council

DESIGN FOR ALL and NON-DISCRIMINATION

Understanding how, what for, where and by whom data is being used is a critical challenge when it comes to general AI adoption, for both governments and companies.

However, AI models such as deep learning may at some point make specific decisions which exclude some people from potential goods or services, and in doing so foster discrimination.

Used in various sectors, for instance to help banks in granting loans, or human resources departments in hiring new employees among several candidates, companies using AI must ensure that no one is left out.

Trust in AI is essential to ensure confidence.
To build and maintain users' trust in AI, fairness and explainability of outputs are required. Hereinafter are two transversal outlooks on the challenge of building an inclusive AI.

Building Trust in AI

First thing in the morning, I drink my favourite coffee I order via my virtual assistant, quickly reading a recent statement by Elon Musk about a potential AI apocalypse (proposed by Medium). Checking my mailbox, I destroy with some annoyance several emails recommending I should try this hotel, that restaurant, etc. Finally, I get a vocal message from my online bank warning me that due to my payment pattern, it seems my account was recently hacked.

In the first 30 minutes of my day, I have already interacted with several different AI-powered systems. And I will keep doing so all day long, as AI has evolved to touch our lives in many ways. It empowers us, but might occasionally annoy, or even scare us, if we listen to some Silicon Valley gurus. As we are going to live with it, we do need to understand how to build trust in AI.

Why explainable AI matters

How to build this trust? One way is to promote AI systems that provide explanations for their outputs. First, for legal matters: a banking program has the obligation to explain why a loan application has been rejected. Second, for accountability reasons: would you envision that a medical program recommends treatment X without any explanation? Who is responsible if the treatment goes wrong? Last, for ethical reasons: in Spain, an insurance company used a "black box" algorithm (deep learning) to compute premiums. After a while, they realised that the more foreigners lived in your neighbourhood, the more the locals pay for their insurance, which is not morally acceptable. This ethical aspect might depend on people's reactions towards AI, as it is driven by history and culture. For instance, the Chinese facial recognition program, that is used to assign social scorings, would never be conceivable in Europe.

Bear in mind that not all AIs need to be explainable: if I use software to help me invest, I may not care if it provides explanations as long as its recommendations are accurate and make me rich (although it might be slightly different if I run a hedge fund and manage money for which I should be accountable to my clients). Proof of stable and correct behaviour (certification aspect) also increases trust in automated systems. We do not need to understand mechanics to trust our car's driving system, but we have to be certain that it almost never fails. However, in the long term, explanations are useful in a co-learning process: a program learns from examples provided by an expert, while human expertise improves if the program provides explicit models.

Beware, explainability is not trust in the accuracy of the outputs: an AI appeared to have been effectively trained to distinguish between pictures of wolves and dogs,

but it emerged later that it had in fact learned to distinguish between snowy and not snowy backgrounds. This program will go wrong if asked to recognise a wolf outside of its natural habitat; programs, like humans, can have bad reasons to give good answers. On a more technical ground, explainability is not certificability either: understanding outputs does not mean that these outputs are compliant with regulations.

What is an explainable AI?

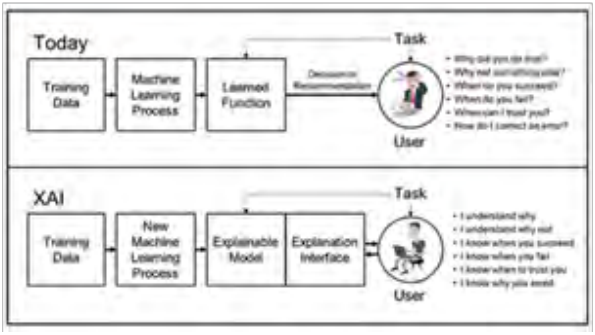
An AI is explainable if its decision-making process can be understood by humans; such a program has to use some kind of semantics, at a level that depends upon the fact that it interacts with a developer, an expert, a user, etc. However, it is easier said than done, as AI is far from being monolithic. Even if they all go under the AI banner, the different algorithms that interacted with me this morning exist in very different paradigms. The methods that have been in a leading position in recent years are related to deep neural networks. Effective at recognising patterns, such as processing images, they are very data-greedy and their main flaw is being "black boxes"; their decision-making process is tough for the average human to understand.

Building explainable AI means making these numerical algorithms interoperate with ontologies and knowledge graphs. These hybrid systems would benefit from the power of numerical methods and the expressivity of symbolic methods that allow them to interact with humans. It may be the greatest challenge for AI in the years to come; building explainable AI means bringing more transparency into the models, more compliance, better model performances and less ethical bias. In short, it is all about building trustworthy AI-powered systems.

The global push to next-generation AI

Public decision-makers have understood what was at stake and are now acting to enhance regulations that will support this necessary evolution. The European Union has made the first move, adopting in 2016 the General Data Protection Regulation (GDPR), in effect since May 2018. It has imposed, among other things, a right to explanation: "The data subject should have the right not to be subject to a decision, which may include a measure, evaluating personal aspects relating to him or her which is based solely on automated processing and which produces legal effects concerning him or her or similarly significantly affects him or her, such as automatic refusal of an online credit application or e-recruiting practices without any human intervention." Although some would see this type of regulation as vague, and therefore useless and even potentially harmful, it showed a creditable willingness to build trust between Europeans and AI-powered programs.

Laws provide a development framework, but funding brings tangible developments. In May 2018, DARPA launched an explainable AI program (XAI, see figures below [82]) whose final delivery is a "toolkit library consisting of machine learning and human-computer interface software modules that could be used to develop future explainable AI systems."



Following the recommendations of an insightful report about AI [83] by MP Cedric Villani (former Fields medal and advisor to Emmanuel Macron on AI matters) the French government has engaged in the process of dedicating substantial public funding (€30 million for three to four years) to projects led by consortiums of industrial groups, start-ups and AI labs working on Explainable AI. The call for projects should be released during the summer of 2019.

Europe is a potential leader in the race for trustworthy AI

In the context of fierce competition over AI, Europe is often considered as lagging behind the two tech giants: US and China. It is often argued that, while the US explore the future, and China addresses huge vertical markets, Europe loses valuable time in imagining and implementing complex regulations.

While there is some truth to it, Europe might well lead the race to explainable AI thanks to a favourable legal framework, and hopefully, substantial funding to support the effort. France, motherland of humanist values and a natural advocate of "AI for humanity," is particularly well-placed. Prominent researchers like J Pitrat and D Kayser have founded a host of French researchers in symbolic AI, who have not yet been identified as a target by GAFAs. Much is at stake; we are building next-generation AI and need the support of all political and economic forces. We must make this thrilling challenge a priority!

Jean-Baptiste Fantun - NukkAI

Building explainable AI systems if of central importance. Explainability is a key component in the ethics frameworks designed across the world, which aims to have a human-centric approach. For instance, Canada and France have signed a pledge to responsibly develop an AI "grounded in human rights, inclusion, diversity and innovation". Even if the Singaporean PPDC AI Framework, Beijing AI Principles and the AI Ethics Guidelines for Trustworthy AI from the European commission have similar views, the different political situation lead to different implementations of these ethical frameworks.

To this end, the principle of "do good" will prove a major challenge depending on the geographic region and cultural differences, as inclusive AI can be interpreted in many ways by societies.

Neither Indifference Nor Essentialism: The Challenges of Building Globally Inclusive AI

AI bias has featured prominently in the news in recent years. Whether it is image recognition technology from Google labelling black people as "gorillas" [84], a recruiting algorithm developed then scrapped by Amazon for discriminating against women [85], or a chatbot by Microsoft rapidly learning to engage in racist and misogynistic hate speech on Twitter [86], there is no shortage of examples where AI has learned to imbibe and reproduce the prejudices of society at large.

In response, there has been a multitude of calls and promises by industry leaders and corporations to build inclusive AI. Last September, IBM released their AI Fairness 360 toolkit [87] for bias mitigation in machine learning, while Facebook announced in May their three-part plan to build more inclusive AI [88]. All of this represents a step in the right direction. But a phrase like "inclusive AI" can be interpreted in many ways. The discussion in English-speaking media has tended to focus around gender and race in a US-centred context. But what does inclusion look like in an international context, or in the highly multicultural societies of Singapore and Southeast Asia?

"Diversity" and "inclusion" are highly context sensitive

After all, "gender" and "race", not to mention other social categories, can mean very different things around the world. In the US, for example, "Asian" evokes someone of East Asian descent, but the term refers to South Asians in the UK, and is not considered a "race" at all in Singapore, where all the major recognized "races" are "Asian". As such, any AI system trained in one locale to use "race" as a feature – or more optimistically, to prevent discrimination on its basis – will not generalise to other locales.

Similar observations can be made about gender. Not only do gender norms and the status of women differ greatly across the region, leading to different biases in the data, Southeast Asia also has a long history of gender pluralism [89], with numerous cultures recognising three or more genders [90]. Any AI system designed to recognise only two genders, as has historically been assumed in the West and its colonies, will thus be entirely incapable of representing such diversity.

In improving representation, beware essentialism

To address these difficulties, it is tempting to simply patch AI systems to accommodate the categories and practices prevalent in the locale they are deployed. This is certainly better than cultural indifference – blithely imposing the assumptions taken for granted in one society upon another. But it also misses the deeper problem with any attempt to better represent the world through categorisations: it tends to essentialise those categories – to assume they have well-defined, immutable

essences – to the detriment of anyone who does not fall neatly into them, and to the restriction of even those who do.

Consider the system of racial categories that Singapore has inherited from the British: Chinese, Malay, Indian, Other. When the British used it, it was rooted in pseudo-scientific beliefs about the superiority of some races over others, and often used to pursue policies of segregation [91]. Singapore's continued use of these categories, by contrast, is well-intended: for example, ensuring ethnic integration via racial quotas, and preserving linguistic heritage through mother tongue policy. But this has not been without its problems. Critics point out [92] that a race-based mother tongue policy has tended to exclude racial minorities from high-performing schools that are gazetted to preserve Chinese language and culture. And it was only in 2010 that biracial children were able to have their multiple ethnic heritages recognised [93] in government systems. If designers of AI – or even AI de-biasing systems – are not careful, they may unintentionally cause similar effects through rigid categorisation, reducing cultural and personal autonomy rather than enabling it.

Indeed, these sorts of problems have already come to light in AI systems that recognise gender. In 2018, the Uber app automatically suspended the accounts of transgender drivers, because its facial ID security feature was unable to accurately identify the faces of drivers undergoing gender transition [94]. A subsequent study [95] of the literature on Automatic Gender Recognition (AGR) has found that more than 95% of papers mistakenly assume that gender is a binary variable, an immutable variable, or both. This simplistic assumption is made even in papers that critique gender bias in AGR technology.

Racial and gender essentialism are but two examples of how categorisation, however well-intended, can go wrong. On top of all this, there is the risk of cultural essentialism, which is a limitation of any rigid locale-based workaround to the problems highlighted above. If AI engineers only localise systems by following the dominant practices of presumably well-defined cultures, this ignores the fact that cultures inevitably overlap and evolve. Singapore is a good example – any AI speech recognition system designed for only English, Malay, or Mandarin would be incapable of parsing the potpourri of those languages (and more) used in a food centre here.

No inclusive AI without an inclusive society

The issues raised above are not just technical issues, but also social and political ones – "political" in the sense of who has the power to develop, direct, or deploy AI. After all, it is only due to the present geopolitical order that contemporary AI services are overwhelmingly US-centric, while also becoming increasingly Sinocentric. A globally inclusive AI ecosystem requires instead that countries coordinate and collaborate, enabling shared and equitable growth of AI capabilities across national borders. It also requires multinational tech corporations to make concerted efforts to diversify and localise their AI research and development teams.

This process of diversification needs to go beyond ensuring that different nationalities are represented. It is crucial that under-represented populations within each

country have a place at the table – and the workstation – as well. Otherwise, all that this "global diversity" will amount to is a roomful of professional men from different countries, each agreeing that everyone's "national interest" must be accounted for, while scarcely knowing the interests of marginalised people in the countries that they purport to represent. To build inclusive AI, we need to recognise that expertise in human concerns is highly distributed by default, and so that diversity is essential at every level of AI development, from data annotation to local offices to international headquarters. As the AI Now Institute puts it [96], we need to always ask: "Which humans are in the loop?"

Even demographic diversity is not enough. AI organisations also need to foster a culture of diversity – one that encourages critical contributions and insights from each person's unique life experiences and expertise. If not, an organisation may have social diversity and yet lack intellectual diversity. Dominant cultural norms may inhibit minorities, such as women in AI, from raising their concerns, or else incentivise staff to focus on uses of AI that are more "globally applicable", which likely implies Western use cases. This is especially likely in engineering and computer science, where the technical and the social are often seen as separate domains. Organisations need to deconstruct this artificial divide, building discussions about social implications into everyday work, and never letting "I'm just an engineer" be an excuse.

Towards versatile, non-essentialist AI

With a social environment that fosters inclusion, many technical avenues for inclusion become viable as well. Today's AI systems are often limited to the categories and labels they are initially provided with. There is thus enormous potential to build AI systems that effectively learn new categories from the data, while also reorganising their existing categories and representations to better suit the tasks at hand – AI that is not essentialist, but ontologically versatile. And if we develop AI to be increasingly personalized, but also privacy-preserving, then the reliance on broad and reductive categories will diminish, enabling AI to treat and respect us as individuals, who may indeed be situated in larger social groups and relations, but should never be reduced to them.

If all this comes to pass, then the future generation of AI systems need not end up like those portrayed in so many dystopian series and novels: laissez faire systems designed with little thought for social implications, unintentionally optimising society towards a less diverse, more polarised world; or authoritarian, impersonal algorithms, reshaping society to conform to the rigid and "orderly" social vision of their creators. Rather, AI and its development will be embedded in a matrix of empowered actors, all of whom have a voice in shaping AI's goals and assumptions, and in deciding how they want to be recognised, represented, and treated as individuals.

In this future, AI will be truly inclusive: partaking in neither indifference, nor essentialism, but embracing the world in its ever-shifting diversity.

Tan Zhi Xuan - AI Researcher, MIT / Board Member, Effective Altruism Singapore

ACCOUNTABILITY

Building explainable AI is critical for societies; it is an important step to meet legal requirements and accountability issues. As AI systems that provide explanations for their outputs are crucial for legal issues (among other reasons), we must push decision-makers to enhance regulations. Should we hold intelligent machines accountable for the decisions they make? It is essential to continue working on the literature on 'algorithmic accountability', as if adversely used, algorithms could affect human rights, or cause societal harms. Discussing this topic will enable the development of a trustworthy next-generation AI. Hereinafter are two views from law experts on the question of decision-making-accountability in the case of autonomous vehicles.

Who is Accountable When AI is Used to Support Decision-Making? The Case of Autonomous Vehicles.

The promise

Autonomous Vehicles (AV) have gone from fiction to reality within a few years, with the emergence of assisted and autonomous driving functionalities. They offer the promise of a better life. They could transform lifestyles and offer Mobility as a Service (MaaS) to all. They could save lives, cut the number of accidents, reduce traffic congestion and pollution thanks to real-time optimisation. They could also reduce bottlenecks in law enforcement. Smart cars can make and help humans make more informed, reliable and swifter decisions, and focus on more value-added activities. Using big data along with machine learning algorithms, artificial intelligence (AI) developers are now able to create computer programs and build systems that can mimic human driving.

The risk(s)

Any vehicle driver or pilot makes thousands of conscious and unconscious decisions with potential impact on himself, others, and the environment. With AVs, decision-making is put partially or fully in the hands of AI systems. Besides its potential for more efficient decisions, algorithms fed by big data can also lead to undesirable or dramatic outcomes. AV and AI entail risks first and foremost to human rights: physical integrity, privacy, safety, security, non-discrimination and self-determination. AVs can indeed kill and hurt, discriminate on the basis of gender or disability, and process massive amounts of information about users' locations, conversations and habits. Blind, opaque or premature reliance on AI systems poses a societal threat. Society and governments have to make choices to ensure AVs are fair, ethical and transparent. How can the AV promise be achieved while mitigating risks? This can only be achieved through adequate accountability requirements and processes.

What's accountability?

Accountability, responsibility and liability are three different concepts by law, philosophy and ethics. Accountability is a legal and ethical duty to account and be answerable for one's decisions and actions. Accountability implies explainability as to how and why decisions are taken, how algorithms and codes are programmed, in light of given standards, rules, benchmarks, values and stakeholders. Responsibility refers to someone being in charge to perform a task properly by the nature of one's position, function or commitment. Responsibility implies an obligation, control or authority. It can also call on feeling responsible based on morality. Liability is relevant only when things go wrong. It is a legal and court concept determining who shall pay for the adverse effects of certain decisions or actions, such as road accidents.

For example, an AV manufacturer may be (i) responsible for building safe AV by hiring the best engineers, (ii) accountable vis-à-vis users, auditors and society, and (iii) liable towards victims in case of accidents.

What laws say

France: The French term responsabilité encompasses accountability, responsibility and liability. The most recent legislation adopted in France in the AV field focuses on facilitating testing and adapting liability regimes. The Action Plan for Business Growth and Transformation ("PACTE" Law) of 22 May 2019) provides, for example, that the driver is exempted from criminal liability for traffic regulation infringements occurring during the time the autonomous system is activated. In addition, the draft general Law On Mobility ("LOM") adopted on 18 June 2019 by the National Assembly, authorises the government to amend liability rules taking into account delegation of decision making to AV systems. France's Presidency has set up a Mission (2019), a Strategy (2018) and a High Representation (2017) for the Development of AV, identifying three priorities: safety, progressivity and acceptability. Success will require accountability benchmarks and processes ahead of liability issues.

EU: The EU brings the benefit of setting common standards for all member states, but also sometimes extraterritorially (like GDPR, the General Data Protection Regulation). The EU identified that fragmented regulatory approaches would hinder the development of AV and it has undertaken various initiatives on AV and AI. Accountability and transparency are in themselves ethical principles under the 2018 AI for Europe Communication. Accountability is a key driver of technological trustworthiness and justice, under the 2019 Guidelines for Trustworthy AI. Accountability requires that mechanisms be put in place both before and after AI development, including their assessment by internal and external auditors. Algorithmic opacity is a challenge for accountability, from technical, societal and legal standpoints. To address the challenge, the EU proposed in April 2019 a Governance Framework for Algorithmic Accountability including policy options to promote governance, including awareness, whistleblowing and oversight.

Question & reflections to foster and address accountability

<u>The "trolley problem" is dead. Long live the legitimacy question.</u>

Should the AV or trolley be coded to kill its passengers or pedestrians in the case that saving both is impossible? This question to date is left for developers and engineers to address. But accountability calls for a more fundamental question: who is legitimate to make that decision in the first place? Should it be left to companies to decide, or should it be for society and lawmakers to draw decision-making fundamentals, especially when human rights and integrity are at stake?

<u>Who's behind the AV wheel? Who should be accountable?</u>

Who exactly makes decisions and who should be accountable have no straight answer. There is a need to address multiplicity, complexity, inter-dependency and indivisibility of decisions and actions. The Society of Automotive Engineers identifies six levels of driving automation, from zero (no automated functions and active human driver) to five (driver-less cars), from which accountability grids may derive.

The decision-making process is complex, at times unpredictable (deep learning) and it involves multiple players, e.g. manufacturers and suppliers of cameras, electronic and machine-learning systems, physical parts, the AV selling or leasing company, CEOs, and authorities that certified or authorised the vehicle. Players may also be unidentifiable where open source software is used.

One novel duty would enable accountability: creating a universal duty on AV input contributors (i) to map their respective involvement and governance and (ii) to map actual and potential risks.

Accountability and risks in light of what?
Initiatives, principles, guidelines and laws face similar challenges as AV and AI themselves: multiplicity and complexity. To date, every country, region or international organisation adopts its own sets of principles. How viable is it? Accountability innovation lies first in streamlining and consolidating the requirements, values, rules and standards in light of which accountability shall be assessed. There will be no risk mapping and upfront care for accountability absent viability and intelligibility. For example, non-discrimination, pollution minimisation and cyber-security could become common standards in light of which any developer of AV should be accountable, worldwide.

Consolidation and viability of accountability requirements foster effective and sustainable innovation investments, interoperability, level playing fields and better governance of accountability exposure.

Who is best placed to hold AV accountable?
AVs are by definition mobile, and function with AI and data flows easily and automatically cross-border. Which jurisdiction, authority, country, or organisation is entitled, competent or best placed to hold AV players accountable? How do we minimise accountability evasion? Oversight, audit and evaluation are crucial, but by whom? Effectiveness of accountability calls for enforcement governance and the creation of a specialised, multi-jurisdictional body or a mutual recognition mechanism.

Once oversight has reached its limits, should accidents or harm occur, that is where liability steps in. Whether bodies competent to hold accountable (e.g. international body) should be the same as the ones competent to holding liable (e.g. courts) is an essential question where integrity, independence, prevention of conflicts of interest and AI acumen will be key factors of success.

Accountability is good for everyone
Ethics are not bad for innovation, nor is accountability. On the developer side, accountability stimulates ecosystem intelligence, better risk management, sustainable investment and growth. On the user side, accountability ensures than non-human cars do not become inhuman, and it builds trust, and in turn, adoption. On the government side, it ensures technological development also means socio-economic development.

Accountability promotes a feeling-responsible attitude and value-based thinking, which presents the most important opportunity for AI and AV to be human by design.

Mona Caroline Chammas, lawyer at the Brussels and New York bars, GOVERN&LAW founding partner

Juliette Goyer, lawyer at the Paris bar, GOVERN&LAW partner

A car with two front-seats' passengers is about to have a fatal accident that could take a pedestrian's life. Who should survive: the AV's passengers or the pedestrian? To this end, the Moral Machine test, developed by MIT, is very enlightening in helping us understand how to assign responsibility. Nevertheless, it is not where the real question lies; who is legitimate to make that decision?
http://moralmachine.mit.edu/

Artificial Intelligence and Legal Responsibility

The use of Artificial Intelligence (AI) is bound to give rise to difficult questions of law. In particular, this includes questions about the allocation of legal responsibility, or liability allocation of legal responsibility for wrongs committed in the course of utilising AI. These are worth exploring in view of the sharp increase in research and investment in AI-related technologies and the plan to integrate AI into various aspects of society. In view of how AI is defined, as an artificial personality capable of thought and decision-making, difficult questions arise in relation to the legal treatment of AI, especially concerning matters of liability. These questions transcend multiple areas within the legal discipline–such as contracts, torts and crime, as well as intellectual property.

Law as regulation

Law is often described as a regulatory 'tool' capable of engaging in social engineering. It interacts with society, with people and technology. Society shapes the law and law shapes society: it is always a two-way stream. Although traditionally, the regulatory effect of the law was perceived as originating from the narrow confines of legislation (Morgan & Yeung, 2007) [97], such as penal legislation that serves to punish acts that threaten, harm, or otherwise endanger life or property, this traditional view has been challenged by regulatory scholarship that foresaw the closing of the public-private divide (Cane, 2002; Baldwin, Cave & Lodge, 2012) [98]. The assumption that the state has the primary standing in "articulating the collective goals of the community" breaks down in light of the increased participation of non-state actors in shaping behaviour through private litigation (Morgan & Yeung, 2007) [97]. Irrespective of the erosion of the public-private divide in the regulatory effect of the law, what makes law an efficient regulatory tool is its ability to hold persons or legal entities, that flout the norms or standards regarded as acceptable in society, 'responsible' or 'liable' for their actions or omissions. This is visible in every area of specialisation within the legal discipline.

Legal responsibility

Almost three decades ago, a judge in New York said that "[c]omputers can only issue mandatory instructions – they are not programmed to exercise discretion" (Pompeii Estate Inc v Consolidated Edison Co (1977). However, this statement has long been proven to be wrong. AI is made possible by software that mimics the decision-making process of the human mind (Blodgett, 1987) [99]. **Yet, unlike humans, AI does not take a physical form and, therefore, is not within the reach of legal sanction or punishment in the traditional sense.** How ought the law to deal with situations where AI-led processes give rise to civil or criminal wrongs? Who is legally responsible or liable for such wrongs? [100]

Take Self-Driving Vehicles (SDVs) for example. The proposed use of SDVs is one of the many initiatives of the Smart Nation Initiative of the Singapore Government.

Although there might be a perceived notion that computers are not prone to error, there are instances when things could go wrong – as they did in October 2016, when an SDV collided with a lorry in the One North area (Lin, 2016) [101]. In such a situation, it is crucial for the law to be able to impose liability on the party legally responsible for the wrong that was committed. While this incident was a minor one with no casualties, when AI is integrated into high-risk activities, the question of legal responsibility becomes a vital matter for consideration. An example of such a high-risk activity is the use of AI for air traffic control; this is going to become a reality as universities have partnered with government agencies to research the use of AI in this field (Civil Aviation Authority, 2018) [102]. However, fusing traditional notions of legal responsibility to AI-driven activities raises difficult questions.

Challenges posed by AI

With most criminal offences (e.g. reckless driving), and torts (e.g. negligence), the wrongdoer's state of mind becomes a determinant factor for the courts in imputing legal responsibility. Yet when AI is involved, how does one determine its 'state of mind'? In cases where the state of mind become relevant, judges have long employed the test of the 'reasonable man' in determining whether the defendant concerned had acted in an objectively reasonable way. Yet, doctrinally, it may not be possible to impose on AI the test of the reasonable man. Even if a criminal or negligent state of mind can be established, how can an artificial construct devoid of physical form or feeling be made legally responsible?

Rather, is it the case that those who built the AI are responsible for its wrong? For instance, can it be said that manufacturers of autonomous vehicles are responsible for the wrong decisions on the part of software that employs AI? Yet, given that AI, by definition, evolves and arguably has a mind of its own, to what extent can its own actions be attributed to those of its makers? In this regard, and if we are to consider AI and its creator as two distinct entities, theories of accessorial liability could have a role to play as regards the allocation of liability on the latter for the former's acts or omissions. However, there are limitations and strict constraints within which accessorial liability is imposed, 'foreseeability' and 'causation' being determinant factors (Honoré, 1997; Cooper, 2017) [103]. To what extent can it be said that the creator of a technology embedding AI had caused, if not foreseen, the wrong committed by the AI when its intelligence evolves and is no longer bound by the algorithms of its creator? Perhaps in such a case, the lawyer defending the AI's creator may plead novus actus interveniens: as the AI's own mind could have disturbed the chain of causation, in that the creator's contribution to building the AI is no longer the effective and dominant cause for the wrong, but rather it is the AI itself that could be clothed with responsibility.

From another perspective, is the device or machine possessing the AI to be treated as an employee of its creator? This, perhaps, might be an attractive argument: vicarious liability on employers for wrongs committed by their employees are not imposed on the basis that the former somehow had contributed to the latter's wrong, but rather in view of the legal relationship between the two parties (Horsey & Rackley, 2015) [104]. Yet most employment statutes define 'employee' to mean a 'person',

i.e. in general terms a human. As such, the avenue of vicarious liability on the superficial belief that AI must be the employee of its creator breaks down under existing notions of the law.

Thus, theoretically, there are challenges in approaching the question of legal responsibility in respect to wrongs committed by AI. Grappling with the question of legal responsibility is important, as unless liability can be imputed on some party, the actions or omissions of AI will remain beyond legal sanction. While SDVs and AI-based air traffic control provide instructive examples of AI and the potential issues of liability, there are many areas for which AI may be employed in the future. Therefore, it is important to reconsider traditional legal theories and doctrines pertaining to 'legal responsibility' or 'liability' in the context of a world driven by AI. There are no easy answers, but answers must be found.

Dr. Althaf Marsoof - NANYANG BUSINESS SCHOOL - NTU

RESPECT FOR HUMAN AND AUTONOMY

If AI systems are accountable to the rule of law, they become legal entities, which opens the door to a fair amount of questions. Do AI and robots deserve rights? How do we define the human treatment of AI? Could AI be considered as a person in terms of the law?

Should robots look like humans to help us better live with AI?

What's more, as artificial intelligence is predicted to become sentient, the question is: how are we going to realise it? Hereinafter are two outlooks on humanoid living sculptures and the importance of animality in the human-machine interface.

The Humanoid Living Sculptures: our Next Interface to Machines

Have you ever tried to engage in a conversation with your pet? You may try, but the relationship will be dim and condescending, as your cat, dog or other animal does not answer with speech. When we talk, however, we do speak to humans. The natural user interface with a machine is not a machine, but a simulacrum of a human, which is very realistic in terms of appearance and behaviour. It makes it, therefore, more difficult to understand that they are robots. This is the future of our world: realistic sculptures that have life.

Working backwards in time, many ancient figures had already thought - somehow and perhaps without realising it - about the human-machine interface. The Greek philosopher Aristotle wrote in 322 BC in his book *Politics*: "For, if each tool could perform its task on command or by anticipating instructions, and if like the statues of Daedalus or the tripods of Hephaestus - which the poet describes as having "entered the assembly of the gods of their own accord" - shuttles wove cloth by themselves, and picks played the lyre, a master craftsman would not need assistants, and masters would not need slaves." Aristotle was speculating that human automata could someday guarantee human equality. Later on, in 250 BC, a Greek engineer named Philon created the Automatic Servant. It was a human-like robot, representing a maid holding a jug of wine in her right hand. By placing their cup in the palm of her left hand, the servant would fill the visitors' cup with wine and water when desired. More recently, Leonardo da Vinci (1452-1519) created a humanoid called the Automaton Knight, that was capable, thanks to a series of pulleys and cables, of independent motion such as sitting down, raising its visor, or manoeuvring its arms. In the 18th century, humanoid automatons were more frequent. The Musée d'Art et d'Histoire of Neuchâtel, for instance, houses a set of three automata built by the Jacquet-Droz family, called the musician, the draughtsman and the writer. In the last couple of centuries, we were able to produce magnificent and realistic statues - Rodin's statues prove it.

Today, technology provides us with new tools to build statues and sculptures, enhanced with simulated life. In one respect, as slavery has disappeared and dull work has decreased, we can say that we have followed Aristotle's dream. Almost everyone can work with dignity. We must move toward a society that is populated with both real people – humans – and with humanoid robots of various human shapes – the new living and realistic humanoid sculptures. Immensely clever than us, they will help us in many ways. With slavery will be a distant memory, Aristotle will smile from his grave.

I am thrilled to follow this dream.

Humanoid Nadine and Prof. Nadia Thalmann.
source: NTU

Nadia Thalmann - NTU

From Minority Report to Ex Machina, from Westworld to Black Mirror, humanoids' design and degree of sentience – their ability to perceive, to feel and experience – are crucial. Pop culture has made a mark on our collective imagination, by promoting robots with human shapes. As humanoids tend towards being living sculptures, it also raises the question of the interaction between humans and robots. Hereinafter is the outlook of Spoon that values animality in the human-machine interface.

AI in Robotics: the "For, By and Among Humans" Rule

Social robotics is a rather new field of research (and development) that aims to design purely interactive robots, or to provide service robots with social interaction capacities to facilitate their integration into society. Although the social trend of human-machine interaction (HMI) is relatively new, some "sociobots" are already available on the market or active in certain environments such as nursing homes, hospitals, hotels, companies and shops. Without falling into a deterministic vision of our technological future, we could soon find ourselves increasingly confronted by artificial social agents, so "living with AI" might also mean "living with robots". But what should these robots be? Spoon [104a] answers that question with its "for, by and among humans" rule. Let's examine this proposition.

Robotics for humans: natural interaction

To promote robotics for humans, it is essential to put the stress on the fundamental characteristic of accessibility, by focusing on natural HMI. We call these HMI animal interactions and defined them as the reproduction, in the machine, of interpersonal coordination capacities based on social cues such as eye contact, emotion detection or shared attention. Providing these abilities to objects is meant to create a social affordance, to reduce use barriers as drastically as possible. Interacting with our creatures and "using" them is an intuition-based process, and does not demand any prerequisite other than basic sociality.

Promoting natural interaction with embodied artificial agents is also a way to create physical avatars which centralise the different AIs of a given place. If our environment is to become smarter and smarter, it is crucial to let us, on one the hand, be aware of the decisions the AIs can make, and to give us, on the other hand, the ability to understand and control them easily.

In this human-centric approach, the shape of robots is a determinant factor. According to the "uncanny valley" theory coined by the Japanese roboticist Masahiro Mori, the more a robot looks like a human being, the more its defects appear monstrous. Moreover, the humanoid shape, even in its most abstract adaptations, proves to be overpromising about the actual capacities of the artificial agent. The quality of natural interaction relies not only on its technical properties but also on what we project onto the machine. Therefore, expectations that are too high can distort the interacting experience and lead to severe disappointment.

We have opted for hybrid shapes where non-humanoid hardware structures such as robotic arms and interactive screens meet with a digital animal face. The latter is a precious social landmark made to create the best possible human-machine understanding without falling into overpromise. The animal bias is also a way to reassure

the users by making the technology as pleasant as possible; it also aims to avoid the fears linked to the technical reproduction of humans which are deeply rooted in European culture. However, the matter of shape strongly depends on the cultural context of the robot's conception and integration. Japan, for instance, is much less reluctant than western countries to adopt humanoid shapes. From a pragmatic point of view, the current golden rule for social robotics design consists of shaping the artefact in accordance with its actual capacities.

Robotics by and among humans: a collective conception of AI for collective social robots

Our second belief is that creating social robots' intelligence requires a collective by design approach. This is a way to establish a constant reminder of the technologies' human genesis, while openly favouring the collective determination of technologies. As accessibility and collectivity are cornerstones of our outlook, we focus specifically on public spaces: stations, public transports, malls, hotels, receptions, monuments etc.

The technical industry as a whole, and consequently society itself, tend to forget the human origins of technologies. This is particularly true for the AI industry, whose objective focuses on the technical reproduction and the automation of cognitive processes. One of the most significant examples of this forgetting is the Go match that pitted Lee Sedol against Google Deepmind's algorithm AlphaGo in 2016. The Go player only managed to win the fourth round, exploiting a flaw of its "adversary". We stand with those who think that Lee Sedol didn't really lose against an AI – or only apparently – but against multiple human intelligences specialising in AI and committed to designing AlphaGo. Seen from this perspective, managing to win the fourth round can be considered an astonishing masterstroke.

One way to remember this human origin of AI and technology in general, is to allow the design process to reach out to a real human environment. To make this ambition concrete, our creatures have a learning scenario called Agora, in which everyone is free to teach them as an open-source programming platform. As its programming is transferred to its human environment, the robot is thought to become a local social network fed by all the different users' interactions. If you ask a question to get information that is not part of its pre-programmed knowledge, its answers will depend on what it has learnt from other users. Every response can be positively or negatively assessed by the users, to ensure collective downstream design.

Artificial Creature, Spoon.ai

Agora is meant to empower users by allowing them to participate in the creation of the artificial creature and to steer the technical design towards a society in the loop direction. This bottom-up approach is thought to be a first step towards integrating people into the design process and shaping social robots on a collective intelligence basis.

SPOON

AI Making Us More Human

(Isaline Duminil, Marketing & Communications Director, JCDecaux Singapore)

Part of the apprehension surrounding AI and the complexity of its systems is due to the fear that it will erode our humanity by overriding our ability to make decisions. In his book U*nderstanding Media: The Extensions of Man* (1964), the early communications theorist Marshall McLuhan was already warning that "we have become people who regularly praise all extensions, and minimise all amputations". This apprehension should be thought of and addressed in different ways.

It is imperative that AI systems understand human values and preferences, to provide an accurate value alignment. Instead of optimising systems to appeal to short-term desires, we must design them to align with our deeper values, in order to attain clear and long-term goals and purposes. As expounded in the section on the accountability of autonomous vehicles, basic parameters should be laid out ahead of time. Since we, as human beings, are building and designing technologies, we need to ensure that developmental criteria meet our core humanistic values.

There are ways in which AI can make us more human. By increasing our fundamental ability to interact with people, regardless of language, we have proved McLuhan's theory, in some way, that we are able to develop technologies which not merely amputate us but can also enhance us. At the same time, with AI automating mundane processes, time and effort can be channelled into improving our relationships with other humans. For instance, these applications of AI have emerged in the healthcare industry; with the ability to streamline the administrative workflow, healthcare professionals can invest in patient care instead.

As seen in the *LWAI Report 2019*, there is a focal point that AI must be human-centric, though societal contexts sway the implementation of AI systems around the world – by governments or companies. Regardless of the direction which evolving technology takes, the development and use of AI boils down to fundamental ethics. The guiding principles of AI put forth by public and private organisations are underpinned by the same need for transparency and accountability. However, we must understand that societies' cultures, as they differ from country to country, affect the way we consider the human-machine relation. For instance, on the Asian continent, South Koreans see machines as purely functional units meant to serve their purpose, whereas Japanese explore the human-centricity notion more deeply.

It is reassuring that conversations on ethics and governance are being initiated when AI is at its nascent stage, as solutions can still be prescribed. The unprecedented influence – and force of transformation at every level of society – of social media in the past decade must be seen as an opportunity which provides sufficient hindsight to understand major pitfalls such as privacy issues.

As a whole, we need to ensure that a system of checks and balances are in place to hold humans accountable for the systems we design.

Looking Back to See the Future : Automation, Cybernation, and AI during the Computer Revolution

(Asst. Prof. Graham Matthews – School of Humanities, NTU)

Michael Frayn's comic novel *The Tin Men*, published in 1965, is set in the William Morris Institute of Automation Research, a fictional research lab for developing artificial intelligence and automating various aspects of life. Research and development at the Institute has been delayed by the construction of a new Ethics Wing tasked with "investigating to what extent computers can be programmed to follow codes of ethical behaviour" (Frayn 2015: 48) [105]. Experts have calculated that if the work of the Institute had gone ahead unimpeded, they would have made over two million professionals redundant over a ten-year period (Frayn 2015: 9) [105]. The novel is a humorous examination of the effects that computers and artificial intelligence were predicted to have on population, education, mobility, culture, and communication during the second half of the twentieth century that also speaks to key issues today.

Present-day discussions concerning the potential effects of the Fourth Industrial Revolution closely echo mid-century debates about the impact of future technological developments such as autonomous vehicles, large-scale data processing, language processing, machine translation, and machine learning on social relations, educational institutions, the workplace, and privacy rights. Looking back at the critical issues facing managers, policymakers, and industrialists can help us to predict the potential impact of new technologies of the future. Developments in automation, cybernetics, and AI stimulated wide-spread concern among government institutions, businesses, and the public about the projected transition from industry to services, the threat of mass unemployment, technologically driven socio-political change, and the evolving relationship between humans, and machines.

They were particularly focused on the impact of machines that can operate or "think" without input from a human brain. Their most optimistic projections held that machines would be capable of doing any work that a human can do within twenty years (Simon 1965) [106]. Nevertheless, influential voices in government and industry expressed concern, not only with "push-button machines", but with the danger of being content with "a push-button type of thinking". Their concern was that the spread of standardisation would erode innovation, creativity, individuality and risk-taking, and they warned against the pressure to overuse and overvalue the solutions provided by AI and computers (Michael 1962; Forbes 1968; Taube 1961) [107].

In 1963, Alice Mary Hilton coined the term 'cyberculture', which referred to the way of life made possible when the entire process of production is carried out by a computer. She described how computers could become conscious and warned that machines must be tailored to meet human needs, rather than humans altering their behaviour to meet the needs of machines. (Hilton 1963: 374) [108].

Meanwhile, the philosopher Jacques Ellul expressed the fear that humans would become obsolete in the face of continuing technological advancement (Ellul 1967: 9) [109]. Whereas humans can draw on both cognitive and emotional reasoning to solve problems, machines are limited to mathematical-logical standards that appear more efficient in the short-term but lead to a deficit in imagination, creativity, and real-world application.

In 1948, Norbert Wiener coined the term 'cybernetics' – derived from the Greek kubernetes meaning 'steersman' or 'governor' – which refers to the science of communication and control in both living beings and machines (Wiener 1961) [110]. Later in life, he developed an avowed dislike for what he called the 'gadget-worshipper'; these were business leaders who sought to centralise control over their organisations and replace independent and creative thinkers with the greater speed and accuracy of machines. The AI would not require time for rest and entertainment, the provision of a living salary, and will not raise moral objections to unethical decisions. Wiener acknowledged another – less trumpeted – benefit of AI, namely: the ability to shift personal responsibility for a dangerous or disastrous decision onto a "mechanical device which one cannot fully understand but which has a presumed objectivity" (Wiener 1964: 60) [111]. From this perspective, AI is not simply an extension of human will but can also function as a scapegoat for erroneous or unethical consequences.

In response to the gadget-worshipper's belief that a highly automatised world would lead to reduced claims on human ingenuity and imagination, Wiener argued that instead, humans will be forced to map out all foreseeable outcomes and exhaustively map out the complete range of interpretations, an impossible task. "A goal-seeking mechanism will not necessarily seek our goals unless we design it for that purpose, and in that designing we must foresee all steps of the process for which it is designed, instead of exercising a tentative foresight which goes up to a certain point" (Wiener, 1964: 68) [111]. Rather than launching necessarily incomplete software and ironing out the bugs through patches, Wiener argued that we must exhaustively determine the potential outcomes of this technology in advance.

Donald Michael from the U.S. Department of Labor, was concerned with three interrelated issues: (i) the shift from manufacturing to services; (ii) greater leisure time; and (iii) the growing division of knowledge within the population. Michael noted that as the population grows and the technology improves, it would become worthwhile to cybernate services. In response he claimed that it is necessary to educate the population to demand 'real' – meaning human – service. Furthermore, he argued that the population must be educated in the arts and humanities not only for work, but to make use of the increase in leisure time projected to come about as AI fulfils more tasks. Mid-level workers have been trained for labour but not for leisure, and it is important for humans to find meaning and purpose in their lives.

Michael predicted the rise of a cybernetic class who would work in synergy with machines. At the same time, the remaining population are engaged in activities requiring judgement and emotional intelligence or in public tasks required by the state that the government will not allow to be cybernated because of the resulting unem-

ployment. He anticipated that rising complexity may cause trust in institutions and expertise to crumble: "how does the citizen manage to be an active member of the democratic community when the issues important to him become more and more complex, the techniques for dealing with them more and more esoteric, the skills required to understand the problems more and more elaborate, and the professionalisation of government deeper and deeper?" (Michael 1964: 19) [112]. He noted that humans make decisions based on emotions rather than mathematical-logical standards and predicted that without socio-cultural acceptance of technological change, humans would turn on the sophisticated technological base that underpins society.

The American businessman John Diebold argued that major developments in science and technology needed to be matched by innovations in culture, economics and society [113]. He recognised that new technologies such as AI and automation were not simply the solution to today's problems but the key to a very different tomorrow. Diebold noted that national advantage in technological development lay solely in the education system and major research institutions. He claimed that the proper role of public policy should be to create the necessary conditions for leadership in the human use of new technology and valued the insights that history, philosophy and the humanities could offer to future debates.

In summary, the key lessons from the computer revolution are: dramatic technological shifts require corresponding changes in culture and society; the overvaluation and overuse of computers and AI risks eroding individuality and creative risk-taking; greater technological complexity risks eroding faith in institutions and expertise; education in the arts and humanities is required to ensure that AI is used to promote human values; and finally, projected increases in leisure time may, sadly, be exaggerated. Overall, mid-century commentators argued that the benefits of greater efficiency and centralised control should be tempered with greater wisdom, beliefs, behaviour and goals.

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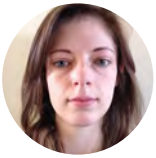

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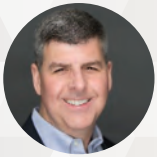

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Notes

LIVE WITH AI 2019 CONCLUSION

Our ability to live well with AI relies on us, and is in our hands. This is what motivates each of us to take part in this think tank. By bringing our own point of view on this exciting transformation of our society, we are serving the next generation and helping to build a better world for them. As pointed out in one of our last board meetings, we foresee greater convergence between technology and human sciences. The recent launch of the National University of Science and Technology for Humanity in Singapore is a perfect example of such convergence. As was true in the 16th Century, it is urgent to include philosophes, human scientists, ethnography experts, and anthropologists in the AI debate, to envision a positive future for our society. After 50 years of excitement over the tremendous potential of the technology in all domains, it's time to reconsider our human core values, to design with AI the systems, models, rules and economics which will allow us to build human-centric products and services accessible to all.

For this reason, we are very proud having received the full support, engagement and participation from the Lee Kuan Yew Center of Innovative Cities at the Singapore University of Technology and Design, the Nanyang Technological University of Singapore, and the INSEAD Emerging Market Institute to conduct our research.

Decision makers and policy makers want fast learnings and concrete action based on positive experimentation, and we will continue to foster such collaboration between corporates, academics, start-ups and policy makers, to deliver applicable and independent recommendations and solutions which will be accessible to anyone who wants to part of this human-centric transformation of our business and society.

Pierre Robinet, Live with AI Founder


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