Preprint of:

Nolin, J. (2021). The Challenge of Challenges and Information Science. In *New Trends and Challenges in Information Science and Information Seeking Behaviour* (pp. 9-19). Springer, Cham.

The Challenge of Challenges and Information Science

Jan Nolin

Swedish School of Library and Information Science

University of Borås, Sweden

Abstract

The 2020s is on track to become one of the most transformative decades in human history. On the one hand, numerous mature technologies will have their mainstream breakthrough in the years to come. As these are combined in various and innovative ways all human endeavors are likely to be transformed. This has been talked about in terms of the fourth Industrial Revolution. On the other hand, unchecked exploitation of human resources, particularly in the form of climate change, need to be efficiently dealt with during the 2020s. The United Nations has stipulated a strategic plan, Agenda 2030, to deal with these, including a strict deadline at the end of the decade. Curiously, few academic researchers work with both the fourth Industrial Revolution and Agenda 2030. The imperative of combining strategic work on these is in this article called the challenge of challenges. The article is concerned with articulation of this meta-challenge as well as discussing the role of academic research, more specifically that of information science. It is argued that information science is well situated to make substantial contributions to the challenges of challenges. Three distinct areas within such contributions are outlined: sustainable targets/indicators, open science and sustainable information literacies.

Introduction

What follows is a “big picture” narrative of a type that is quite rare in contemporary scholarly texts. For most scholars, including the undersigned, research is a process of focusing narrowly demarcated phenomena, systematically devoting years of the career to highly specialized discussions. Climate scientists have for decades warned about “business as usual” scenarios of greenhouse emissions, pointing to the need for a break with such seemingly intractable trajectories. Interestingly, academic research progresses in similar solid “business as usual” trajectories wherein disciplines discuss their own traditional problems. The starting point of the current text is that from the perspective of this researcher, three fundamental trajectories within research can be identified as we enter the third decade of the 2000s:

1. The fourth Industrial Revolution, as articulated by the World Economic Forum and its chairman Klaus Schwab, [1] [2] will create breathtaking transformation of the way humans relate to technology as well as broad scale changes of society itself. This involves public breakthrough of a wealth of technologies that already exist but have not yet become mainstream. Some of these are actually clusters of technologies such as Internet of things, robot technology, and biotechnology. Other technologies can function as platforms for a forum of innovations. Examples of this are 3D printers, augmented reality, blockchain technology, and artificial intelligence. Academic research will, business as usual, make broad and significant contributions to this revolution. Although other labels can be used to describe the ways technology will transform the 2020s, the fourth Industrial Revolution appears to be the most sophisticated and best grounded. Schwab emphasizes that the revolution will be broadly disruptive within all areas of human endeavor and change the very essence of what it means to be human. [1]
2. Climate change, extinction of species, degradation of land areas as well as various forms of pollution will continue to place stress on the natural environment as well as civilizations as they exist today. A substantial amount of necessary work need engagement from the academic research community. The United Nations have through long-standing work pulled most of the involved challenges into the so-called Agenda 2030 with 17 sustainable development goals (SDGs) to be effectively dealt with by 2030. [3] Climate change alone may be broadly disruptive within all areas of human endeavor and change the very essence of what it means to be human.
3. Research, as well as other specialized discourses, on the fourth Industrial Revolution and Agenda 2030 are not clearly combined/coordinated.

While there is a wealth of texts surrounding the first two trajectories, there is scant articulation of the third. As it stands, involved academic researchers are specialized, business as usual, to make contributions to either the fourth Industrial Revolution or Agenda 2030, but not to both. The much-needed simultaneous work on both of these is here called the *challenge of challenges*. The aim of the current text is to articulate this challenge of challenges and, thereafter, to identify a few ways in which information science can make such a contribution. The remainder of the text is structured accordingly. This means that the challenge of challenges is initially described. Thereafter, information science will be promoted as being well situated to make substantial contributions to the challenge of challenges. Finally, three different areas within which information science can make a contribution are briefly reviewed. The article ends with the conclusion.

What is the challenge of challenges?

The challenge of challenges is a problem not only for academic research, but for all specialized experts within society. The fundamental problem is that human civilizations are dealing with two vastly different trajectories that appear inevitable: we will make society much more technological and we will also destroy fundamental natural states upon which society relies upon. Discussions on these seemingly inevitable trajectories both touch upon exploitation of natural resources of the Earth. In addition, they are both concerned with Earth's natural resources within the same timescale. Schwab predicts mainstreaming of numerous technologies during the 2020s up until 2027 (see Table 1). [1] Agenda 2030 has, of course, the deadline for human intervention by 2030. However, despite these similarities these discussions are held apart. The challenge of challenges is therefore to link together domain specific specialists working with one or the other of these trajectories and connect discussions on the same natural resources of the earth during the same time period, the 2020s.

Expected year of tipping point						
2021	Robot and services					
2022	Internet of and for things	Wearable Internet	3D printing and manufacturing			
2023	Implantable technologies	Big data for decisions	Vision as the new interface	Our digital presence	Governments and the Blockehain	Supercomputer in pocket

2024	Ubiquitous computing	3D printing and human health	Connected home			
2025	3D printing and consumer products	AI and white-collar jobs	Sharing economy			
2026	Driverless cars	AI and decision-making	Smart cities			
2027	Bitcoin and the Blockchain					

Table 1: Mainstreaming of various technologies during the 2020s as part of the fourth Industrial Revolution according to a wide survey of expert expectations. [1]

The challenge of challenges also involves combining the fundamentally optimistic "we will make tremendous technological advancements for the betterment of humanity" narrative of the fourth Industrial Revolution with the pessimistic "we need to save the world from extreme forms of exploitation" worldview underpinning Agenda 2030. This is not only a difference of the character of discourse, it is also a separation of agency, drivers and level of economic resources.

The primary agency for the fourth Industrial Revolution lies within the private sector and the driver is mostly a matter of generating profits. This involves both large corporations such as Google, Apple and Microsoft and a torrent of startups with original ideas for generating profit. Involved stakeholders are strong and committed. As modern welfare states rely upon a high technological and competitive private sector, governments tend to further sponsor developments within the fourth Industrial Revolution quite extensively. The fourth Industrial Revolution will happen.

In contrast, primary agency for Agenda 2030 resides within government agencies and NGOs working toward responsible use of common natural resources and of attending to a wide range of equity issues. The main drivers are grounded in public service, ethics and a recognition that those living today are leaving sparse natural resources but many problems to future generations. There is much less of a profit generating element within this discourse and governments typically spend much less on the production of specialized knowledge connected to Agenda 2030 compared to the fourth Industrial Revolution. Strong commitment to Agenda 2030 during the 2020s is seemingly necessary for long-standing survival of contemporary civilization as we know it today.

It is striking that both Schwab and climate modelling researchers use similar language. For the fourth Industrial Revolution there are numerous tipping points in which a certain technology shifts from being used by early adopters and instead become mainstream. [1] Numerous such tipping points are expected during the 2020s. Climate modellers have similar long-standing discussions on tipping points in which slow warming reaches a threshold. Once the climate tips over that threshold rapid changes occurs even if there is no additional forcing. [4] [5] Moving beyond a tipping point is therefore discussed as a point of no return, efforts to decrease CO2 may no longer be efficient.

Schwab does not present an optimistic viewpoint of the 2020s as humans move into a symbiotic relationship with technology. [1] He expects the world as we know it to be turned upside down by technologically driven trajectories. However dire, this analysis does not take into account the parallel challenges of dealing with climate change and other issues of Agenda 2030.

The main idea of sustainable development, as it was originally formulated by the Brundtland Commission in 1987 was that humankind for decades have dealt with social, economical and ecological challenges on a global scale. [6] Before the Brundtland report different stakeholders worked diligently to attain political primacy for issues that they were passionate about. Consequently, NGOs striving to mitigate poverty could become pitted against environmental activists. The idea with sustainable development was to remove such conflicts and deal with the challenges of humanity together. The social, economical and ecological problems needed to be dealt with within the same time period, not one after the other or in conflict with each other.

The challenges of challenges for the 2020s is to revisit this idea of solving everything together during the same time period. There is an exciting opportunity here if it can be put into action. The fourth Industrial Revolution is a project that will rebuild societies and human actions as we know it. It is likely to force a break with business as usual. Curiously, such a break with business as usual is what is required for Agenda 2030. Rebuilding society because of an environmental crisis has never been an easy sell during the 2000's. Nonetheless, if economical and technological drivers in any case are leading humanity this way, why cannot Agenda 2030 piggyback on that momentum? If only the ambitions of Agenda 2030 become integrated into this whirlwind of technological development, progress can become much swifter for many goals. But will this happen?

The most practical strategy in dealing with the challenge of challenges involves to, in various ways, inject sustainability issues into discussions and developments of the fourth Industrial Revolution. Many disciplines should be involved in this. In the following, it will be argued that information science is well-positioned to play a substantial role in this process.

The main disciplines supporting the fourth Industrial Revolution

Although not everything within the development of the fourth Industrial Revolution is a matter of exploiting new information technology, most of it is. This means that the primary academic support of the revolution resides within those four disciplines that deal with information/data, i.e. computer science, information systems, informatics and information science. Of these, computer science is by far the most technologically oriented and important. Computer science is extremely well-funded globally and has in recent decades emerged as much more than a discipline, actually similar to a faculty of its own. The other three disciplines are much smaller and information science is the least well-developed institutionally. Informatics and information systems have a focus on human computer interaction and IT within organizations. The various breakthroughs of the fourth Industrial Revolution will supply a wealth of research opportunities for all these four disciplines. However, information science need to find an identity, doing research within which the other three disciplines lack interest or competence. It is here suggested that the most valuable way of profiling in developing the identity of information science is to highlight the challenge of challenges by inserting Agenda 2030 into discussions of the fourth Industrial Revolution.

Information science is soft/hard

Becher and Trowler made a fundamental distinction between research disciplines that are soft, i.e. situated within the social and human sciences, or hard, i.e. positioned within natural or technological research. [7] Information science is one of these disciplines that is a little bit of both, but more on the soft side. Of the four disciplines dealing with information/data Information science is clearly the softest. There are many advantages for discipline to have

both a hard and soft side. This is particularly the case when there is a need to negotiate softer societal values of sustainability with the technologically driven ambitions of the fourth Industrial Revolution. As much of the developments within the fourth Industrial Revolution deals with advances within computer science, these four disciplines all appear to be well situated to contribute to the trajectory of the fourth Industrial Revolution. However, information science, as the softest, is arguably best placed to insert the concerns of Agenda 2030 into the discussions surrounding the fourth Industrial Revolution.

Information science and the public sector

As noted above, the trajectory of the fourth Industrial Revolution is driven by the private sector and fundamental concerns of economic profit. In this context, it should be noted that there is a difference between information science and the three other disciplines that deal with information/data. Contrary to the others, there is a strong tradition of making contributions to the public sector. This is largely a result of historical ties between information science and librarianship, frequently articulated in the disciplinary entity of Library and Information Science. Given this, information science is a discipline with substantial potential of connecting to policy ideas of Agenda 2030. Frequently, and increasingly, information science includes specialized policy research within areas such as cultural policy, information policy and research policy. These are all policy areas that in various ways can be connected to Agenda 2030. In contrast to the other three disciplines, information science has a strong tradition of dealing with freedom of information, public service, trusted information, cultural commons, inclusion and accessibility. Given this, information science is well-placed to be able to insert the concerns of Agenda 2030 into discussions surrounding the fourth Industrial Revolution.

Information science and sustainable targets and indicators

Agenda 2030 contains 17 SDGs. [3] These are formulated loftily and broadly, e.g. no poverty, quality education, gender equity, climate action etc. However, to each of these there are

targets and indicators. Altogether, there are 169 targets and 232 global indicators. It is here argued that research on sustainable targets and indicators can and should be a huge area for information science. We should in various ways be able to discuss these as crucial and central aspects of development of new information technology.

For instance, target 7.1 states that by 2030 there should be universal access to affordable modern energy services. At a glance, this would appear to be a challenge for the energy sector and not IT. Nonetheless, the development of the fourth Industrial Revolution will undoubtedly place enormous stress on the existing energy system. Many new technologies are pushed on the market without any concern about compounded consequences for the energy system.

A pertinent example is blockchain technology which is increasingly used in numerous innovative types of transactions, bypassing the traditional banking system. The most highlighted blockchain technology is the bitcoin which is designed with a mining system that releases a limited amount of bitcoins to the world market until 2140. Huge amounts of advanced mathematical calculations are used in order to "mine" a bitcoin. De Vries aptly describes bitcoin as "extremely energy-hungry by design". [8] Table 2 illustrates the environmental impact of a technology that was designed without any thought about sustainability. There is currently no sustainability accountability for development of information technology with such huge consequences for the world's energy consumption.

	Carbon footprint	**Electrical energy**	**Electronic waste**
Global footprint and comparable country	32.08 Mt CO2 Tunisia	67.54 Twh Czech Republic	10.12 kt Luxembourg
Footprint of individual transaction and comparable activities	283.66 kg CO2 709,146 VISA transactions	597.18 kWh average US household for 20.18 days	89.50 grams 1.3 8 C-size batteries

Table 2: Environmental impact of bitcoin technology as of September 9, 2020 according to https://digiconomist.net/bitcoin-energy-consumption/.

A related target is 12.2: to achieve sustainable management and efficient use of natural resources by 2030. This refers back to the central message of the Brundtland Commission to not develop such exploitation of natural resources that there is scarcity for future generations. [3] However, for the context of the current argument, without clear connections to Agenda 2030, the fourth Industrial Revolution will take what is needed for the technological innovations of 2020 regardless of future scarcity issues.

The main point is that the targets and indicators of Agenda 2030 supplies rich areas for information science research as well as for other disciplines to inject SDG discussions into the fourth Industrial Revolution.

Information science and open science

Target 7a within Agenda 2030 deals with the enhancement of international cooperation to make it possible for clean energy research and technology to be disseminated as quickly as possible. This connects to an important policy concept recently adopted by the European Commission vision for research as one of its three pillars: open science. [9] This can be seen as an umbrella concept that most crucially include open access (to scholarly journal articles) and open research data. Open science is a vague and difficult concept and it is challenging to identify various strategic initiatives that will be appropriate or successful for all types of research. Nonetheless, in the research most intimately tied to targets such as 7a it would appear to be a win-win solution for the scholarly community to promote as much openness as is ethically possible. Information science through its sub area of scholarly communication has a long tradition of investigating open access and increasingly today also open research data. It is important to emphasize that the current transformation of how researchers publicize the results as well as how they collect, store, manage and make available primary data are part of the fourth Industrial Revolution. It is therefore reasonable to expect future disruption of open science in the years to come.

There is much to be gained by allowing some of this research to be connected to the goals of Agenda 2030. In particular, research on renewable and clean energy is developed in a multitude of countries, corporations and sectors. A major problem is that individual projects have difficulty benchmarking themselves against competing efforts. It becomes challenging to establish if the research one is involved in is ahead or behind other projects both in regards to sophistication and economic feasibility. It would be strategically sound for researchers within information science to investigate how opening up of relevant metadata could be facilitated as well as to improve searchability of different efforts ongoing. This could be a substantial focus within information science.

Information science and sustainable information literacies

The E-handbook on Sustainable Development Goals Indicators is a central document to drive discussions and actions toward Agenda 2030. [10] However, it is not an easily accessible text and the logics involved are not apparent. This is one of many examples in which the original discussions within information science regarding information literacy (or media and information literacy) could be expanded to also talk about sustainable information literacy. A broad range of professionals need to be educated on how to read and understand such documents. In particular, the focus in the current text is on those professionals who in various ways are engaged with the fourth Industrial Revolution.

Take, for instance, Goal 13 on climate action. One would assume that this is the goal that those engaged in restriction of greenhouse gas emissions should be focused on. However, that is not the case. Goal 13 is concerned with mitigating the consequences of inevitable climate change, i.e. minimizing number of people killed and loss of property in cases of disasters such as flooding. It should be noted that this is a bit strange as the full name of Goal 13 is "Take urgent action to combat climate change and its impact". However, there is only one target in Goal 13, Target 13.1: "Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries". This appears to exclude the all-important "stop climate change from happening" , instead focusing on mitigating impact. The two indicators connected to Target 13.1 are also oriented in this narrow fashion.

If we instead are interested in stopping uncontrolled warming of the world we have to look elsewhere in Agenda 2030. Restrictions of greenhouse gases are indirectly situated within three different Goals. First, Goal 7: affordable and clean energy deals with the transformation to clean and renewable energy but does not mention greenhouse gas emissions as target or indicator. Second, Goal 9 on resilient infrastructure has indicator 9.4.1 stipulating decreases of CO2 emissions connected to infrastructure. Third, Target 12c within Goal 12 (sustainable production and consumption) deal with removing subsidies for fossil fuels. All in all, it appears strange that these are the only targets that, although indirectly, ties to this central challenge of our time.

Another difficulty of the targets and indicators is that many indicators are discussed through advanced mathematics, which many professionals will find daunting. Overall, there are huge opportunities here for information science to extend discussions on information literacy to

sustainable information literacy. In addition, information scientists should critically engage with these core policy texts and identify problems, as has briefly been done above.

Conclusion

The starting point of this article lies in the assumption that the 2020s is a crucial decade for the future of humanity. It can be expected that avalanche of technological innovations will reach a tipping point of mainstream use in the decade to come. At the same time there is an urgent need to make drastic changes in the way we utilize the resources of the Earth. In a sense, the original divide between research dealing with nature, technology and society is no longer sustainable.

The twofold aim of this article has been to articulate the challenges of challenges and thereafter to identify various ways in which information science can contribute. The challenge of challenges amounts to connecting the fourth Industrial Revolution with Agenda 2030 within the practices of academic researchers. Specifically, this text is concerned with the role of information science. On the face of it, it would appear to be too obvious to mention that such integration of two different civilization transformative processes ongoing at the same time need to be locked into each other in a variety of ways. However, the experience of this author is that it is not obvious within the Academy and few researchers feel that the trajectories of their careers make it possible for them to take one, much less both, of these transformative processes into account. Rather, specialized researchers tend to continuously probe specialized issues without understanding, or concern, that fundamentally transformative processes lie in the near future.

One obvious approach to these problems is to identify opportunities. There are, indeed, opportunities for information science here. I have argued that this disciplinary domain is well situated to investigate a broad range of issues related to the fourth Industrial Revolution from a variety of perspectives. I have also identified three different areas in which substantial value can be produced in order to inject Agenda 2030 into discussions of the fourth Industrial Revolution. These three areas were sustainable targets and indicators, open science and sustainable information literacy. This is far from a comprehensive list of opportunities.

Rather, more research opportunities are bound to appear when information scientists engage more systematically with Agenda 2030.

There is an additional challenge to the opportunities outlined above. Information scientists have so far to a lesser degree engaged with sustainable development. There has been only limited interest in concepts such as sustainable information [11], sustainable information services [12], sustainable information practices [13] and Agenda 2030. This is an unsustainable situation as we move into the 2020s.

References

[1] Schwab K (2017) The fourth industrial revolution. World Economic Forum, Geneva

[2] Schwab K, Davis, N (2018) Shaping the future of the fourth industrial revolution. World Economic Forum, Geneva

[3] United Nations (2015) Transforming our world: the 2030 Agenda for sustainable development. https://sustainabledevelopment.un.org/post2015/transformingourworld. Accessed 10 September 2020

[4] Hansen J, Sato M, Kharecha, P et al (2008). Target atmospheric CO_2: Where should humanity aim? Open Atmospheric Science Journal 2: 217-231

[5] Lenton, TM, Held H, Kriegler E et al (2008) Tipping elements in the Earth's climate system. Proceedings of the National Academy of Sciences USA 105(6):1786-1793

[6] Brundtland GH, Khalid M., Agnelli S et al (1987) Our common future. United Nations, New York

[7] Becher T, Trowler PR (2001) Academic tribes and territories: Intellectual enquiry and the culture of disciplines. Second edition. McGraw-Hill Education, London

[8] De Vries A (2018) Bitcoin's growing energy problem. Joule, 2(5):801-805

[9] European Commission (2016) Open science, open innovation, open to the world: a vision for Europe. European Commission, Brussels

[10] United Nations (2016) E-handbook on Sustainable Development Goals Indicators. https://unstats.un.org/wiki/display/SDGeHandbook?preview=/34505092/38535788/SDGeHandbook-150219.pdf. Accessed 10 September 2020

[11] Nolin J (2010) Sustainable information and information science. Information Research, 15(2)

[12] Chowdhury G (2012) Building environmentally sustainable information services: A green IS research agenda. Journal of the American Society for Information Science and Technology, 63(4):633-647

[13] Nathan LP (2012) Sustainable information practice: An ethnographic investigation. Journal of the American Society for Information Science and Technology, 63(11):2254-2268