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# Digital Disruption of Industry: Tectonic Tremor That Cannot Be Ignored

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## Abstract in Finnish

### Teollisuuden digitaalinen murros: mannerlaatat tärisyvät

Digitaalisesta murroksesta on puhuttu paljon aivan viime vuosina, vaikka digitalisaation historia ulottuu ainakin seitsemän vuosikymmenen taakse, modernin tietokoneen alkuaikoihin. Yksittäisen murroksen asemesta onkin tunnistettavissa viisi "vallankumousta", jotka määrittävät digitalisaation historiallista kehitystä:

1. Laskennallinen vallankumous (n. 1950 alkaen)
2. Kommunikaatiovallankumous (1980-luvulta alkaen)
3. Kaupallinen vallankumous (n. 1995 alkaen)
4. Kollaboratiivinen vallankumous (n. 2010 alkaen)
5. Kognitiivinen vallankumous (joka on juuri alkamassa)

Jokainen digitaalinen murros on saanut alkunsa, kun tekniset ratkaisut ovat kehittyneet, yleistyneet ja mahdollistaneet uusia tapoja toimia. Samalla vallankumous näyttäisi nostaneen digitaalisuuden aina uudelle institutionaaliselle tasolle, jossa sillä on ollut kertaluokkaa aiempaa suurempi vaikutus. Siinä missä alkuaikojen tietokoneet tukivat päätöksentekoa hyvin rajatuissa operatiivisissa ongelmissa, tämän päivän digitekniikoiden sovellutukset järjestyvät kokonaisia toimialoja.

Teollisuuden digitaalinen murros onkin nähtävissä uutena vaiheena jatkumossa, jossa digitalisaation järjestysvaikutus asteittain kasvaa. Siinä missä aiemmat murrokset ovat aiheuttaneet vasta voimistuvaa tärinää, meillä on olevan murroksen kohdalla voidaan jo puhua maanjäristyksestä, jota ei enää voi olla sivuuttamatta. On odotettavissa, että seuraava järjestys tulee liikuttelemaan kokonaisia mannerlaattoja – suorastaan talouden ja yhteiskunnan perusteita.

## Brief History of Digital Disruptions

When did "digital" become so critical? Binary arithmetic dates back to Leibniz, and information and communication technologies have been the mainstay of business for decades. Yet only in the last year or two has the buzzword *digitalization* truly pervaded mainstream business language. So what has changed? What is going on? Is digitalization a mere hype or a moniker for a fundamental shift that underlies a number of concurrent developments?

It is easier to recognize revolutionary changes in retrospect. The advent of general-purpose stored-program electronic digital computers in the late 1940s can be seen as such a revolution. The combination of electronics technology with digital computation in binary enabled unforeseen computation power that could be harnessed to handle larger and larger quantities of data and to address increasingly complex calculations. Over the years, computing penetrated most functional areas in business. This *Computational Revolution* enabled to

extract and summarize data from the underlying transaction processing systems to management information systems that facilitated solving structured and semi-structured decision problems of operational and middle managers.

The next major breakthrough was the *Communications Revolution* through the introduction and rapid increase in the number of personal computers in the 1980s. Contemporaneously with rapid developments in telecommunications technologies, the proliferation of PCs meant a paradigm shift from a centralized computing organization to a “federal” IT structure. A market for ICT services emerged, outsourcing abounded, and leading companies used technology to redesign their business networks. Strategic information systems built on company-specific strengths were intended to provide competitive advantage.

In the mid-1990s, the Web heralded the *Commercial Revolution*, wherein the very business models stemmed from the landscape-changing properties of the Internet: universal, open standards; infinite virtual capacity; reduced transaction costs; reduced information asymmetry; disintermediation; network externalities. Coinciding with deregulation and new emerging markets, the onset of the Internet denoted a relentless push for lower costs, higher performance, and new innovations.

It can be argued that we are currently living in the aftermath of *Collaborative Revolution*. The synergistic SMAC technologies (Social, Mobile, Analytics, Cloud) emerged to prominence around 2010 and have since “SMACed the biz up” to the level of platform ecosystems, bringing about tectonic tremor that we may now recognize as “digitalization.” Incumbent plat-

form businesses such as Amazon, Google, Facebook, and Apple have secured an enviable position as network economy heavyweights, while new digital platforms, such as Uber or AirBnB have come into being very rapidly, disrupting entire industries and their way of doing business.

And just as we have come to grips with the vast extent of disruption caused by digital technologies and their transformative implications to industries, the next wave of disruption looms on the imminent horizon. *Cognitive Revolution*, ushered in by cognitive technologies such as machine learning, natural language processing, or robotics, will have even more far-reaching consequences. The “Global Brain,” purportedly enabled by cognitive computing, will inexorably, infinitely and irreversibly transform the world as we know it.

The brief history of digital disruptions since 1950s, as recounted above, is summarized in Table 1. Each disruption has transpired, when technological solutions have developed, diffused and enabled new ways of working. Each time, the revolution seems to have exalted digitalization to a new institutional level, at which it has brought about an order of magnitude larger impact than before.

The digital disruption of industry can thus be seen as yet another stage in a continuum of increasing digitalization. Whereas the earlier disruptions have caused increasing tectonic tremor, the on-going disruption at the level of industry structures represents an earthquake that cannot be ignored. It is to be expected that the next disruption, the Cognitive Revolution, will shatter the very foundations of economy and society.

Table 1. History of digital disruptions.

Revolution	Ascension	Enablers	Lever
Computational Revolution	1950	Electronics + Binary computation	Management Information System
Communications Revolution	1980	Personal computer + Telecommunications	Strategic Information System
Commercial Revolution	1995	The Internet	Business Model
Collaborative Revolution	2010	Social + Mobile + Analytics + Cloud	Platform Ecosystem
Cognitive Revolution	Imminent	Cognitive technologies	Global Brain

## **Increasing Tremor: Commercial and Collaborative Revolutions**

The Commercial Revolution, brought about by the proliferation of the Internet in the 1990s, already intensified competition. Anyone anywhere in the world could make products, services, and information available to anyone anywhere else in the world, spurring race, innovation and tactical manoeuvring. New global realities forced organizations to open themselves to the environment. Off-shoring, outsourcing, joint ventures, and other types of mutual dependencies shifted business focus from internal operations to those outside the organization. In the wake of this revolution, digital technologies increasingly enabled effectuating change in the environment rather than merely adapting to it. This started to separate the wheat from the chaff: those with high capability to leverage high velocity markets to their advantage and those lagging farther and farther behind.

The Collaborative Revolution, however, has engendered even more far-reaching reverberations. Social media provides businesses new access to customers, and mobile technologies enable new ways to interact and communicate. Business analytics leverages “Big Data” produced by social and mobile to predict customer needs with unprecedented accuracy and speed. And the Cloud provides a ubiquitous computing platform that enables and accelerates all of the above.

The increasing rate of change and deepening interdependence between technologies, organizations, and the economy give rise to dynamic field forces, whose complexity is beyond prediction and control of any single agent. Not only is change continuous, but it is also increasingly disruptive: unpredictable “black swan” events may destabilize entire industries and economies in a matter of days, if not hours. These disruptions are almost impossible to anticipate, yet need to be accounted for. As discontinuities are faster than response, strategy cannot be based on extrapolation of trends. Continuous environmental scanning is vital to detect changes in the environment. Boundary spanners, as the eyes and ears of the organization, identify weak signals, make sense of them, and create intelligence for decision-making.

Business analytics is in a key role in sensing relevant changes in the context and seizing the afforded opportunities. Analytics and optimization are embedded into virtually all business decisions at the front lines of operations. Every device, shipment, and consumer leaves a digital data trail that can be analysed to data-enrich offerings for the benefit of customers and markets. Data and algorithms increasingly drive decisions and actions without human intervention. This level of analytics capability is very complex and requires a lot of hard work. The analytics processes have to be automated, scaled massively, and executed lightning-quick.

To ensure that the foresight has an impact, the generated insights should be communicated directly to the decision-makers at different organizational levels. Major decisions need to be made carefully, yet quickly. As the relationship between cause and effect in a complex environment is non-linear, safe-to-fail probes are needed to validate the foresight insights.

Disruptive change also calls for upfront consideration for resiliency: robust interdependencies within networks and ecosystems, planning for contingencies, and capacity for recovery and renewal. Deliberate business and ecosystem design as well as systems and systems-of-systems thinking grow in importance.

## **Impending Earthquake: Cognitive Revolution**

History helps us understand the past, explain the present, and predict the future. In the case of digital disruptions, the pattern of evolution is clear. The next revolution, just as the previous ones, will be enabled by a new set of technologies and propel digitalization to the next, more encompassing institutional level. This would seem to be the global, planetary level.

It is widely seen that so-called “cognitive technologies” – computing applications able to perform tasks that have formerly required human intelligence – will be the enabling technological base for the next digital revolution. Catalysed by advances in computing power and machine learning algorithms, the performance of these technologies has substantially improved. Applications such as

speech recognition, natural language processing, or computer vision are infiltrating business applications, and as both the technology and the market matures, the range of applications and extent of use for cognitive technologies are expected to increase.

Such as major earthquakes, Cognitive Revolution is potentially very dangerous, even lethal. Entrepreneur Elon Musk has said it is potentially “more dangerous than nukes,” and theoretical physicist Stephen Hawkins has warned that true artificial intelligence poses a risk to the very existence of mankind. Leading Artificial Intelligence (AI) researchers in academia and industry have aired concerns about unintended behaviour stemming from dramatic advances in AI. If machines and robots will ever learn to design even better machines, human intelligence would be very rapidly eclipsed by “intelligence explosion” of ultra-intelligent systems. Should the goals of this superintelligence conflict with human values and interests, AI would pose a real threat of human extinction. It would be like the proverb-

bial genie in the bottle: getting you what you ask for, not what you want. To safeguard against these existential concerns, technology and technology governance will have to deal with fundamental universals such as laws, ethics and morals.

Concomitantly, another emerging technology – blockchain – provides a secure digital distributed ledger that enables simplified “smart contracts” with no need for a trusted third party. This bears potential to disrupt the very bedrocks of the economy and the society. The technology enables, for instance, issuing cryptocurrencies outside of the established banking system, or starting up decentralized autonomous organizations (DAOs) without the red tape pertaining to the traditional incorporation of business entities.

While we cannot ignore the tectonic tremor of the digital disruption of industry, an order of magnitude bigger earthquake of digitalization is yet to come.

### Disruption Brief Series

Disruption Brief series consists of short notes by the researchers of the *Digital Disruption of Industry* consortium and their co-authors. It is intended for rapid dissemination of the ideas and thought of the authors for comments and debate in an accessible form. The notes represent work in progress; therefore, we reserve the right to update them if we believe we have learned something new about the topic in question.

*"When my information changes, I alter my conclusions. What do you do, sir?"* – John Maynard Keynes

### Author Bio



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