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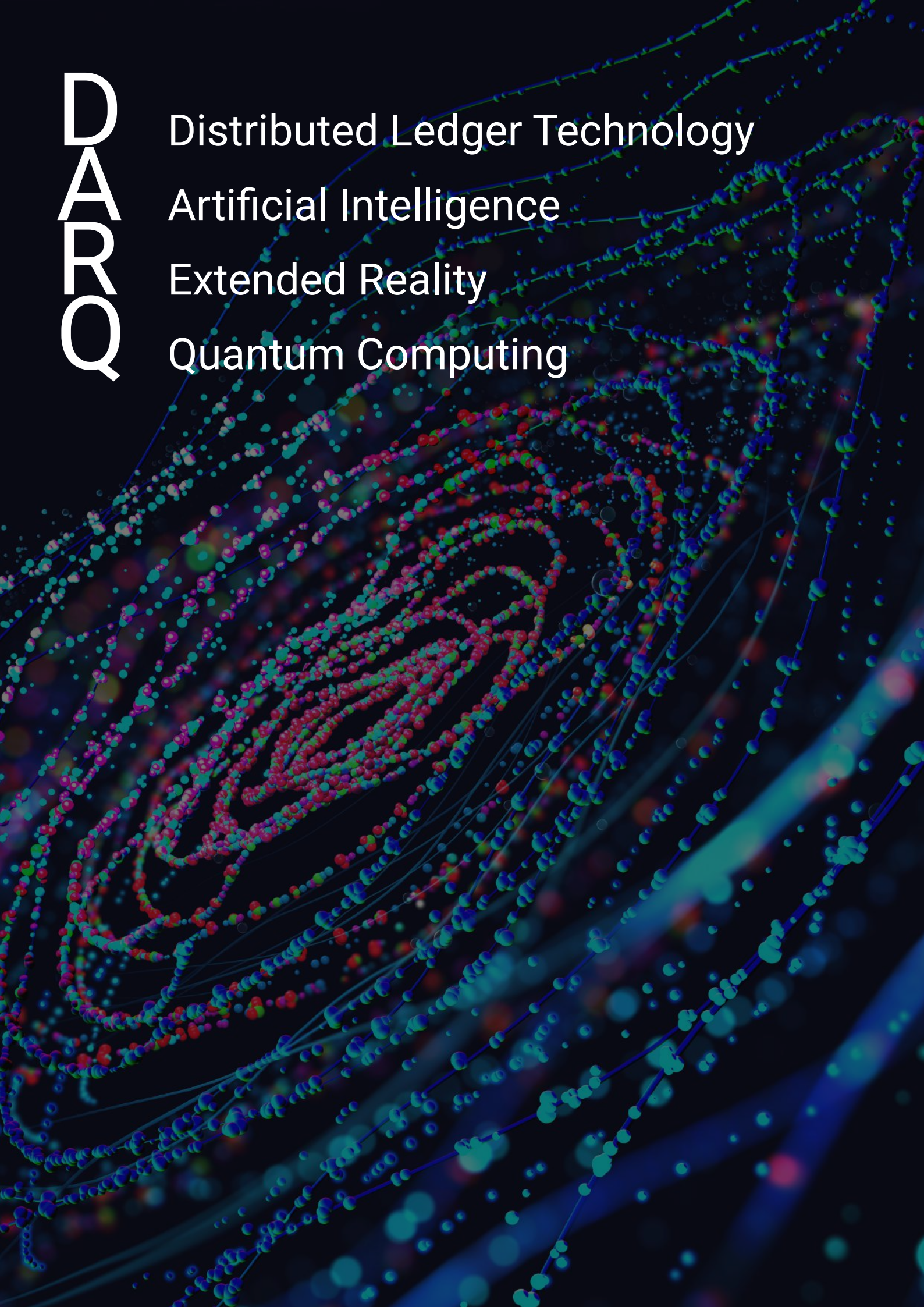
DARQ is (almost) here


DARQ
Distributed Ledger Technology
Artificial Intelligence
Extended Reality
Quantum Computing

What is DARQ, and why are we entering a post-digital society?

What is a post-digital society?

First there was post-modernism. There was even post-history. Now we have post-digital.

In a report by Accenture titled 'The Post-Digital Era is Upon Us Are You Ready for What's Next?', it was predicted that we would soon be entering a post-digital age. The assumption was that as countries complete their digital transformations, we will no longer require the designation 'digital' in relation to our societies. It would be like saying we are still in the 'industrial' age because we have factories.

While it is hard to imagine that your local barber won't take cash or that your corner shop will have an app, the point is that digital services now touch every aspect of our lives. Everyone has a powerful computer in their pocket. Your grandma might even be buying Bitcoin. Most of us have a digital presence on a social media platform.

According to Accenture, this first wave of digital transformation is almost complete.

If we are all digital, what's next?

Next comes a new wave of innovation. Some are calling it a digital renaissance. There is a stampede of acronyms to get your head around. One of those is DARQ.

DARQ is the supergroup of emerging technologies. DARQ would make HG Wells sit up and pinch himself in disbelief.

The four emergent technologies of DARQ

DARQ is the latest acronym to join the list of emerging technologies that promise science-fiction fantasies in the near-future. It is an umbrella acronym that groups together Distributed Ledger Technology (DLT), Artificial Intelligence (AI), Extended Reality (XR) and Quantum Computing (providing the mysterious 'Q').

These technologies are all at different points on the adoption curve. Before we examine the collective power of DARQ and why these particular technologies have been lumped together in a sinister acronym, we will briefly explain DLT, XR and Quantum compute, as these are perhaps lesser known and are in earlier stages of adoption.

Distributed Ledger Technology (DLT)

Distributed Ledger Technology (DLT) is, essentially, blockchain for networks. Without the need for trusted third parties, DLT creates a consensus of replicated assets across multiple sites and geographies with no central administrator. The network corrects itself and ensures a single timeline of entries via a complicated mix of cryptography, economics and game theory to incentivise honest ledger entries.

A Che Guevara zeal is attached to blockchain in the public mind: a sense of power/money/data being returned to the people. In terms of DLT, this will probably fade, because data is not that exciting and doesn't sell tee shirts; but more significantly, it will almost certainly go mainstream and be adopted by mainline government services. While it may not be cool, it will be quietly revolutionary.

A distributed ledger takes this ancient and timeless means of tabulating records into a new era. Sharing an asset database across multiple sites, with each participant in the network holding an identical copy, has the distinct advantage of removing the need for an issuing authority or large IT companies to manage and authenticate data.

Centralised systems are more expensive and create a single point of failure.

Estonia has been experimenting with DLT for some time already. The Estonian government has been using DLT in the form of Keyless Signature Infrastructure (KSI), developed by a company called Guardtime. KSI allows citizens to access and update tax and identity records without a high burden on the state.

Overall, DLT will increase the efficiency and accessibility of public services in countries that are able to deploy this technology. As it stands, the merit of these systems does not necessarily outweigh the high technical barriers and risk of failure: but in time that will change as costs decrease and use cases increase. The technical protocols needed to access such systems may also be off-putting for some members of the public.

There needs to be more use case analysis for DLT across all sectors, examining the economic incentives vs risk and cost.

There are many exciting possibilities for DLT, many of which come from a convergence with other DARQ technologies.

With networks themselves becoming more distributed, and with the growth of Edge compute and IoT, there is a general shift away from siloed data toward data clouds and AI decision-making at local nodes. The potential for licensing and authorising goods, services and payments for a user in a real-time environment is advantageous to circular economies and autonomous technologies.

The fact is, much of the paper-pushing and administration of the state could eventually be fully automated and handled with breath-taking speed. For business, the prospects are equally game-changing. Services that require licencing and application procedures could run in the background and completion times might be cut down from hours to minutes or even seconds. Administration will become totally virtual in some cases, handled exclusively by AI and DLT. This will have dramatic effects on the labour market and there might be unforeseen risk factors such as system flaws that can be exploited internally or by cyber-attack.

Extended Reality (XR)

Extended Reality groups together Augmented Reality (AR) and Virtual Reality (VR) into one term that carries the inevitable weight of the Metaverse. Given the recent change of Facebook's corporate name to Meta, these much hyped but underperforming technologies still have high hopes pinned on them.

There are quite escapist fantasies attached to XR and the Metaverse. If democracy really is on the retreat in many parts of the world, and if climate change leads to increasing humanitarian disasters and waves of migrants flooding over borders, it is not hard to entertain dystopian futures where digital societies retreat into the safe familiarity of the imagination.

The main applications of AR/VR appear to lie in education, healthcare, and gaming; in most cases corporate uses involve training via immersive experiences. But so far VR relies on a clunky headset and tends to cause motion sickness. AR requires either glasses (the spectacular failure of Google Glass is still

in recent memory) or using your phone as a window and moving it around to find Pokémon.

However, with approximately 20% of Facebook's workforce working in the AR/VR division, called Facebook Reality Labs, there could be breakthrough devices to make the jump from reality to virtual less of a bump.

Combined with the low latency and bandwidth of 5G, and the power of Quantum and Edge compute, there are limitless possibilities if the right hardware can be developed.

Our environment will become a playground of immersive experiences that leave our screens behind:

- Tags: Floating labels identify the names of trees and wildflowers in parks
- Navigation: a floating line that hovers over the street, guiding you to your destination
- Shopping: product information that projects into mid-air, giving personal recommendations and reviews. The items on your list are highlighted on the shelves so you can find them easily
- Advertising: Billboards showing different adverts to different people
- Reminders and notes running in text across floors and walls, or integrated in other ways into your visual environment
- Games: updates to the Pokémon Go formula, with treasure hunts and other city-wide games
- Facial recognition and cues: analysis of micro-expressions so you know if a date is going well or not
- Fashion: Mirrors that show the dress you just picked up mapped onto your body
- Art: Large projections in the street as artworks or museum installations: historical views of the city mapped onto current buildings
- Social: Friends joining you at home as a holographic avatar
- A haptic maze: barriers and walls that have a physical presence due to haptic gloves. Used in games and other virtual spaces

Although much of this will certainly come to pass, the unknown factor is what the interfaces and hardware will look like.

DARQ will be the catalyst that accelerates our progress toward what currently sounds like science-fiction.

Schrödinger's cat as binary code

Quantum Computing uses the properties of quantum states, such as superposition and entanglement, to perform computations. This new dawn of computing will solve problems that are impossible (or near impossible) for everyday computers.

Calculations involving big data and biological simulations, many of which are essential to predict weather patterns and create vaccines, will require quantum compute.

To give you some idea of the difference in speed; if you wanted to find one item in a list of 1 trillion and it took one microsecond to check an item:

- A classical computer would take about 1 week to find the item;
- A quantum computer would take about 1 second

Quantum computers are currently about the size of a domestic fridge. A classical computer uses bits, tiny gates that can either be on or off (1 or 0). But on a quantum level the physical world is a lot more fuzzy. There are indeterminate states, and sometimes cats are both alive and dead.

Quantum computers use qubits, which can be in a variety of states from on to off, and even in both states simultaneously. Through a state called superposition, qubits can be mapped

into vast computational spaces and used to represent complex problems.

This allows a quantum computer to deal with a high degree of uncertainty in calculations, which is much closer to the natural world we live in.

Imagine a maze. To fine the one optimum path, from start to finish, a classical computer would have to try different routes at random until it finds the correct one. A quantum computer can effectively try every single route at the same time, finding the solution in a fraction of the time.

There are currently severe limitations to quantum computers. The superconductors used to quantum tunnel electrons need to be cooled to just above Absolute Zero with superfluids. Qubits are by nature incredibly unstable, and therefore very sensitive to interference. Quantum computers have to be isolated and shielded against electrical waves, temperature changes, vibrations etc.

Quantum computing will revolutionise Artificial Intelligence, creating paradigm-shifting advances. Google is already using quantum computers to create better software for autonomous cars.

Despite these barriers, companies and countries around the world are racing to scale a stable quantum computer. IBM, Microsoft and Google are all competing to achieve supremacy. China and France have both invested billions into quantum computing research.

Of all the DARQ technologies, Quantum is probably at the earliest stage of adoption.

DARQ is all about convergence

The excitement around DARQ comes from the catalyst effect of converging technologies. There is no way of knowing exactly what the knock-on effects of these technologies will be as they interact and emerge with each other.

A high number of use cases are becoming apparent which feature all or most of these technologies being used together. Take this one near-future scenario as an example:

- You get home from work and you feel weak and nauseous. Your smart watch bleeps and suggests you speak to an AI assistant, who just happens to be called Alexa.
- "Hi Dave, what seems to be the problem?" You reel off your symptoms to a sympathetic Alexa who already has a large database of empathetic replies and even humour tailored to put you at ease.
- Your watch has already sent Alexa encrypted diagnostic information gathered over the past few days. Alexa makes a quick diagnosis, using Edge compute and software developed by quantum computers. Data is referenced and recorded in a huge NHS database stored in DLT.
- The prescription pops up on your laptop and you have been notified that an autonomous vehicle will shortly be dispatched by the pharmacy to deliver the pills. 5G, IoT sensors and Edge compute guide your small delivery vehicle the three miles to your door, and your prescription is delivered promptly into your secure mailbox.
- Another bleep from your watch confirms that the money has left your digital wallet.
- "Take one pill with food three times daily and have a nice day!" chirps Alexa.

A very DARQ future

There are potential legal and ethical precedents to these converging, distributed intelligent networks.

The combination of automated protocols to access and update public or private databases with trusted peers, distributed sensors (IoT) that surveil our actions, and AI to make decisions rapidly based on this data could lead to powerful

methods of control and surveillance. We might see the emergence of police states in autocratic countries that go much further than previous incarnations.

Future society will take many decisions out of our hands and move them to local nodes, returning as information, machine actions, signals and environmental changes.

This will eventually encompass all aspects of our lives, from smart homes to education to transport to health to shopping and entertainment.

Everything will be responsive and personalised.

The report by Accenture notes how the Japanese e-commerce company Zozotown uses skin-tight spandex 'Zozosuits' that pair with an app to provide precise body measurements. This gives customers the ability to order tailormade pieces of clothing in as little as 10 days.

We are already in a future where you can walk into a hotel and find your favourite cocktail is ready and waiting at the bar.

While there are huge advantages to an intelligent network supporting our daily needs (including our emotional needs), it will come at a cost. Personal data, privacy and freedom will be fought over as companies and governments enter into millions of subliminal transactions with citizens and customers, sharing huge volumes of data that could be exploited by cyber-attacks.

We will never be in the post-security age

While blockchains are often touted as being un-hackable, that isn't exactly true. There is the once (but no longer) hypothetical 51% attack which led to Ethereum splitting into two alternate timelines: Ethereum and Ethereum Classic. Occasionally there are flaws in the code that underpin the protocols (although usually fixed in secret before anyone can exploit them). There are glitches in smart contracts that can be maliciously exploited (these are particularly dangerous because it is not possible to patch a smart contract.)

And most vulnerable of all are the exchanges which allow cryptocurrencies to be traded: between March and May this year at least 6000 Coinbase customers had funds removed from their accounts.

Quantum encryption

Quantum technology has potential negative ramifications for blockchain technologies. It is predicted that within a decade we might have quantum computers that can break the encryption of digital wallets and perform 51% attacks on cryptocurrencies.

Current encryption systems rely on the difficulty of breaking down large numbers into prime numbers, called factoring. For classical computers, this is slow and expensive, but quantum computers can do it quickly. That could put all our data at risk.

According to Wired magazine, intelligence agencies around the world have been stockpiling vast amounts of encrypted data in the hope they will gain access to a quantum computer that can crack it.

One answer to this is quantum encryption. It relies on the uncertainty principle: the quantum principle that you can't measure something without influencing the result. In theory, quantum encryption keys are impossible to hack.

Quantum compute offers both new forms of attack and defence. Whether the technology lends itself more to one that the other could have far-reaching effects on our personal data and security.

Your personal data as currency

Most of us have become accustomed to the trade-off between giving up our personal data and access to free services such as social media. Even if we feel vaguely uneasy about

this unknown volume of data mirroring our movements, we are dependent on and addicted to the tools it provides.

Personal data as purchasing power is likely to become even more contested in a future where intelligent networks mediate every branching fork in our daily lives. New privacy laws will be required, but they will be hard to mediate with so many micro-decisions and an exponential rise in all forms of data. Society may even have to redefine what constitutes personal data.

The dawn of DARQ

DARQ technologies won't be relevant for every business right now, but they are likely to impact every business one way or another in a relatively short period of time:

- Many of these technologies may be accessible through cloud partners and data centres or As-a-Service models.
- AI is the most developed and most adopted of the four DARQ technologies. It will be a catalyst, essential to all other technologies in both development and application. AI will lay the foundation for intelligent networks that integrate with DARQ and run the interfaces that access those technologies.
- Quantum compute might take a decade to fully emerge as a commercial form of compute. However, vendor services from Microsoft, Google and IBM could be available in the near future.
- Hopefully the UK government will follow in the footsteps of Estonia, and we will see a common shared platform for DLT that will increase the efficiency of identity and financial checks, taxes and other public services.
- AR/VR (XR) will continue to be a niche market until the point at which comfortable and unintrusive hardware pushes it into the mainstream. If the Metaverse ever catches on and becomes more than a nebulous alternative reality where everyone is plugged into Facebook, there will be a cascade of marketing and business opportunities. This might be the closest we get to a mirror world, where brands are mapped to their digital twins.

We are entering a future where our digital identity will take an almost physical form.

We will have to adapt to new ways of living and working and get used to intelligent systems making decisions on our behalf. This may require a complete shift in the social contract and new roles for government.

It is too early to say exactly what form Industry 4.0 will take —but the use cases speak for themselves. DARQ is already here.

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