

What's Hot in 2018

Technology Trends

David Smith, Chief Executive
Global Futures and Foresight

www.thegff.com



What's Hot in Technology 2018

Contents

Executive summary.....	2
Shoppable social	4
Data becomes toxic	5
Employees+	6
Self-inflating structures.....	7
Interaction 4.0	8
New consumer industries.....	9
Photonics.....	10
Personalised analytics.....	11
Machines have their own bank accounts.....	12
Hashgraph.....	13

Executive summary

The founder of the World Economic Forum, Klaus Schwab, suggests that being surrounded by digital tech will be a 'transformation will be unlike anything humankind has experienced before'.ⁱ People and the organisations they inhabit could change profoundly as a result. Schwab's statement stands as both as a prediction of future possibilities and as a comment on the dramatic impact it could have on incumbents. Indeed, 54 percent of organisations predict they'll be out-innovated and possibly fail within five years if their digital transformation plans prove unsuccessfulⁱⁱ.

Disruption to business is nothing new yet the pace and extent of change is, with the current transformation happening 10 times faster and at 300 times the scale, or roughly 3,000 times the impact, of the Industrial Revolutionⁱⁱⁱ. Those that refuse, or are unable, to change their business models and legacy systems (whether cultural, organisational or technological) are losing ground to start-ups and a new range of competitors.

At the start of 2017 we identified blockchain, IoT security, robo-bosses, and a new era of shadow I.T. as among the key events for the year and beyond. During the year Bitcoin embarked on a surge unseen in competing asset classes and currencies whilst a huge IoT based botnet has been closely tracked by security analysts throughout the year that reportedly has the potential to take the internet down^{iv}. Elsewhere predictions that '...machine intelligence will be an additional seat at the table in the boardroom^v,' have surfaced, whilst shadow I.T has grown despite the imminent challenge posed by European GDPR legislation to such a poorly coordinated data strategy.

More than ever, as we approach the second decade of the twenty first century, we are appreciating that technologies alone do not confer competitive advantage. They are clearly key, but the ways in which they are used, abused, aligned with strategies and used to create new propositions is where their value lies. Already prominent technologies will continue to evolve and offer new opportunities and challenges. A range of newly emerging technologies and the processes they impact will start to shape the operating environment in which businesses find themselves. Together with the requisite organisational and cultural changes, these technologies may help determine tomorrow's winners from its' losers and spectacular crashes.

Shoppable social

Whilst social media's impact on branding is established, social as a vehicle for sales is less supported by statistics. Between January and March 2016, e-commerce vendor Custora '...crunched data about \$100 billion in sales among 500 million shoppers and found that only 1.5 percent of retailers' last-click e-commerce transactions came via social media^{vi}.' Despite this, there is reason to believe that social media could be an important medium for retail, not just in the medium to long term but within the next couple of years.

What does it mean?

The lines between retail, social network and entertainment will blur to an even greater extent in 2018 than we have seen thus far. Amazon has already launched a shoppable social network called Spark^{vii}, which could prove the prototype for further variants. Future iterations may be needed as Accenture believes that '...although social media is revenue ready, the majority of organisations have barely tapped into an omnichannel model that integrates social in a meaningful way^{viii}.' Since video is expected to comprise 85 percent of net traffic, whilst 50 percent of commerce is expected to arrive via mobile^{ix}, social video and other omnichannel mediums may need to be integrated to allow social shopping to flourish.

It is plausible that our expectations of social shopping will be increasingly shaped by models originating outside of the west. Buy+, for example, is a Chinese virtual reality shopping experience backed by Alibaba, that managed to engage over eight million users within a week of launching^x. There is no explicit social feature yet, but it is not difficult to imagine social additions that create, or in some cases recreate, the social nature of shopping and link to other users and experiences. Another Chinese example of the kind of form social shopping could take can be found with WeChat. This messaging app in China that has been described as a combination of WhatsApp, Amazon, Deliveroo, and Uber is also, perhaps critically, becoming a central hub for online merchants^{xi}.

What to do about it:

- Extend your thinking of social, and what it could deliver, beyond the current iteration of Facebook.
- Tie any ideas back to your core proposition; social retail should be a way of furthering your current strategy, or helping build a new one.
- Research into how social shopping is evolving in China and beyond.

Data becomes toxic

Data competency has already ordained winners and losers and in 2018, it will continue to do so, albeit from new perspectives. Less than 30 percent of the value inherent in current data has been captured^{xii}, whilst data volume will overwhelm all but the most prepared since average human knowledge is doubling every 13 months – meaning, within a couple of years, the total information volume may double every 11 hours^{xiii}. This alone will necessitate an organisational revolution and a new outside-in approach to data competencies, especially to comply with the imminent May 2018 EU directive on General Data Protection Regulation (GDPR). A broader issue of legality may emerge however.

What does it mean?

At its core GDPR is about clarifying where personally identifiable information is in any given organisation^{xiv}. This, in parts, shifts data from a competitive advantage to a potential liability; around 65 percent of current enterprise data is estimated to be 'digital debris^{xv},' with no upside but a large approaching downside. Since the law is remarkably broad in application – impacting any company that holds data on European residents or citizens, fines paid to the European regulator in 2018 are expected to increase 90-fold over the 2015 level, assuming the same volume of data security breaches occur^{xvi}. The

looming deadline has given impetus to identity and access management tech spending, which is expected to grow 12-15 percent annually over the next five years to \$16 billion by 2022^{xvii}.

Beyond GDPR, there is a common vulnerability in many data models. Many lack explicit consumer consent – especially via apps, and few have an equivalence to 'key facts' in financial services. GDPR may help with data stewardship but organisations will need to move beyond it. As consumers realise the value inherent in their data, the legality of current data models will be successfully challenged in court. What data we hold and how we use it will be the life and death of our companies.

What to do about it:

- Ensure GDPR compliance as a priority if you have not already done so.
- Ensure silos of data do not compromise your overall legal standing.
- Look to build trust and brand reputation through careful data stewardship that reinvests and created value in consumers.

Employees+

Arguments surrounding automation suggest either a replacement by machine paradigm or else a scenario in which we adjust our skills and work alongside machines. As a subset of the latter is the option of enhancing ourselves, to help better work alongside machines or perhaps in some cases, better compete with them.

What does it mean?

Perhaps with an eye towards competing in the coming world of automated work, 70 percent of employees say they would consider mind and body-boosting treatments if it improved their job prospects^{xviii}. Smart drugs such as modafinil are already reportedly widespread in academia and industry and examples of stronger enhancements are emerging. DARPA¹ scientists have unveiled a cheap and non-invasive brain device – essentially a cap - that boosts learning by 40 percent^{xi}. Said to alter ‘functional connectivity in humans,’ pioneering companies will likely look to ways in which they could use such technologies, especially since 81 percent of CIOs already believe wearables will perform in the workplace^{xx}.

Technologies such as DARPA’s cap could help re-orient spend and

corporate focus towards employee journeys, which is currently outspent (across all industries) by customer journeys by x1000^{xxi}. Continuous learning ROI could be boosted, costs lowered and outcomes enhanced by investments in such devices. It could also enable better planning for the future; Deloitte notes that ‘...one key capability of the organization of the future is the ability to form teams rapidly. This requires a clear understanding of each employee’s skills^{xxii}.’ Identifying, remedying or else rehiring for such skills will become critical to organisational agility, and meeting these challenges central to employees’ individual prospects.

What to do about it:

- Examine how human productivity could be enhanced, through an array of technological and neuroscientific approaches
- Craft HR policies to deal with the broad range of biohacking options that employees might undertake.
- Plan for the skills your business needs now, and map out what skills could become central to future prospects. How does this link to your own continuous learning offerings?

¹ DARPA (Defense Advanced Research Projects Agency) is an agency of the United States Department of Defense.

Self-inflating structures

With housing shortages contributing to acute market misalignments in some advanced economies, and the need for 'insta-infrastructure,' following catastrophes around the world, a new built form paradigm is required. Furthermore, in a business world demanding agility, companies will increasingly value flexible solutions to their office space issues.

What does it mean?

3D printing already provides a platform for addressing these issues and its slow burn into the mainstream will continue, whether through custom printing pharmaceuticals^{xxiii} or through Dubai's commitment to print a quarter of all its buildings by 2030^{xxiv}. Instances of fully printed houses appearing in around fourteen hours have hit the headlines in 2017.

In 2018, more tech based solutions will appear to compliment 3D printing, such as MIT's self-inflating structures project that works as a '...functional tool for things such as distributed assembly processes, transportation of goods, emergency response and architecture^{xxv}.' Self-inflating structures could also feed into 'automated infrastructure,' of which Professor Carlo Ratti encourages us to '...think of dynamic and temporary floating infrastructure like on-demand bridges

and stages, that can be assembled or disassembled in a matter of hours^{xxvi}.'

Flexibility in the built form could radically redraw the economy; in 2018, we expect proto examples of this change of direction to hit the headlines.

What to do about it:

- Consider how changes to the cost, location and use of buildings and infrastructure could impact your current assets. Could any become stranded?
- Assess what opportunities could arise because of new built forms, and new ownership/access/financing models that would surely accompany them.
- Examine whether partnerships with pioneers, such as universities, could be used to improve your processes and value proposition.

Interaction 4.0

The way we will buy, build and use technology is changing rapidly, which means the teams and ecosystems that build it and run it will need to change too. In 2016 mobile net use overtook computer net use, whilst by 2020, '...50 percent of all searches could be voice searches, and around 30 percent will involve no screen whatsoever^{xxvii}.'

Virtual reality, holograms, augmented reality and haptics will all feature; 2018 will see the omnichannel become a lot more crowded.

What does it mean?

Daily consumer activities comprising healthcare, work, leisure and commerce could shift to third spaces enabled by ambient technologies; for example, more hospital stays or even diagnostics take place in patients' homes. This tech shift will mean consumers will not just be doing things differently, but doing different things, in different places. A wider range of equipment and services will become available locally or even within the home, as the 'as-a-service' concept expands to include a wider range of opportunities and markets.

Designing for engagement will become a critical task as the omnichannel expands to include a wider array of touch points. Since new forms of interaction will impact all core competencies for organisations – from management of workers, marketing and

sales to customer service – there is a need to address it at the very top of the organisation. In some instances, this will include core users such as consumers and front-line employees. What does interaction look like with an outside-in approach?

What to do about it:

- Design will become increasingly part of traditionally non-creative jobs whilst designers may need to augment their skills. Overall design of corporate architecture will also receive much attention to allow companies to take advantage of deep seated changes in engagement.
- Organisations will need to reimagine how their workers get things done and where, how and where they interact and engage with consumers and whether their current organisational structure is conducive to this agility.
- Our interfaces will need to become more anticipatory and predictive. Do our systems reflect this or do we need to upgrade?

New consumer industries

Consumers '...demand experiences, not just products, and have become active participants at every stage of the value chain^{xxviii}'. In many cases this erodes industry boundaries and creates new markets at the intersections of collision, such as wellcare where health, wellness and beauty collide. There is no one single technology that is singularly driving this hot trend; rather the realisation that B2B2C markets are reconfiguring into delivering desired consumer outcomes. How to organise for this – in terms of aligning organisation structure to technology provision – will be key.

What does it mean?

Industry boundaries will continue to erode, creating new markets at the intersections of collision. Consumers will increasingly shape these markets at both active and passive levels – providing adjuncts and alternatives to traditional industries. Different thinking as well as technology will be key in driving change; with normal human behaviour being put to work in various ways (such as through nudge theory and behavioural science). In fact, Accenture/WEF project that consumer industries will change more in the next 10 years than in the last 40^{xxix}.

The Economist Intelligence Unit, meanwhile, has noted that 80 percent of customers demand new consumption models including subscribing, leasing and sharing. Even individual technologies could prompt new consumer industries; 3D printed products sell the license, not the copy (or distribution), creating a whole new business model, notes Futurist Gerd Leonhard. Indeed, the 3D printing enabled 'repair economy' could ultimately blend some industries together and alter models as high-end design becomes mass market. On a global scale, billions of people are emerging as first-time consumers, and leapfrog tech in emerging economies could mean different consumer evolution there versus mature economies.

What to do about it:

- New digitally born industries could further erode the remaining boundaries surrounding the IT function as technology becomes integral to almost every business function and relationship.
- Looking for instances of future 'industry collision,' will enable new models, engagement strategies and revenue streams to be explored.
- If our markets move, we need to move with the, at a minimum. Where will our customers 'be' in the future?

Photonics

As an intermediate step on the path to quantum computing, photonic computing could provide the '...same accuracy as the best conventional chips while slashing the energy consumption by orders of magnitude and offering 100 times the speed^{xxx}. By 2020, larger systems capable of achieving multiple Exaflops are forecast to arrive,^{xxxi} allowing organisations to do different things rather than simply do the same things differently.

What does it mean?

This forecast, if realised, would enable even handheld devices to have AI capabilities built into them without outsourcing the heavy lifting to large servers, something that would otherwise be next to impossible.' All data could therefore be processed in near real-time, at the edge of networks such as the IoT. Information technology strategies, consumer behaviour and the architecture within which to operate would all shift as a result, some in unpredictable ways.

I.T ecosystems will increasingly need to exist 'out there' – at the edge- rather than within the organisational walls. However, a diminishing number of companies are actively investing in research in emerging technologies. For many technologies, it pays not to be on the 'bleeding edge,' but rather prepare for a timely alignment of overall strategy

to tech strategies. This requires a better radar than ever, yet a range of short-term priorities often impinge on the medium term. For those wanting to engage in personalised marketing, delivery of real-time insight to business units or even ways of reorganising organisational models, exploration of photonics and its possibilities could prove fruitful in 2018.

What to do about it:

- Forms of collaboration may be needed to create a tech radar.
- Photonics will produce new sensor technologies and further fuel the growth of the IoT. Preparing for this growth, and the opportunities and challenges that abound, should become a medium term strategic issue.
- It will almost certainly require a rethinking of how I.T. operates both internally and externally, with new CIO skills and aptitudes required.

Personalised analytics

With McKinsey estimating around a third of the current CEO remit as already outsourceable, and examples of mass automation of management roles already appearing with hedgefunds and beyond, 2018 will see a clamour from professionals seeking to future-proof their roles.

What does it mean?

Ironically, A.I may provide an answer. 'Personalized analytics (will) become mirrors and lenses for refocusing professional effectiveness^{xxxii}', says MIT research fellow, Michael Schrage MIT research fellow. 'Michael envisions selvesware serving the role of a perpetually present leadership coach providing real-time advice on executive behaviour^{xxxiii}.'

Wearables and implantables are likely to merge with neuroscience to provide ever more quantifiable ways of gaging employee performance. Figuring out who works best with whom or which hours are best for different team members could well prove key drivers of productivity.

Working with and alongside robots will prove one of the key challenges for workers of the 21st century, from both a cultural and skills perspective. Ensuring digital and cultural readiness amongst the workforce in an appropriate structure will be key in addressing an area that current change management cannot

sufficiently cope with. Personalised analytics could be a key platform for assessing how AI impacts organisations.

What to do about it:

- Successful quantified worker initiatives will never be fulfilled without a well-crafted plan that includes IT deployment, business process change, and, most importantly, change management
- New performance management processes will be needed that incorporate new metrics and KPIs, augmented by artificial intelligence.
- Design and craft an operational model most suited to an A.I rich environment, starting with your key staff and positions and looking at how A.I can enable their overall goals and strategies.

Machines have their own bank accounts

The WEF has proposed the concept of a data bank account. A person's data, it suggested, should '...reside in an account where it would be controlled, managed, exchanged and accounted for^{xxxiv}.' Indeed, by 2027, a significant proportion of personal income is likely to be derived from the data people generate^{xxxv}. Since a lot of data and even wealth will be generated by machines in the future, hitherto unthinkable or even laughable prospects could come to the fore.

What does it mean?

There can be little doubt that widespread automation brings about a raft of societal and ethical questions. Previously fringe ideas will gain currency as the automated economy takes hold. The rights of robots to the fruits of their own production may become one such issue in the near future. The Commonwealth Bank of Australia is reportedly considering the implications of a future in which '...machines have their own bank accounts and pay for replacement parts and engineers to service them^{xxxvi},' whilst the European Union has already called for 'the consideration of a Civil Law Rule of Robots^{xxxvii}'. Intellectual property rights could flow from this, suggesting machines could become their own economic agents to a degree currently considered unthinkable.

Despite the above examples, the chances of full robo-rights in 2018 is close to zero. However, as a point of possible future legislation, those employing A.I solutions will be well advised to map out where possible changes could impact them and draw up strategies and scenarios for dealing with it.

What to do about it:

- Set out scenarios for various future robot-related legislation – from taxes to robot rights and beyond.
- Assess the use of robotics within your organisation, in terms of scope, density and relation to existing employees.
- Establish a capability, either in-house or through collaborative means to keep watch over low-probability, high impact events.

Hashgraph

Blockchain will undoubtedly create waves in 2018 and beyond, from the Bitcoin express through to practical uses in smart contracts and across countless industries. This is not to suggest that this new technology will not in time be supplanted itself by competitors offering improved features. 2018 will see an explosion in rival technologies underpinning new cryptocurrency and ledger systems.

What does it mean?

Current issues with blockchain include its perceived mathematical fairness (which some say could be improved), its speed of use, and its large energy needs. mathematically fairer and using less energy. The last point would appear particularly important, since various reports have estimated that '...by 2020, bitcoin mining could be consuming the same amount of electricity every year as is currently used by the entire world^{xxxviii}.'

Hashgraph is an entirely new distributed ledger technology, or consensus protocol. It claims to work at 50,000 the speed of blockchain^{xxxix}, or at 250,000+ transactions per second. Compared to 10 per second for bitcoin or Ethereum,

this would at first glance appear to solve much of the scalability issue that has thus far prevented more intensive exploration of blockchain by companies.

Comparing the two may not be entirely fair though – Hashgraph is a private, as opposed to public, distributed ledger. Nevertheless, it also claims to use a mathematically fairer algorithm whilst using less energy^{xl}. 2018 may not see Hashgraph compete directly with Blockchain but it could prove more than a match for blockchain use within individual companies. It might for example, '...be able to compete with something like Ripple for banking applications^{xli}.'

What to do about it:

- For private projects, investigate competing technologies to blockchain, especially within financial services and data heavy sectors.
- Assess the opportunities and challenges to both your industry and your position in it, from a range of ledgers each improving aspects of blockchain.
- Create projects to scope how, where and with whom, such technologies could be deployed.

About David Smith

David is recognised as a leading strategic futurist who combines the experience gained from a 35 year IT and business career with strategic visioning to help organisations better prepare for the future. His career has spanned European and US corporations. He is a much sought after keynote speaker and is the author of many works on embracing change and the drivers of change. Before establishing Global Futures and Foresight, an independent futures research firm, he created and ran the Unisys internal Think Tank, The Global Future Forum. Prior to this he was head of strategic marketing for their \$2bn global financial services business.



David and his organisation has been engaged by some of the largest and most prestigious firms from around the world including: The European Commission, NATO, BBC and financial services firms including HSBC, Lloyds/TSB, Atom Bank, RBS, Lloyds, More Than, e-sure, Travelers, Allianz, QBE and Lloyds syndicates along with many other prestigious firms including CSC, Unisys, Cisco, Microsoft, Siemens, Deloitte, Ernst & Young, PWC, Bausch & Lomb, Linpac, Kraft, Heinz, John Lewis, Roche, Philips, Ogilvy etc. He is also a regular lecturer at business schools across Europe.

david.smith@thegff.com

About Global Futures and Foresight

Global Futures and Foresight is a research and consulting organisation that helps organisations be better prepared to embrace change, innovate and develop new strategies and solutions and helps clients to avoid the risk of being blindsided by external disruptive change.

<http://www.thegff.com> tel: +44 (0) 1372 210941

About Marcela Lopez, Artist

Front cover by Marcela.



Marcela Lopez, Colombian artist with European influences based in UK. Commissions and artwork for sale. My subject matter is landscape. Using my hands I choose plaster to capture the movement of water and trees on wooden boards. Through my artwork I intend to invite viewers to a peaceful moment of reflection. I see my artworks gently brightening up any space and being a source point of serenity and comfort.

References

- ⁱ Source: World Economic Forum, 2017 <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>
- ⁱⁱ Source: Beta News, 2017 <https://betanews.com/2017/07/26/digital-transformation-fail/>
- ⁱⁱⁱ Source: The Economist, 016 <http://www.economist.com/news/special-report/21700761-after-many-false-starts-artificial-intelligence-has-taken-will-it-cause-mass>
- ^{iv} Source: Krebson Security, 2017 <https://krebsonsecurity.com/2017/10/reaper-calm-before-the-iot-security-storm/>
- ^v Source: Industry Week, 2017 <http://www.industryweek.com/emerging-technologies/does-new-tech-leadership-future>
- ^{vi} Source: AdWeek, 2017 <http://www.adweek.com/digital/even-mobile-world-retailers-arent-convinced-social-media-can-sell-170576/>
- ^{vii} Source: Business Insider, 2017 <http://www.businessinsider.com/how-amazon-spark-social-network-works-2017-7>
- ^{viii} Source: Raconteur, 2017 <https://www.raconteur.net/business/why-social-shopping-is-yet-to-take-off>
- ^{ix} Source: Forbes, 2017 <https://www.forbes.com/sites/steveolenski/2017/05/15/with-mikmak-latest-move-brands-can-expedite-path-to-purchase-instagram-snapchat/#34063f5245ee>
- ^x Source: Venture Beat, 2017 <https://venturebeat.com/2017/09/08/vr-will-be-an-essential-part-of-the-future-of-retail/>
- ^{xi} Source: Raconteur, 2017 <https://www.raconteur.net/business/why-social-shopping-is-yet-to-take-off>
- ^{xii} Source: McKinsey, 2017 <http://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/how-to-win-in-the-age-of-analytics>
- ^{xiii} Source: Forbes, 2017 <https://www.forbes.com/sites/schoolboard/2017/10/09/the-future-of-your-career-depends-on-lifelong-learning/#406a94be1bd7>
- ^{xiv} Source: Economist Intelligence Unit, 2017 <https://perspectives.eiu.com/technology-innovation/gdpr-%E2%80%93-issue-hearts-and-minds-not-cyber>
- ^{xv} Source: Forbes, 2017 <https://www.forbes.com/sites/forbestechcouncil/2017/12/06/if-gdpr-compliance-doesnt-start-with-information-governance-youll-probably-fail/2/#174bc5d4547e>
- ^{xvi} Source: Economist Intelligence Unit, 2017 <https://perspectives.eiu.com/technology-innovation/gdpr-%E2%80%93-issue-hearts-and-minds-not-cyber>
- ^{xvii} Source: CSO Online, 2017 https://www.csoonline.com/article/3241116/compliance/gdpr-turbocharges-identity-and-access-management-spending.html#tk.twt_cso
- ^{xviii} Source: Spectator, 2017 <https://blogs.spectator.co.uk/2017/08/the-pill-popping-future-of-work-looks-terrifying/>
- ^{xix} Source: Impact Lab, 2017 <http://www.impactlab.net/2017/11/02/darpa-scientists-unveil-brain-device-that-boosts-learning-by-40-percent/>
- ^{xx} Source: Cognizant, 2017 <https://www.cognizant.com/whitepapers/Wearables-At-Work-Are-They-Fit-for-the-Workplace-codex1542.pdf>
- ^{xxi} Source: Boston Consulting Group, 2016 <https://www.bcgperspectives.com/onwards-upwards-growth/people-productivity/need-treat-employees-thoughtfully-as-customers>
- ^{xxii} Source: Deloitte University Press, 2017 <https://dupress.deloitte.com/dup-us-en/focus/human-capital-trends/2017/organization-of-the-future.html>
- ^{xxiii} Source: Gizmodo, 2017 <https://gizmodo.com/the-future-of-pharmaceuticals-is-printing-custom-drugs-1818846684>
- ^{xxiv} Source: Gulf Today, 2016 <http://gulftoday.ae/portal/ea6e7ae1-b73a-4fa5-8572-26a52eeb042d.aspx>
- ^{xxv} Source: MIT Media, 2017 <https://www.media.mit.edu/projects/auto-inflatables/overview/>
- ^{xxvi} Source: PC Magazine, 2016 <http://in.pcmag.com/robotics-automation/108021/news/amsterdam-to-test-autonomous-boats>
- ^{xxvii} Source: Forbes, 2017 <https://www.forbes.com/sites/bernardmarr/2017/12/04/9-technology-mega-trends-that-will-change-the-world-in-2018/2/#418237165a9f>
- ^{xxviii} Source: World Economic Forum, 2017 <https://www.weforum.org/agenda/2017/08/disruption-in-consumer-industries-turning-the-operating-model-inside-out/>
- ^{xxix} Source: World Economic Forum, 2017 <https://www.weforum.org/agenda/2017/08/disruption-in-consumer-industries-turning-the-operating-model-inside-out/>
- ^{xxx} Source: Scientific American, 2017 <https://www.scientificamerican.com/article/light-powered-computers-brighten-ai-rsquo-s-future/>
- ^{xxxi} Source: University of Augsburg, 2016 https://www.informatik.uni-augsburg.de/en/chairs/sik/research/running/el4hpc/disruptive_tech/disruptive_tech_report.pdf

-
- ^{xxxii} Source: Harvard Business Review, 2017 <https://hbr.org/2017/06/bots-wont-just-help-us-buy-stuff-theyll-help-us-become-better-versions-of-ourselves>
- ^{xxxiii} Source: Computer World <https://www.computerworld.com/article/3230973/mobile-wireless/the-future-of-mobility-are-we-asking-the-right-questions.html>
- ^{xxxiv} Source: Orange Research, 2017 <https://recherche.orange.com/en/selling-ones-behavioral-data-an-impossible-market/>
- ^{xxxv} Source: Forbes, 2016 <https://www.forbes.com/sites/kevinmurnane/2016/12/07/future-tech-seventeen-microsoft-researchers-on-the-technology-of-2017-and-2027/#72c9a27a2bf8>
- ^{xxxvi} Source: Computer World, 2017 <https://www.computerworld.com.au/article/630552/cba-preparing-machine-to-machine-economy/>
- ^{xxxvii} Source: The Conversation, 2017 <https://theconversation.com/could-intelligent-machines-of-the-future-own-the-rights-to-their-own-creations-86005>
- ^{xxxviii} Source: World Economic Fourn, 2017 <https://www.weforum.org/agenda/2017/12/bitcoin-consume-more-power-than-world-2020/>
- ^{xxxix} Source: Squawker, 2017 <https://squawker.org/technology/blockchain-just-became-obsolete-the-future-is-hashgraph/>
- ^{xl} Source: Squawker, 2017 <https://squawker.org/technology/blockchain-just-became-obsolete-the-future-is-hashgraph/>
- ^{xli} Source: The Street, 2017 <https://www.thestreet.com/story/14385913/1/is-hashgraph-technology-just-hype-or-can-it-dethrone-blockchain-.html>