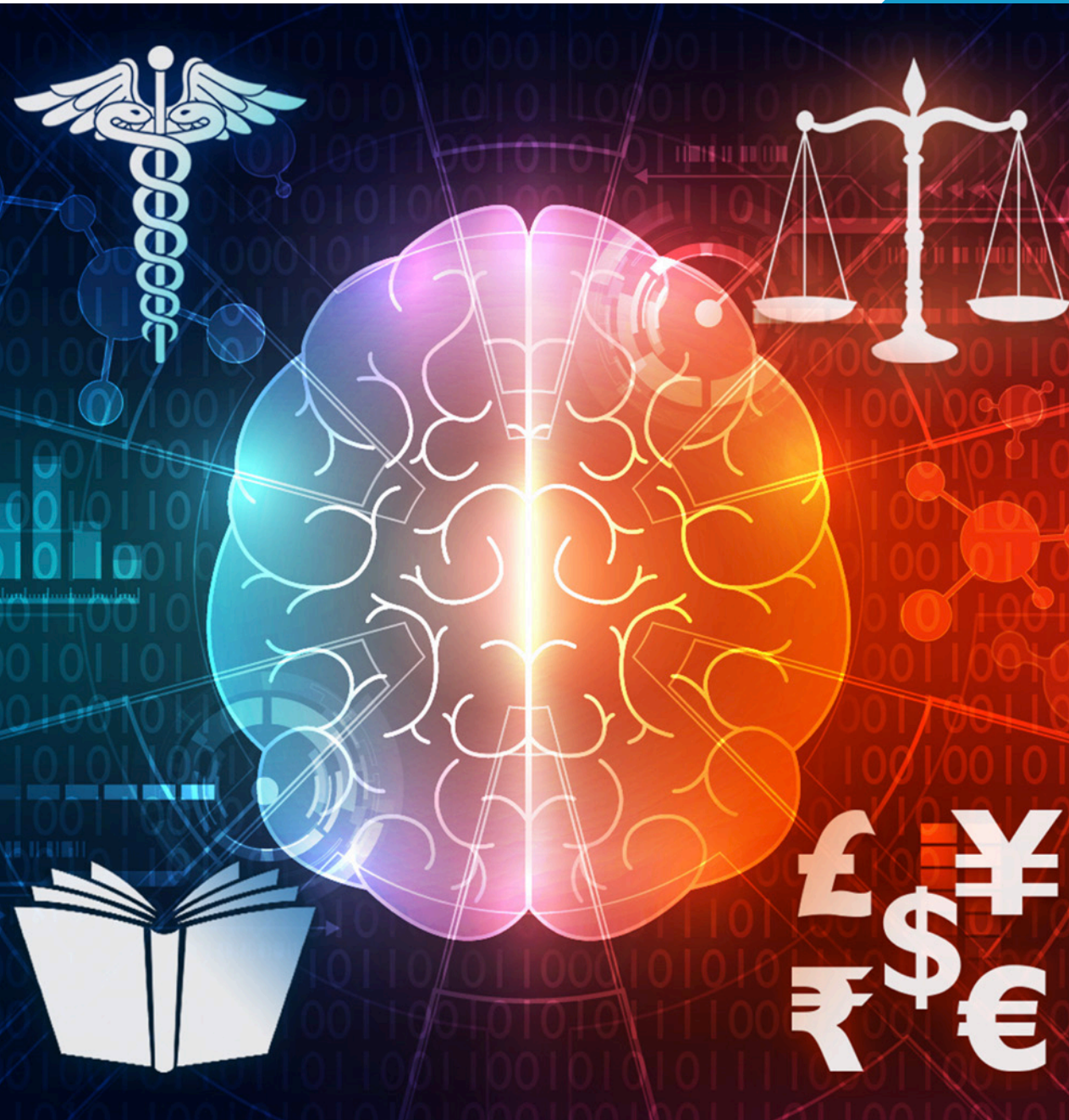


Executive Summary

Disrupting the Professions through Machine Learning and Digital Trust

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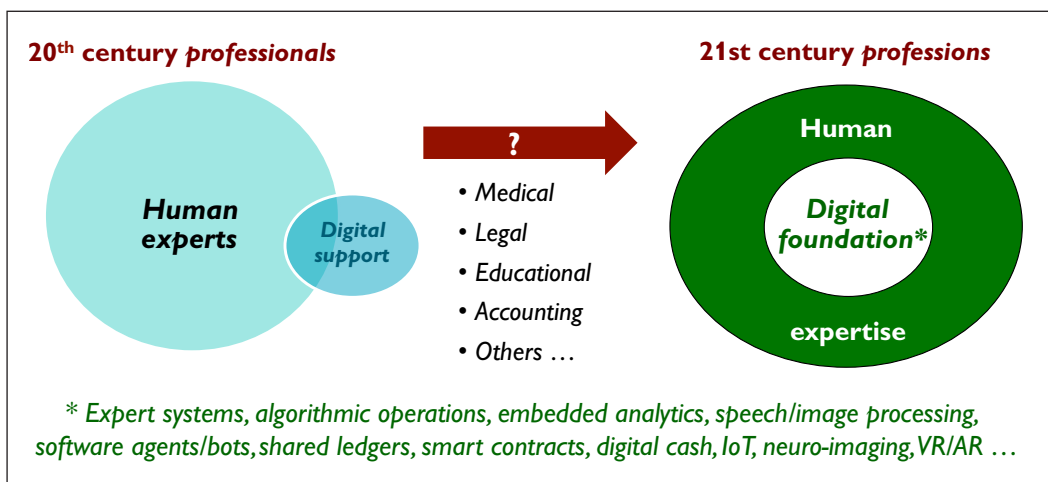
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While the work of doctors, lawyers, professors and accountants has been only moderately affected by information technology thus far, the digital innovations of the 2020s are aimed directly at automating knowledge, learning and trust – the very traits that have defined ‘the professions’ for literally centuries. This realization was the starting point for our research into how advanced forms of human expertise will likely evolve during the machine intelligence era.

It’s clear that significant professional evolution is needed – both by society and the professions themselves. Costs are too high, citizen access too low, and the professional workload often crushing. To address these challenges, the medical, legal, education and accounting professions must establish and leverage a *21st century digital foundation* that puts data, software and machine learning at their operational core. This is the only way to achieve the required scale, efficiency and innovation.

Fortunately, today’s information technologies – expert systems, software agents, speech and image processing, algorithmic operations, shared ledgers, smart contracts, digital cash, the internet of things (IoT), virtual/augmented reality, biometrics and neuro-imaging – are almost ideally suited to this task. Taken together, they will move the use of technology beyond today’s digital support, and establish a powerful digital foundation where human and machine strengths and expertise complement each other, as depicted in the figure below.



Project focus: How will the coming wave of machine learning and digital trust affect the professions over the next decade?

Project scope and definitions

The words *professions* and *professionals* can have a wide range of meanings, but the common denominator is that being a professional is to *profess* a skill, typically one that has earned societal recognition through some sort of trusted credential, such as a degree, licence or membership.

In our research, we used doctors, lawyers, professors and accountants/auditors¹ as our ‘Big Four’ high-end proxies for professionals who deal mostly with specialized information and knowledge, a realm that also includes statisticians, actuaries, tax advisors, recruiters, translators, editors, teachers, scientists, consultants, government officials and similar job functions.

Outside of this project’s scope are professionals who work with the wider physical world: architects, surgeons, dentists, pilots, sailors, drivers, engineers, electricians, machinists, policemen, soldiers and so on. We exclude these individuals because changes here are likely to be driven by robotics, 3D printing, new materials and other physical world innovations that require a different analytical framework. The outlook for these professionals would be an important companion study.

What about IT professionals? While IT professionals are a unique case, their experience demonstrates the very thing we expect to see. There has been an explosion in IT innovation without a major increase in the total number of IT professionals. Additionally, IT professionals have already gone through virtually all of the specific forms of disruption we envision, and this makes their experience especially relevant.

1. The major auditing/accounting firms – Deloitte, PwC, EY and KPMG – refer to themselves as *professional services firms* as they perform a wide range of financial, legal and technical work. But in this report, when we talk about accounting/auditing firms, we are looking mostly at this particular function.

The need for disruption

Although professionals are working as hard as ever, both societal and personal dissatisfaction are often on the rise, even as many professional services firms continue to prosper. In their insightful 2016 book, *The Future of the Professions*, Richard and Daniel Susskind argue that professional disruption is not primarily an industry threat to be managed, but rather a societal solution that needs to be embraced. Consider the familiar problems below:

- High costs make it difficult for the professions to fulfil their medical, legal, educational and other societal missions.
- Information overload makes it difficult for many professionals to keep up with their fields.
- Like all of us, professionals make mistakes, are subject to predictable behavioural biases and blind spots, and often have a weak understanding of statistics and probability.
- The professions generally do not provide their customers with a modern digital experience, and in this sense are not keeping pace with market expectations.

Put simply: extensive digital automation is needed to meet societal service and access requirements, and this will require significant changes in the way professionals work.

Technology can address these issues, but why hasn't more change occurred?

It is remarkable how these problems of citizen access, information overload, human error and the need for a digital customer experience seem to lend themselves to a quick technological fix through modern digital approaches. Indeed, the potential for radical business model improvements has been obvious since the early days of the dot.com era, when revolutions in healthcare, law, education and financial services were widely, but wrongly, predicted.

Nothing nurtures a sense of scepticism more than greatly hyped expectations that fail to materialize. In our discussions with clients this feeling was palpable. Every firm has its digital believers, but even these individuals find it difficult to push for aggressive digital transformation programmes. Several digital enthusiasts essentially said to us: "I can't even bring this stuff up right now; we're so busy with immediate business pressures, and our senior executives have heard these claims too many times."

Why hasn't more change occurred? We think the simplest explanation is that previous medical, legal, educational and other professional innovations *could not learn*. They were mostly rule-based systems, and thus the way they read, for example, the millionth mammogram was the way they read the first, which too often was incorrectly. It's the ability to continually learn from real customer data and real customer outcomes that sets today's learning-based expert systems apart from their predecessors.

1989-2005 – Web/eCommerce

- Free, ad-supported services
- On demand
- Browse/search
- Choice/convenience
- Service aggregation
- Channel disintermediation
- Global scale, MC=0

2006-2016 – Social/mobile/cloud

- Mobility/apps/location
- Virtual computing/storage
- Software-as-a-Service
- Social media/content
- Open source/P2P/sharing

2017-2030 – Machine learning, knowledge and trust

1. Learning-based expert systems
2. Algorithmic operations
3. Embedded analytics
4. Speech/image processing
5. Software agents/bots
6. Shared ledgers/smart contracts
7. Digital cash
8. Internet of things/sensors
9. Augmented/virtual reality
10. Biometrics/neuro-imaging

The coming wave of machine learning and digital trust

The three main phases of internet innovation are shown in the figure above. In terms of this project, the key message is that the first two waves haven't been strong enough to reshape the professions, but we think the third one will.

The first five of the technologies shown in the figure are aimed at improving and automating societal knowledge, learning and decision-making; the next two will be used to enhance business and societal trust, and will often rely on blockchain-based approaches. In contrast, sensors, IoT, biometrics, neuro-imaging, and augmented/virtual reality will give us unprecedented insights into human thinking and behaviour. Deep learning will be used across all three of these domains, both supporting and replacing human expertise.

Of course, it's easy to be sceptical. Speech recognition systems still make amusing errors; virtual and augmented reality systems can be physically uncomfortable and dorky looking; expert systems and shared ledgers often face complex implementation challenges; smart light switches and toothbrushes can make the IoT seem trivial; algorithmic operations often have subtle built-in biases; Bitcoins are heavily used by speculators and criminals; and so on.

But while every era has had its sceptics, each eventually created vast new markets and giant new firms, with significant disruptive effects. If this new layer of machine intelligence and digital trust matches the societal impact of the web and social/mobile/cloud eras, then the changes we are describing will be just the starting point. Indeed, this wave could easily be even more powerful than the first two because machine intelligence enables even more fundamental innovation possibilities. Given that the last two generations of sceptics have wound up on the wrong side of history, we are wary of betting on the third.

The one thing we know for sure is that market-changing events can come suddenly. Imagine Amazon and Walmart establishing shared ledger accounting across their vast supply and distribution chains, Facebook organizing the global population of everyone with a particular medical condition, Google re-inventing language learning through its speech recognition and translation services, the use of neuro-imaging and other biometrics to legally prove if someone is telling the truth, or a new generation of start-ups that take these possibilities for granted. All of these have the potential to shatter many of today's professional norms and practices.

Formulas for machine intelligence innovation

The reason there is so much focus on machine intelligence (MI)² today is that Silicon Valley has found a three-part formula for MI innovation and success: 1) large, focused data sets, 2) deep learning architectures and processing power, and 3) web-based business and deployment models³.

What strikes us most about this formula is how different it is from the situation in most professional firms today. Although professional firms have vast amounts of data, effective use is often another story entirely. Data is mostly kept within individual schools, hospitals, regional partner practices or organizational silos. Consequently, it is difficult for professional firms to develop useful diagnostics and embedded analytics, let alone the large but focused data sets needed for deep learning breakthroughs. This lack of a solid *data foundation* is deeply rooted in the professional business model, and stems from confidentiality/regulatory concerns, lack of industry standards and fragmented supplier structures.

These realities help explain why many internal machine intelligence efforts have struggled. Often, the problem isn't the technology; it's the underlying data, which usually requires extensive (and expensive) cleaning, organizing and labelling in order to capture detailed domain knowledge. The work is difficult; the costs are high; the potential scale economies low (outside of nationalized health and education systems), and the benefits mostly speculative. The business model disconnect is equally problematic. The high fixed prices that characterize most professions today are sharply at odds with early-stage internet-style pricing, often making experimentation difficult.

Taken together, the gap between Silicon Valley's powerful machine learning success formula and the situation inside most professional services firms today appears to be the biggest disruptive threat that most traditional organizations face.

2. Throughout this report, we will use the term Machine Intelligence. While many people prefer *Artificial Intelligence*, the two terms are essentially synonymous.

3. See David Moschella, *There is Now a Formula for Machine Intelligence Innovation*, LEF May 2016

Disruptive vs. sustaining change

To use the familiar terms of Clayton Christensen, new technologies can be either *sustaining* or *disruptive*. The former fit naturally within incumbent cultures and business models. The latter do not, and thus are mostly championed by a new set of firms. These distinctions explain why in this study we have focused less on the impact of individual digital innovations and more on the potential for business model change. We believe there are six such shifts that will be particularly relevant to the professions:

1. Value creation will *migrate* to new digital players.
2. Professional services will be more *consumerized*, with innovation coming from the bottom up.
3. Each of the Big Four professions will become more specialized and *dis-integrated*.
4. New information flows will make significant professional sector *convergence* possible.
5. New forms of professional trust will emerge – especially ratings/reviews, transparency, micro-credentials, blockchain, *explainability*, and technology-based *truth*.
6. An ever-wider array of specific *machine intelligence* applications will emerge well before we see any sort of overall digital doctor, lawyer, etc.

Taken together, these six forces will define what we think is the most probable path of long-term change. Notably, the IT industry has already experienced all of these effects, and in the full report we show how they have both benefited and changed the IT profession.

More importantly, in the full report, we use these dynamics as our principal means of assessing the potential for disruptive change in each of the Big Four professions, and we recommend that clients use this framework to track the evolution of each profession going forward. Below are just a sample of our top-level findings along these lines:

- Healthcare will most closely resemble the IT industry pattern in that there will be an explosion of innovation and usage without a major increase in the total number of medical professionals. It is the sector where all six of our key forces are closest to being equally strong.
- Capturing senior legal expertise will be the hardest expert system challenge, and the Law has been the least disrupted professional sector thus far. However, the potential for dis-integration, convergence and machine intelligence is high. The combination of digital forensics, biometrics, neuro-imaging and deep learning to prove ‘the truth’ could be the most disruptive legal scenario of all.
- Education has the greatest potential for personalization and global scale, especially for the top-tier schools. Education will also be the best test of whether machines can somehow match the trust of the traditional doctor/patient, teacher/student or attorney/client relationships. But education also has the highest levels of developed-world inertia.
- Accounting/auditing has always been the most IT-intensive of the professions and thus more naturally rides the software curve. Disruptive change seems tied to the future of shared ledgers and the blockchain. The major accounting/auditing firms are generally well positioned because their digital consulting businesses enable them to gain deep experience in these areas without directly affecting their traditional revenue streams, a situation unique among the professions.

Time to prepare

As major changes will take time, we advise clients to position themselves via the seven steps below:

1. Improve your firm’s overall situational awareness of what is happening in Silicon Valley and elsewhere in your sector. Most large firms are doing this today.
2. Think in terms of using machine intelligence across your full digital stack; this means having modern infrastructure and applications. Many professional services firms still have a long way to go.
3. Provide your customers with a modern, Amazon-like digital experience.
4. Assess the state of your firm’s data foundation, and identify where in your ecosystem the richest data sets are emerging. This is where the biggest value chain shifts are most likely to occur.
5. Determine which forms of machine intelligence are most relevant to your firm. We have identified 20 key areas across four categories: sensing, interacting, analyzing and automating.

6. Assess the state of your firm's digital strategy, skills and culture. The full report contains two self-assessment exercises appropriate for most knowledge workers and their firms.
7. Choose the appropriate machine intelligence talent deployment and operating model, while recognizing that your approaches will likely evolve over time.
8. Believe in a future of machine learning and digital trust.

Overcoming scepticism

The changes we have discussed are currently barely noticeable to today's leading firms. The technologies that will drive machine learning and digital trust are still immature, and will only come to fruition over time. They can also be fiendishly complex and hard to implement. Even many IT professionals struggle to understand how things like blockchains and deep learning actually work.

Given that the professions have proved stable for decades, it's understandable that many professionals remain sceptical. We often hear the following:

- "We don't make any money doing any of these things"
- "We've heard all this before"
- "I'll be retired before any of this matters to our bottom line"
- "Maybe in the other professions, but not in ours"

The difficult thing about the first three of these statements is that they are often true. The fourth is basically wishful thinking, grounded in our tendency to see our own situations as more special than they really are. Taken together, the four statements are a formula for 'let's wait and see'.

Today, the challenge is not in the waiting (as things will take time); it's in the seeing. In our research, we have sought to help clients visualize the most likely paths of future change, while arguing that this new wave of intelligent capabilities is not just coming; it's *what the professions need*. Rising cost, workload and citizen access pressures can only be alleviated through the digital foundations and dynamics this research has described, and those professionals who embrace these changes will clearly benefit.

But building a 21st century foundation in a world full of more immediate concerns requires senior leaders who believe that these challenges are vital to their firm's and their profession's future. Technology has proved the sceptics wrong time and again. Odds are, it will do so once more. The scenario for 21st century professional change appears to be coming into place, and may be here sooner than you think. Best to bet on the coming wave of machine learning and digital trust, not against it.

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